Environmental Solutions Division

Methodology for Oregon's 2012 Water Quality Report and List of Water Quality Limited Waters

(Pursuant to Clean Water Act Sections 303(d) and 305(b) and OAR 340-041-0046)

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Environmental
Quality

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DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

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I. Introduction

The federal Clean Water Act (CWA) Section 305(b) requires that states submit a biennial water quality inventory report in April of even numbered years. The report provides information on the water quality of all navigable state waters; the extent to which state waters provide for the protection and propagation of a balanced indigenous population of shellfish, fish, and wildlife, and allow recreational activities in and on the water; and how pollution control measures are leading to water quality standards being met.

The CWA Section 303(d) additionally requires that each state identify waters where existing pollution controls are not stringent enough to achieve state water quality standards, and establish a priority ranking of these waters. Section 303(d) requires states to develop Total Maximum Daily Loads (TMDLs) for the identified waters. TMDLs describe the amount of each pollutant a water body can receive and not violate water quality standards. States submit the list of waters needing TMDLs (303(d) list) to EPA and EPA either approves or disapproves the list within thirty days after the submission.

EPA regulations (40 CFR 130.7 and 40 CFR 130.8) specify the process for developing the 303(d) list and the content of the biennial water quality report. EPA guidance recommends that States submit an **integrated report** to satisfy 305(b) and 303(d) requirements.[1] The integrated report presents the results of assessing available data to determine where water quality standards are met or not met, and identifies the pollutants causing water quality limitations or impairments.

EPA regulations require States describe the methodology, data, and information used to identify and list water quality limited segments requiring TMDLs. The assessment methodology contains the "decision rules" used to evaluate data and information. Oregon Administrative Rules (OAR 340-041-0046) also require the specific evaluation process be identified.

This document, **Methodology for Oregon's 2012 Water Quality Report and List of Water Quality Limited Waters,** describes how DEQ developed Oregon's 2012 Integrated Report for 305(b) and 303(d). The methodology is consistent with key elements of Oregon's water quality standards, including designated uses, narrative and numeric criteria, antidegradation requirements, and standards application procedures, and is the framework DEQ used to assess water quality conditions. The methodology builds on DEQ's protocols from previous 305(b)/303(d) assessments. The 303(d) list produced from the 2012 Integrated Report incorporates, updates, and supplements 303(d) lists from previous assessment years and after approval by EPA will become Oregon's effective 303(d) list.

Oregon's 2012 Integrated Report focused on a statewide evaluation of toxic pollutant data and an analysis of dissolved oxygen data for the Willamette and Umatilla River Basins. DEQ focused on these areas for the following reasons:

- EPA finalized additions to Oregon's 2010 303(d) list on December 14, 2012. EPA based the additions on a review of water quality data collected from January 1, 2000 through December 28, 2010. Due to the length of time it took EPA to publish a final 303(d) list, DEQ approached the 2012 Integrated

[1] October 12, 2006, Memorandum from Diane Regas, EPA Office of Wetlands, Oceans and Watershed Re: Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions [HYPERLINK "http://www.epa.gov/owow/tmdl/2008_ir_memorandum.html"]

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Report with the objective of focusing on data that EPA had not evaluated or where data evaluations would provide the most benefit to DEQ programs.

- DEQ completed a major revision of Oregon's toxic substance water quality criteria protecting human health that were approved by EPA and effective for Clean Water Act purposes in October 2011. While EPA added new 303(d) listings of impaired waters based on these revised criteria, EPA did not review the entire 2010 Integrated Report to determine whether other updates were needed to reflect the revised criteria. The 2012 Integrated Report more fully reviewed previous 303(d) listings and updated those to be consistent with the revised and withdrawn human health criteria.
- Oregon's toxic substance water quality criteria protecting aquatic life were revised in 2004 with minor changes adopted in December 2013. EPA approved most of the revised aquatic life criteria in January 2013 and approved additional corrections and clarifications in April 2014. DEQ initiated the 2012 Integrated Report and completed most of the data review before these revised aquatic life criteria were effective for Clean Water Act purposes.
- DEQ was piloting the rotating basin approach described in EPA's 2009 memorandum.[2] DEQ's objective with piloting this approach for the 2012 Integrated Report was to evaluate the viability of synchronizing the 303(d) assessment with the basin assessment watershed approach. These complimentary efforts would help enable DEQ to evaluate and prioritize water quality issues and actions in each of the state's major river basins, focusing on three basins per year (with the objective of evaluating the state's 15 basins over a five year period). This approach, described in more detail in Section III, allows for more in-depth evaluation of the current status of water quality and beneficial use support in each basin, in addition to the prioritization of TMDLs. Because the Willamette Basin is very large, DEQ was conducting basin assessments for two basins, the Willamette and the Umatilla.

The 2012 Integrated Report methodology is consistent with the following state and federal rules, guidance, and policies:

- Water Quality Standards, Beneficial Uses, Policies, and Criteria for Oregon: Oregon Administrative Rules Chapter 340 Division 41 [HYPERLINK "http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_041.html"]
- June 22,1998 DEQ Letter to EPA Region 10, Policy Clarification of Oregon Water Quality Standards Revisions [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/EPALetter06-22-1998.pdf"]
- February 4, 2004 DEQ Letter to EPA Region 10, Oregon Responses to EPA Questions on State's Water Quality Temperature Standards [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/temperature/clarificationltr.pdf"]
- March 21, 2011, Memorandum from Denise Keehner, Office of Wetlands, Oceans, and Watersheds Re: Information Concerning 2012 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions [HYPERLINK "http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/upload/final_2012_memo_document.pdf"]

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[2] May 5, 2009, Memorandum from Suzanne Schwartz, EPA Office of Wetlands, Oceans, and Watersheds Re: Information Concerning 2010 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions [HYPERLINK "http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/final52009.cfm"]

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- May 5, 2009, Memorandum from Suzanne Schwartz, EPA Office of Wetlands, Oceans, and Watersheds Re: Information Concerning 2010 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions [HYPERLINK "http://water.epa.gov/lawsregs/lawsguidance/cwa/tmdl/final52009.cfm"]
- October 12, 2006, Memorandum from Diane Regas, EPA Office of Wetlands, Oceans and Watershed Re: Information Concerning 2008 Clean Water Act Sections 303(d), 305(b), and 314 Integrated Reporting and Listing Decisions [HYPERLINK "http://www.epa.gov/owow/tmdl/2008_ir_memorandum.html"]
- Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b), and 314 of the Clean Water Act: United States Environmental Protection Agency, (July 29, 2005) [HYPERLINK "http://www.epa.gov/owow/tmdl/2006IRG/"]
- Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act: United States Environmental Protection Agency, (July 21, 2003) [HYPERLINK "http://www.epa.gov/owow/tmdl/tmdl0103/index.html"]
- Federal Water Pollution Control Act Chapter 26 Water Pollution Prevention and Control
- 40 CFR Part 130.7 (Code of Federal Regulations)
- 40 CFR Part 130.8 (Code of Federal Regulations)

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II. Oregon's Water Quality Standards

The objective of the Clean Water Act is to restore and maintain the physical, chemical and biological integrity of the Nation's waters (CWA Section 101(a)). To achieve this objective, States develop and adopt water quality standards. Water quality standards include beneficial uses, narrative and numeric criteria, and anti-degradation and implementation policies. Oregon's water quality standards are adopted in Oregon Administrative Rules (OAR) Chapter 340 Division 41 ([HYPERLINK "http://www.deq.state.or.us/regulations/rules.htm"]). These rules include policies and criteria that are applicable throughout the state.

Beneficial uses for Oregon waters are designated by the Oregon Environmental Quality Commission. General beneficial uses are designated by water basin or water body in OAR 340-041-0101 through OAR 340-041-0340, Figure 1, and Tables 101A through 340A. Specific fish uses are further designated in Tables 101B through 250B and Figures 130A through 340B. Beneficial fish use designations include explicit water body segment locations and time periods throughout the state for sensitive salmonid species and life stages that were added to Oregon's water quality standards in 2003. For example, the general beneficial uses in the Hood Basin are designated in OAR 340-041-0160 and Table 160A as follows, and the fish use designations and salmon and steelhead spawning use designations throughout the Hood Basin are shown in Figures 160A and 160B [HYPERLINK "http://www.deq.state.or.us/wq/rules/div041tblsfigs.htm" \l "t1"]:

Basin-Specific Criteria (Hood)

340-041-0160

Beneficial Uses to Be Protected in the Hood Basin

(1) Water quality in the Hood Basin (see Figure 1) must be managed to protect the designated beneficial uses shown in Table 160A (November 2003).

(2) Designated fish uses to be protected in the Hood Basin are shown in Figures 160A and 160B (November 2003).

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Table 160A
Designated Beneficial Uses
Hood Basin
(340-41-0160)

Beneficial Uses	Hood River Basin Streams
Public Domestic Water Supply[1]	X
Private Domestic Water Supply[1]	X
Industrial Water Supply	X
Irrigation	X
Livestock Watering	X
Fish & Aquatic Life[2]	X
Wildlife & Hunting	X
Fishing	X
Boating	X
Water Contact Recreation	X
Aesthetic Quality	X
Hydro Power	X
Commercial Navigation & Transportation	
[1] With adequate pretreatment (filtration & disinfection) and natural quality to meet drinking water standards.	
[2] See also Figures 160A and 160B for fish use designations for this basin.	

Table produced November, 2003
[HYPERLINK "http://www.deq.state.or.us/wq/rules/div041/dbutables/table160a.pdf"]

Oregon water quality standards include statewide narrative criteria established in OAR 340-041-0007. Narrative criteria include provisions for:

- Less stringent natural conditions to supersede numeric criteria (OAR 340-041-0007(2)[3]
- Prohibitions on fungi or other growths that negatively impact beneficial uses (OAR 340-041-0007(9)
- Prohibitions on tastes, odors, or toxic conditions that negatively impact beneficial uses (OAR 340-041-0007(10)
- Prohibitions on bottom deposits that negatively impact beneficial uses (OAR 340-041-0007(11)

A statewide antidegradation policy is established in OAR 340-041-0004 to guide decisions that affect water quality. Additional policies for applying water quality standards to determine water quality limited waters are contained in OAR 340-041-0046 and in standards for specific pollutants.

Oregon water quality standards for specific pollutants are established in OAR 340-041-0009 (Bacteria) through OAR 340-041-0036 (Turbidity). These standards contain both narrative and numeric criteria for specific pollutants. Some pollutant criteria are applicable in waters with specified beneficial use designations,

[3] This provision in Oregon's standards was disapproved by EPA August 8, 2013, and is no longer effective for federal Clean Water Act purposes in Oregon. See [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/FedEffectiveStandards.pdf"]

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such as numeric criteria for temperature and dissolved oxygen that apply where and when certain fish uses are designated. For the Integrated Report, each pollutant is assessed independently. The methodology for assessing each pollutant is discussed in Section IV. Assessment Protocols by Pollutant or Parameter in this document.

Oregon's criteria for toxic substances (OAR 340-041-0033) were revised in 2004 (aquatic life criteria) and 2011 (human health criteria). The human health criteria for toxic substances (Table 40) were approved by EPA in October 2011 and are currently effective criteria for 303(d) Clean Water Act purposes and were applied for the 2012 Integrated Report. EPA acted on the revised aquatic life criteria in January, 2013 to approve and disapprove select criteria. EPA's action occurred well after Oregon's 2012 Integrated Report assessment was underway and DEQ was not able to incorporate the criteria approved in that action. DEQ applied the aquatic life criteria in Table 20 previously referenced in OAR 340-041-0033 that were effective prior to EPA's action in 2013. See Attachment 4 for the combined aquatic life and human health criteria that were applied for purposes of the 2012 Integrated Report.

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III. 2012 Integrated Report Process

DEQ prepared the 2012 Integrated Report by assembling data and information about surface waters in Oregon, comparing data and information to appropriate Oregon water quality standards, determining the condition and status of waters where data and information were available, updating assessments from previous reporting, and identifying the waters that do not meet water quality standards and support beneficial uses. The steps are described more fully in the following sections. The 2012 Integrated Report process will be complete when DEQ receives approval from EPA on the final 2012 list of water quality limited waters needing a TMDL (Category 5: 303(d) list).

A. Rotating Basin Approach

Beginning in 2011, DEQ has been conducting in-depth assessments of the state's basins. These assessments take the form of local water quality status and action plans which describe water quality conditions and include recommendations for actions that DEQ and others who are interested in these basins can take to improve water quality. The rotating basin approach follows the principles of adaptive management and the watershed approach. This approach uses the best information available to take action on immediate problems. It also involves using new information to improve practices over time. This "continuous improvement" process allows DEQ to focus its resources in three basins or watersheds a year and regularly assess the situation in each basin by using an outcome-based approach to determine what actions are working or not working.

The rotating basin approach allows Oregon DEQ to:

- Share its findings with affected stakeholders and residents of the basins so all parties learn how to better manage our watersheds.
- Prioritize immediate and long-term actions that can be taken in a particular basin or watershed through DEQ's Water Quality Status and Acton Plan documents.
- These actions will emphasize working closer with all affected parties to identify goals and measure success.
- Encourage all involved to be flexible and open to new ways of solving problems (including voluntary collaboration where possible) and avoiding duplication of efforts.

To date, DEQ has conducted two rounds of Basin Reports addressing three basins each; and is working toward finalizing the third round of Basin Reports covering the Willamette Basin and the Umatilla Basin.

With the 2012 Integrated Report, DEQ sought as a first step to evaluate how the basin assessment approach could be aligned with efforts to develop the Integrated Report. To that end, DEQ focused on updating the Integrated Report for the Willamette Basin and Umatilla Basin for dissolved oxygen and toxic pollutants, consistent with DEQ's concurrent efforts to evaluate water quality conditions in its development of Basin Reports for those basins.

B. Tribal Waters

Only those waters that are under the State of Oregon's jurisdiction are subject to the State's 303(d) and 305(b) activities. DEQ did not intentionally include tribal waters when assessing water quality or developing the 303(d) list for the 2012 Integrated Report. DEQ does not develop TMDLs for tribal waters. When a water

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body lies partially within Tribal Reservation boundaries, DEQ only assesses the segments that are within Oregon's jurisdiction to prepare Oregon's 303(d) list.

DEQ used available geographic information to determine boundaries of the Burns Paiute Reservation, Fort McDermitt Reservation, Grand Ronde Reservation, Siletz Reservation, Umatilla Reservation, and Warm Springs Reservation in order to exclude those waters from the Integrated Report.

C. Assembling Data and Information

To gather information on water quality for Oregon's 2012 Integrated Report, DEQ issued a public call for data, solicited data from other agencies, and retrieved data results from DEQ's monitoring activities. The assembled data and information included analytical data for surface water and fish tissue sampling, and public health fish consumption advisory information. The assembled data and information were reviewed by DEQ to determine if the data included all required metadata elements, met the data quality requirements, and were acceptable to use for the 2012 Integrated Report. The process of assembling data and information for the 2012 Integrated Report is described in more detail in the following sections.

1. Call for Data

DEQ issued a public call for data for the 2012 Integrated Report by posting information on DEQ's on-line website at [HYPERLINK "http://www.deq.state.or.us/wq/assessment/2012DataInfo.htm"] and notifying interested parties using an electronic e-mail subscription list. The subscription list includes federal agencies, state agencies, tribes, local governments, watershed councils, private and public organizations, and individuals from the general public. DEQ accepted data submittals from December 16, 2011 through January 31, 2012. DEQ identified priority interests with the call for data to:

- Focus on two basins, the Willamette Basin and the Umatilla Basin, in order to use a Watershed Approach.
- Obtain data to evaluate revised human health criteria for toxic pollutants (Table 40).
- Obtain data to evaluate listings for toxic pollutant criteria that were revised or withdrawn, particularly iron and arsenic.

The call for data included a description of the requirements for data type, quality assurance/quality control (QA/QC), and data formats. Information on data submittal procedures, forms, and templates were available on-line at [HYPERLINK "http://www.deq.state.or.us/wq/assessment/2012DataInfo.htm"] .

DEQ received responses or data submittals from the following entities:

- Center for Biological Diversity
- City of Canby
- City of Gresham
- City of Salem
- City of Wilsonville
- Clackamas County Soil and Water Conservation District
- Tualatin Joint Water Commission

Most of the submitted data were for the time period January 1, 2000 through December 31, 2011.

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2. Data Retrievals

For the 2012 Integrated Report, DEQ assembled data from two sources:

- Oregon DEQ's Laboratory Analytical and Storage Retrieval (LASAR) database – Surface water sampling data were retrieved as follows:
    - October 18, 2012 – Monitoring results from approximately 275 stations throughout the state when available for 12 toxic substances (arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel selenium, silver, and zinc when available) from samples collected for the period January 1, 2000 through December 31, 2011
    - April 17, 2013 – Fish tissue sampling results for skinless fillet samples from throughout the state for mercury analyses
    - March 26, 2013 – Monitoring results for dissolved oxygen from continuous sampling and grab sampling for the period January 1, 2000 through December 31, 2011 from 772 sampling locations in the Willamette Basin and the Umatilla subbasin (Hydrologic Unit Code 17070103).

  Data retrieval from LASAR was limited to results with data quality level A or B. Data from continuous sampling temperature data loggers were not retrieved for the 2012 Integrated Report.
- USGS Oregon Water Sciences Center ([HYPERLINK "http://or.water.usgs.gov/"]) – Solicited and received from Leonard Orzol (Database Manager, [HYPERLINK "mailto:llorzol@usgs.gov"]):
    - April 23, 2012 – Monitoring results from approximately 138 stations in the Willamette Basin when available for 37 toxic pollutants from samples collected for the period January 1, 2000 through December 31, 2011. No data were available in this time period in the Umatilla Basin
    - April 23, 2012 – Monitoring results for dissolved oxygen for the period January 1, 2000 through December 31, 2011 from 563 sampling locations in the Willamette Basin and the Umatilla subbasin (Hydrologic Unit Code 17070103).

  Results from USGS with data quality level A were used for the 2012 data evaluation.

3. Metadata Requirements

To be able to evaluate data for the Integrated Report, DEQ required that metadata accompany the sampling results submitted in response to the call for data, and be available for data retrieved from agency sources. Required metadata included site descriptions and geographic information for each sampling location including monitoring station latitude, longitude, LLID, and river mile, as described below. Missing or incomplete metadata often made data not usable for the Integrated Report. DEQ's georeferencing system is described in more detail in Section III. D. 3 (a) Assessment Unit Location.

4. QA/QC Requirements

DEQ only used high quality data meeting data quality level A or B requirements for the 305(b)/303(d) assessment. Analytical laboratory data were reviewed against current Quality Control (QC) limits established for the analytical method and/or the QC limits established by the laboratory that performed the testing and supplied the data to DEQ. DEQ also utilized EPA National Functional Guidelines for Data Review as guidance when reviewing laboratory data. [HYPERLINK "http://www.epa.gov/superfund/programs/clp/guidance.htm"]

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DEQ used DEQ's Data Quality Matrix (March 2009) to review data quality for water quality parameters measured in the field. [HYPERLINK "http://www.deq.state.or.us/lab/techrpts/docs/DEQ04-LAB-0003-QAG.pdf"]

5. Data Quality Review and Usability of Submitted Data

DEQ reviewed the completeness of site metadata and QA/QC level of data results that were received through the call for data. A summary of data acceptance and usability of data submitted for the 2012 Integrated Report is shown in the following table:

Table [SEQ Table * ARABIC]: 2012 Oregon Integrated Report Data Quality Review Summary

Data source	Stations with metadata	Analytical Results QA/QC	Grab, Field, or Continuous sample results	Data or information usable for 2012 IR
Center for Biological Diversity	No information from Oregon state waters			No
City of Canby	Incomplete	Incomplete	Incomplete	No
City of Gresham	10	2168 results for 17 toxic substances	__	Yes
City of Salem Drinking Water Sources	Incomplete	182 results	Acceptable	No
City of Salem	11	__	General parameters - Parameters not evaluated in 2012 IR	No
City of Wilsonville	Incomplete	Incomplete	Incomplete	No
Clackamas County Soil and Water Conservation District	10	Incomplete	Not acceptable	No
Tualatin Joint Water Commission	Incomplete	Incomplete	Incomplete	No

D. Determining Water Quality Status

The goal of the 2012 Integrated Report is to provide information about the condition and quality of Oregon's surface waters. Using available data, information, and water quality standards, DEQ reaches conclusions about whether conditions support the beneficial uses designated for the water body and meet water quality standards applicable in the water. The conclusions are communicated by using a set of assessment status categories described in EPA guidance and commonly used by states completing 303(d) and 305(b) Integrated Reports.

1. Assessment Categories

EPA continues to recommend using five reporting categories as shown in Table 2 to classify water quality status.[4] The categories represent varying levels of water quality standards attainment and beneficial use

[4] Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act: United States Environmental Protection Agency, (July 29, 2005) [HYPERLINK "http://www.epa.gov/owow/tmdl/2006IRG/"]

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support, ranging from Category 1, where all designated uses for a water body are supported, to Category 5, where a water body is impaired and a TMDL is required to return the water to a condition where the water quality standards are met.

Table [SEQ Table * ARABIC]: Assessment Categories

Category	Description
Category 1	All designated uses are supported. (Oregon does not use this category.)
Category 2	Available data and information indicate that some designated uses are supported and the water quality standard is attained.
Category 3	Insufficient data to determine whether a designated use is supported.
	Oregon further sub-classifies waters if warranted as: **3B:** Potential concern when data are insufficient to determine use support but some data indicate non-attainment of a criterion.[5]
Category 4	Data indicate that at least one designated use is not support but a TMDL is not needed. This includes:
	4A: TMDLs that will result in attainment of water quality standards have been approved.
	4B: Other pollution control requirements are expected to address pollutants and will result in attainment of water quality standards.
	4C: Impairment is not caused by a pollutant (e.g., flow or lack of flow are not considered pollutants).
Category 5	Data indicate a designated use is not supported or a water quality standard is not attained and a TMDL is needed. This category constitutes the Section 303(d) list that EPA will approve or disapprove under the Clean Water Act.

DEQ uses the policy of independent applicability to assess attainment of water quality standards, as recommended by EPA.[6] Each water quality standard is evaluated independently and a category is assigned for a water body for each standard where sufficient data are available. Since no water body has sufficient data or information to assess all designated uses and water quality standards, DEQ does not classify waters as Category 1. Figure 1 summarizes DEQ's general process for assigning assessment categories to describe the status of Oregon waters.

[5] EPA disapproved Oregon's use of subcategory Category 3C: Impairing pollutant unknown on March 15, 2012. This subcategory was removed from Oregon's 2012 Integrated Report.

[6] Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act: United States Environmental Protection Agency, (July 29, 2005) [HYPERLINK "http://www.epa.gov/owow/tmdl/2006IRG/"]

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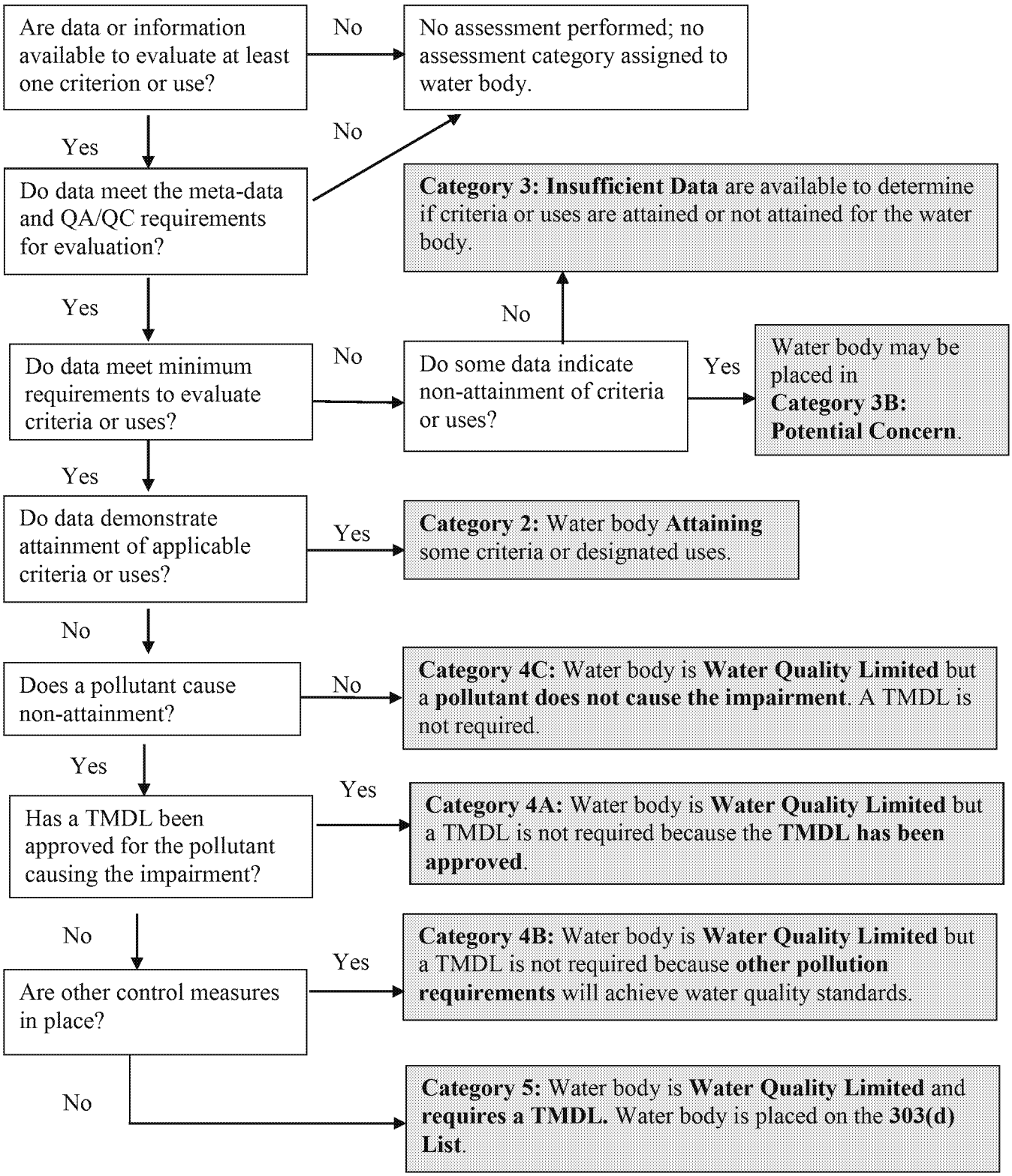
Figure [SEQ Figure * ARABIC]: Assigning Assessment Categories



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2. Evaluating Data and Information

To characterize conditions in Oregon waters, DEQ assembled the water quality data and information available from monitoring sites or sampling points on a water body. Samples may have been collected from one or more sampling locations and analyzed for a variety of pollutants or other chemical or physical characteristics. Monitoring may have occurred once or multiple times at a single location. The site monitoring data are the basis for characterizing the overall water quality status in a water body. The requirements and protocols for evaluating monitoring data for specific pollutants and water quality standards are discussed in detail in **Section IV Assessment Protocols by Pollutant.**

The initial step in DEQ's data evaluation process was to evaluate the data available at each monitoring site by comparing sampling results to water quality standards. Data at individual sampling sites were evaluated independently using the assessment protocols for each specific pollutant or standard and assigning an assessment status category for the site for each pollutant or standard (e.g. Station X: Pollutant parameter Y - Category 2: Attaining based on 0 out of Z results at the site exceeding criteria). Where sample results included duplicate sample results collected for QA/QC purposes and identified as sample primary and sample duplicate, the maximum (or minimum for dissolved oxygen) result was evaluated and counted only as one result. Results for the individual monitoring sites were then aggregated or grouped to determine the appropriate assessment unit for the water body or segment of the water body, and the water quality status assessment category for the assessment unit.

As part of the site data review, DEQ confirmed that site location information and analytical data results were complete, accurate, and appropriate for evaluation. Correct site location information was critical in order to determine what water quality standards were applicable to the available data, and to choose the appropriate numeric criteria to apply for pollutants that have several possible criteria. Accurate and complete information about sample and analytical results was critical to determine if site data were comparable to the water quality standard and met the assessment protocol for the specific pollutant.

In order to report on conditions in the water body, DEQ considered several factors to aggregate site data into water body assessment units and assign a water quality status for the assessment unit. DEQ defined water body assessment units for specific pollutants and in some cases for multiple seasons for the same pollutant. Factors considered were:

- The distribution of monitoring sites on a water body
- The pollutant or water quality standard
- The designated beneficial uses of a water body, particularly sensitive fish uses
- The water quality status for specific pollutants at individual sites
- Previous assessment information for the water body

Using the conclusions from the 2012 water body assessments, DEQ added new assessments to the Integrated Report and updated previous water body assessments if warranted. If no data or information for a pollutant or water body were reviewed for 2012, the water body assessments from previous Integrated Report cycles remain part of the 2012 Integrated Report and Category 5: 303(d) list.

3. Determining Assessment Units and Status

The 2012 Integrated Report reports information about water quality for unique combinations of water body assessment unit, pollutant, and season. The assessment unit identifies the water body or segment of the water body being assessed, the pollutant identifies the chemical or parameter associated with the applicable water quality standard, and the season specifies the date or time period when the standard is being applied. DEQ's process for defining assessment units and assigning status assessment categories the Integrated Report is described in the following sections.

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a) Assessment Unit Location

DEQ identifies assessment units using location information from the hydrographic network for Oregon water bodies and the starting and ending river miles for segments on that network. DEQ uses a 1:100,000 geo-referenced river reach system compiled for the Pacific Northwest. The river reach system is the hydrography component in a regional rivers and fisheries information system known as StreamNet. Information about this system is available at [HYPERLINK "http://www.streamnet.org/pnwr/PNWNAR.html"] . A stream based identifier called the LLID (Longitude/Latitude ID) is used to uniquely identify streams and lakes and is linked to georeferencing location information. All reaches that make up a given stream are assigned this unique LLID. The LLID is derived from the longitude and latitude of the mouth of the stream or the center of a lake. Longitude precedes latitude to conform to standard x, y ordering. The code is 13 characters long, with 7 characters for decimal degrees of longitude followed by 6 characters for decimal degrees of latitude, with implied decimal points. (Example: Columbia River LLID 1240483462464, mouth located at longitude -124.0483 latitude 46.2464)

One LLID uniquely identifies a stream or river, with river mile 0 assigned at the mouth of the stream where it intersects with the next order stream and river mile maximum corresponding to the headwater location. Lakes, reservoirs, and ponds are identified by the LLID derived from the longitude and latitude at the center point of the water body. If there is a through flowing stream, the lake or reservoir may also be identified as a segment on a stream LLID with the stream river mile minimum at the lake outlet and river mile maximum at the lake inlet. (Example: Fish Lake LLID 1223333423868 North Fork Little Butte Creek RM 15.6 to 17.8)

Some water bodies are not large enough to be included on the StreamNet 1:100,000 river reach system and do not have an assigned LLID. In those cases, DEQ used other geospatial base layers such as the Pacific Northwest Hydrography 1:24,000 layer or National Hydrography Dataset to obtain geospatial information for the hydrographic feature and derive an equivalent LLID identifier using the general guidelines described above. In a few cases where the feature was apparent on satellite imagery but not identified on available geospatial base layers, DEQ digitized the feature to create geospatial information and assigned an LLID using the protocols described above. In earlier assessment cycles, water bodies that did not have a georeferenced location and LLID were given a placeholder LLID (such as 1111111111111) so that information could be retained in the assessment database even though not available for geospatial applications. Where possible, these streams were identified using the most current geospatial information available in 2012 and updated in the 2012 Integrated Report.

DEQ uses the water body name associated with the stream or lake LLID in the geospatial information system, and gives preference to the water body name assigned in the USGS Geographic Name Information System if there are multiple names. Many water bodies in Oregon are not named, and are identified as Unknown in the geospatial information and the Integrated Report. DEQ many include informal names in these cases.

b) Assessment Unit – General Segmentation Rules

DEQ considered several factors and followed these general rules and decision hierarchy to determine water body assessment unit segments for various pollutants and time periods or seasons:

- For a new assessment of a water body/pollutant/season combination:
    - With only one monitoring site, the assessment unit segment was defined from the mouth to headwaters of the water body, or
    - For a water body with multiple monitoring sites, the assessment unit segment was defined based on the location and status of monitoring stations on the water body. See Table 4.
- Where updating a previously assessed water body/pollutant/season combination, the previous assessment unit was usually retained.

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- For an assessment using a water quality standard applicable at locations specifically designated for certain beneficial uses, the assessment unit correlates to the locations designated in water quality standards:
    - Examples are temperature and dissolved oxygen criteria applicable for specific fish uses or during certain sensitive time periods or seasons.
    - Segments were defined for contiguous sections of a water body with the same designated fish use or designated time period for that use.
    - A single water body may be represented by multiple assessment units with different criteria for temperature or dissolved oxygen applicable at different times.
    - The spawning criteria apply to an assessment unit during the designated spawning time, and the non-spawning criteria apply at all other times.

The Sandy River (LLID 1224071455697) provides an example in Table 3 of how assessment units are correlated to segments with designated fish uses. The Sandy River is designated for salmon and trout rearing and migration fish use from river mile 0 to 26 (Segment "A") and for core cold water habitat from river mile 26 to 55.5 (Segment "B"). These fish uses have numeric temperature criteria specific to those fish uses. The Sandy River also has four reaches designated for salmonid spawning use during different time periods (Segments "C" through "F") and one with no spawning use, as shown in the following table. The spawning criterion is applicable in those assessment units, but only during the time period designated for spawning use. Based on the water quality standards, the Sandy River would have 6 assessment units correlated to segments with designated fish use or time periods where different numeric temperature criteria apply.

Table [SEQ Table * ARABIC]: Example Fish Beneficial Use Segments – Sandy River

Assessment Unit	River Mile Start	River Mile End	Use	Time Period	Numeric Temperature Criteria (° Celsius)
A	0	26	Salmon and trout rearing and migration	Year round non-spawning	18.0
B	26	55.5	Core cold water habitat	Year round non-spawning	16.0
C	0	26	Spawning	October 15 – May 15	13.0
D	26	48	Spawning	August 15 – June 15	13.0
E	48	49.1	Spawning	October 15 – June 15	13.0
F	49	54	Spawning	January 1 – June 15	13.0
	54	55.4	No spawning		

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c) Assessment Unit – General Rules to Assign Status

A status category was assigned to an assessment unit based on the status at monitoring sites within the assessment unit. The process generally followed this decision hierarchy:

- For a new assessment of a water body/pollutant/season combination:
  - With only one monitoring site, the status at the monitoring site was assigned to the assessment unit.
  - With multiple monitoring sites, the status was assigned based on the locations of monitoring stations with sufficient information to indicate Category 5: 303(d) or Category 2: Attaining status. If none of the stations had sufficient data to determine whether water quality standards were met or exceeded, the assessment unit was assigned Category 3: Insufficient data status. See Table 4.
- Where updating a previously assessed water body/pollutant/season combination, a previous Category 5: 303(d) assessment status was generally carried forward until a preponderance of data showed a Category 2: Attaining or Category 4 status was supported by site data, and a previous Category 2: Attaining status was carried forward unless new data show water quality standards are not met. See Table 5.
- For assessment units correlated to water quality standard fish use designations, if any site in a segment did not meet the applicable water quality criterion, the segment was assigned Category 5: 303(d) status. If one or more sites in a segment met the water quality criterion, and no stations exceeded the criterion, the segment was assigned Category 2: Attaining status. If all of the stations on a segment had insufficient data, the segment was assigned Category 3: Insufficient data status.

d) Combined Assessment Unit Segment and Status Determination

The following Tables 4 through 6 illustrate application of the decision hierarchy to define assessment units and assign a water quality status category to water bodies based on evaluating monitoring site data and information.

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Table [SEQ Table * ARABIC]: Defining Assessment Units and Status - New Assessments

If:	Then:	
2012 stations	**2012 Assessment Unit**	**2012 Assessment Unit Status**
One or more stations Category 5: 303(d)	Mouth to headwaters of water body	Category 5: 303(d)
One or more stations Category 5: 303(d) with upstream Category 2: Attaining station	Segment from mouth to upstream Category 2: Attaining station	Category 5: 303(d)
One station Category 5: 303(d) with downstream Category 2: Attaining station	Segment begins at halfway point between Category 5: 303(d) station and downstream Category 2: Attaining station, and ends at headwaters or next upstream Category 2: Attaining station	Category 5: 303(d)
One or more stations Category 5: 303(d) with other stations Category 3: Insufficient data	Mouth to headwaters	Cat 5: 303(d) list
One or more stations Category 2: Attaining	Mouth to headwaters	Category 2: Attaining
One or more stations Category 2: Attaining with other stations Category 3: Insufficient data	Mouth to headwaters	Category 2: Attaining
One or more stations Category 3: Insufficient data	Mouth to headwaters	Category 3: Insufficient data

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Table [SEQ Table * ARABIC]: Defining Assessment Units and Status – Previously Assessed Waters*

If	And	Then	
2012 Station status	**Previous Assessment Unit Status**	**2012 Assessment Unit**	**2012 Assessment Unit Status**
One or more stations Category 5: 303(d)	Category 5: 303(d)	Same	Category 5: 303(d) list
	Category 4A: WQ limited, TMDL approved	Same	Cat 4A: WQ limited, TMDL approved
	Category 2: Attaining	Same	Category 5: 303(d) list
One or more stations Category 2: Attaining	Category 5: 303(d)	Same	Category 5: 303(d) list (Check for data and station equivalency to delist to Category 2: Attaining).
One or more stations Category 3B: Potential Concern	Category 5: 303(d)	Same	Category 5: 303(d) list
	Category 3B: Potential Concern or Category 3: Insufficient data	Same	Category 3B: Potential Concern
	Category 2: Attaining	Same	Category 3B: Potential Concern
Combination Category 5: 303(d), Category 2: Attaining, and Category 3: Insufficient data	Category 5: 303(d)	Same	Category 5: 303(d) list
Combination Category 5: 303(d), Category 2: Attaining, and Category 3: Insufficient data	Category 2: Attaining	Same	Category 5: 303(d) list
One or more stations Category 3: Insufficient data	Category 5: 303(d)	Same	Category 5: 303(d) list
One or more stations Category 2: Attaining	Category 2: Attaining	Same	Category 2: Attaining
One or more stations Category 2: Attaining	Category 4A: WQ limited, TMDL approved	Same	Category 2: Attaining
One or more stations Category 2: Attaining and/or Category 3: Insufficient data	Category 2: Attaining	Same	Category 2: Attaining
One or more stations Category 3: Insufficient data	Category 2: Attaining	Same	Category 2: Attaining
	Category 3B: Potential Concern	Same	Category 3B: Potential Concern
One or more stations Category 3: Insufficient data	Category 3: Insufficient data		Category 3: Insufficient data

*See specific assessment protocols for bacteria (E. coli and fecal coliform) for details on updating assessment segments and status assignment.

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Table [SEQ Table * ARABIC]: Defining Assessment Units and Status – Beneficial Uses Designated in Water Quality Standards**

If:	And:	Then:	
2012 Station status		**2012 Assessment Unit**	**2012 Assessment Unit Status**
One or more stations Category 5: 303(d)		Start and end of river miles for contiguous segments with same designated use	Category 5: 303(d)
One or more stations Category 5: 303(d)	Previous assessment unit status Category 2: Attaining or Category 3	Start and end river mile for designated use	Category 5: 303(d)
One or more stations Category 5: 303(d)	TMDL approved for temperature or dissolved oxygen for stream or watershed	Start and end river mile for designated use	Category 4A: WQ limited, TMDL approved
One or more stations Category 5: 303(d) status, others Category 3: Insufficient data		Start and end river mile for designated use	Category 5: 303(d) list
One or more stations Category 2: Attaining; others Category 3: Insufficient data		Start and end river mile for designated use	Category 2: Attaining
One or more stations Category 3: Insufficient data		Start and end river mile for designated use	Category 3: Insufficient data
No data evaluated	Pollutant and time period previously assessed	Retain previous segment start and end	Retain previous status

** Temperature and dissolved oxygen water quality standards apply at locations and times that are specified in Oregon Administrative Rules (OAR) Chapter 340 Division 41 for designated fish beneficial uses and designated spawning time periods.

4. Delisting Water Bodies

Once a water body is found to be water quality limited and is assigned to Category 5: 303(d) status, the water remains on Oregon's 303(d) list until DEQ delists or removes it from Category 5: 303(d) and EPA approves delisting those waters. This section describes the rationale DEQ used to justify delisting water bodies from Category 5: 303(d) and assigning another status category.

a) Current information shows water quality standards are attained

A water body was delisted and assigned to **Category 2: Attaining** if there was sufficient information from the current assessment to evaluate the pollutant or parameter and the information demonstrated that currently applicable water quality standards were being met. Data used for delisting must meet data quality requirements and minimum sample requirements for Category 2: Attaining as described in the "Data

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Requirements" section for the pollutant. Generally, similar data were required to delist a water body as initially used to place the water body on the 303(d) list. For example, if the listing was based on two successive years of a standard not being met, DEQ looked for at least two successive years of data indicating that the standard is being met. The rationale for the delisting action was noted as **Delisted – Data show criteria met.**

b) Current information shows an error in the Category 5: 303(d) listing

A water body was delisted if there was information to show that the Category 5: 303(d) status was assigned in error. New data or review in the current assessment evaluation may show errors in previous listings due to site location errors, incorrect inclusion of inappropriate data or site data not meeting data quality requirements, data evaluations not consistent with the assessment protocols, a flaw in the original assessment rationale, listing of water bodies that already have TMDLs in place, or duplicate listings for the same water body and pollutant. The delisting was supported with a description and documentation of the error and the information used to correctly assign a status category to the water body or indicate the assessment record is **Inactive**. The delisting action was noted as **Delisted – Listing error**.

c) Water quality standards have changed or no longer apply in certain water bodies

If water quality standards have been revised since a water body was listed in Category 5: 303(d), the data and information available for the current assessment were evaluated using the currently applicable criteria and the current assessment methodology.[7] If water quality standards have changed or the beneficial use designations for a water body have been refined since it was first listed in Category 5: 303(d), the numeric or narrative water quality criteria appropriate to the currently designated beneficial use were applied to evaluate data and information. See Section IV. Assessment Protocols by Pollutant or Parameter for more detailed protocols for the pollutants with recent Oregon water quality standards changes including:

- Toxic pollutant criteria which were revised and became effective for Clean Water Act purposes in 2011 and 2012,
- Fish beneficial use designations where specific temperature and dissolved oxygen criteria apply, which were clarified and became effective for Clean Water Act purposes in 2003, and
- Bacteria criteria in freshwater currently measured as E. coli.

If available information showed that the currently effective criteria were being met, the water body was delisted and placed in **Category 2: Attaining**. The delisting action was noted as **Delisted – Criteria change or use clarification.** When no data were available to evaluate against currently applicable criteria, or data were insufficient to demonstrate attainment of the current criteria, the water body remains in Category 5: 303(d).

If the beneficial use designation is no longer appropriate in a water body, and specific pollutant criteria do not apply, the previously listed water body was delisted. No status category was assigned in this case, but a note was added saying **Criteria change or use clarification**. The delisting action was noted as **Delisted – Criteria change or use clarification.** This may be the case for waters previously listed for temperature or dissolved oxygen based on spawning criteria, where the current designated use of the water body does not include salmonid or resident trout spawning use. Once delisted, the assessment for the outdated criteria or beneficial use will no longer be reported in subsequent Integrated Reports.

If there are no currently applicable criteria because the pollutant criteria were withdrawn, the previously listed water body was delisted. No status category was assigned, but a note was added saying **No criteria**. The delisting action is noted as **Delisted – Criteria change or use clarification.** This was the case for waters

[7] See Toxic Substances section for discussion of the applicable criteria used for the 2012 Integrated Report.

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previously listed for manganese which currently does not have criteria for freshwater in Oregon water quality standards.

d) Water quality standard pollutant changed

With recent water quality standard changes, several toxic substance criteria for a family or group of chemicals were replaced by criteria for individual chemicals. Examples are criteria for chemical groups such as dichlorobenzenes, dichloroethylenes, halomethanes, and polynuclear aromatic hydrocarbons that are replaced with individual criteria. Data and information available for the current assessment were evaluated using the currently applicable criteria for the individual pollutants which are discussed in more detail in **Section IV Assessment Protocols by Pollutant.**

If available information showed that the currently effective criteria were being met for individual pollutants in the group, the water body listing for the chemical group was delisted with the delisting action noted as **Delisted – Criteria change or use clarification** and the status noted **No criteria**. The water body was reported as **Category 2: Attaining** based on data for individual pollutants in the water body. When no data were available to evaluate against currently applicable criteria for individual pollutants, or data were insufficient to demonstrate attainment of the current criteria for individual pollutants, the water body remains in Category 5: 303(d).

e) TMDLs approved for water body and pollutant

After TMDLs for a water body and pollutant are completed by DEQ and approved by EPA, the water body can be delisted from Category 5: 303(d) and placed in **Category 4A: Water Quality Limited TMDL Approved** with the delisting action noted as **Delisted – TMDL approved.** The water body retains the water quality limited status (per OAR 340-41-0002(70)) until information shows that water quality standards are attained. If a TMDL is developed for a pollutant on a watershed scale, all water body segments listed for that pollutant criteria within the watershed are delisted and placed in Category 4A. When the EPA approval of the TMDL states that the allocations will lead to attainment of the water quality criteria and that other water bodies identified as impaired for those pollutants do not need to be added to the Category 5: 303(d) list, waters identified as impaired in subsequent assessments are given the status of Category 4A: Water Quality Limited TMDL approved.

f) Other pollution control requirements in place

When pollution controls or practices required by local, State, or Federal authorities are in place, and will result in the attainment of water quality standards in a reasonable period of time, these other requirements may be satisfactory alternatives to TMDLs that address impaired water and achieve restoration. Examples other requirements are point source National Pollutant Discharge Elimination (NPDES) permits or CWA Section 401 certification conditions for hydroelectric projects that address all the significant pollutant sources on a water body. The measures and conditions are expected to result in attainment of water quality standards. When these control measures are in place, the water bodies will be delisted from Category 5: 303(d) and placed in **Category 4B: Water Quality Limited Other Control Measures in Place** with the delisting action noted as **Delisted – Other control measures in place**.

g) Pollutant does not cause impairment

When data or information indicate that water body impairment is not being caused by pollutants, the water can be delisted from Category 5: 303(d) and placed in **Category 4C: Water Quality Limited but a pollutant does not cause the impairment.** The delisting action was noted as **Delisted – Water quality limited, not a pollutant**. EPA defines a pollutant according to Section 502(6) of the Clean Water Act. In Oregon's 1998 assessment, DEQ placed water bodies on the Category 5: 303(d) list based on observations that habitat modification and flow modification caused impairments of beneficial uses in those waters. Habitat modification listings were based on information indicating inadequate pool frequency and lack of large woody debris. Flow modification listings were based on inadequate flow to maintain in-stream water rights

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purchased by Oregon Department of Fish and Wildlife. However, EPA subsequently clarified that flow and habitat modification are not pollutants under the Clean Water Act. In 2002, ODEQ removed these water bodies from the 303(d) list.

Another case for delisting may be demonstrated in water bodies listed in Category 5: 303(d) for biocriteria or for other use impairments based on a harmful algae bloom (HAB) advisories or excess chlorophyll-a levels. When sufficient data analysis or information is available to conclude that the impairment is not due to a pollutant, the water will be delisted from Category 5: 303(d) and placed in **Category 4C: Water Quality Limited but a pollutant does not cause the impairment.** The delisting action is noted as **Delisted – Water quality limited, not a pollutant**.

E. Public Review

The draft 2012 Integrated Report and a draft 2012 list of water quality limited waters were available for public review and comment from January 2, 2014 through 5:00 PM February 24, 2014. A public hearing to take comment on the draft list was held on January 14, 2014.

DEQ reviewed the submitted public comments and made changes to the 2012 Integrated Report and 2012 303(d) list where appropriate. DEQ prepared a document summarizing public comments and DEQ's response to those comments. The final 2012 Integrated Report and 303(d) list submitted to EPA reflect all changes DEQ found to be appropriate.

F. Submittal of Oregon's 2012 Integrated Report and 303(d) List

DEQ will submit Oregon's 2012 Section 303(d) list of Category 5: Water quality limited waters needing a TMDL to US EPA Region 10 for review and approval. Along with the Section 303(d) list, DEQ will also submit to EPA the 2012 Integrated Report, response to comments, the Methodology for Oregon's 2012 Water Quality Report on List of Water Quality Limited Waters, and a prioritization and TMDL schedule. Only water bodies in the Category 5: Water quality limited waters needing a TMDL (Section 303(d) list) are subject to EPA's approval.

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IV. Assessment Protocols by Pollutant or Parameter

For the 2012 Integrated Report, DEQ evaluated water quality data and information to determine if the water quality standards set out in Oregon Administrative Rules Chapter 340 Division 41 (OAR 340-041) are being met in Oregon. In the following sections, the assessment protocols used to determine the water quality status and assign an assessment category to a water body are discussed for specific parameters/pollutants, narrative and numeric criteria, and designated uses. The water quality standard citation from Oregon Administrative Rules is given for each parameter.[8] Each parameter and criterion is evaluated independently. Data are evaluated for each monitoring site, and an overall status was assigned to the water body assessment unit segment based on the available site monitoring data and information. Data are not available for all parameters in each water body. Therefore, **Category 1** indicating all designated uses are supported and all criteria are met **is not used** for Oregon's assessment.

The protocols for the 2012 Integrated Report evaluation build on and update protocols and methodologies used in past water quality assessments for 303(d) and 305(b) reporting. Results from previous assessments remain valid if not updated with new data or information and are incorporated in the 2012 Integrated Report. All protocols for pollutants or parameters that have been evaluated in past assessments as well as the protocols updated and applied for the 2012 Integrated Report are described in the following sections.

[8] OAR numbering changes periodically as rules are revised. Every attempt has been made to update the corresponding rule citation in this document to reflect the numbering current at the date of this document.

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PARAMETER: Aquatic Weeds or Algae

BENEFICIAL USES AFFECTED: Domestic and Industrial Water Supply, Irrigation, Livestock Watering, Fish and Aquatic Life, Fishing, Boating, Water Contact Recreation, Aesthetic Quality

NARRATIVE CRITERIA: OAR 340-41-0007

NUMERIC CRITERION: OAR 340-041-0019

340-041-0007
Statewide Narrative Criteria
(9) The development of fungi or other growths having a deleterious effect on stream bottoms, fish or other aquatic life, or that are injurious to health, recreation, or industry may not be allowed;

340-041-0019
Nuisance Phytoplankton Growth
See: Chlorophyll-a

ASSESSMENT PROTOCOL:

This protocol will be used to implement the statewide narrative criterion that prohibits deleterious or injurious effects on aquatic and human beneficial uses from biological growths, and will be applied specifically to aquatic weeds or algae. The growth of aquatic weeds or algae does not in itself indicate deleterious or injurious effects on beneficial uses. Nor does it identify whether a pollutant or which pollutant is causing the impairment and should be addressed by point source or other controls through a Total Maximum Daily Load. This assessment protocol identifies the indicators that will be used to determine that beneficial uses have been negatively affected by the presence of excess algal or weed growth.

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)

- Aquatic Weeds: Documented reports of excessive growths of invasive, non-native aquatic plants that dominate the assemblage in a water body and have a harmful effect on fish or aquatic life or are injurious to health, recreation, or industry. Plants include aquatic species on the Oregon Department of Agriculture Noxious Weed Policy and Classification System designated as "A", "B", or "T" weeds or those covered by a quarantine in OAR 603-052-1200.
- Algae: Health advisories issued by the Oregon Health Authority, in conjunction with other federal, state, county, city or local agencies, warning that potentially harmful levels of toxins produced by blue-green algae (cyanobacteria) are present in a water body. Health advisories related to recreational water contact are posted by the Oregon Public Health Division Harmful Algae Bloom Surveillance (HABS) program at: [HYPERLINK "http://public.health.oregon.gov/HealthyEnvironments/Recreation/HarmfulAlgaeBlooms/Pages/Blue-GreenAlgaeAdvisories.aspx"].
- Algae: Documented evidence that algae, including periphyton (attached algae) or phytoplankton (floating algae), are causing other standards to be exceeded (e.g. pH, chlorophyll a, or dissolved oxygen) or impairing a beneficial use.

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Category 4: Water Quality Limited, TMDL Not Needed

- TMDLs for specific pollutants have been completed and approved to address the excessive or harmful aquatic weed or algae growth in a water body (Category 4A);
- Another control mechanism such as an aquatic vegetation management plan is in place and is being implemented to control plant growth (Category 4B); or
- Adequate information indicates that the algae or weed growth is not due to pollutants or is a natural condition (Category 4C).

Category 3: Insufficient Data
Available data or information for the water body are not sufficient to determine if the narrative criterion is exceeded. (See NOTE on Phosphate Phosphorus Benchmark under Toxic Substances.)

Category 2: Attaining
Not applicable.

TIME PERIOD:
Year Round

DATA REQUIREMENTS:
Information, data or health advisories.

DATA REVIEWED:
2012 Integrated Report
DEQ did not evaluate data or information for aquatic weeds or algae for the 2012 Integrated Report.

Last Data Review
DEQ evaluated data and information for aquatic weeds or algae for the 2010 Integrated Report.

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PARAMETER:	**Bacteria - E. coli (Escherichia coli)** (Freshwaters and Estuarine Waters Other than Shellfish Growing Waters)
BENEFICIAL USES AFFECTED:	Water Contact Recreation
NARRATIVE CRITERION:	OAR 340-041-0009(4)
NUMERIC CRITERION:	OAR 340-041-0009(1) (a)

340-041-0009
Bacteria
(1) Numeric Criteria: Organisms of the coliform group commonly associated with fecal sources (MPN or equivalent membrane filtration using a representative number of samples) may not exceed the criteria described in paragraphs (a) and (b) of this paragraph:
(a) Freshwaters and Estuarine Waters Other than Shellfish Growing Waters:
(A) A 30-day log mean of 126 E. coli organisms per 100 milliliters, based on a minimum of five (5) samples;
(B) No single sample may exceed 406 E. coli organisms per 100 milliliters.
(4) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or shellfish propagation, or otherwise injurious to public health may not be allowed;

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)
A 30-day log mean greater than 126 E. coli organisms per 100 ml based on a minimum of five (5) samples, <u>or</u> more than 10% of the samples exceed 406 E. coli organisms per 100 ml, with a minimum of at least two exceedances.

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3: Insufficient Data
Less than 5 samples are available to evaluate for the season of interest, or 5 to 9 samples for the season of interest with 1 sample exceeding 406 E. coli organisms per 100 milliliters.

Category 3B: Insufficient Data – Potential Concern
Less than 5 samples are available to evaluate for the season of interest, with 2 or more samples exceeding 406 E. coli organisms per 100 milliliters.

Category 2: Attaining
The 30-day log mean is equal to or less than 126 E. coli organisms per 100 ml based on a minimum of five (5) samples, <u>and</u>, if data from 10 or more samples are available, 90% of the samples are below 406 E. coli organisms per 100 ml. If data from 5 to 9 samples are available, no exceedances of 406 E. coli organisms per 100 ml.

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If data are insufficient to calculate a 30-day log mean, then, for 10 or more samples, 90% of the samples are below 406 E. coli organisms per 100 ml; or for 5 to 9 samples, no samples greater than 406 E. coli organisms per 100 ml.

TIME PERIOD:

Summer: June 1 through September 30 (period of highest use for water contact recreation). (A summer 30-day log mean is calculated for sampling dates beginning on May 17 through September 16.)

Fall-Winter-Spring (FWS): October 1 through May 31. (A FWS 30-day log mean is calculated for sampling dates beginning September 17 through May 16.)

DATA REQUIREMENTS:

Data collected since 2001. A minimum of 5 representative data points available per site collected on separate days for each time period of interest. The numeric value of results reported as the Minimum Reporting Level (MRL) was used to calculate the 30-day log mean.

DATA REVIEWED:

2012 Integrated Report

DEQ did not evaluate data for E. coli bacteria for the 2012 Integrated Report.

DEQ reviewed EPA action on Oregon's 2010 303(d) list. Where EPA found impairments from E. coli bacteria but did not add new 303(d) listings because TMDLs were already approved, DEQ added these assessments as new Category 4A records for the 2012 Integrated Report based on EPA's analysis of data.

Last Data Review

EPA reviewed E. coli bacteria data to propose additions to Oregon's 2010 303(d) list. EPA took final action on the 303(d) additions in December, 2012.

NOTES:

The E. coli numeric criteria protect water contact recreational uses in freshwaters and estuarine waters. Estuarine waters are defined in OAR 340-041-0002(22) to mean all mixed fresh and oceanic water in estuaries or bays from the point of oceanic water intrusion inland to a line connecting the outermost points of the headlands or protective jetties. For the review of water quality data, the inland extent of estuarine waters was identified where recorded specific conductivity measurements were above 200 uS/cm.

The E. coli numeric criteria are not applied in marine waters.

The bacteria standard was changed in 1996 to use E. coli as the indicator organism for water contact recreation protection, replacing the previous standard based on fecal coliform. Only the current E. coli standard is applied in freshwaters and estuarine non-shellfish growing waters in reviewing data for the assessment. Listings in previous years may have identified freshwater water bodies as water quality limited using fecal coliform as the indicator. If data evaluated for the assessment show the current E. coli criteria for freshwater are met, the water body will be delisted for older fecal coliform listings. The listings are retained if no data for E. coli are available for the evaluation, or if E. coli is also listed.

Estuarine waters are also considered coastal recreation water subject to the federal water quality criteria based on Enterococci, and are additionally presumed to be potential shellfish growing waters, subject to the fecal coliform criteria to protect that beneficial use. The assessment methods for these standards are discussed in the next sections.

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PARAMETER: Bacteria - Enterococci

(Coastal Recreation Waters including Marine Coastal Waters and Coastal Estuaries)[9]

BENEFICIAL USES AFFECTED: Water Contact Recreation

NUMERIC CRITERION: 40 CFR Part 131.41
(Water quality criteria for Oregon marine coastal recreation waters promulgated by EPA effective 12/16/2004)

40 CFR Part 131.41
(c) *EPA's section 304(a) ambient water quality criteria for bacteria.*
(2) Marine waters:

A Indicator	B Geometric mean	C Single sample maximum (per 100 ml)
		C2 Moderate use coastal recreation waters (82% confidence level)
Enterococci[c]	35/100 ml[a]	158[b]

Footnotes to table in paragraph (c)(2):
a. This value is for use with analytical methods 1106.1 or 1600 or any equivalent method that measures viable bacteria.
b. Calculated using the following: single sample maximum = geometric mean*10^ (confidence level factor*log standard deviation), where the confidence level factor is: 75%: 0.68; 82%: 0.94; 90%: 1.28; 95%: 1.65. The log standard deviation from EPA's epidemiological studies is 0.7.
c. These values apply to enterococci regardless of origin unless a sanitary survey shows that sources of the indicator bacteria are non-human and an epidemiological study shows that the indicator densities are not indicative of a human health risk.

ASSIGNMENT OF ASSESSMENT CATEGORY:

EPA recommends using the geometric mean as the relevant criteria for 303(d) listing purposes.[10] The single sample maximum is a statistical construct to allow decisions for beach advisories based on small data sets. Marine waters in coastal Oregon have not been designated for a specific level of recreational use. The single sample maximum criterion for moderate use coastal recreation waters is currently used by the Oregon Health Authority Beach Monitoring Program to trigger a water contact advisory. See [HYPERLINK "http://public.health.oregon.gov/HealthyEnvironments/Recreation/BeachWaterQuality/Pages/index.aspx"] .

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[9] 40 CFR Part 131.41 (b) *Definitions.* (1) *Coastal Recreation Waters* are the Great Lakes and marine coastal waters (including coastal estuaries) that are designated under section 303(c) of the Clean Water Act for use for swimming, bathing, surfing, or similar water contact activities. Coastal recreation waters do not include inland waters or waters upstream from the mouth of a river or stream having an unimpaired natural connection with the open sea. [HYPERLINK "http://www.ecfr.gov/cgi-bin/text-idx?SID=316ff723c7e3f73322676fb3ce32a8af&node=se40.22.131_141&rgn=div8"]

[10] US EPA Office of Water, EPA-823-F-06-013, August 2006, Water Quality Standards for Coastal Recreation Waters: Using Single Sample Maximum Values in State Water Quality Standards

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Category 5: Water Quality Limited, TMDL Needed (303(d) List)
A geometric mean for samples collected over a seasonal sampling period greater than 35 Enterococci per 100 ml based on a sample set of 5 or more samples.

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3: Insufficient Data
Less than 5 samples are available for evaluation for a seasonal sampling period.

Category 3B: Insufficient Data – Potential Concern
Less than 5 samples are available for a seasonal sampling period, and one or more samples exceeds the single sample maximum of 158 Enterococci per 100 ml, or the Oregon Beach Monitoring Program has issued one or more advisories based on monitoring results for Enterococci in a seasonal sampling period (not including precautionary advisories).

Category 2: Attaining
The geometric mean for samples collected over a seasonal sampling period is equal or less than 35 Enterococci per 100 ml.

TIME PERIOD:
Summer: May 1 through September 30 (period of highest use for water contact recreation)
Winter: October 1 through April 30

DATA REQUIREMENTS:
Data collected since 2001. A minimum of 5 representative data points available per site collected on separate days for each seasonal time period in a given year. For results reported at or below the Minimum Reporting Level (<MRL), the numeric value of the MRL was used to calculate the geometric mean.

DATA REVIEWED:
2012 Integrated Report
DEQ did not evaluate data or information for Enterococci bacteria for the 2012 Integrated Report.

Last Data Review
DEQ evaluated data and information for Enterococci bacteria for the 2010 Integrated Report.

NOTES:
Coastal recreation waters for the assessment are identified as all marine waters and coastal estuaries. Coastal recreation waters do not include inland waters or waters upstream from the mouth of a river or stream having an unimpaired natural connection with the open sea.

The Oregon Beach Monitoring Program has identified 92 coastal beaches in Oregon. Each of these beaches is assigned a beach name and beach identification number that are used in reporting to EPA. For the Integrated Report, the identified coastal beaches were used as the assessment units and defined as segments along the Pacific Ocean or an estuarine river location.

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The Oregon Beach Monitoring Program may issue precautionary advisories based on heavy rainfall, flooding, or sewage spills. These advisories are not included in the data summarized in the assessment.

PARAMETER: Bacteria – Fecal coliform

(Marine Waters and Estuarine Shellfish Growing Waters)

BENEFICIAL USES AFFECTED: Shellfish Growing (fishing/shellfish consumption)

NARRATIVE CRITERION: OAR 340-041-0007(10)
OAR 340-041-0009(4)

NUMERIC CRITERION: OAR 340-041-0009(1) (b)

340-041-0007
Statewide Narrative Criteria
(10) The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed;

340-041-0009
Bacteria
(1) Numeric Criteria: Organisms of the coliform group commonly associated with fecal sources (MPN or equivalent membrane filtration using a representative number of samples) may not exceed the criteria described in paragraphs (a) and (b) of this paragraph:

(b) Marine Waters and Estuarine Shellfish Growing Waters: A fecal coliform median concentration of 14 organisms per 100 milliliters, with not more than ten percent of the samples exceeding 43 organisms per 100 ml.

(4) Bacterial pollution or other conditions deleterious to waters used for domestic purposes, livestock watering, irrigation, bathing, or shellfish propagation, or otherwise injurious to public health may not be allowed;

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)
For a datasets of less than 30 samples, a minimum of 2 exceedances of 43 organisms/100 ml. For datasets with greater than 30 samples, 10% of the samples must exceed 43 organisms/100mL.
OR, for datasets with a minimum of 5 samples, the median value is greater than 14 organisms/100 ml.

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3: Insufficient Data
Less than 5 samples available for analysis, or 5 to 9 samples with 1 exceedance and the median is 14 organisms/100 ml or less.

Category 3B: Insufficient Data – Potential Concern
Less than 5 samples available to evaluate, with 2 or more samples exceeding 43 organisms per 100 milliliters.

Category 2: Attaining

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A minimum number of 5 samples per site, with 90% of the samples less than 43 organisms/100 ml and the median value of 14 organisms/100 ml or less.

TIME PERIOD:
Year Round

DATA REQUIREMENTS:
Data collected since 2001. A minimum of 5 representative samples per site collected on separate days. The numeric values of results reported at or above the Minimum Reporting Level (MRL) were used to calculate the median concentration. Data were evaluated for marine and estuarine waters.

DATA REVIEWED:
2012 Integrated Report
DEQ did not evaluate data for fecal coliform bacteria for the 2012 Integrated Report.

DEQ reviewed EPA action on Oregon's 2010 303(d) list. Where EPA found impairments from fecal coliform bacteria but did not add new 303(d) listings because TMDLs were already approved, DEQ added these assessments as new Category 4A records for the 2012 Integrated Report based on EPA's analysis of data.

Last Data Review
EPA reviewed fecal coliform bacteria data to propose additions to Oregon's 2010 303(d) list. EPA took final action on the 303(d) additions in December, 2012.

NOTES:
DEQ has determined that fecal coliform water quality criteria should be applied to marine and estuarine waters that support recreational shellfish harvesting as well as commercial shellfish harvesting (Minutes from the Estuary Workgroup Meeting, DEQ, Newport, Oregon, July 13, 2001).

Marine waters are defined in OAR 340-041-0002(34) as all oceanic, offshore water outside of estuaries or bays and within the territorial limits of Oregon. Estuarine waters are defined in OAR 340-041-0002(22) as mixed fresh and oceanic water in estuaries or bays from the point of oceanic water intrusion inland to a line connecting the outermost points of the headlands or protective jetties. For the review of water quality data, the inland extent of estuarine waters was identified where recorded specific conductivity measurements were above 200 uS/cm. However, coastal lakes were not included as estuarine shellfish growing waters for this assessment.

The fecal coliform criteria protect the beneficial use of shellfish growing in marine and estuarine waters. Prior to 1996, fecal coliform were also the indicator organisms to protect water contact recreation in freshwater and estuarine waters. The bacteria standard was changed in 1996 to use E. coli as the indicator organism. However, assessments in previous years may have identified freshwater water bodies as water quality limited for water contact recreation using fecal coliform data. These listings are retained unless data for E. coli are available for evaluation for the current assessment. If data show the current E. coli criteria are met, the water body will be delisted for water contact recreation impairments.

Marine and estuarine waters are also subject to the federal water quality criteria protecting water contact recreation use in coastal waters based on Enterococci as the indicator organism. The assessment of this use in coastal recreation waters is discussed in the previous section on Enterococci.

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PARAMETER: Biocriteria

BENEFICIAL USES AFFECTED: Aquatic Life

NARRATIVE CRITERION: OAR 340-041-0011

> **340-041-0011**
> **Biocriteria**
> Waters of the State must be of sufficient quality to support aquatic species without detrimental changes in the resident biological communities.

NARRATIVE ASSESSMENT PROTOCOL:

Detrimental changes in resident biological communities are a form of pollution.[11,12] EPA guidance recommends using biological community assessments as an indicator for aquatic life beneficial use support.[13] This protocol is used to implement Oregon's narrative standard for Biocriteria. The protocol applies numeric benchmarks to evaluate the integrity of aquatic biological communities. Biological assessments look at conditions in the biological communities, but do not by themselves indicate if changes are related to pollutants, or identify which pollutant should be addressed by point source or other controls through a Total Maximum Daily Load. EPA guidance recommends listing waters with aquatic use impairments as Category 5: 303(d) even if the pollutant is not known.[14] This protocol outlines the process and assessment category assignment that Oregon used for the Integrated Report to apply the narrative criterion.

This protocol is based on biological assemblage information for freshwater macroinvertebrates collected by DEQ at reference sites throughout Oregon. Freshwater macroinvertebrates include insects, crustaceans, snails, clams, worms, mites, etc. DEQ identifies sites in a given region that are least disturbed by anthropogenic activities and uses these as reference sites.[15] Biological assessment tools use information from these reference sites to predict the variety and number of aquatic life species expected in Oregon streams and to make inferences about the biological condition of the waters.[16]

Assessing Macroinvertebrate Communities

To assess the biological integrity of macroinvertebrate communities, DEQ used a statistical method called a multivariate predictive model.[17] Using data from reference sites, the model describes the number and types of macroinvertebrates that are expected to be in a water body when the water is in least disturbed conditions. Reference sites are grouped by predictor variable factors that are not affected by human activities (e.g., sampling date, ecoregion, longitude, elevation, precipitation, or air temperature). DEQ developed a model specifically for Oregon, but similar model approaches are used for bioassessments in the United Kingdom

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[11] Federal Water Pollution Act Section 502(19) (33 U.S.C 1362) (Clean Water Act)
[12] Oregon Administrative Rules 340-041-0002(39)
[13] US EPA, July 29, 205, Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act, page 41.
[14] US EPA, July 29, 205, Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act, page 60.
[15] Drake, D., April 2004, Selecting Reference Condition Sites - An Approach for Biological Criteria and Watershed Assessment, ODEQ Technical Report WSA04-002. [HYPERLINK "http://www.deq.state.or.us/lab/techrpts/docs/WSA04002.pdf"]
[16] Stoddard,J.L., et.al., 2006. Setting Expectations for the Ecological Condition of Streams: The Concept of Reference Condition. Ecological Applications. 16(4): 1267-1276
[17] Hubler, S., July 2008, PREDATOR: Development and Use of RIVPACS-type Macroinvertebrate Models to Assess the Biotic Condition of Wadeable Oregon Streams, Technical Report DEQ08-LAB-0048-TR

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(RIVPACS), Australia (AusRIVas), Canada (BEAST), and in broad areas in the United States (typically called RIVPACS models, though different from the U. K. models).

DEQ developed the PREDictive Assessment Tool for ORegon, or PREDATOR, to assess the macroinvertebrate communities in Oregon's perennial, wadeable streams. PREDATOR analyzes data from reference sites grouped into three regions in Oregon and models the expected assemblage. Information from a sampling site can be compared to the macroinvertebrate assemblage predicted by the model and an assessment made about how different the observed assemblage is from the expected or reference assemblage. Data collected at a sampling site is used to generate a number for the observed versus expected (O/E) macroinvertebrate taxa. This number represents the "missing" taxa at a site, and can be expressed as "% taxa loss".

For the assessment, DEQ selected values of % taxa loss to use to assign a status category to a water body. The benchmark values are indicators of differences from reference conditions that may indicate detrimental changes to biological communities and an impairment in aquatic life use support that violates the narrative standard. A discussion of the scientific basis for the model development, statistical analysis of reference site data, and basis for selecting benchmark values in terms of the reference site distributions in different regions in Oregon is given in a separate technical paper.[16]

ASSIGNMENT OF ASSESSMENT CATEGORY:

Benchmark values are expressed in terms of the percent of taxa not found in a site assemblage compared to the expected assemblage predicted by the PREDATOR model. The benchmark values are summarized in Table 7.

Category 5: Water Quality Limited, TMDL Needed (303(d) List)
Macroinvertebrate sampling data from perennial, wadeable streams evaluated by DEQ using the PREDATOR model showing:

- ≥ 15% taxa loss in the Marine Western Coastal Forest (MWCF) region,
- ≥ 22% taxa loss in the Western Cordillera and Columbia Plateau (WCCP) region, or
- ≥ 50% taxa loss in the Northern Basin and Range (NBR) region.

Category 4: Water Quality Limited, TMDL Not Needed
In some water bodies, DEQ has information relating specific pollutants to the condition of the biological communities in the water body. Where data are available identifying a specific pollutant as the cause of detrimental changes to biological communities, and a TMDL has been approved with load allocations for the pollutant, the water body will be placed in Category 4 if no additional TMDLs are needed. Water bodies will also be placed in Category 4 for biological criteria if adequate information is available to indicate that detrimental changes to biological communities are not due to a pollutant.

Category 3B: Insufficient Data – Potential Concern
Some macroinvertebrate sampling data from perennial, wadeable streams evaluated using the PREDATOR model are inconclusive and are insufficient to assign a status category until additional information is collected.

Macroinvertebrate sampling data from perennial, wadeable streams evaluated by DEQ using the PREDATOR model showing:

- 8% to 14% taxa loss or > 24% taxa gain in the Marine Western Coastal Forest (MWCF) region,
- 8% to 21% taxa loss or > 23% taxa gain in the Western Cordillera and Columbia Plateau (WCCP) region, or
- 25% to 49% taxa loss in the Northern Basin and Range (NBR) region.

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Results showing taxa loss in these ranges could be due to sampling error or modeling error and may be over or under-estimating taxa loss. A large gain of observed taxa over expected may indicate more natural diversity, or may indicate disturbance that has enhanced diversity.[18] Additional samples are necessary to better assess biological conditions. A minimum of 5 replicate samples should be collected to provide sufficient data for status classification. The stream is a potential concern until more information is evaluated.

Category 2: Attaining
Macroinvertebrate sampling data from perennial, wadeable streams evaluated by DEQ using the PREDATOR model showing:

- 0% to 8% taxa loss or 0% to 24% taxa gain in the Marine Western Coastal Forest (MWCF) region,
- 0% to 7% taxa loss or 0% to 23% taxa gain in the Western Cordillera and Columbia Plateau (WCCP) region, or
- < 25% taxa loss in the Northern Basin and Range (NBR) region.

TIME PERIOD:
Year Round

DATA REQUIREMENTS:
Site sample data must be collected during or after 1998 to be comparable to the reference site data (1998 to 2004) that is used in the PREDATOR model. Site samples must be collected within the model season of June 1 through October 15. Field duplicates and seasonal replicate samples are averaged to account for sampling and seasonal variability.

Site sample data must be collected using standard field methods and identified to appropriate taxonomic levels, as described in the DEQ Mode of Operations Manual, or equivalent protocols used throughout the Pacific Northwest.[19] The standard method for macroinvertebrate sampling requires collecting organisms from specific habitats within a specified size reach of a stream. The data are evaluated to generate one sample result in the PREDATOR model.

One sample result is sufficient to evaluate for the assessment using the benchmarks developed from the PREDATOR model. If samples from multiple years are available, the most recent sample result in either Category 2: Attaining or Category 5: 303(d) will determine the site status. If the most recent sample result is Category 2: Attaining and a previous sample is Category 5: 303(d), the site status will be Category 3B. Recent Category 2: Attaining sample results must outnumber earlier Category 5: 303(d) sample results for the site status to be considered Category 2.

When results for replicate site samples are collected to clarify inconclusive results (Category 3B), a minimum of 5 samples is required to achieve the target statistical confidence. The site will be assigned a status category if 3 out of 5 replicate samples show results in the Category 2: Attaining or Category 5: 303(d) ranges. Replicate samples must be collected in the same sampling season, in the same reach, or in adjacent and comparable reaches.

DATA REVIEWED:
2012 Integrated Report

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[18] Ward, J.W, and Stanford, J.A., 1983, Intermediate-Disturbance Hypothesis: An Explanation for Biotic Diversity Patterns in Lotic Ecosystems. In Dynamics of Lotic Systems, Ann Arbor Science, Ann Arbor, MI, pages 347-356.
[19] ODEQ, 2009, Mode of Operations Manual, Version 3.2, DEQ03-LAB-0036-SOP, [HYPERLINK "http://www.deq.state.or.us/lab/techrpts/docs/DEQ03LAB0036SOP.pdf"]

ED_002660_00013602-00038

DEQ did not evaluate data or information for biocriteria for the 2012 Integrated Report.

DEQ reviewed EPA's action on Oregon's 2010 303(d) list. Based on EPA's determination that waters with impaired biological conditions should be placed on the 303(d) list, DEQ re-assigned several waters to Category 5: Water Quality Limited, TMDL Needed (303(d) List).

Last Data Review
DEQ evaluated data and information for biocriteria for the 2010 Integrated Report. EPA reviewed DEQ's analysis and determined that waters with impaired biological conditions should be added to Oregon's 2010 303(d) list. EPA took final action to add these waters to the 303(d) list in December, 2012.

DELISTING:

Once TMDLs are approved for pollutants that will also improve biological conditions, water bodies may be delisted for biocriteria. These waters will be placed in Category 4: Water Quality Limited, TMDL Not Needed if no additional TMDLs are needed.

Water bodies may be delisted for biocriteria based on multiple site sampling events showing results that are attaining benchmarks. A minimum of 5 samples must be collected in the same sampling season and in the same or adjacent and comparable reaches, with 3 out of 5 samples showing results that attain appropriate benchmarks. These waters will be placed in Category 2: Attaining.

SEGMENTATION:

General segmentation protocols will be followed (Appendix 1). The status category from one sampling site will apply to the sampling reach and upstream portions of the wadeable, perennial stream. A minimum segment length of 0.6 miles will be imposed when multiple sample sites are closely located within a small stream reach. Given the sampling design and field protocols, assessment segments less than 0.6 miles are likely to impose artificial divisions that are not true representations of stream conditions.

Table [SEQ Table * ARABIC]: Biocriteria Assessment Benchmarks

PREDATOR Model Region	Assessment Category		
	Category 5: Water Quality Limited	Category 3B: Insufficient Data Potential Concern	Category 2: Attaining
Marine Western Coastal Forest	≥ 15% taxa loss	9% - 14% taxa loss or > 24% taxa gain	0% - 8% taxa loss or 0% - 24% taxa gain
	PREDATOR score ≤ 0.85	PREDATOR score 0.86 to 0.91 or > 1.24	PREDATOR score 0.92 to 1.24
Western Cordillera and Columbia Plateau	≥ 22% taxa loss	8% - 21% taxa loss or > 23% taxa gain	0% - 7% taxa loss or 0% - 23% taxa gain
	PREDATOR score ≤ 0.78	PREDATOR score 0.79 to 0.92 or > 1.23	PREDATOR score 0.93 to 1.23
Northern Basin and Range	≥ 50% taxa loss	25% - 49% taxa loss	< 25% taxa loss
	PREDATOR score ≤ 0.50	PREDATOR score 0.49 to 0.75	PREDATOR score > 0.75

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PARAMETER: Chlorophyll a

(Nuisance Phytoplankton Growth)

BENEFICIAL USES AFFECTED:

Water Contact Recreation
Aesthetics
Fishing
Water Supply
Livestock Watering

NUMERIC CRITERION: OAR 340-041-0019

340-041-0019
Nuisance Phytoplankton Growth

(1) (a) The following values and implementation program must be applied to lakes, reservoirs, estuaries and streams, except for ponds and reservoirs less than ten acres in surface area, marshes and saline lakes:

(b) The following average Chlorophyll a values must be used to identify water bodies where phytoplankton may impair the recognized beneficial uses:

(A) Natural lakes that thermally stratify: 0.01 mg/1;

(B) Natural lakes that do not thermally stratify, reservoirs, rivers and estuaries: 0.015 mg/1;

(C) Average Chlorophyll a values may be based on the following methodology (or other methods approved by the Department): A minimum of three samples collected over any three consecutive months at a minimum of one representative location (e.g., above the deepest point of a lake or reservoir or at a point mid-flow of a river) from samples integrated from the surface to a depth equal to twice the secchi depth or the bottom (the lesser of the two depths); analytical and quality assurance methods must be in accordance with the most recent edition of Standard Methods for the Examination of Water and Wastewater.

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)

The average Chlorophyll a value over three consecutive months exceeds the value referenced in the rule. The average must be calculated with at least one sample in each month.

Category 4: Water Quality Limited, TMDL Not Needed

- TMDLs for specific pollutants have been completed and approved to address nuisance phytoplankton growth and exceedance of chlorophyll a values in a water body (Category 4A);
- Another control mechanism such as a control strategy develop and adopted according to OAR 340-041-0019(2) is being implemented to control phytoplankton growth (Category 4B); or
- Adequate information indicates that phytoplankton proliferation is not due to pollutants or is a natural condition (Category 4C).

Category 3: Insufficient Data

Less than 3 samples available in three consecutive months to calculate an average, or less than one sample available in any month of the three consecutive month period.

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Category 2: Attaining
The average Chlorophyll a value over three consecutive months is less than the value referenced in the rule.

TIME PERIOD:
Summer: June 1 through September 30 or three month periods beginning May through August
Fall-Winter-Spring (FWS): October 1 through May 31 or three month periods beginning September through April

DATA REQUIREMENTS:
Data collected since 2001. A minimum of three samples collected over any three consecutive months (at least one per month) at a minimum of one representative location (e.g., above the deepest point of a lake or reservoir or at a point mid flow of a river).

DATA REVIEWED:
2012 Integrated Report
DEQ did not evaluate data or information for Chlorophyll a for the 2012 Integrated Report.

DEQ reviewed EPA action on Oregon's 2010 303(d) list. Where EPA found impairments from Chlorophyll a but did not add new 303(d) listings because TMDLs were already approved, DEQ added these assessments as new Category 4A records for the 2012 Integrated Report based on EPA's analysis of data.

Last Data Review
EPA reviewed Chlorophyll a data to propose additions to Oregon's 2010 303(d) list. EPA took final action on the 303(d) additions in December, 2012.

NOTES:
Information on thermally stratified lakes was obtained from the Atlas of Oregon Lakes[20].

Lakes are identified by an LLID assigned to a point at the center of the water body. They may also be identified with an LLID for a stream which flows into or out of the lake, and river miles are assigned at those points on the stream line.

Saline lakes were identified in coastal areas and Oregon Closed Basins where recorded specific conductivity measurements were generally above 200 uS/cm.

[20] Johnson, D.M., Petersen, R.R., Lycan, D.R., Sweet, J.W., Neuhaus, M.E., Schaedel, A.L., 1985, Atlas of Oregon Lakes: Corvallis, OR, Oregon State University Press, 317 p.

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PARAMETER: Dissolved Oxygen

BENEFICIAL USES AFFECTED:

Fish and Aquatic Life
Salmon and Steelhead Spawning
Resident Trout Spawning
Cold-Water Aquatic Life
Cool-Water Aquatic Life
Warm-Water Aquatic Life
Estuarine Water

NUMERIC CRITERION: OAR 340-041-0016

340-041-0016
Dissolved Oxygen
Dissolved oxygen (DO): No wastes may be discharged and no activities may be conducted that either alone or in combination with other wastes or activities will cause violation of the following standards: The changes adopted by the Commission on January 11, 1996, become effective July 1, 1996. Until that time, the requirements of this rule that were in effect on January 10, 1996, apply:
(1) For water bodies identified as active spawning areas in the places and times indicated on the following Tables and Figures set out in OAR 340-041-0101 to 340-041-0340: Tables 101B, 121B, and 190B, and Figures 130B, 151B, 160B, 170B, 180A, 201A, 220B, 230B, 260A, 271B, 286B, 300B, 310B, 320B, and 340B, (as well as any active spawning area used by resident trout species), the following criteria apply during the applicable spawning through fry emergence periods set forth in the tables and figures and, where resident trout spawning occurs, during the time trout spawning through fry emergence occurs:

(a) The dissolved oxygen may not be less than 11.0 mg/l. However, if the minimum intergravel dissolved oxygen, measured as a spatial median, is 8.0 mg/l or greater, then the DO criterion is 9.0 mg/l;
(b) Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 11.0 mg/l or 9.0 mg/l criteria, dissolved oxygen levels must not be less than 95 percent of saturation;
(c) The spatial median intergravel dissolved oxygen concentration must not fall below 8.0 mg/l.

(2) For water bodies identified by the Department as providing cold-water aquatic life, the dissolved oxygen may not be less than 8.0 mg/l as an absolute minimum. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/l, dissolved oxygen may not be less than 90 percent of saturation. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 8.0 mg/l as a 30-day mean minimum, 6.5 mg/l as a seven-day minimum mean, and may not fall below 6.0 mg/l as an absolute minimum (Table 21);
(3) For water bodies identified by the Department as providing cool-water aquatic life, the dissolved oxygen may not be less than 6.5 mg/l as an absolute minimum. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 6.5 mg/l as a 30-day mean minimum, 5.0 mg/l as a seven-day minimum mean, and may not fall below 4.0 mg/l as an absolute minimum (Table 21);
(4) For water bodies identified by the Department as providing warm-water aquatic life, the dissolved oxygen may not be less than 5.5 mg/l as an absolute minimum. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen may not fall below 5.5 mg/l as a 30-day mean minimum, and may not fall below 4.0 mg/l as an absolute minimum (Table 21);

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(5) For estuarine water, the dissolved oxygen concentrations may not be less than 6.5 mg/l (for coastal water bodies);
(6) For ocean waters, no measurable reduction in dissolved oxygen concentration may be allowed.

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)
For the time period of interest (spawning or non-spawning), greater than 10% of the samples do not meet the appropriate criteria, and at least 2 samples do not meet the criteria.

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address the pollutant and result in the attainment of water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3: Insufficient Data
Fewer than 5 samples collected on separate days for the time period of interest, or 5 to 9 samples for the time period of interest with 1 sample that does not meet the appropriate criterion.

Category 2: Attaining
For 10 or more samples in the time period of interest, greater than 90% of samples meet the appropriate criteria. For 5 to 9 samples in the time period of interest, all samples meet the appropriate criteria.

TIME PERIOD:

Spawning Time Period: During places and times indicated in tables and figures referenced in OAR 340-041-0016(1) as active spawning areas and any active spawning area used by resident trout species.
Non-Spawning Time Period: Year round or during periods outside the identified spawning time period.

DATA REQUIREMENTS:

Data collected since 2000. A minimum of 5 samples collected on separate days per site per applicable criteria time period (spawning or non-spawning) are required. A **sample** can be one "grab sample" or a single measurement in a set of continuous monitoring data results (i.e. multiple measurements collected over an extended time period). For the 2012 Integrated Report, all samples including grab samples and single measurements in continuous data sets were counted as discreet **samples**.

For the 2012 Integrated Report, DEQ calculated a "percent saturation" in order to fully apply the spawning and cold water dissolved oxygen criteria using a known and consistent methodology. DEQ used sample temperature data and derived station elevations from 30 meter Digital Elevation Model data to calculate a percent saturation value using the following equation:[21] Although field measurements of percent saturation may be collected, DEQ did not evaluate sample results that did not have the necessary corresponding temperature value to calculate the percent saturation for the 2012 Integrated Report.

$$DO_{Theo} = e\text{^}(-139.34411 + 157570.1/T - 66423080/T\text{^}2 + 12438000000/T\text{^}3 - 862194900000/T\text{^}4) * (1 - 0.0001148 * \text{SIte_elvm})$$

$$PS = 100 * \frac{DO_{Meas}}{DO_{Theo}}$$

[21] Pelletier and Chapra. 2008. Qual2Kw theory and documentation (version 5.1), *Washington Department of Ecology*, Olympia, WA.

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Where PS = Percent saturation dissolved oxygen,
DO_{Theo} = Theoretical Dissolved Oxygen in mg/L,
DO_{Meas} = Measured Dissolved Oxygen in mg/L,
T = Temperature in Kelvin, and
Site_elvm = Site elevation in meters

DATA REVIEWED:

2012 Integrated Report

DEQ evaluated the following data for dissolved oxygen for the 2012 Integrated Report:

USGS data - Monitoring results for dissolved oxygen for the period January 1, 2000 through December 31, 2011 from 563 sampling locations in the Willamette Basin and the Umatilla subbasin (Hydrologic Unit Code 17070103).

DEQ LASAR data - Monitoring results for dissolved oxygen from continuous sampling and grab sampling for the period January 1, 2000 through December 31, 2011 from 772 sampling locations in the Willamette Basin and the Umatilla subbasin (Hydrologic Unit Code 17070103).

DETERMINING APPLICABLE CRITERIA:

Oregon's water quality standards for dissolved oxygen include different criteria for freshwaters supporting several types of aquatic life including sensitive fish species and life stages, as well as criteria for estuarine and ocean waters. The criteria apply to various waters throughout the state and at different time periods throughout a calendar year. Determining the applicable criteria to use to assess dissolved oxygen data is the first step in the data evaluation process. The water quality standards have been clarified through several policy letters and memorandum that are incorporated into the assessment protocols in order to provide a method to determine what criteria apply to specific water bodies, and when to apply the criteria. (See Appendices)

The dissolved oxygen criteria in OAR 340-041-0016 applicable to freshwater aquatic life and fish uses are summarized in the following table:

Table [SEQ Table * ARABIC]: Dissolved Oxygen Criteria to Protect Aquatic Life*

Dissolved Oxygen Standard	Spawning	Cold	Cool	Warm
Aquatic Life Use	Active spawning areas	Cold-water aquatic life	Cool-water aquatic life	Warm-water aquatic life
Dissolved Oxygen Criteria (mg/l)	11.0	8.0	6.5	5.0
Dissolved Oxygen % Saturation	Not less than 95 % saturation	Not less than 90 % saturation	—	—

* DEQ determined that information available for the 2012 Integrated Report was not adequate to apply the additional criteria in OAR-340-041-0016(2), OAR-340-041-0016(3), OAR-340-041-0016(4), and Table 21.

The aquatic life categories are defined in water quality rules (OAR 304-041). In 1998, DEQ determined that maps with ecoregion information would be used as a guideline to identify waters supporting cold-water and cool-water aquatic life, and specific waters without salmonid designated uses would identify warm-water

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uses.[22, 23] Water quality standards adopted in 2003 further refined beneficial designations for sub-categories of fish uses and also identified the places and times that support active spawning for salmon and steelhead species. DEQ updated guidelines in 2004 in order to provide guidelines to identify locations and time periods for resident trout and bull trout (char) spawning to supplement the salmon and steelhead spawning designations.[24] In 2010, DEQ updated the 1998 memo to incorporate references to updated maps and ecoregion information to use to identify the applicable cold or cool-water criteria to apply where "salmon and trout rearing and migration" or "redband or Lahontan cutthroat trout" were the designated fish use.[25] Based on the water quality standards, current beneficial use designations, and referenced implementation memos developed to clarify the standards, DEQ used the following strategy to determine the applicable criteria to use to evaluate dissolved oxygen data for the Integrated Report.

Cold Water Criteria:
Cold-water aquatic life is defined in OAR 340-041-0002 (9) to mean:

> "... aquatic organisms that are physiologically restricted to cold water, including but not limited to native salmon, steelhead, mountain whitefish, char (including bull trout), and trout."

As indicated in OAR 340-041 Table 21, the uses and level of protection achieved by the numeric criteria are:

> "Principally cold-water aquatic life. Salmon, trout, cold-water invertebrates, and other native cold-water species exist throughout all or most of the year. Juvenile anadromous salmonids may rear throughout the year. No measurable risk level for these communities."

As implemented for the Integrated Report, during non-spawning time periods the **cold water criteria** for dissolved oxygen were applied to waters with the following designated uses referenced in basin-specific beneficial uses in OAR 340-041-0101 through OAR 340-041-0340 and in rule Tables 101A to 340A, Tables 101B to 250B, and Figures 130A to 340B:

- Core cold-water habitat
- Bull trout spawning and juvenile rearing
- Salmon and trout rearing and migration depending on ecoregion
- Redband or Lahontan cutthroat trout depending on ecoregion

Cool Water Criterion:
Cool-water aquatic life is defined in OAR 340-041-0002 (12) to mean:

> "... aquatic organisms that are physiologically restricted to cool waters, including but not limited to native sturgeon, Pacific lamprey, suckers, chub, sculpins, and certain species of cyprinids (minnows).."

As indicated in OAR 340-041 Table 21, the uses and level of protection achieved by the numeric criterion are:

> "Mixed native cool-water aquatic life, such as sculpins, smelt, and lampreys. Waterbodies includes estuaries. Salmonids and other cold-water biota may be present during part or all of the year but do not form a dominant component of the community structure. No measurable risk to cool-water species, slight risk to cold-water species present."

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[22] Letter from DEQ to EPA, Region 10, Policy clarifications for Oregon's water quality standards interpretation, June 22, 1998 [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/EPALetter06-22-1998.pdf"]
[23] Omernik, J. and Gallant, A., 1986, Ecoregions of the Pacific Northwest, EPA/600/3-86/033
[24] Letter from DEQ to EPA Region 10, Oregon responses to EPA questions re: the State's water quality temperature standards, February 4, 2004 [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/temperature/clarificationltr.pdf"]
[25] DEQ Memorandum, June 8, 2010, Application of DO criteria, [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/MemoDOCriteria20100608.pdf"]

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As implemented for the Integrated Report, during non-spawning time periods, the **cool water criterion** for dissolved oxygen was applied to waters with the following designated uses referenced in basin-specific beneficial uses in OAR 340-041-0101 through OAR 340-041-0340 and designated in rule Tables 101A to 340A, Tables 101B to 250B, and Figures 130A to 340B:

- Salmon and steelhead migration corridors
- Salmon and trout rearing and migration depending on ecoregion
- Redband or Lahontan cutthroat trout where designated as uses in Tables 121B, 140B, 190B, 250B, and Figures 180A, 201A, 260A, 310A depending on ecoregion
- Cool water species (no salmonid use) where designated in Tables 140B, 190B, 250B and Figures 130A, 180A, 201A, 286A, 340A (except where identified as warm water in guidelines)

Warm Water Criterion:

Warm-water aquatic life is defined in OAR 340-041-0002 (69) to mean:

> "... the aquatic communities that are adapted to warm-water conditions and do not contain either cold- or cool-water species"

As indicated in OAR 340-041 Table 21, the uses and level of protection achieved by the numeric criterion are:

> "Waterbodies whose aquatic life beneficial uses are characterized by introduced, or native, warm-water species."

As implemented for the Integrated Report following guidelines from 1998, the warm water criterion was applied to waters where salmonid fish rearing and spawning are not designated beneficial uses and where warm-water species are designated uses.[26] One such warm water species is the Borax chub, designated as a use in the Malheur Lake Basin on Table 190B (current rule numbering).

- For specific waters designated as Cool water species (no salmonid use) in Tables 140B, 190B, 250B and Figures 130A, 180A, 201A, 286A, 340A where identified in guidelines and
- Borax Lake Chub

Following the 1998 guidelines, the warm water criterion was applied to specific water bodies summarized in the following table:

Table [SEQ Table * ARABIC]: Application of Warm Water Dissolved Oxygen Criterion

Current Table or Figure	Fish Use Designation	Water body	Extent
Figure 201A	Cool water species (no salmonid use)	Malheur River	Namorf to Mouth
Figure 201A	Cool water species (no salmonid use)	Willow Creek	Brogan to Mouth
Figure 201A	Cool water species (no salmonid use)	Bully Creek	Reservoir to Mouth
Table 250B	Cool water species (no salmonid use)	Owyhee River	River Mile 0 to 18
Table 190B	Cool water species (no salmonid use); Borax Lake Chub	Malheur Lake Basin	Natural Lakes; water associated with Borax Lake and Lower Borax

[26] Letter from DEQ to EPA, Region 10, Policy clarifications for Oregon's water quality standards interpretation, June 22, 1998 [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/EPALetter06-22-1998.pdf"]

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			Lake
Table 140B	Cool water species (no salmonid use)	Goose and Summer Lakes Basin	High Alkaline and Saline Lakes

Spawning Criteria:
The **spawning criteria** for dissolved oxygen were applied in locations and during the time periods designated for active salmon and steelhead spawning in OAR 340-041-0101 to 340-041-0340 in Tables 101B, and 121B, and Figures 130B, 151B, 160B, 170B, 180A, 201A, 220B, 230B, 260A, 271B, 286B, 300B, 310B, 320B, and 340B.

The **spawning criteria** for dissolved oxygen were also applied in locations and during the spawning time periods designated for Lahontan trout use in OAR 340-041-0190 Table 190B.

Spawning locations and time periods for other fish species are not specifically designated in water quality standards. In the absence of specific information, DEQ developed guidelines to assist in determining locations and timing to apply the dissolved oxygen spawning criteria for resident trout (such as rainbow, redband, Westslope and coastal cutthroat) and char (bull trout).[27] These guidelines use the locations where fish uses for salmonids are designated in OAR 340-041 and mapped in Figures 130A through 340B, and assume spawning occurs in all those stream reaches during certain time periods. DEQ may use other information, such as documentation from Oregon Department of Fish and Wildlife or US Fish and Wildlife Service if available, to refine the locations and time periods when the spawning criteria are applied where spawning locations are not specifically designated in rule. The documentation supporting this determination for a specific water body will accompany the assessment for that water body.

As implemented for the Integrated Report, the **spawning criteria** for dissolved oxygen were applied to waters during the time periods summarized in the table below. To protect all resident trout spawning in areas where bull trout (char) spawning is a designated use, the assumed spawning time period was extended to June 15. Also, as implemented in the Integrated Report, some water types and locations were not considered likely spawning areas and were not evaluated using the spawning criteria.

[27] Letter from DEQ to EPA Region 10, Oregon responses to EPA questions re: the State's water quality temperature standards, February 4, 2004 [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/temperature/clarificationltr.pdf"]

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Table [SEQ Table * ARABIC]: Application of Spawning Dissolved Oxygen Criteria

Location (Basin)	Location (Subbasin or Water)	Designated Fish Use	Designated Spawning Time Period	Assumed Spawning Time Period	Combined: Assumed Resident Trout and Bull Trout Spawning Time Periods
Deschutes, Grande Ronde, Hood, John Day, Mid Coast, North Coast, Rogue, Sandy, South Coast, Umatilla, Umpqua, Willamette	Columbia River, Snake River	Salmon and Steelhead Spawning	As designated		
Malheur Lake Basin		Lahontan Trout	As designated		
Deschutes, Hood, Powder		Bull Trout Spawning & Juvenile Rearing		August 15 – May 15	August 15 – June 15
Klamath, South Willamette, Malheur		Bull Trout Spawning & Juvenile Rearing		August 15 – May 30	August 15 – June 15
Grande Ronde	Wenaha	Bull Trout Spawning & Juvenile Rearing		August 15 – March 31	August 15 – June 15
Grande Ronde	Imnaha	Bull Trout Spawning & Juvenile Rearing		August 15 – May 31	August 15 – June 15
Grande Ronde	Upper Grande Ronde	Bull Trout Spawning & Juvenile Rearing		September 1 – April 15	September 1 – June 15
Grande Ronde	Wallowa	Bull Trout Spawning & Juvenile Rearing		September 1 – May 15	September 1 – June 15
John Day, Umatilla, Walla Walla		Bull Trout Spawning & Juvenile Rearing		September 1 – April 30	September 1 – June 15
All Basins		Salmon and Trout Rearing and Migration		January 1 – May 15	
All Basin		Redband Trout		January 1 – May 15	
All Basins		Core Cold-Water Habitat		January 1 – June 15	
All Basins		Bull Trout Spawning		January 1 – June 15 (for resident trout	

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Location (Basin)	Location (Subbasin or Water)	Designated Fish Use	Designated Spawning Time Period	Assumed Spawning Time Period	Combined: Assumed Resident Trout and Bull Trout Spawning Time Periods
				spawning)	
As designated		Salmon and Steelhead Migration Corridors		No assumed spawning	
As designated		Cool Water Species (no salmonid use)	No salmon, steelhead, or resident trout spawning		
Lakes and Reservoirs		Salmon and Steelhead Spawning	As designated	No other assumed spawning	
Estuarine Waters				No assumed spawning	

Estuarine Criterion:
Estuarine water is defined in OAR 340-041-0002 (22) to mean:

> "... all mixed fresh and oceanic waters in estuaries or bays from the point of oceanic water intrusion inland to a line connecting the outermost points of the headlands or protective jetties."

As implemented for the Integrated Report, the **estuarine criterion** for dissolved oxygen was applied to samples from coastal waters when conditions indicated mixing of fresh and salt water. DEQ used specific conductivity measurements as the indicator for estuarine conditions. Measured specific conductivity greater than 200 uS/cm was used to indicate that ocean water was mixing with fresh water.

For dissolved oxygen data collected in the coastal waters of the North Coast, Mid Coast, South Coast, Rogue and Umpqua Basins, the specific conductivity of each sample was evaluated. For continuous data, the daily mean specific conductivity was calculated. If the recorded specific conductivity was greater than 200 uS/cm, the estuarine criterion of 6.5 mg/L was applied. If the recorded specific conductivity was less than 200 uS/cm, the appropriate freshwater criteria were applied.

Ocean Waters:
Ocean water is defined in OAR 340-041-0002 (44) to mean:

> "... all oceanic, offshore waters outside of estuaries or bays and within the territorial limits of Oregon."

There is no numeric dissolved oxygen criterion applicable to ocean waters [OAR 340-041-0016 (6)]. The criterion for ocean waters is no measurable reduction in dissolved oxygen concentration. Data were not available to evaluate this criterion for the Integrated Report.

Summary:
The following flow chart (Figure 2) illustrates the evaluation process for dissolved oxygen data for the Integrated Report.

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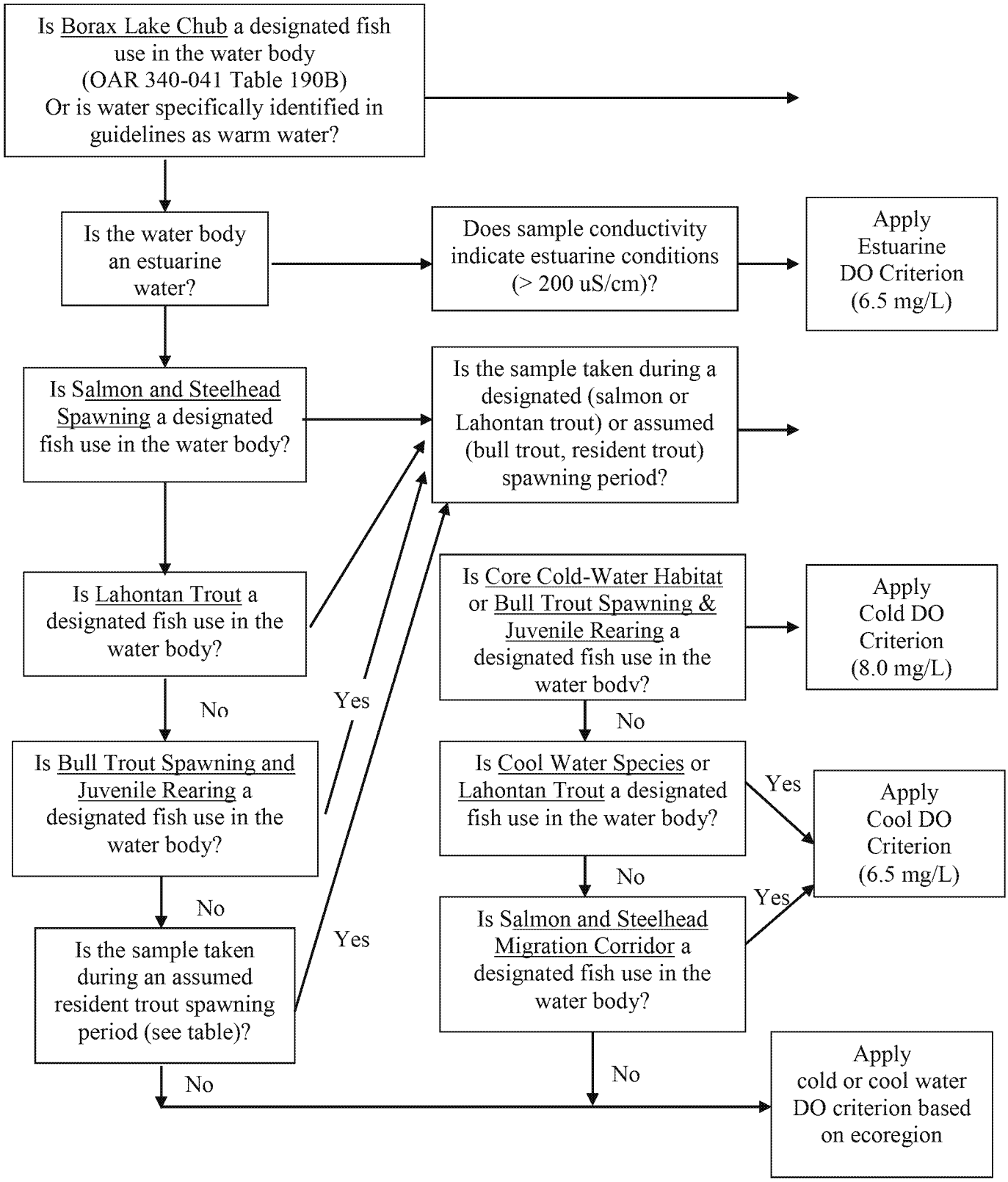
Figure 2: Evaluation of Dissolved Oxygen Data



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PARAMETER: pH

BENEFICIAL USES AFFECTED: Resident Fish and Aquatic Life
Water Contact Recreation

NARRATIVE CRITERION: OAR 340-041-0021(2)

NUMERIC CRITERION: Statewide: OAR 340-041-0021
Basin-Specific: OAR 340-041-0101 through OAR 340-041-0350

340-041-0021
pH
(1) Unless otherwise specified in OAR 340-041-0101 through 340-041-0350, pH values (Hydrogen ion concentrations) may not fall outside the following ranges:
(a) Marine waters: 7.0-8.5;
(b) Estuarine and fresh waters: See basin specific criteria (OAR 340-041-0101 through 340-041-0350).
(2) Waters impounded by dams existing on January 1, 1996, which have pHs that exceed the criteria are not in violation of the standard, if the Department determines that the exceedance would not occur without the impoundment and that all practicable measures have been taken to bring the pH in the impounded waters into compliance with the criteria.

Table [SEQ Table * ARABIC]: Summary of pH Basin Specific Criteria (OAR 340-041-0101 through 340-041-0350)

	OAR	Water	Criteria Range
General	**340-041-0021(1)(a)**	Marine	7.0 to 8.5
General	**340-041-0021(1)(b)**	Estuarine and fresh waters	See basin specific criteria
Basin or Water Body	**OAR**	**Water**	**Criteria Range**
Columbia River	**340-041-0104(1)**	Main stem Columbia River (mouth to river mile 309):	7.0 to 8.5
Snake River	**340-041-0124(1)**	Main stem Snake River (river miles 260 to 335)	7.0 to 9.0
Deschutes Basin	**340-041-0135(1)(a)**	All other basin streams (except Cascade lakes)	6.5 to 8.5
	340-041-0135(1)(b)	Cascade lakes above 3,000 feet altitude	6.0 to 8.5
Goose and Summer Lakes Basin	**340-041-0145(1)(a)**	Goose Lake	7.5 to 9.5
	340-041-0145(1)(b)	All other basin waters	7.0 to 9.0*
Grande Ronde Basin	**340-041-0156(1)**	All basin streams (other than main stem Snake River)	6.5 to 9.0*
Hood Basin	**340-041-0165(1)(a)**	Hood River Basin streams (except main stem Columbia River and Cascade lakes)	6.5 to 8.5
	340-041-0165(1)(b)	Cascade lakes above 3,000 feet altitude	6.0 to 8.5

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Basin or Water Body	OAR	Water	Criteria Range
John Day Basin	**340-041-0175(1)**	All basin streams (other than the main stem Colombia River)	6.5 to 9.0*
Klamath Basin	**340-041-0185(1)(a)**	Fresh waters except Cascade lakes	6.5 to 9.0*
	340-041-0185(1)(b)	Cascade lakes above 5,000 feet altitude	6.0 to 8.5
Malheur Lake Basin	**340-041-0195(1)**		7.0 to 9.0*
Malheur River Basin	**340-041-0207(1)**		7.0 to 9.0*
Mid Coast Basin	**340-041-0225(1)(a)**	Marine waters	7.0 to 8.5
	340-041-0225(b)	Estuarine and fresh waters	6.5 to 8.5
North Coast Basin	**340-041-0235(1)(a)**	Marine waters	7.0 to 8.5
	340-041-0235(1)(b)	Estuarine and fresh waters	6.5 to 8.5
Owyhee Basin	**340-041-0256(1)**		7.0 to 9.0*
Powder/Burnt Basins	**340-041-0265(1)**	All basin streams (other than main stem Snake River)	6.5 to 9.0*
Rogue Basin	**340-041-0275(1)(a)**	Marine waters	7.0 to 8.5
	340-041-0275(1)(b)	Estuarine and fresh waters (except Cascade lakes)	6.5 to 8.5
	340-041-0275(1)(c)	Cascade lakes above 3,000 feet altitude	6.0 to 8.5
Sandy Basin	**340-041-0290(1)(a)**	All basin waters (except main stem Columbia River and Cascade lakes)	6.5 to 8.5
	340-041-0290(1)(b)	Cascade lakes above 3,000 feet altitude	6.0 to 8.5
South Coast Basin	**340-041-0305(1)(a)**	Estuarine and fresh waters	6.5 to 8.5
	340-041-0305(1)(b)	Marine waters	7.0 to 8.5
Umatilla Basin	**340-041-0315(1)**	All basin streams (other than main stem Columbia River)	6.5 to 9.0*
Umpqua Basin	**340-041-0326(1)(a)**	Marine waters	7.0 to 8.5
	340-041-0326(1)(b)	Estuarine and fresh waters (except Cascade lakes)	6.5 to 8.5
	340-041-0326(1)(c)	Cascade lakes above 3,000 feet altitude	6.0 to 8.5
Walla Walla Basin	**340-041-0336**		6.5 to 9.0*
Willamette Basin	**340-041-0345(1)(a)**	All basin waters (except main stem Columbia River and Cascade lakes)	6.5 to 8.5
	340-041-0345(1)(b)	Cascade lakes above 3,000 feet altitude	6.0 to 8.5.

*When greater than 25 percent of ambient measurements taken between June and September are greater than pH 8.7, and as resources are available according to priorities set by the Department, the Department will determine whether the values higher than 8.7 are anthropogenic or natural in origin.

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)

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Greater than 10 % of the samples are outside the range of the appropriate criterion and a minimum of at least two samples outside the range of the appropriate criterion for the time period of interest.

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3: Insufficient Data
Less than 5 samples for the time period of interest, or 5 to 9 samples for the time period of interest with 1 sample outside the range of the appropriate criterion.

Category 3B: Insufficient Data – Potential Concern
Less than 5 samples are available to evaluate for the season of interest, with 2 or more samples outside the range of the appropriate criterion for the time period of interest.

Category 2: Attaining
For 10 or more samples in the time period of interest, 90% or greater of the samples are within the range of the appropriate criterion. For 5 to 9 samples in the time period of interest, all samples are within the range of the appropriate criterion.

TIME PERIOD:
Summer: June 1 through September 30
Fall-Winter-Spring (FWS): October 1 to May 31

DATA REQUIREMENTS:
Data collected since 2001. A minimum of 5 representative data points available per site collected on separate days for each time period of interest.

DATA REVIEWED:
2012 Integrated Report
DEQ received information in the 2012 Call for Data from Center for Biological Diversity (CBD) regarding ocean acidification and global climate changes relating to ocean pH conditions. The submitted information in articles and journal papers was not specific to Oregon's state waters, and did not include metadata or data results that could be compared to Oregon's water quality standards for pH for marine or estuarine waters. The submitted information did not contain any new information beyond what CBD submitted to EPA in comments to EPA's proposed additions to Oregon's 2010 303(d) list. To respond to comments on the draft 2012 303(d) list, DEQ retrieved and evaluated pH data from LASAR, STORET, and USGS for 231 monitoring stations at marine and estuarine monitoring sites in Oregon waters for the time period January 2000 through December 2011.

DEQ reviewed EPA action on Oregon's 2010 303(d) list. Where EPA found impairments from pH but did not add new 303(d) listings because TMDLs were already approved, DEQ added these assessments as new Category 4A records for the 2012 Integrated Report based on EPA's analysis of data.

Last Data Review
EPA reviewed pH data to propose additions to Oregon's 2010 303(d) list. EPA took final action on the 303(d) additions in December, 2012.

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The Center for Biological Diversity submitted information in articles regarding ocean acidification and global climate changes relating to ocean pH conditions with comments to EPA's proposed additions. EPA reviewed this information and provided a detailed review of the relevance and content of the submitted information and determined that no additions to Oregon's 303(d) list were warranted.[28]

NOTES:

Cascade Lakes are natural and man-made lakes at elevations over 3,000 or 5,000 feet, as specified in the basin criteria and shown in Table 6.

[28] December 14, 2012 The EPA Evaluation of Ocean Acidification Information [HYPERLINK "http://www.epa.gov/region10/pdf/water/303d/oregon/final_OR_OA_evaluation.pdf"]

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PARAMETER: Sedimentation

BENEFICIAL USES AFFECTED: Resident Fish and Aquatic Life
Salmonid Fish Spawning and Rearing

NARRATIVE CRITERION: OAR 340-041-0007(11)

> **340-041-0007**
> **Statewide Narrative Criteria**
> (11) The formation of appreciable bottom or sludge deposits or the formation of any organic or inorganic deposits deleterious to fish or other aquatic life or injurious to public health, recreation, or industry may not be allowed;

WATER QUALITY LIMITED DETERMINATION (CATEGORY 5: 303(D)):

Previous water quality assessment methodologies (Listing Criteria for Oregon's 1998 303(d) List of Water Quality Limited Water Bodies) have used stream specific documentation that showed excessive sedimentation was a significant limitation to fish or other aquatic life. This included information indicating beneficial uses impairment (aquatic community status, biomonitoring reference sites, or fishery data) and measurement data for benchmarks such as cobble embeddedness or percent fines.

DEQ is considering approaches to apply a numeric benchmark based on measurements of stream conditions to implement the narrative criteria.

ATTAINING CRITERION DETERMINATION (CATEGORY 2):

DEQ is currently reviewing approaches to apply a numeric benchmark based on measurements of stream conditions to implement the narrative criteria.

DATA REVIEWED:

2012 Integrated Report
DEQ did not evaluate data or information for sedimentation for the 2012 Integrated Report.

Last Data Review
EPA reviewed data and information for sedimentation to propose additions to Oregon's 2010 303(d) list. EPA took final action on the 303(d) additions in December, 2012.

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PARAMETER: Temperature

BENEFICIAL USES AFFECTED: Fish and Aquatic Life

NARRATIVE CRITERION: OAR 340-041-0028

NUMERIC CRITERION: OAR 340-041-0028(4)

340-041-0002
Definitions
(57) "Seven-Day Average Maximum Temperature" means a calculation of the average of the daily maximum temperatures from seven consecutive days made on a rolling basis.

340-041-0028
Temperature
[...]
(4) Biologically Based Numeric Criteria. Unless superseded by the natural conditions criteria described in section (8) of this rule, or by subsequently adopted site-specific criteria approved by EPA, the temperature criteria for State waters supporting salmonid fishes are as follows:

(a) The seven-day-average maximum temperature of a stream identified as having salmon and steelhead spawning use on subbasin maps and tables set out in OAR 340-041-0101 to 340-041-0340: Tables 101B, and 121B, and Figures 130B, 151B, 160B, 170B, 220B, 230B, 271B, 286B, 300B, 310B, 320B, and 340B, may not exceed 13.0 degrees Celsius (55.4 degrees Fahrenheit) at the times indicated on these maps and tables;

(b) The seven-day-average maximum temperature of a stream identified as having core cold water habitat use on subbasin maps set out in OAR 340-041-101 to 340-041-340: Figures 130A, 151A, 160A, 170A, 220A, 230A, 271A, 286A, 300A, 310A, 320A, and 340A, may not exceed 16.0 degrees Celsius (60.8 degrees Fahrenheit);

(c) The seven-day-average maximum temperature of a stream identified as having salmon and trout rearing and migration use on subbasin maps set out at OAR 340-041-0101 to 340-041-0340: Figures 130A, 151A, 160A, 170A, 220A, 230A, 271A, 286A, 300A, 310A, 320A, and 340A, may not exceed 18.0 degrees Celsius (64.4 degrees Fahrenheit);

(d) The seven-day-average maximum temperature of a stream identified as having a migration corridor use on subbasin maps and tables OAR 340-041-0101 to 340-041-0340: Tables 101B, and 121B, and Figures 151A, 170A, and 340A, may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit). In addition, these water bodies must have coldwater refugia that are sufficiently distributed so as to allow salmon and steelhead migration without significant adverse effects from higher water temperatures elsewhere in the water body. Finally, the seasonal thermal pattern in Columbia and Snake Rivers must reflect the natural seasonal thermal pattern;

(e) The seven-day-average maximum temperature of a stream identified as having Lahontan cutthroat trout or redband trout use on subbasin maps and tables set out in OAR 340-041-0101 to 340-041-0340: Tables 120B, 140B, 190B, and 250B, and Figures 180A, 201A, and 260A may not exceed 20.0 degrees Celsius (68.0 degrees Fahrenheit);

(f) The seven-day-average maximum temperature of a stream identified as having bull trout spawning and juvenile rearing use on subbasin maps set out at OAR 340-041-0101 to 340-041-0340: Figures 130B, 151B, 160B, 170B, 180A, 201A, 260A, 310B, and 340B, may not exceed 12.0 degrees Celsius (53.6 degrees Fahrenheit). From August 15 through May 15, in

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bull trout spawning waters below Clear Creek and Mehlhorn reservoirs on Upper Clear Creek (Pine Subbasin), below Laurance Lake on the Middle Fork Hood River, and below Carmen reservoir on the Upper McKenzie River, there may be no more than a 0.3 degrees Celsius (0.5 Fahrenheit) increase between the water temperature immediately upstream of the reservoir 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.

[...]

(6) Natural Lakes. 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. Absent a discharge or human modification that would reasonably be expected to increase temperature, DEQ will presume that the ambient temperature of a natural lake is the same as its natural thermal condition.

(7) Oceans and Bays. Except for the Columbia River above river mile 7, ocean and bay waters 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. Absent a discharge or human modification that would reasonably be expected to increase temperature, DEQ will presume that the ambient temperature of the ocean or bay is the same as its natural thermal condition.

[...]

(9) Cool Water Species.

(a) No increase in temperature is allowed that would reasonably be expected to impair cool water species. Waters of the State that support cool water species are identified on subbasin tables and figures set out in OAR 340-041-0101 to 340-041-0340; Tables 140B, 190B and 250B, and Figures 180A, 201A and 340A.

(b) See OAR 340-041-0185 for a basin specific criterion for the Klamath River.

(10) Borax Lake Chub. State waters in the Malheur Lake Basin supporting the Borax Lake chub may not be cooled more than 0.3 degrees Celsius (0.5 degrees Fahrenheit) below the natural condition.

[...]

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)

Where continuous temperature data are collected, the seven-day-average maximum temperature exceeds the applicable criterion. Seven-day average maximum temperature means a calculation of the average of the daily maximum temperatures from seven consecutive days, made on a rolling basis.

Category 4: Water Quality Limited, TMDL Not Needed

TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3: Insufficient Data

Where continuous temperature data are collected, insufficient data are available to calculate the seven-day-average maximum temperature.

Category 2: Attaining

Where continuous temperature data are collected, the seven-day-average maximum temperature attains the applicable criterion.

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TIME PERIOD:

In designated salmon and steelhead spawning areas, the spawning criterion will be applied during the time periods indicated in tables and figures referenced in OAR 340-041-0028(4)(a). Other applicable criteria will be applied during non-spawning time periods.

DATA REQUIREMENTS:

Continuous temperature data collected since 2001 for the time period of interest. "Grab" temperature readings will not be evaluated.

DATA REVIEWED:

2012 Integrated Report

DEQ did not evaluate data for temperature for the 2012 Integrated Report.

Last Data Review

EPA reviewed data for temperature to propose additions to Oregon's 2010 303(d) list. EPA took final action on the 303(d) additions in December, 2012.

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PARAMETER: Total Dissolved Gas

BENEFICIAL USES AFFECTED: Resident Fish and Aquatic Life

NARRATIVE CRITERION: OAR 340-041-0031(1)

NUMERIC CRITERION: OAR 340-041-0031(2)

> **340-041-0031**
> **Total Dissolved Gas**
> (1)Waters will be free from dissolved gases, such as carbon dioxide hydrogen sulfide, or other gases, in sufficient quantities to cause objectionable odors or to be deleterious to fish or other aquatic life, navigation, recreation, or other reasonable uses made of such water.
> (2) Except when stream flow exceeds the ten-year, seven-day average flood, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 110 percent of saturation. However, in hatchery-receiving waters and other waters of less than two feet in depth, the concentration of total dissolved gas relative to atmospheric pressure at the point of sample collection may not exceed 105 percent of saturation.

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)
More than 10 % of the samples exceed standard and a minimum of at least two exceedances of the standard, or a survey that identifies beneficial use impairment due to total dissolved gas such as assessment of fish conditions.

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

TIME PERIOD:

Year Round

DATA REVIEWED:

2012 Integrated Report
DEQ did not evaluate data or information for total dissolved gas for the 2012 Integrated Report.

Last Data Review
DEQ evaluated data and information for total dissolved gas for the 2004 Integrated Report.

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PARAMETER: Toxic Substances

BENEFICIAL USES AFFECTED: Aquatic Life – Fresh Water and Marine Water
Human Health – Water and Fish Ingestion, Fish Consumption, Drinking Water

NARRATIVE CRITERION: OAR 340-041-0033(2)
OAR 340-041-0033(5)

NUMERIC CRITERION: OAR 340-041-0033(3)
OAR 340-041-0033(4)

340-041-0033
Toxic Substances
(1) Amendments to sections (1-5) and (7) of this rule (OAR 340-041-0033) and associated revisions to Tables 20, 33A, 33B, 33C, and 40 become effective on April 18, 2014. The amendments do not become applicable for purposes of ORS chapter 468B or the federal Clean Water Act, however, unless approved by EPA pursuant to 40 CFR 131.21 (4/27/2000).

(2) Toxic Substances Narrative. Toxic substances may not be introduced above natural background levels in waters of the state in amounts, concentrations, or combinations that may be harmful, may chemically change to harmful forms in the environment, or may accumulate in sediments or bioaccumulate in aquatic life or wildlife to levels that adversely affect public health, safety, or welfare or aquatic life, wildlife, or other designated beneficial uses.

(3) Aquatic Life Numeric Criteria. Levels of toxic substances in waters of the state may not exceed the applicable aquatic life criteria listed in Table 30.

(4) Human Health Numeric Criteria. The criteria for waters of the state listed in Table 40 are established to protect Oregonians from potential adverse health effects associated with long-term exposure to toxic substances associated with consumption of fish, shellfish, and water.

(5) To establish permit or other regulatory limits for toxic substances for which criteria are not included in Table 30 or Table 40, the department may use the guidance values in Table 31, public health advisories, and other published scientific literature. The department may also require or conduct bio-assessment studies to monitor the toxicity to aquatic life of complex effluents, other suspected discharges, or chemical substances without numeric criteria.
...[29]

CRITERIA APPLIED FOR 2012 INTEGRATED REPORT:

New or Revised Criteria:
Oregon's **toxic substance human health criteria** were revised and adopted by the Oregon Environmental Quality Commission in 2011. The human health criteria were approved by EPA in October 2011 and are effective for all Clean Water Act purposes including 303(d) listing. New and revised human health criteria apply to pollutants in the water column except for methylmercury criteria established for concentrations in fish tissue. All human health metals criteria are for total metal concentrations unless noted. The revised human health criteria are listed in OAR 340-041-0033 Table 40 and were applied for the 2012 Integrated Report.

[29] Cited July 7, 2014 [HYPERLINK "http://arcweb.sos.state.or.us/pages/rules/oars_300/oar_340/340_041.html"]

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Oregon's **toxic substance aquatic life criteria** were revised and adopted by the Oregon Environmental Quality Commission in 2004. EPA approved and disapproved a number of Oregon's aquatic life criteria in January 2013. EPA approved most of the metals criteria which are for the most part expressed as the dissolved fraction. Previous metals criteria were expressed as total recoverable concentrations. In December 2013, the Oregon Environmental Quality Commission adopted minor changes to correct errors identified in EPA's January 2013 action and also consolidate the aquatic life toxic substance criteria into one table. EPA approved these revisions in April 2014. The approved aquatic life criteria are listed in OAR 340-041-0033 Table 30.

While the approved aquatic life criteria are effective for Clean Water Act purposes, the approval from EPA occurred late in the process of data evaluation for the 2012 Integrated Report. For the 2012 Integrated Report, the pre-revision aquatic life numeric criteria on OAR 340-041 Table 20 were used. The table attached in Appendix 4 lists the combined aquatic life and human health numeric criteria that were applied for the 2012 Integrated Report. See Appendix 5 for OAR 340-041 Table 20 water quality criteria.

Withdrawn Criteria:
Oregon's human health criteria for eight toxic pollutants (beryllium, cadmium, chromium III, chromium VI, lead, mercury (for total mercury in water column), silver, and 1,1,1 trichloroethane) were withdrawn by the Oregon Environmental Quality Commission in 2004 to be consistent with criteria in EPA's National Toxics Rule and EPA National Recommended Water Quality Criteria. EPA approved the withdrawal of these human health criteria in June 2010.

Oregon's Environmental Quality Commission also withdrew human health criteria for iron and manganese (except in saltwater) in December 2010. The withdrawal of these criteria was approved by EPA in June 2011.

Aquatic life criteria remain in effect for cadmium, chromium III, chromium VI, lead, iron (total), mercury (total mercury in water column), and silver as listed on OAR 340-041-0033 Table 20 and were applied to evaluate data for the 2012 Integrated Report.

In addition, revisions to Oregon's human health criteria in 2011 included the withdrawal of 13 criteria for general chemical families or groups (chlorinated benzenes; DDT; dichlorobenezenes; dichlorobenzidine; dichloroethylenes; dichloropropene; dinitrotoluene; dinitro-o-cresol; 2,4; diphenylhydrazine; endosulfan; halomethanes; monochlorobenzene; and polynuclear aromatic hydrocarbons) and replacement or renaming more specific criteria for the most toxic chemicals. The withdrawal of these criteria was approved by EPA in October 2011.

Details and Criteria Tables:
Details of the toxic substance criteria standards and revision process are available at [HYPERLINK "http://www.deq.state.or.us/wq/standards/toxics.htm"] . The table attached in Appendix 4 lists the combined aquatic life and human health numeric criteria that were applied for the 2012 Integrated Report. The toxic pollutant criteria tables effective after April 2014 are available at [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/tables303140.pdf"] .

Evaluating Sample Results:
To evaluate water quality, DEQ compared sampling results from different water body types (freshwater, estuarine, or saltwater) to the most stringent pollutant criterion applicable for the beneficial uses (aquatic life or human health) protected in the water. General protocols for evaluating sample data are discussed in the following paragraphs and details on protocols for several complex criteria for specific toxic pollutants are

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discussed in later sections. In general, all waters in Oregon are designated for fish and aquatic life uses and human uses associated with consumption of fish, shellfish, and water.

Results Less than Detection

DEQ compared each sample result to the most stringent applicable toxic substance criterion. Any detectable result was considered a valid sample to compare to the criterion. For sample results reported as "non-detect" or less than a minimum reporting limit (<MRL or equivalent lab reporting limit), the reporting limit was compared to the most stringent applicable criterion. If the reporting limit was lower than the criterion, the sample result was considered valid to evaluate and counted as attaining the criterion. If the reporting limit was higher than the criterion, the "non-detect" sample result was not considered valid to use to determine either exceedance or attainment of the criterion and was not counted as a valid result for assigning a status. When analytical or method duplicate results were reported with different MRLs, the lowest MRL was used to determine if the sample was valid. Since many toxic substance criteria are very low and laboratory methods are not able to detect concentrations at those low levels, many results are reported as "non-detect". The number of valid sample results evaluated against the criteria may be 0 or less than the actual number of reported results.

Total or Dissolved Metals Criteria

Oregon's criteria for metals are established for either the "total" or "dissolved" fraction of the pollutant in water. Sampling data may be available for one or both fractions for the pollutant with the expectation that the total concentration will be higher than the dissolved concentration. If sampling data did not specify whether the metal analysis was for the total or dissolved fraction, DEQ assumed the reported result was for the total fraction. When available, DEQ evaluated data that matched the fraction specified by the criterion.

When the criterion is expressed as a total fraction, results for dissolved fractions were counted as valid results if the detected result exceeded the total criterion, but were not considered valid or counted to determine attainment if the result was less than the total criterion.

Duplicate Samples

DEQ evaluated only the maximum (or minimum in the case of alkalinity) result for duplicate sample results, and did not count duplicate sample in the sample count.

ASSIGNMENT OF ASSESSMENT CATEGORY:

Based on the evaluation of valid samples results at each site, an assessment category was assigned using the following protocols.

Category 5: Water Quality Limited, TMDL Needed (303(d) List)

Two (2) or more valid results not meeting the most stringent applicable criterion for concentrations of a specific toxic substance in the water,

Or

A fish consumption advisory issued by the Oregon Department of Human Services for a specific water body based on pollutants in fish tissue issued. Fish advisories are posted at: [HYPERLINK "http://public.health.oregon.gov/newsadvisories/Pages/RecreationalAdvisories.aspx"]),

Or

The geometric mean of a minimum of three (3) or more valid results not meeting the fish tissue criterion for **methylmercury** if the results are from skinless fillets of individual fish,[30]

Or

[30] Protocol based on US EPA Office of Science and Technology, 2001. Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion. EPA 823-R-10-001. Washington, D.C.

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The arithmetic mean of two (2) or more valid results not meeting the fish tissue criterion for **methylmercury** if the results are from composited skinless fillets from multiple fish of the same species.
(Note: DEQ did not evaluate data results for analyses of whole fish samples for the 2012 Integrated Report.)

Category 4: Water Quality Limited, TMDL Not Needed
TMDLs needed to attain applicable water quality standards have been approved (Category 4A), other pollution control requirements are expected to address pollutant and will attain water quality standards (Category 4B), or impairment is not caused by a pollutant (Category 4C).

Category 3B: Insufficient Data – Potential Concern
One (1) valid sample result not meeting the most stringent applicable criterion for a specific toxic substance, (See Notes regarding the alkalinity criterion.)

Category 3: Insufficient Data
Less than 5 valid samples for the toxic pollutant (unless assigned Category 3B),
Or
Less than 3 valid samples for **methylmercury** in fish tissue when the results are from skinless fillets of individual fish,
Or
Less than 2 valid samples for **methylmercury** in fish tissue from a composite sample composed of skinless fillets of multiple fish of the same species.
(Note: DEQ did not evaluate data results for analyses of whole fish samples for the 2012 Integrated Report.)

Category 2: Attaining
A minimum of 5 valid samples collected and all valid results meet the most stringent applicable criterion for a specific toxic pollutant,
Or
The geometric mean of a minimum of 3 valid samples meeting the human health criterion for **methylmercury** when the results are from skinless fillets of individual fish,
Or,
The arithmetic mean of a minimum of 2 valid samples meeting the human health criterion for **methylmercury** when the results are from a composite sample composed of skinless fillets of multiple fish of the same species.
(Note: DEQ did not evaluate data results for analyses of whole fish samples for the 2012 Integrated Report.)

TIME PERIOD:
Year Round

DATA REQUIREMENTS:
Data collected between January 1, 2000 and December 31, 2011.

DATA REVIEWED:
2012 Integrated Report
DEQ evaluated the following data for toxic substances for the final 2012 Integrated Report:

> DEQ LASAR data - Monitoring results from approximately 275 stations throughout the state when available for 12 toxic substances (arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, and zinc when available) from samples collected for the period January 1, 2000

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through December 31, 2011. Fish tissue sampling results for skinless fillet samples from throughout the state for total mercury analyses.

USGS data - Monitoring results from approximately 138 stations in the Willamette Basin when available for 11 toxic substances (arsenic, beryllium, cadmium, chromium, copper, iron, lead, nickel, selenium, silver, and zinc) and 26 other toxic pollutants when available from samples collected for the period January 1, 2000 through December 31, 2011. No toxic substance data were available in this time period in the Umatilla Basin.

City of Gresham – Monitoring results from 10 sites with 2168 results for 4 toxic metals (copper, lead, nickel, zinc) and 13 other toxic pollutants.

New or modified fish consumption advisories due to mercury in fish tissue issued for Powder River (Brownlee and Phillips Reservoirs) and Applegate Lake, and PCBs and mercury in the Columbia River.

DETERMINING APPLICABLE CRITERION:

Oregon's water quality standards for toxic substance criteria contain numeric criteria that protect both human health and aquatic life. Individual toxic pollutants may have multiple criteria for different beneficial uses that are protected in most waters in Oregon. For the Integrated Report, the most stringent of either the aquatic life or human health criterion applicable to a water body was used to evaluate site monitoring data and assign an assessment category to the water.

Applying Human Health and Aquatic Life Criteria:

Oregon's toxic substance human health criteria are applicable to waters designated for drinking water and fishing. The criteria in OAR 340-041-0033 Table 40 include criteria labeled "Water + Organism" that apply where both fishing and drinking water supply are designated uses. The criteria labeled "Organism Only" apply to waters designated for fishing. Most of Oregon's waters are designated for both public and private domestic water supply (drinking water) and fishing uses, so the human health criteria are widely applicable throughout the state.

Oregon's toxic substance aquatic life criteria in OAR 340-041-0033 contain numeric criteria that should not be exceeded in freshwater and marine waters (saltwater). Criteria protect aquatic life during both short term (acute 1-hour average) and long term (chronic 96-hour average) exposures to concentrations of toxic pollutants that should not be exceeded more than once every three years. The site monitoring data available for the 2012 Integrated Report are not sufficient to calculate averages over the exposure periods to apply the frequency and duration allowances, so daily site sampling results were compared to the most stringent applicable aquatic life criterion to determine exceedances.

To evaluate site monitoring data, the most stringent human health or aquatic life criterion applicable to the water type was used. To select the most stringent of the criteria, DEQ applied EPA guidance to determine when freshwater or saltwater (marine) aquatic life criteria for toxic substances were applicable, and additionally considered the human health criteria for each compound.[31]

Applying Criteria in Marine Waters:

Marine waters are defined in OAR 340-041-0002(34) as "...all oceanic, offshore waters outside of estuaries or bays and within the territorial limits of the State of Oregon." EPA recommends using saltwater aquatic life criteria for waters where the salinity is equal to or greater than 10 parts per thousand (approximately

[31] 2002, National Recommended Water Quality Criteria: 2002, U.S. EPA Office of Water, EPA 822-R-02-047. Page 9. [HYPERLINK "http://www.doeal.gov/SWEIS/OtherDocuments/348%20epa-822-r-02-047(2002).pdf"]

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equivalent to conductivity 20,000 uS/cm).[32] DEQ identified marine waters using geographic information and confirmed the identification using salinity or conductivity data from monitoring sites.

For marine waters, DEQ applied the more stringent of the marine acute or chronic aquatic life criteria or the human health criteria for "Organism-Only" at each sampling site. Ammonia criteria (Acute Criteria CMC and Chronic Criterion CCC) were calculated for these sites using the appropriate equations for saltwater.

Note: DEQ did not evaluate data or information for toxic substances in marine waters for the 2012 Integrated Report.

Estuarine Waters:
Estuarine waters are defined in OAR 340-041-0002(22) as "...all mixed fresh and oceanic waters in estuaries or bays from the point of oceanic water intrusion inland to a line connecting the outermost points of the headlands or protective jetties." EPA recommends using the more stringent of freshwater or saltwater aquatic life criteria where salinity is between 1 and 10 parts per thousand. In past assessments, DEQ identified estuarine waters using geographic information and confirmed the identification using salinity or conductivity data from monitoring sites. For consistency with other pollutant evaluations such as bacteria, the inland extent of estuarine waters was identified as the point where recorded specific conductivity measurements were above 200 uS/cm (approximately 0.1 ppth salinity) and DEQ used best professional judgment to resolve uncertain determinations. However, for the 2012 Integrated Report, DEQ identified estuarine sites using names (e.g. "bay", "slough") and best professional judgment rather than using conductivity data due to questions about potential accuracy, temporal fluctuations, and representativeness issues with site measurements.

For estuarine waters, DEQ applied the more stringent of the freshwater or marine acute or chronic aquatic life criteria or the human health criterion for "Organism Only" at each sampling site. Estuarine waters are generally not designated for drinking water use. However, if there was no "Organism Only" criterion, the "Water + Organism" criterion was applied if more stringent than the aquatic life criteria. Ammonia criteria for estuarine waters were calculated using the appropriate equations for freshwater. In addition, hardness-dependent freshwater criteria for metals were applied to the estuarine sites.

Freshwater:
DEQ evaluated all waters that were not identified as marine or estuarine as freshwater. DEQ applied the most stringent of the freshwater acute or chronic aquatic life criteria or the human health criteria for "Water + Organism" or "Organism Only" at each sampling site.

DETAILED PROTOCOLS FOR SPECIFIC TOXIC POLLUTANTS:

The following section describes additional protocols used to apply criteria for specific toxic pollutants to sample results if needed to correctly evaluate data. In order to apply OAR 340-041 Table 20 criteria, pollutant chemical names cited in the 1986 guidance document used to develop the criteria were correlated to chemicals identified by their unique CAS registry number and available chemical and CAS registry information. [33,34,35,36] Criteria in OAR 340-041-0033 Table 40 include both chemical names and CAS registry

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[32] Monitoring data are more commonly collected for conductivity. A general conversion is: Salinity 0.1 parts per thousand = 200 microSiemens/cm conductivity at 20°C. Consult on-line reference table at [HYPERLINK "http://www.envcoglobal.com/files/u5/Envco%20Conductivity%20to%20salinity%20conversion%20table.pdf"] attributed to equation of P.K. Weyl, Liminology and Oceanography, 9:75 (1964).
[33] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001
[34] National Institute of Standards and Technology web site "Search for Species Data by CAS Registry" at [HYPERLINK "http://webbook.nist.gov/chemistry/cas-ser.html"]
[35] Agency for Toxic Substance and Disease Registry web site at [HYPERLINK "http://www.atsdr.cdc.gov/"]

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numbers and are usually clearly identified. [37] DEQ has developed memoranda to address analytical and monitoring issues that relate to specific toxic pollutants and water quality criteria.[38] DEQ followed these guidelines when necessary to resolve questions on how to evaluate data for the 2012 Integrated Report.

Alkalinity Criterion
The aquatic life freshwater criterion for alkalinity is "20 mg/L or more as $CaCO_3$ freshwater aquatic life except where natural concentrations are less."[39] Alkalinity should not be below this value in order to protect aquatic life.

Alkalinity is a measure of carbonate and bicarbonate ions and the buffering capacity of water to pH changes. Freshwater systems have natural variations in pH that are related to photosynthetic activity and other inorganic and organic chemical reactions. Applying the alkalinity criterion as an isolated standard to determine where water is water quality limited may lead to incorrect conclusions about overall natural water quality. For Integrated Report evaluations, analytical data indicating alkalinity less than the criterion is flagged as a **Category 3B Insufficient Data – Potential Concern**. Professional judgment should be used during TMDL development or on a case-by-case basis to consider alkalinity information along with information for other related pollutant pollutants such as pH, chlorophyll a, aquatic weeds or algae growth, and dissolved oxygen when addressing beneficial use support.

Note: DEQ did not evaluate data or information for alkalinity for the 2012 Integrated Report.

Ammonia Criteria
Ammonia criteria for aquatic life are established based on the concentration of un-ionized ammonia (NH_3), which is the principal toxic form of ammonia, and are pH and temperature specific.[40] Monitoring data results are typically reported as "total ammonia as N". For the assessment evaluation, criteria were calculated for freshwater and saltwater first for un-ionized ammonia (NH_3), and then converted to criteria for total ammonia as N in order to evaluate monitoring data results. If temperature or pH data were not available, criteria were not calculated and the sample result was not evaluated. Ammonia criteria for estuarine waters were calculated using the appropriate equations for freshwater.

Ammonia Criteria – Freshwater
Ammonia criteria for freshwater were calculated based on pH, temperature, and the presence or absence of salmonids or other fish with ammonia-sensitive life stages. For the Integrated Report, salmonids are assumed to be present everywhere. Values for freshwater criteria for un-ionized ammonia (NH_3) are calculated first, then converted to criteria for total ammonia as N using the following formulae.[41, 42] EPA recommends criteria calculations not be extrapolated beyond the pH and temperature limits specified in the following equations. To calculate criteria for results with pH values outside the range of pH values specified below (6.5 - 9.0), DEQ used 6.5 when reported pH values were less than 6.5, and 9.0 when reported pH values were greater than 9.0.

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[36] US EPA Substance Registry Services web site "Substance Search" at [HYPERLINK "http://iaspub.epa.gov/sor_internet/registry/substreg/searchandretrieve/substancesearch/search.do"]
[37] EPA National Recommended Water Quality Criteria website at: [HYPERLINK "http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm"]
[38] DEQ Memorandums with Recommendations for Analysis and Implementation of Specific Toxic Pollutants [HYPERLINK "http://www.deq.state.or.us/wq/standards/toxics.htm"]
[39] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001
[40] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001
[41] 1985, Ambient Water Quality Criteria for Ammonia - 1984, U.S. EPA Office of Water, EPA 440/5-85-001
[42] 1986, Quality Criteria for Water 1986, U.S. EPA Office of Water, EPA 440/5-86-001

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Note: DEQ evaluated USGS data for ammonia data from the Willamette Basin for the 2012 Integrated Report. The ammonia calculations assumed salmonids were present at every site. DEQ did not evaluate ammonia data for estuarine waters for the 2012 Integrated Report.

Freshwater Acute Criterion (CMC = Criterion Maximum Concentration):
Salmonids present:

$CMC_{NH3} = 0.52 / FT / FPH / 2$

Where:

$FT = 1$ when $20 \leq$ Temperature (T) ≤ 30
Or
$FT = 10^{0.03(20-T)}$ when $0 \leq T < 20$

And:

$FPH = 1$ when $8 \leq pH \leq 9$
Or
$FPH = \frac{1 + 10^{7.4-pH}}{1.25}$ when $6.5 \leq pH < 8$

Salmonids absent:

$CMC_{NH3} = 0.52 / FT / FPH / 2$

Where:

$FT = 0.71$ when $25 \leq T \leq 30$
Or
$FT = 10^{0.03(20-T)}$ when $0 \leq T < 25$

And:

$FPH = 1$ when $8 \leq pH \leq 9$
Or
$FPH = \frac{1 + 10^{7.4-pH}}{1.25}$ when $6.5 \leq pH < 8$

Freshwater Chronic Criterion (CCC = Criterion Continuous Concentration):
Salmonids present:

$CCC_{NH3} = 0.80 / FT / FPH / RATIO$

Where:

$FT = 1.4$ when $15 \leq T \leq 30$
Or
$FT = 10^{0.03(20-T)}$ when $0 \leq T < 15$

And:

$FPH = 1$ when $8 \leq pH \leq 9$
Or
$FPH = \frac{1 + 10^{7.4-pH}}{1.25}$ when $6.5 \leq pH < 8$

And:

$RATIO = 16$ when $7.7 \leq pH \leq 9$
Or
$RATIO = 24*(10^{7.7-pH}/1+10^{7.4-pH})$ when $6.5 \leq pH < 7.7$

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Salmonids absent:

$$CCC_{NH3} = 0.80 / FT / FPH / RATIO$$

Where:

$FT = 1$ when $20 \leq T \leq 30$

Or

$FT = 10^{0.03(20-T)}$ when $0 \leq T < 20$

And:

$FPH = 1$ when $8 \leq pH \leq 9$

Or

$FPH = \frac{1 + 10^{7.4-pH}}{1.25}$ when $6.5 \leq pH < 8$

And:

$RATIO = 16$ when $7.7 \leq pH \leq 9$

Or

$RATIO = 24*(10^{7.7-pH}/1+10^{7.4-pH})$ when $6.5 \leq pH < 7.7$

Ammonia criteria calculated above are for the un-ionized ammonia (NH_3) fraction.[43] Criteria for total ammonia as N are calculated using the following equations:[44]

pKa = 0.09018 + (2729.92/(273.15 + Temperature))
Fraction = 1/(10^(pKa – pH) + 1)

$CMC_{(Total\ ammonia\ as\ N)} = CMC_{NH3}$ /Fraction*0.822
$CCC_{(Total\ ammonia\ as\ N)} = CCC_{NH3}$ /Fraction*0.822

Ammonia Criteria – Saltwater

Ammonia criteria for saltwater are established for un-ionized ammonia (NH_3) which is the principal toxic form of ammonia.[45] The saltwater criteria are calculated for marine sites. Marine sites are identified using geographic information and confirmed with salinity or conductivity data. A default salinity value of 10 ppth was used if site specific data were not available.

Saltwater Acute Criterion (CMC^S = Criterion Maximum Concentration):

$CMC^S_{NH3} = 0.233$ mg/L

Saltwater Chronic Criterion (CCC^S = Criterion Continuous Concentration):

$CCC^S_{NH3} = 0.035$ mg/L

EPA provides a model to approximate the percent un-ionized ammonia in saltwater using the equations below, and to calculate the criteria in terms of total ammonia as N.

% Unionized Ammonia (UIA) =

$100*[1+10^{\wedge} (pKaS +0.0324*(298-T) +0.0415*P/T-pH)]^{-1}$

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[43] 1985, Ambient Water Quality Criteria for Ammonia - 1984, U.S. EPA Office of Water, EPA 440/5-85-001. [HYPERLINK "http://www.epa.gov/waterscience/criteria/library/ambientwqc/ammonia1984.pdf"]

[44] 1999, 1999 Update of Ambient Water Quality Criteria for Ammonia, U.S. EPA Office of Water, EPA 822-R-99-014. [HYPERLINK "http://www.epa.gov/waterscience/criteria/ammonia/99update.pdf"]

[45] 1989, Ambient Water Quality Criteria for Ammonia (Saltwater)-1989, U.S. EPA Office of Water, EPA 440/5-88-004; [HYPERLINK "http://www.epa.gov/ost/pc/ambientwqc/ammoniasalt1989.pdf"]

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Where:

S = salinity (g/kg)
T = temperature (°K)
P = 1 atm pressure (default)

And:

$pK_a^S = 9.245+0.116*MIS$
MIS = Molal Ionic Strength of seawater =
(19.9273*S)/ (1000-1.005109*S)

To calculate the criteria in terms of total ammonia as N:

Saltwater Acute Criterion (CMC = Criterion Maximum Concentration):
$CMC^S_{(Total\ ammonia\ as\ N)} = CMC^S_{NH3}$ /UIA*0.822= 0.233/UIA*0.822

Saltwater Chronic Criterion (CCC = Criterion Continuous Concentration):
$CCC^S_{(Total\ ammonia\ as\ N)} = CCC^S_{NH3}$ /UIA*0.822= 0.0.035/UIA*0.822

Arsenic Criteria
Human health water quality criteria for arsenic were revised and approved by EPA in October 2011.[46] The revised criteria in OAR 340-041-0033 Table 40 are based on total inorganic arsenic (CAS No. 7440382) rather than total recoverable arsenic. The aquatic life criteria for arsenic III in OAR 340-041 Table 20 were also considered for the 2012 Integrated Report.

The available data for arsenic are primarily samples analyzed for either total recoverable or total dissolved arsenic. DEQ does not have sufficient data or information for Oregon waters to estimate how much of the total arsenic concentration is in the inorganic arsenic form. A study completed by the Idaho Department of Environmental Quality of 40 sample results from major rivers in Idaho showed the median percent inorganic arsenic in total arsenic sample results equal to 76%.[47]

Note: To evaluate available data for the 2012 Integrated Report, DEQ multiplied total arsenic data results by 76% to approximate the inorganic arsenic fraction and evaluated that amount using the most stringent applicable criterion.[48]

Beryllium Criteria - Withdrawn
EPA approved the withdrawal of Oregon's human health criteria for beryllium in June 2010. Since Oregon does not have aquatic life criteria, there are no currently effective water quality criteria for beryllium. With the 2012 Integrated Report, DEQ will remove assessments for beryllium from the report.

Public drinking water systems in Oregon are subject to the federal Safe Drinking Water Act Maximum Contaminant Level (MCL) for beryllium (4 µg/L). If beryllium sample results exceeded the MCL in a water body that was identified as providing source water for a public water system (PWS), and the finished water samples from the PWS also exceeded the MCL, DEQ intended to place the water body in **Category 5: Water**

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[46] Arsenic rulemaking documents at: [HYPERLINK "http://www.deq.state.or.us/wq/standards/metals.htm"]
[47] Idaho Department of Environmental Quality. March 2010. Arsenic, Mercury, and Selenium in Fish Tissue and Water from Idaho's Major Rivers: A Statewide Assessment. Found at: [HYPERLINK "http://www.deq.idaho.gov/media/639752-arsenic_mercury_fish_tissue_report_0310.pdf"]
[48] November 14, 2012 DEQ Memorandum RE: Implementation for Total Inorganic Arsenic and Arsenic III Water Quality Criteria [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/Arsenic.pdf"]

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Quality Limited, TMDL Needed (303(d) List). However, based on data available through June 2013, no Oregon public water systems have reported any incidents of beryllium water supplies exceeding the MCL.

For water bodies previously listed as Category 5: 303(d) for beryllium, the water body was delisted in the 2012 Integrated Report and no status category is assigned for the delisted record since there are no currently effective water quality criteria.

Bis Chloromethyl Ether (CAS No. 542881) Criteria
Current human health criteria in OAR 340-041-0033 Table 40 include numeric criteria for chloromethyl ether, bis (CAS 542881). There are no analytical methods currently recommended to measure this chemical in water samples.[49]

Chlordane (CAS No. 57749) and Heptachlor (CAS No. 76448) Criteria
OAR 340-041-0033 Table 20 and Table 40 criteria for chlordane were applied to sample results reported for the technical product (CAS No. 12789036) or non-specific chlordane (CAS No. 57749), or to the sum of isomers, other constituents, and metabolites of chlordane including *cis*-chlordane (synonym α-chlordane) (CAS No. 5103719), *trans*-chlordane (synonym γ- chlordane) (CAS No. 5103742), γ-chlordane (CAS No. 5566347), *cis*-nonachlor (CAS No. 5103731), *trans*-nonachlor (CAS No. 39765805), and oxychlordane (CAS No. 27304138).

Another known major constituent of chlordane mixtures is heptachlor (CAS No. 76448). OAR 340-041-0033 Table 20 and Table 40 criteria for heptachlor were applied separately for this chemical.

Chlorine
OAR 340-041-0033 Table 20 includes numeric criteria for chlorine to protect aquatic life. There are no corresponding human health criteria. The aquatic life criteria for chlorine in freshwater and saltwater are expressed as "total residual chlorine" which is the sum of free and combined chlorine. The aquatic life criteria for chlorine in saltwater are expressed as "chlorine-produced oxidants", which is the sum of free and combined chlorine and bromine[50]

Note: DEQ did not evaluate data or information for chlorine for the 2012 Integrated Report.

Chromium Criteria
Oregon's human health criteria for chromium III and chromium VI were withdrawn in 2004 and the withdrawal was approved by EPA in June 2011. The aquatic life criteria in OAR 340-041-0033 Table 20 include criteria for two oxidation states of chromium - chromium III (trivalent) and chromium VI (hexavalent). The criteria for chromium III are hardness dependent.

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[49] March 20, 2013 DEQ Memorandum RE: Implementation for Water Quality Criterion Bis Chloromethyl Ether (CAS #: 542-88-1) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/BisChloromethylMemo.pdf"]
[50] December 7, 2012 DEQ Memorandum RE: Implementation Instructions for the Water Quality Criterion Chlorine (CAS #: 7782-50-5) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/chlorineMemo.pdf"]

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Most sample analyses are done for total chromium and do not report concentrations for the separate oxidation states.[51] To evaluate available data, results for total chromium are compared to the most stringent applicable criterion for either oxidation state.

Note: For the 2012 Integrated Report when chromium data were available, DEQ applied the most stringent applicable criteria listed on OAR 340-041-0033 Table 20 which are those for chromium VI (hexavalent). These criteria are not hardness dependent and no hardness correction factor was applied to criteria to evaluate the total chromium data.

Cyanide Criteria

Revised human health criteria in OAR 340-041-0033 Table 40 for cyanide specify the criteria apply to **total** cyanide (CAS No. 57125). The OAR 340-041-0033 Table 20 aquatic life criteria for cyanide do not specify the form that is addressed. Information from EPA guidance used to develop Oregon's criteria indicates the recommended criteria were derived from drinking water MCLs that are based on free cyanide.[52] The numeric criteria for aquatic life are more stringent than the human health numeric criteria. DEQ recommends that total or "available" cyanide data may be used as a conservative surrogate for free cyanide in cases where there are no analytical results based on free cyanide.[53]

Note: DEQ did not evaluate data for cyanide for the 2012 Integrated Report.

DDT, DDD, and DDE Criteria

Revised human health criteria in OAR 340-041-0033 Table 40 specify criteria for DDT 4,4 (CAS No. 50293), DDD 4,4 (CAS No. 72548), and DDE 4,4 (CAS No. 72559).

The OAR 340-041-0033 Table 20 aquatic life criteria for DDT do not include criteria for the DDT metabolites. However, EPA water quality criteria used to develop Oregon's criteria described the numeric criteria values to apply to "DDT and its metabolites".[54] For application of the aquatic life criteria to evaluate data for the Integrated Report and consistent with other DEQ implementation guidance, analytical data results for DDT, DDD, and DDE were summed together and compared to the most stringent aquatic life criteria for DDT..[55]

Note: For the 2012 Integrated Report, DEQ compared data to the most stringent applicable criteria, which were the human health criteria. Data for DDT, DDD, and DDE were evaluated separately using the applicable human health criterion.

Demeton Criteria

The OAR 340-041-0033 Table 20 criteria for demeton are applicable to sample results reported as demeton (CAS No. 8065483) and disulfoton (CAS No. 298044). The two pesticides are toxicologically similar and

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[51] October 23, 2012 DEQ Memorandum RE: Implementation Instructions for Water Quality Criteria Chromium III (CAS #: 16065-83-1) and Chromium VI (CAS #: 18540-29-9) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/chromium.pdf"]

[52] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001

[53] November 14, 2012 DEQ Memorandum RE: Implementation Instructions for Free and Total Cyanide Water Quality Criteria (CAS #: 57-12-5) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/cyanide.pdf"]

[54] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001, page

[55] March 20, 2013 DEQ Memorandum RE: Implementation Instructions for Water Quality Criterion DDT,-4,4' (CAS #: 50-29-3) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/DDTmemo.pdf"]

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EPA allows use of toxicity data for both compounds. For the Integrated Report, the demeton criteria are applied to both pesticide products.

Note: DEQ did not evaluate data for demeton for the 2012 Integrated Report.

Dichlorobenzenes Criteria
Criteria for the class dichlorobenzenes were replaced in OAR 340-041-0033 Table 40 with new criteria for dichlorobenzene (m) 1,3 (CAS No. 541731), dichlorobenzene (o) 1,2 (CAS No. 95501), and dichlorobenzene (p) 1,4 (CAS No. 106467). These criteria were approved by EPA in 2011 and are applied to sample results for the individual isomers. Prior to the approved revision, the criteria for the class were applied to the sum of sample results reported for the isomers.

Note: DEQ did not evaluate data for any of the dichlorobenzenes for the 2012 Integrated Report.

Dichloroethylenes Criteria
Criteria for the class dichloroethylenes were replaced in OAR 340-041-0033 Table 40 with new criteria for dichloroethylene 1,1 (synonyms 1,1-dichloroethene or 1,1-DCE) (CAS No. 75354) and dichloroethylene trans 1,2 (CAS No. 156605). These criteria were approved by EPA in 2011 and are applied to sample results for the individual chemicals.

Note: DEQ did not evaluate data for any of the dichloroethylenes for the 2012 Integrated Report.

Dichloropropene Criteria
Criteria for the compound dichloropropene were replaced in OAR 340-041-0033 Table 40 with new criteria for the compound specifically identified as dichloropropene 1,3 (CAS No. 542756). These criteria were approved by EPA in 2011 and are applied to sample results for that chemical.

Prior to the approved revision, the criteria for the compound dichloropropene were applied to the sum of sample results reported sum of sample results reported for the isomers cis-1,3-dichloropropene (CAS No. 10061015); trans-1,3-dichloropropene (CAS No. 10061026); mixtures of cis- and trans-1,3-dichloropropene (CAS No. 542756); 1,1-dichloropropene (CAS No. 563586); and 1,2-dichloropropene (CAS No. 563542).

Note: DEQ did not evaluate data for dichloropropene 1,3 for the 2012 Integrated Report.

Dinitrophenols Criteria
OAR 340-041-0033 Table 40 includes numeric criteria for the class of dinitrophenol isomers (CAS No. 25550587) and for one of the isomers, dinitrophenol 2,4 (CAS No. 51285). For application of the human health criteria to evaluate data for the Integrated Report and consistent with other DEQ implementation guidance, analytical data results measured as dinitrophenol 2,4 will be used as the surrogate for the dinitrophenol criteria.[56]

Note: DEQ did not evaluate data for dinitrophenols for the 2012 Integrated Report.

Dioxin (2,3,7,8-TCDD) (CAS No. 1746016) Criteria

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[56] October 23, 2012 DEQ Memorandum RE: Implementation Instructions for the Water Quality Criterion Dinitrophenols (CAS #: 25550-58-7) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/dinitrolphenols.pdf"]

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OAR 340-041-0033 Table 40 criteria for dioxin were applied to sample results reported for the specific congener 2,3,7,8-tetrachlorodibenzodioxin (TCDD) (CAS No. 1746016).

Note: DEQ did not evaluate data for dioxin for the 2012 Integrated Report.

Diphenylhydrazine 1,2 (CAS No. 122667) Criteria
OAR 340-041-0033 Table 40 includes numeric criteria for diphenylhydrazine 1,2 to protect human health. There are no corresponding aquatic life criteria. Diphenylhydrazine 1,2 is difficult to analyze given its rapid decomposition rate in water. Instead, azobenzene, which is a decomposition product of 1,2 diphenylhydrazine, is analyzed as an estimate of this chemical. The water quality criterion for diphenylhydrazine 1,2 can be applied to analytical results from azobenzene.[57]

Note: DEQ did not evaluate data for 1,2 diphenylhydrazine for the 2012 Integrated Report.

Endosulfan Criteria
OAR 340-041-0033Table 20 aquatic life criteria for the group endosulfan were applied to sample results reported for endosulfan (CAS No. 115297) or to the sum of sample results reported for the isomers α-endosulfan (CAS No. 959988) and β-endosulfan (33213659), and the reaction product endosulfan sulfate (CAS No. 1031078) found in technical grade Endosulfan. OAR 340-041-0033 Table 40 individual human health criteria for endosulfan Alpha, endosulfan Beta, and endosulfan sulfate.

Note: For the 2012 Integrated Report, DEQ evaluated data for endosulfan using the most stringent criteria which were the aquatic life criteria applied to sample results reported for Endosulfan or the sum of the sample results for the isomers.

Guthion (Azinphos Methyl) Criteria
For the 2012 Integrated Report, OAR 340-041-0033Table 20 aquatic life criteria for Guthion were applied to results for Guthion (synonym azinphos methyl) (CAS No. 86500) but not for the metabolic breakdown product azinphos methyl oxygen analog (CAS No. 961228).

Halomethanes Criteria
Criteria for the class Halomethanes were replaced in OAR 340-041-0033 Table 40 with new human health criteria for bromoform (synonym tribromomethane) (CAS No. 75252), dichlorobromomethane (CAS No. 75274), methyl bromide (CAS No. 74839), and methylene chloride (synonym dichloromethane) (CAS No. 75092). These criteria were approved by EPA in 2011 and are applied to sample results for the individual chemicals.

Note: DEQ did not evaluate data for any of the Halomethanes for the 2012 Integrated Report.

Hexachlorocyclohexane, BHC, and Lindane Criteria
OAR 340-041-0033 Table 20 aquatic life and Table 40 human health criteria for BHC gamma (synonym hexachlorocyclohexane (Lindane)) were applied to sample results reported for that chemical (CAS No. 58899). The pesticide product Lindane is generally > 99% the gamma isomer (synonyms γ-HCH or γ-BHC).

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[57] November 14, 2012 DEQ Memorandum RE: Implementation Instructions for the Water Quality Criterion1,2 Diphenylhydrazine (CAS #: 122-66-7) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/diphenylhydrazine.pdf"]

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OAR 340-041-0033 Table 40 human health criteria for the isomer BHC alpha (synonyms hexachlorocyclohexane alpha , α-HCH or α-BHC) were applied to results for that chemical (CAS No. 319846).

OAR 340-041-0033 Table 40 human health criteria for the isomer BHC beta (synonyms, hexachlorocyclohexane beta, β-HCH or β-BHC) were applied to results for that chemical (CAS No. 319857).

OAR 340-041-0033 Table 40 human health criteria for the hexachlorocyclo-hexane-technical (CAS No. 608731) apply to the technical grade pesticide which is a mixture consisting of α, β, γ, δ, and ε isomers. For application of the human health criteria to evaluate data for the Integrated Report and consistent with other DEQ implementation guidance, DEQ applies the hexachlorocyclo-hexane-technical criteria to the sum of analytical results for the four major isomers.[58]

Note: DEQ did not evaluate data for hexachlorocyclohexane (Lindane) or BHC for the 2012 Integrated Report.

Iron Criteria

Oregon's human health criterion for iron was withdrawn by DEQ in 2011 and the withdrawal was approved by EPA in June 2011.[59]

For the 2012 Integrated Report, sample results for iron were compared to the OAR 340-041-0033 Table 20 aquatic life. This criterion is applicable to total recoverable concentrations of iron in a water sample. Sample results for dissolved metal fractions were not considered valid to use to determine attainment of the criteria and were not counted as valid results to determine attainment or to delist Category 5: 303(d) impaired waters. This is because dissolved metals generally constitute only a fraction of total metal present in an ambient water sample. However, if the dissolved fraction results exceed the applicable criteria, the results were counted as valid results to determine exceedance. Waters that were previously listed as Category 5: 303(d) for iron were delisted if sufficient data were available to show the aquatic life criterion was met.

Manganese Criteria

Oregon's human health criteria for manganese were revised by DEQ in 2011 and the revisions were approved by EPA in June 2011.[60] Both the human health criterion for "water and fish ingestion" and the criterion for "fish consumption only" in fresh water were withdrawn. OAR 340-041-0033 Table 40 retains the "Organism Only" criterion for total manganese for saltwater in order to protect human health for the consumption of oysters and other marine mollusks. There are no aquatic life criteria for manganese.

Note: For the 2012 Integrated Report, DEQ evaluated data for manganese from estuarine sites and applied the human health "Organism Only" criterion. Water bodies in freshwater that were previously listed as Category 5: 303(d) were delisted because there are no currently applicable criteria. Other categories assigned in previous assessments using the withdrawn numeric criteria for freshwater may not be accurate.

Mercury and Methylmercury Criteria

Human health water quality criteria for mercury were revised and approved by EPA in October 2011. The revised criterion in OAR 340-041-0033 Table 40 is expressed as a fish tissue concentration of methylmercury

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[58] November 14, 2012, DEQ Memorandum RE: Implementation Instructions for the Water Quality Criterion Hexachlorocyclo-hexane-Technical (CAS #: 608-73-1) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/bhcTechnical.pdf"]

[59] Rulemaking documents at: [HYPERLINK "http://www.deq.state.or.us/wq/standards/metals.htm"]

[60] Rulemaking documents at: [HYPERLINK "http://www.deq.state.or.us/wq/standards/metals.htm"]

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(CAS No. 22967926) rather than total mercury in the water column. The aquatic life criteria for mercury in OAR 340-041-0033 Table 20 continue to apply to total mercury in the water column.

For the 2012 Integrated Report, DEQ reviewed available data for mercury only in skinless fillet fish tissue from resident fish. Data were available for analyses of fish tissue for total mercury using EPA Method 7473, rather than methylmercury.[61] Scientific literature indicates that 90 % or more of mercury in fish muscle (tissue not including skin) is methylmercury.[62] To evaluate data for the 2012 Integrated Report, DEQ used sample results for total mercury in skinless fish fillets reported in mg/kg with "significant figures" limited to two decimal places. Based on the approximation that 90% of the reported mercury was methylmercury, DEQ concluded that any total mercury fish tissue result exceeding the methylmercury criterion (0.040 mg/kg) would also reasonably approximate an exceedance by the methylmercury component in fish tissue. Fish tissue analyses for mercury may be from skinless fillets of individual fish, individual whole fish analyses, or composited skinless fillets from multiple fish. For the 2012 Integrated Report, DEQ only assessed waters with data from individual skinless fillet fish samples. DEQ compared geometric mean concentrations of mercury from skinless fish fillets in individual resident fish to the human health fish tissue criterion and assigned an assessment category following EPA guidance.[63] DEQ did not assess fish tissue results from analyses for whole fish.

For the2012 Integrated Report, DEQ also reviewed water column data for total mercury for comparison to the OAR 340-041-0033 Table 20 aquatic life criteria. DEQ also reviewed fish consumption advisories issued due to mercury levels in fish. Waters placed in Category 5: 303(d) due to fish consumption advisories will not be delisted until the advisory has been lifted.

Metals Criteria – General

Total Recoverable and Dissolved Concentrations

Criteria for metals in OAR 340-041-0033 Table 20 and Table 40 human health criteria are for total recoverable concentrations (i.e. total and dissolved forms present in an unfiltered water sample). To evaluate water quality data, DEQ compared sample results to the applicable criteria using results that matched the fraction specified by the criterion, when available. If the data did not identify the analysis as total or dissolved, the result was evaluated as if it were a total analysis. (**Note**: Most criteria for metals in OAR 340-041-0033 Table 30 aquatic life criteria are expressed in terms of dissolved concentrations, except for cadmium (acute), copper (freshwater), iron, and mercury which are expressed as total recoverable.)

The dissolved metal concentration in a water sample generally measures only a fraction of the total metal present in the water. When the criterion is expressed as a total fraction, results for dissolved fractions were counted as valid results if the detected result exceeded the total criterion, but were not considered valid or counted to determine attainment if the dissolved result was less than the total criterion.

When samples on the same date were reported for both total and dissolved fractions, the fraction best matching the applicable criterion was evaluated and counted as one sample.

Hardness Dependent Criteria

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[61] 2007, Method 7473, Mercury in Solids and Solutions by Thermal Decomposition, Amalgamation, and Atomic Absorption Spectrophotometry. U.S. EPA Office of Solid Waste

[62] Ullrich, S.M., Tanton, T.W. and Abdrashitova, S.A., 2001. Mercury in the Aquatic Environment: A Review of Factors Affecting Methylation. Critical Reviews in Environmental Science and Technology, **31**(3): 241-293.

[63] US EPA Office of Science and Technology, 2001. Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion. EPA 823-R-10-001. Washington, D.C.

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The freshwater aquatic life criteria in OAR 340-041-0033 Table 20 for several metals (cadmium, chromium III, copper, lead, nickel, silver, and zinc) are expressed as a function of hardness (mg/L) in the water column. These criteria are flagged on Table 20 with a "+" notation and footnoted to indicate the numeric criteria were calculated using a hardness of 100 mg/L. Criteria for these metals are calculated using the following formulae:[64] Because the criteria are expressed as total recoverable metals, total recoverable hardness values were used to derive criteria.

Total Recoverable Criterion:
Freshwater Acute Criterion: Criterion maximum concentration

$$CMC = (\exp(m_A*[\ln(hardness)] + b_A))$$

Freshwater Chronic Criterion: Criterion chronic concentration

$$CCC = (\exp(m_C*[\ln(hardness)] + b_C))$$

Table [SEQ Table * ARABIC] Factors for Hardness Dependent Metals Criteria

Metal	Freshwater Acute Criterion CMC		Freshwater Chronic Criterion CCC	
	m_a	b_a	m_c	b_c
Cadmium	1.128	-3.828	0.7852	-3.490
Chromium III	0.819	3.688	0.819	1.561
Copper	0.9422	-1.464	0.8545	-1.465
Lead	1.273	-1.460	1.273	-4.705
Nickel	0.8460	3.3612	0.8460	1.1645
Silver	1.72	-6.520		
Zinc	0.8473	0.8604	0.8473	0.7614

If hardness was not measured directly as $CaCO_3$, the following equation was used to calculate the hardness value[65]:

$$\text{Hardness, equivalent } CaCo_3 \text{ (mg/L)} = 2.497 \text{ Ca (mg/L)} + 4.1189 \text{ Mg (mg/L)}$$

To determine the applicable hardness dependent criteria, DEQ followed EPA federally promulgated water quality standards recommendations in 40 CFR 131to use a minimum of 25 mg/L as calcium carbonate hardness to calculate criteria even if the actual ambient hardness is less than 25 mg/l as calcium carbonate.[66] The maximum hardness value should not exceed 400 mg/L as calcium carbonate, even if the actual ambient hardness is greater than 400 mg/l as calcium carbonate. Additionally, if no hardness data were available, DEQ applied a default hardness of 25 mg/L to calculate the criteria. Hardness-dependent freshwater criteria for metals were applied to the estuarine sites.

[64] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001
[65] 1998, Standard Methods for the Examination of Water and Wastewater, 20th edition, American Public Health Association, American Water Works Association, Water Environment Federation
[66] 40 CFR Section 131.36(c)(4)(i).

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Note: For the 2012 Integrated Report, DEQ evaluated data for metals chromium, iron, manganese, mercury, silver, and thallium as well as the hardness-dependent metals cadmium, copper, lead, nickel, and zinc. DEQ applied the most stringent applicable criteria listed on OAR 340-041 Table 20 for chromium VI, which is not hardness dependent, and silver, which is the freshwater chronic criterion that is not hardness dependent.

Nitrosamines Criteria
Oregon's human health criteria in OAR 340-041-0033 Table 40 were revised in 2011 for the nitrosamine class of nitrogen containing chemicals as well as for the following individual derivatives in the class:

- Nitrosodibutylamine N- (CAS No. 924163)
- Nitrosodiethylamine N- (CAS No. 55185)
- Nitrosodimethylamine N- (CAS No. 62759)
- Nitrosodi-n-propylamine, N (CAS No. 621647)
- Nitrosodiphenylamine N- (CAS No. 86306)
- Nitrosopyrrolidine N- (CAS No. 930552)

For the Integrated Report, the sum of all the results for individual nitrosamines was compared to the criteria for nitrosodiethylamine, N. This is the most toxic of the nitrosamine derivatives and its numerical criteria are equal to the criteria established for total nitrosamines.[67]

Note: DEQ did not evaluate data for nitrosamines for the 2012 Integrated Report.

Parathion Criteria
The OAR Table 20 aquatic life criteria for parathion were applied to results for ethyl parathion (CAS No. 56382). In previous assessments, the criteria were also applied to results for methyl parathion (CAS No. 298000). Both pesticides were registered and in use when previous Table 20 criteria were established.

Note: For the 2012 Integrated Report, DEQ evaluated data and applied the criterion for parathion.

PCB Criteria
OAR 340-041-0033Table 20 and Table 40 criteria for PCBs (Polychlorinated Biphenyls) were applied to <u>either</u> the sum of sample results reported as Aroclors, <u>or</u> the sum of sample results reported as individual congeners.

Note: For the 2012 Water Quality Assessment, DEQ evaluated PCB data from USGS. The data were reported as "total PCBs"; and the results were not identified as using either congener or Aroclor analytical methods. DEQ also reviewed fish consumption advisories to update assessment.

Pentachlorophenol Criteria
Oregon's human health criterion on OAR 340-041-0033 Table 40 for pentachlorophenol was revised in 2011. Freshwater aquatic life criteria on OAR 340-041-0033 Table 20 remain in effect. The aquatic life criteria for Pentachlorophenol (CAS No. 87865) are pH dependent and can be calculated by:[68]

<u>Acute Criterion (CMC = Criterion Maximum Concentration)</u>
CMC=(exp(1.005(pH)-4.830)

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[67] October 23, 2012 DEQ Memorandum RE: Implementation Instructions for the Water Quality Criterion Nitrosamines (CAS#: 35576-91-1) [HYPERLINK "http://www.deq.state.or.us/wq/standards/docs/toxics/nitrosamines.pdf"]

[68] 1986, Ambient Water Quality Criteria for Pentachlorophenol, U.S. EPA Office of Water, EPA 440/5-86-009.

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Chronic Criterion (CCC = Criterion Continuous Concentration):
CCC=exp(1.005(pH)-5.290).

Generally, as pH decreases, the toxicity of pentachlorophenol increases. A pH of 7.8 was used to generate the numeric criteria in Table 20. To evaluate pentachlorophenol, criteria can be calculated following the 1986 guidance using the equations shown above. If pH data were not available, the freshwater criteria for pentachlorophenol could not be calculated. Human health criteria for pentachlorophenol are not pH dependent and water quality data can be directly compared to the criteria.

Note: For the 2012 Integrated Report, DEQ did not evaluate data for pentachlorophenol.

Phosphorus Criterion/Phosphate Phosphorus Benchmark
The OAR 340-041-0033 Table 20 aquatic life criterion of 0.1 µg/L applies to elemental phosphorus (P) in marine or estuarine waters. This is based on the EPA criterion to protect marine organisms against toxic effects.[69]

Neither Oregon nor EPA has set a criterion for phosphate phosphorus. EPA has recognized the relationship between phosphates, as major nutrients, and excessive aquatic weed and algae growth, and lake and reservoir eutrophication.[70] EPA recommends that total phosphates as phosphorus (P) should not exceed 50 ug/L in streams to control excessive aquatic growths. For the 2010 Water Quality Report, this value is used as a benchmark to evaluate water quality data for phosphate phosphorus. Water bodies with total phosphates as phosphorus (P) greater than 50 ug/L are a **Category 3B Insufficient Data – Potential Concern** for conditions that may result in not meeting water quality standards.

Note: For the 2012 Integrated Report, DEQ did not evaluate data for phosphorus or phosphate phosphorus.

Polynuclear Aromatic Hydrocarbons Criteria
Criteria for the group Polynuclear Aromatic Hydrocarbons (PAHs) were replaced in OAR 340-041-0033 Table 40 with human health criteria for the following:

Acenaphthene (CAS 83329)
Anthracene (CAS 120127)
Benz[a]anthracene (CAS 56553)
Benzo[a]pyrene (CAS 50328)
Benzo[b]fluoranthene (CAS 205992)
Benzo[k]fluoranthene (CAS 207089)
Chrysene (CAS 218019)
Dibenz[a,h]anthracene (CAS 53703)
Fluoranthene (CAS 206440)
Fluorene (CAS 86737)
Indeno[1,2,3-c,d]pyrene (CAS 193395)
Pyrene (CAS 1290000)

These criteria were approved by EPA in 2011 and are applied to sample results for the individual chemicals.

Note: DEQ evaluated data where available for the individual chemicals for the 2012 Integrated Report.

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[69] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001 for Phosphorus
[70] 1986, Quality Criteria for Water, U.S. EPA Office of Water, EPA 440/5-86-001 for Phosphate Phosphorus

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PARAMETER: Turbidity

BENEFICIAL USES AFFECTED: Resident Fish and Aquatic Life
Water Supply
Aesthetics

NARRATIVE CRITERION: OAR 340-041-0007 (10

NUMERIC CRITERION: OAR 340-041-0036

340-041-0007
Statewide Narrative Criteria
(10) The creation of tastes or odors or toxic or other conditions that are deleterious to fish or other aquatic life or affect the potability of drinking water or the palatability of fish or shellfish may not be allowed;

340-041-0036
Turbidity
Turbidity (Nephelometric Turbidity Units, NTU): No more than a ten percent cumulative increase in natural stream turbidities may be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity. However, limited duration activities necessary to address an emergency or to accommodate essential dredging, construction or other legitimate activities and which cause the standard to be exceeded may be authorized provided all practicable turbidity control techniques have been applied and one of the following has been granted:
(1) Emergency activities: Approval coordinated by the Department with the Oregon Department of Fish and Wildlife under conditions they may prescribe to accommodate response to emergencies or to protect public health and welfare;
(2) Dredging, Construction or other Legitimate Activities: Permit or certification authorized under terms of section 401 or 404 (Permits and Licenses, Federal Water Pollution Control Act) or OAR 141-085-0100 et seq. (Removal and Fill Permits, Division of State Lands), with limitations and conditions governing the activity set forth in the permit or certificate.

ASSIGNMENT OF ASSESSMENT CATEGORY:

Category 5: Water Quality Limited, TMDL Needed (303(d) List)
A systematic or persistent increase (of greater than 10%) in turbidity due to an operational activity that occurs on a persistent basis (e.g. dam release or irrigation return, etc.);
Or,
For impairments to beneficial use as drinking water supply, Public Water System operator indicates that high turbidity days (days with turbidity ≥5 NTU) are causing operational difficulty and source water data validate this impairment. The data are considered to validate an impairment if more than 45 high turbidity days per year occur for any year for which data are available.

Category 3: Insufficient Data
For beneficial use as drinking water supply, available data are not sufficient to determine if the use is impaired. One or more turbidity shutdowns are documented in the Safe Drinking Water Information System database, but there are not data to show whether shutdown is normal after a large storm event, or indicates a problem and impaired beneficial use.

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Category 3B: Potential Concern, Insufficient Data
For beneficial use as drinking water supply, available data are not sufficient to determine if the use is impaired, but indicate a potential concern. The Public Water System operator indicates that high turbidity days are causing operational difficulties, but there are not data available to validate this impairment, or if shutdowns due to high turbidity may be the result of unusual or infrequent weather events.

Category 2: Attaining
For beneficial use as drinking water supply, Public Water System operator indicates that high turbidity days are not causing operational difficulty and/or source water data show water quality is good. Water quality is considered good if there are 45 or less high turbidity days per year for all years for which data are available.

TIME PERIOD:
Year Round

DATA REVIEWED:
2012 Integrated Report
DEQ did not evaluate data or information for turbidity for the 2012 Integrated Report.

Last Data Review
DEQ evaluated data and information for turbidity for the 2010 Integrated Report.

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Appendix 1. June 22,1998 DEQ Letter to EPA, Policy Clarification of Oregon Water Quality Standards Revisions

Appendix 1

June 22, 1998

Philip Millam
Director, Office of Water, OW-134
U.S. Environmental Protection Agency, Region X
1200 Sixth Avenue
Seattle, Washington 98101

Dear Phil:

This letter is to provide policy clarification of the Oregon water quality standards revisions that were submitted for Environmental Protection Agency's (EPA) approval on July 10, 1996. Specifically, this letter addresses how the Department of Environmental Quality (ODEQ) is interpreting certain language contained in the Oregon Water Quality Standards (OAR 340-41) and responds to questions that EPA has raised in its review of the standards.

The regulatory clarifications included herein will be incorporated into the water quality standards, to the extent possible, during the next triennial review. As there are quite a number of issues that are candidates for review in the next triennial review, we will need to carefully prioritize these issues working with EPA and the next Policy Advisory Committee.

The following comments are organized in the following manner: beneficial use issues, numeric criteria issues and implementation issues.

BENEFICIAL USE ISSUES:

Bull Trout Waters: The language in the rule (OAR 340-41- basin (2)(b)(A)) reads: *"...no measurable surface water temperature increase resulting from anthropogenic activities is allowed: ... (v) In waters determined by the Department to support or to be necessary to maintain the viability of native Oregon bull trout, when surface water temperatures exceed 50.0° F (12.8° C)"*. [Please note that the specific citation for the temperature criteria for Bull Trout may vary slightly in its numbering depending on the basin, this example and subsequent citations are from the standards for the Willamette Basin (OAR 340-41-445)].

The Department has consulted with the Oregon Department of Fish and Wildlife (ODFW) to make a determination of the current distribution of Bull Trout. Maps have been developed by ODFW as part of an effort to develop plans to protect and restore Bull Trout populations. These maps can be found in the following publication: "Status of Oregon's Bull Trout" (Oregon Department of Fish and Wildlife; October 1997; Buchanan, David, M. Hanson, and R. Hooton; Portland, OR) which is available from ODFW or viewed in the "StreamNet" website (www.streamnet.org). A map showing the most recent Bull Trout distribution (export file dated June 1997) has been sent separately to EPA and a digital version can be provided to EPA.

The Department will use the 1997 Bull Trout distribution maps contained in the 1997 ODFW publication to clarify the phrase "waters determined by the Department to support or to be necessary to maintain the viability of native Oregon Bull Trout." The temperature criteria of 50°F applies to the stream reaches which indicate that "Spawning, Rearing, or Resident Adult Bull Trout" populations are present. These waters are shown by a solid green line on the maps that are referenced.

The mapping and planning effort is an on-going effort by ODFW. Any changes made to the mapped distribution will represent a change in the standard which would be submitted to EPA for approval. The Bull Trout portion of the standards will be revised to incorporate a reference to the 1997 ODFW publication or identify any other means for determining waters that support or are necessary to support Bull Trout in the next triennial standards review.

Waters supporting spawning, egg incubation and fry emergence: The language in the rule reads:

Temperature (OAR 340-41- basin (2)(b)(A)): *"…no measurable surface water temperature increase resulting from anthropogenic activities is allowed: … (iv) In waters and periods of the year determined by the Department to support native salmonid spawning, egg incubation, and fry emergence from the egg and from the gravels in a basin which exceeds 55°F (12.8°C)".*

Dissolved Oxygen (OAR 340-41- basin (2)(a)(A)): *"For waterbodies identified by the Department as providing salmonid spawning, during the periods from spawning until fry emergence from the gravels, following criteria apply…"*

The Beneficial Use Tables (Tables 1-19 in the Oregon water quality standards) indicate the recognized beneficial uses to generally be protected **in the basin**. In some basins (e.g. Table 15, Malheur River Basin), the information in the Tables has been refined for particular water bodies. In general, salmonid spawning and rearing are shown on the tables to be found in all basins. In order to make the spawning determinations, information on location and timing in a specific waterbody is further developed through consultation with ODFW as spawning does not occur at all times of the year or in all locations in the basin. In addition, timing often varies from year to year depending on seasonal factors such as flow. ODFW, in cooperation with other federal and tribal fishery agencies has begun to map out this information on a species by species basis (StreamNet Project) but this work is still several years from completion.

ODEQ is submitting the attached table that identifies when the spawning criteria listed under the dissolved oxygen and temperature standards will be applied to a basin. This table provides the generally accepted time frame during which spawning occurs. However, spawning periods for Spring Chinook and Winter Steelhead vary with elevation (e.g. Spring Chinook tend to spawn earlier and fry emergence occurs later in the Spring for Winter Steelhead in streams at higher elevations). Therefore, to address differences in actual spawning periods, the Department will consult directly with the ODFW to determine if waterbody specific adjustments (which would be changes to the standards) are necessary.

Furthermore, the Department will apply the antidegradation policy in specific actions, e.g. permits, 401 certification and 303(d) listing, to protect spawning that occurs outside the identified time frames or utilize the narrative temperature criteria that applies to threatened or endangered species.

Application of the warm water Dissolved Oxygen Criteria (OAR 340-41- basin (2)(a)(F)): The language in the rule reads: *"For waterbodies identified by the Department as providing warm-water aquatic life, the dissolved oxygen shall not be less than 5.5 mg/l as an absolute minimum..."*

Warm-water criteria is applied in waters where Salmonid Fish Rearing and Salmonid Fish Spawning are not a listed beneficial use in Tables 1 - 19 with the exception of Table 19 (Klamath Basin) in which the cool water dissolved oxygen criteria will be applied (see Klamath TMDL supporting documentation, (Hammon 1998)). Specifically, the warm water criteria would be applied to:

Table 15: Malheur River (Namorf to Mouth), Willow Creek (Brogan to Mouth), Bully Creek (Reservoir to Mouth);
Table 16: Owyhee River (RM 0-18);
Table 17: Malheur Lake Basin - Natural Lakes;
Table 18: Goose and Summer Lakes Basin - High Alkaline & Saline Lakes.

Application of the cool-water Dissolved Oxygen Criteria (OAR 340-41- basin (2)(a)(E)): The language in the rule reads: *"For waterbodies identified by the Department as providing cool-water aquatic life, the dissolved oxygen shall not be less than 6.5 mg/l as an absolute minimum..."*

Cool-water aquatic life is a sub-category of cold-water aquatic life and is defined under OAR 340-41-006 (52) as *"the aquatic communities that are physiologically restricted to cool waters, composed of one or more species having dissolved oxygen requirements believed similar to the cold-water communities. Including but not limited to Cottidae, Osmeridae, Acipenseridae, and sensitive Centrachidae such as the small-mouth bass."* This criteria will be applied on an ecoregional basis[1] (see attached map) as follows:

West Side:

Cold Water: Coast Range Ecoregion - all, Sierra Nevada Ecoregion -all, Cascade-all, Willamette Valley - generally typical including Willamette River above Corvallis, Santiam (including the North and South), Clackamas, McKenzie, Mid Fork and Coast Fork mainstems.
Cool Water: Willamette Valley Ecoregion - most typical.

East Side (with the exception of waters listed under warm water criteria in Tables 15-19):

[1] The original Ecoregions described in "Ecoregions of the Pacific Northwest" (James Omernik and A. Gallant, 1986, EPA/600/3-86/033) were used. This work is currently being updated but is not complete for Oregon. The terms most typical and generally typical are defined as follows: "The most typical portions of ecoregions are generally those areas that share all of the characteristics that are predominant in each ecoregion. The remaining portions, generally typical of each ecoregion, share most, but not all, of these same characteristics. These areas are defined on maps included in the publication referenced above and have been sent separately to EPA.

Cold Water: Eastern Cascades Slopes and Foothills - most typical, Blue Mountain - most typical.
Cool Water: Remainder of Eastern Oregon Ecoregions.

NUMERIC CRITERIA ISSUES:

Temperature criteria for waters without a specific numeric criterion: The temperature criteria of 64°F will be applied to all water bodies that support salmonid fish rearing as identified in Tables 1 - 19. This would include all waters except those listed as warm water above. Currently, there is no numeric criteria for those waters listed as warm water. This was an inadvertent oversight for the rivers described under 2 and 3 below which will be corrected by setting site specific criteria during the next triennial review. In the mean time, these waters will be protected as follows:

1. There is a criteria that covers natural lakes and would cover lakes in the Malheur Lake Basin (Table 17) and Goose and Summer Lakes Basin (Table 18). This criteria (OAR 340-41-922 (2)(b)(A)) reads: *"...no measurable surface water temperature increase resulting from anthropogenic activities is allowed: ... (vii) In natural lakes"*.

2. The waters shown in the Klamath Basin (Table 19) are currently listed in Oregon's 1994/96 303(d) list for temperature based on exceedence of the criterion that is linked to dissolved oxygen. This criterion (OAR 340-41-965 (2)(b)(A)) reads: *"...no measurable surface water temperature increase resulting form anthropogenic activities is allowed: ... (vi) In Oregon waters when the dissolved oxygen (DO) levels are within 0.5 mg/l or 10 percent saturation of the water column or intergravel DO criterion for a given stream reach or subbasin."* An additional narrative criterion would apply to these waters as they contain a federally listed Threatened and Endangered species - Lost River Sucker and Shortnose Sucker, both of which are listed as endangered (USFWS, 7/88, 53FR27130). This criterion (OAR 340-41-965 (2)(b)(A)) states: *"no measurable surface water temperature increase resulting form anthropogenic activities is allowed: ... (v) In stream segments containing federally listed Threatened and Endangered species if the increase would impair the biological integrity of the Threatened and Endangered population."* A Site Specific Criteria is currently being developed as part of a TMDL for these waters and a new criteria for temperature will be established. This criterion will be adopted by the EQC and submitted to EPA for approval prior the completion of a TMDL. This work should be accomplished during our next triennial standards review (1998 - 2000). The TMDL schedule is currently being negotiated with EPA.

3. Warm water streams in the lower Malheur and Owyhee (Table 15 and 16) would be addressed in a similar manner using temperature criterion that relates to dissolved oxygen. These waters were not listed on the current 303(d) list as the waters were not within 0.5 mg/l or 10 percent saturation of the water column DO criterion. These waters are included in beneficial use survey work that the Department is undertaking in the Snake River Basin/High Desert Ecoregion. This work, which will include the development of numeric temperature criteria for these waters, will be accomplished during our next triennial standards review (1998-2000).

Willamette and Columbia River Temperature Criteria: The language in the rule (OAR 340-41-445 (2)(b)(A)) reads: *"...no measurable surface water temperature increase resulting from anthropogenic activities is allowed: ... (ii) In the Columbia River or its*

associated sloughs and channels from the mouth to river mile 309 when surface water temperatures exceed 68.0°F (20.0°C); (iii) In the Willamette River or its associated sloughs and channels from the mouth to river mile 50 when surface water temperatures exceed 68.0°F (20.0°C);"

For the Columbia River, this is not a change to the previous standard (OAR 340-41-445 (2) (b) (D). The Columbia River forms the boundary between the states of Oregon and Washington and this criterion is consistent with the current temperature standard for the State of Washington.

For the Willamette River, this value represents a decrease from the previous temperature criteria of 70°F and makes it consistent with the Columbia River numeric criteria. The technical committee had recommended the 68°F criteria for these large, lower river segments recognizing that temperatures were expected to be higher in these segments as factors such as the naturally wide channels would minimize the ability to shade these rivers and reduce the thermal loading.

Both of these rivers are water quality limited for temperature and the temperature criteria can be revisited as part of the effort to develop Total Maximum Daily Loads. The Department is currently working with EPA to develop a temperature assessment for the Columbia River and is participating in a Willamette Basin Reservoir Study with the Corp of Engineers and other state agencies. The timing of specific TMDLs is currently being negotiated with EPA.

64° F Temperature Criteria: EPA has expressed concern that the 64°F criterion may not be fully protective. The Final Issue Paper on Temperature indicates that "the incidence of disease from *Chondrococcus columnaris* increases above 60-62° F and cites various sources for this statement (page 2-4 and Appendix D of the Final Issue Paper on Temperature). This is based both on observations from laboratory studies and field studies.

A review of this literature indicates that it is difficult to establish a temperature criteria for waters that experience diurnal temperature changes that would assure no affects due to *C. columnaris*. For example, J. Fryer and K. Pilcher ("Effects of Temperature on Diseases of Salmonid Fishes, EPA-660/3-73-020, 1974) conducted in the laboratory studies using constant temperatures and concluded:

> "When coho and spring chinook salmon, and rainbow trout are infected with *C. columnaris* by water contact, the percentage of fatal infections is high at temperatures of 64°F and above, moderate at 59°F and approaches zero at 49°F and below. A temperature of 54°F is close to the threshold for development of fatal infection of salmonids by *C. columnaris."*

There is literature that suggests that fish pathogens which affect Oregon's cold-water fishes become more infective and virulent at temperatures ranging from the lower mid-sixties to low seventies (Becker and Fujihara, 1978). Ordal and Pacha (1963) found that mortalities due to *C. columnaris* outbreaks are lessened or cease when temperatures are reduced below 65°F. Bell (1986) suggested that outbreaks of high virulence strains of *C. columnaris* occur when average water temperatures reach 15.5°C and the low virulence strains become apparent with average water temperatures over 20°C.

A good discussion of field studies is given in the report "Columbia River Thermal Effects Study" (EPA, 1971).

> "Natural outbreaks of columnaris disease in adult salmon have been linked to high water temperatures in the Fraser River, British Columbia. ...The pathological effects of the disease became evident when water temperatures along the migration route, and in spawning areas, exceeded 60°F. Prespawning mortality reached 90 percent in some tributaries. Columnaris is the infected sockeye spawners was controlled when temperatures fell below 57-58°F and mortalities were reduced. "

> "Data collected on antibody levels in the Columbia River fish "...suggest peak yearly effective infection of at least 70 percent to 80 percent of most adult river fish species" (Fujihara and Hungate, 1970). Occurrence of the disease was generally associated with temperatures above 55°F; the authors further suggest that the incidence of columnaris may be increased by extended periods of warm temperatures than by peak summer temperatures."

> "Other factors including the general condition of the fish, nutritional state, size, presence of toxicants, level of antibody protection, exposure to nitrogen supersaturation, level of dissolved oxygen, and perhaps other factors interrelate in the infection of fish by diseases. However, the diseases discussed here are of less importance at temperatures below 60°F; that is, in most instances mortalities due to columaris are minimized or eliminated below that level."

As indicated in the section on "Standard Alternatives and Technical Evaluation" in the Temperature Issue Paper, the technical committee had recommended a temperature range (58 - 64°F) as being protective for salmonid rearing. While 64°F is at the upper end of the range, the key to this recommendation is the temperature unit (page 3-2) that is used in the standard - the seven-day moving average of the daily maximum temperatures. Exceedence of the criteria is based on the average of the daily maximum temperatures that a waterbody experiences over the course of seven consecutive days exceeding 64°F.

Streams experience a natural fluctuation of daily temperatures so streams that were just meeting the temperature standard would be experiencing temperatures over 60°F for only short periods of time during the day and have lower average temperatures. For example, the Department has summarized temperature data collected at 6 sites around the state which are near the 7-day average of the daily maximum of 64°F (see table below). As shown, the daily average temperatures typically range between 55-60°F. Risks should be minimized at these average temperatures.

In conclusion, the criteria does not represent an assured no-effect level. However, because the criteria represent a "maximum" condition, given diurnal variability, conditions will be better than criteria nearly all of the time at most sites.

	7-Day Statistic	Average Daily Temperatures						
		Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7
Grande Ronde Basin								
East Fork Grande Ronde River	64.7	57.8	58.1	57.4	57.1	57.3	58.0	58.1
Beaver Creek (upstream La Grande Res.)	65.2	55.1	56.5	58	58.2	59.7	60.1	59.9
Umpqua Basin								
Jim Creek (mouth)	62.5	58.2	59.5	59.9	60.1	58.6	55.7	56.8
Pass Creek (upper)	64.4	59.0	58.7	58.1	58.5	59.1	59.3	57.7
Tillamook Basin								
Myrtle Creek (mouth)	65.0	57.7	59.1	58.6	57.9	58.0	57.6	56.8
Sam Downs Creek (mouth)	63.9	55.8	55.9	55.5	55.5	55.7	55.6	56.1

Minimum Dissolved Oxygen Criteria for Cool Water and Warm Water Species:

Warm Water: The Oregon warm water criteria for dissolved oxygen is 5.5 mg/l as a 30 day mean and 4.0 mg/l as a minimum. These values meet or exceed the recommended national criteria for warm water criteria for other life stages (5.5 mg/l as a 30 day mean and 3.0 as a 1 day minimum as shown in Table 1 of the dissolved oxygen criteria in *Quality Criteria for Water, 1986* (EPA 440/5-86-001)). These values are slightly below national criteria suggested for protection of early life stages (6.0 mg/l as a 7 day mean and 5.0 as a 1 day minimum as shown in Table 1 of the dissolved oxygen criteria in *Quality Criteria for Water, 1986)*. As shown on Table 2 of the dissolved oxygen criteria in *Quality Criteria for Water, 1986*, this would represent a slight impairment for early life stages.

This criteria would be applied to both native and non-native warm water species. Table 2-3 in the Temperature Issue Paper (page 2-14) contains a list of non-salmonid fish species present in Oregon. Warm water species include: Borax Chub; Cyprinids (goldfish, carp, fathead minnows); Centrarchids (Bluegill, Crappie, Large-mouth Bass); and Catfish. The only known warm-water species that is native to Oregon is the Borax Chub, which is found near a hot springs. The others have been introduced and now perpetuate themselves in some basins. These species are typically Spring spawners (April - June) during which times dissolved oxygen values are not at the seasonal lows (July - August) and typically have not been found to be a problem. In addition, salmonid spawning criteria, which are more protective, typically apply during these time period.

It should be noted that most of the introduced warm water species now compete with the native cold and cool water species for habitat and food. There are numerous recovery plans being developed for these native species. A level of protection that may have a slight production impairment for non-native warm water species is not necessarily undesirable.

Cool Water: A cool water classification was created to protect cool water species where cold-water biota may be present during part or all of the year but would not form the dominate community structure. The cool water criteria match the national coldwater criteria - other life stages criteria.

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Table 2-3 in the Temperature Issue Paper (page 2-14) contains a list of non-salmonid fish species present in Oregon. Cool water species include: Chub; Suckers; Sandroller; Sturgeon; Centrarchids (Small-mouth Bass); Striped Bass; and Walleye. Small mouth bass, striped bass and walleye are introduced species. This category was set up to provide more protection than that afforded by the other life stage criteria for warm water fish and, as discussed in the Gold Book, we provided these cool water species with the cold water species protection suggested in the national criteria (Table 1 of the dissolved oxygen criteria in *Quality Criteria for Water*, 1986). These species are typically Spring spawners (April - June) during which times dissolved oxygen values are not at the seasonal lows (July- August) and typically have not been found to be a problem.

Table 2-2 of the Dissolved Oxygen Issue Paper indicates that salmonids and other cold-water biota may be present during part or all of the year but may not dominate community structure. Any salmonid spawning would still be covered by the salmonid spawning standard. The Oregon standards provide higher protection for salmonid spawning and cold water rearing than that recommended under the national criteria by choosing the "no production impairment" levels suggested in Table 2 of the dissolved oxygen criteria in *Quality Criteria for Water*, 1986.

When adequate information/data exists: The dissolved oxygen standard provides multiple criteria for cold, cool and warm water aquatic life. For example, OAR 340-41-445 (2) (a) (D) reads: *"For waterbodies identified by the Department as providing cold-water aquatic life, the dissolved oxygen shall not be less than 8.0 mg/l as an absolute minimum. Where conditions of barometric pressure, altitude, and temperature preclude attainment of the 8.0 mg/l, dissolved oxygen shall not be less than 90 percent of saturation. At the discretion of the Department, when the Department determines that adequate information exists, the dissolved oxygen shall not fall below 8.0 mg/l as a 30-day mean minimum, 6.5 mg/l as a seven-day minimum mean, and shall not fall below 6.0mg/l as an absolute minimum (Table 21)."*

In this example, the Department would routinely compare dissolved oxygen values against 8.0 mg/l criteria (the higher dissolved oxygen criteria). Most dissolved oxygen data are collected by a grab sample during the day time and would not reflect minimum conditions, that is why we would use a more restrictive criteria. Adequate information to use the other criteria would involve the collection of diurnal data over long enough periods of time (e.g. multiple days or multiple weeks) during critical time periods (e.g. low flow periods, hottest water temperature periods, period of maximum waste discharge). Such data would be collected through continuous monitoring with proper quality assurance. Based on this data collection, sufficient data would be available to calculate means, minimum means and minimum values and to compare to the appropriate criteria. Models that would provide these statistics could also be compared to the appropriate criteria.

In addition, for actions such as permitting and developing TMDLs, additional information on the beneficial uses of the waterbody will be considered such as: species present; listing status of those species; locations, time periods and presence of sensitive early life stages, etc. Based on presence of early life stages or T&E species, the more conservative criteria would be used.

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IMPLEMENTATION ISSUES:

Air temperature exemption to the water temperature criteria: OAR 340-41-basin (2)(b) (B) specifies that *"an exceedence of the numeric criteria identified subparagraph (A) … of this subsection will not be deemed a temperature standard violation if it occurs when the air temperature during the warmest seven-day period of the year exceeds the 90th percentile of the seven-day average daily maximum air temperature calculated in a yearly series over the historic record. However, during such periods, the anthropogenic sources must still continue to comply with their surface water temperature management plans developed under OAR 340-41-026(3)(a)(D)."*

This policy identifies criteria to be used in certain limited circumstances to determine whether a violation of the temperature water quality standard has occurred. This interpretation would be applied for the purposes of enforcement of standards and the 303(d) listing determinations. Our interpretation of how this air temperature exemption would be applied has been sent to you separately. In the 1994/96 303(d) list, no water bodies were excluded from the list for this reason.

Exceptions to the policy that prohibits new or increased discharged load to receiving streams classified as being water quality limited:

OAR 340-41-026 (3) (C) states "the new or increased discharged load shall not be granted if the receiving stream is classified as being water quality limited under OAR 340-41-006(30)(a), unless…"

OAR 340-41-026 (3) (a) C (iii) added new language under this policy which defines a condition under which a new or increased discharged load could be allowed to a water quality limited waterbody for dissolved oxygen. The language states: "*(iii) Effective July 1, 1996, in waterbodies designated water-quality limited for dissolved oxygen, when establishing WLAs under a TMDL for waterbodies meeting the conditions defined in this rule, the Department may at its discretion provide an allowance for WLAs calculated to result in no measurable reduction of dissolved oxygen. For this purpose, "no measurable reduction" is defined as no more than 0.10 mg/l for a single source and no more than 0.20 mg/l for all anthropogenic activities that influence the water quality limited segment. The allowance applies for surface water DO criteria and for Intergravel DO if a determination is made that the conditions are natural. The allowance for WLAs would apply only to surface water 30-day and seven-day means, and the IGDO action level."*

This is an implementation policy for OAR 340-41-026 (3) (C) and clarifies that we could allow for an increase in load in a waterbody that is water quality limited for dissolved oxygen as long as it did not result in a measurable reduction of dissolved oxygen as defined above and it was determined that the low DO values were due to a natural condition. A site specific criteria for the waterbody would need to be developed and submitted to EPA for review and approval.

All feasible steps: OAR 340-41-026 (3) (D) indicates that: *"Sources shall continue to maintain and improve, if necessary, the surface water temperature management plan in order to maintain the cooling trend until the numeric criterion is achieved or until the Department, in consultation with the Designated Management Agencies (DMAs), has*

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determined that all feasible steps have been taken to meet the criterion and that the designated beneficial uses are not being adversely impacted. In this latter situation, the temperature achieved after all feasible steps have been taken will be the temperature criterion for the surface waters covered by the applicable management plan. The determination that all feasible steps have been taken will be based on, but not limited to, a site-specific balance of the following criteria: protection of beneficial uses; appropriateness to local conditions; use of best treatment technologies or management practices or measures; and cost of compliance."

As indicated, if the waters do not come into compliance with the standard after all feasible steps have been taken, the Department would develop a site-specific criteria which would be submitted to EPA for approval pursuant to EPA policy.

1.0° F increase for new or increased discharge loads from point sources or hydro-power projects in temperature water quality limited basins: OAR 340-41-026 (3) (F), (G), (H) state: *"(F) In basins determined by the Department to be exceeding the numeric temperature criteria, and which are required to develop surface water temperature management plans, new or increased discharge loads from point source sources which require an NPDES permit under Section 402 of the Clean Water Act or hydro-power projects which require certification under Section 401 of the Clean Water Act are allowed a 1.0°F total cumulative increase in surface water temperatures as the surface water*

temperature management plan is being developed and implemented for the water quality limited basin if:

- *(i) in the best professional judgment of the Department, the new or increased discharge load, even with the resulting 1.0°F cumulative increase, will not conflict with or impair the ability of the surface water temperature management plan to achieve the numeric temperature criteria; and*
- *(ii) A new or expanding source must demonstrate that it fits within the 1.0°F increase and that its activities will not result in a measurable impact on beneficial uses. This latter showing must be made by demonstrating to the Department that the temperature change due to its activities will be less than or equal to 0.25°F under a conservative approach or by demonstrating the same to the EQC with appropriate modeling.*

(G) Any source may petition the Department for an exception to paragraph (F) of this subsection, provided:

- *(i) The discharge will result in less than 1.0°F increase at the edge of the mixing zone, and subparagraph (ii) or (iii) of this paragraph applies;*
- *(ii) The source provides the necessary scientific information to describe how the designated beneficial uses would not be adversely impacted; or*
- *(iii) The source demonstrates that:*
  - *(I) It is implementing all reasonable management practices;*
  - *(II) Its activity will not significantly affect the beneficial uses; and*
  - *(III) The environmental cost of treating the parameter to the level necessary to assure full protection would outweigh the risk to the resource.*

OAR 340-41-026 (3) (F) and (G) reflect an implementation policy for OAR 340-41-026 (3) (C). They clarify under what conditions the Department could allow for an increase in load to a waterbody that is water quality limited for temperature as long as the load did not result in a measurable increase in temperature (less than or equal to 0.25°F) or a

cumulative increase of 1.0°F under (F) but a source could petition for up to the cumulative increase of 1.0°F under (G). The cumulative increase typically addresses the situation where there may be multiple new or increased discharges. A TMDL would still be developed to bring the waterbody back into compliance with the temperature criteria. The WLA and the permit for the new or increased source would target the appropriate temperature criteria using a conservative approach as shown below (e.g. calculations would be made using 63°F so that the cumulative increase would not be above the standard of 64°F).[2]

OAR 340-41-026 (3) (H) states: "*Any source or DMA may petition the Commission for an exception to paragraph (F) of this subsection, provided:*

- *(i) The source or DMA provides the necessary scientific information to describe how the designated beneficial uses would not be adversely impacted; or*
- *(ii) The source or DMA demonstrates that:*
  - *(I) It is implementing all reasonable management practices;*
  - *(II) Its activity will not significantly affect the beneficial uses; and*
  - *(III) The environmental cost of treating the parameter to the level necessary to assure full protection would outweigh the risk to the resource. "*

This exemption is a variance policy in which a source can petition the Commission to allow the temperature to increase by a specified amount for a limited period of time in order to allow for new or increased point source discharges to water quality limited waters until a TMDL is prepared. The variance would be submitted to EPA for review and approval. These variances would be reviewed again during the development of a TMDL or at permit renewal.

Source Petition for an exception to temperature criteria: OAR 340-41-basin (2)(b)(C) specifies that *"Any source may petition the Commission for an exception to subparagraph (A)…of this subsection for discharge above the identified criteria if: (i) The source provides the necessary scientific information to describe how the designated beneficial uses would not be adversely impacted; or (ii) a source is implementing all reasonable management practices or measures; its activity will not significantly affect the*

[2] Examples of various of discharge scenarios using a conservative mass balance analysis. The odd numbered examples show a scenario when the stream meets standards. The subsequent even numbered example shows the scenario when the stream is above standard. Examples 1 - 4 would be addressed under OAR 340-41-026 (3) (F); examples 5 - 8 would be addressed under OAR 340-41-026 (3) (G); and examples 9 - 10 would be addressed under OAR 340-41-026 (3) (H).

Example	Upstream		Effluent		Downstream		Change in
	Flow	Temp	Flow	Temp	Flow	Temp	Temp
1	10	63	0.4	69.5	10.4	63.25	0.25
2	10	73	0.4	69.5	10.4	72.87	-0.13
3	10	63	0.1	88	10.1	63.25	0.25
4	10	73	0.1	88	10.1	73.15	0.15
5	10	63	0.4	79.5	10.4	63.63	0.63
6	10	73	0.4	79.5	10.4	73.25	0.25
7	10	63	0.4	89	10.4	64.00	1.00
8	10	73	0.4	89	10.4	73.62	0.62
9	10	61.5	1	89	11	64.00	2.50
10	10	73	1	89	11	74.45	1.45

beneficial uses; and the environmental cost of treating the parameter to the level necessary to assure full protection would outweigh the risk to the resource."

This will be, for most cases, a variance policy which allows the temperature to increase by a specified amount for a limited period of time in order to allow for an existing point source to discharge to water quality limited waters until a TMDL is prepared. In the case where that source would be the major cause for the temperature criteria to be exceeded and a TMDL would not be developed for that waterbody to bring it back into compliance, a site specific criteria would be developed and submitted to EPA for approval.

pH Standard exception: OAR 340-41-basin (2) (d) states *"The following exception applies: Waters impounded by dams existing on January 1, 1996, which have pHs that exceed the criteria shall not be considered in violation of the standard if the Department determines that the exceedence would not occur without the impoundment and that all practicable measures have been taken to bring the pH in the impounded waters into compliance with the criteria."*

This language was intended to address the situation where a hydroproject would be applying for a 401 re-certification and it was found that the action of impounding the waters caused algal growth which caused the reservoir to subsequently exceed the pH standard. This might set up the situation where the only way to re-certify the project would be to destroy the dam which may not be the preferred option. In the cases where this exception would be applied, the Department would develop either a TMDL for nutrients in the upstream watershed, develop a site specific criteria for the waterbody or develop a use attainability analysis to modify the uses for portions of the reservoir.

Final Note: ODFW has a great deal of knowledge regarding location and timing for presence, spawning, etc of fish in Oregon streams. Much of this information is either in the files contained in local field offices or is gained from the judgment of the local biologist. Until recently, it has not been mapped. A mapping effort is underway and is furthest along for Bull Trout and Anadromous fish species. There is a coordinated effort underway entitled "StreamNet" (www.streamnet.org). This work is focused on a species by species mapping which would need to be generalized to match cold, cool, warm-water classification and spawning vs rearing groupings indicated in the standards. Issues such as mapping scales and coverage would still need to be worked out. This effort, to better categorize aquatic life uses, could be addressed in subsequent triennial standards reviews but will need additional funding to complete.

There are quite a number of standards related issues that are candidates for consideration during the next triennial review. ODEQ and EPA should get together once ODEQ has hired a new standards coordinator to discuss priorities and approaches for conducting the next triennial review process.
Please feel to contact Andy Schaedel (503-229-6121) or Lynne Kennedy (503-229-5371) if you have further questions.

Sincerely,

Michael T. Llewelyn
Administrator, Water Quality Division

cc: Water Quality Managers

Appendix 1

Appendix 2. February 4, 2004 DEQ Letter to EPA Region 10, Oregon Responses to EPA Questions on State's Water Quality Temperature Standards

Appendix 2

Oregon
Quality Headquarters
Theodore Kulongoski, Governor

Department of Environmental

811 SW Sixth Avenue
Portland, OR 97204-1390
(503) 229-5696
FAX (503)229-6124
TTY (503) 229-6993

February 4, 2004

Mr. Randy Smith, Director
Office of Water
U.S. EPA Region 10
1200 Sixth Avenue
Seattle, WA 98101

Re: Oregon Responses to EPA Questions re the State's water quality temperature standards

Dear Mr. Smith:

This letter is a follow up to our similar correspondence of December 19, 2003, which described Oregon's newly adopted antidegradation and temperature rules. There are three purposes for this letter. First, we are offering similar clarifications regarding the State's intended methodology for identifying natural conditions for parameters other than temperature. Second, we are commenting on several proposed conservation measures EPA is developing pursuant to consultation under the Endangered Species Act. Finally, we are providing your Agency with information on the application of the dissolved oxygen criteria to resident fish spawning.

Natural Conditions

As we indicated in our earlier letter, our revised rules make it clear that where ODEQ identifies a natural condition which is less stringent than the numeric criteria set out in the State's water quality standards, the natural condition supercedes the numeric criteria. Very similar language appeared in our previous rules, which were previously approved by EPA.

By definition, "natural conditions" are those pollutants that are present in the State's waters that are not attributable to anthropogenic activities. Rather, these conditions are caused by local geophysical, hydrological and meteorological processes and wildlife. ODEQ anticipates that site-specific natural conditions might be identified for the following parameters:

- Bacteria (attributed to wildlife)

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- Metals (attributed to naturally eroding ore deposits)
- Nutrients (attributed to background soil, vegetation and/or wildlife conditions)
- Sediments and Turbidity (attributed to soil erosion and/or organic matter not accelerated by human activities)
- Other parameters attributed to similar natural processes.

Prior to a natural condition superceding otherwise applicable numeric criteria, ODEQ will make a finding as to the level at which the pollutant is present with no influence from anthropogenic activities. Similarly, ODEQ will document the natural process contributing to the presence of the pollutant. The specific methodology used to support a natural condition finding may vary in each local situation. However, in general the methodologies used will be similar to that described in our December 19, 2003 letter:

- Reference streams,
- Pollutant transport models,
- DNA testing,
- Historical data (where available) and/or
- Other sampling methods and studies.

The public will have specific notice of these natural conditions whenever they are relevant to one of the Clean Water Act regulatory programs. The public notices and documentation accompanying the biannual 303(d) listing process, draft TMDLs, draft NPDES permits and 401 water quality certifications will indicate that the otherwise applicable numeric criteria have been superceded by a natural conditions finding. Moreover, since 303(d) listings and TMDLs are transmitted to EPA for approval, the Agency will have an opportunity to review ODEQ 's natural conditions conclusions. ODEQ is committed to work with EPA as natural condition methodologies are refined in the TMDL, NPDES and 303(d) listing contexts.

ODEQ expects that natural conditions will most commonly be identified through the TMDL process. In that circumstance, EPA will have an opportunity to review and evaluate any natural condition determination as part of its TMDL approval action. ODEQ will list the water bodies where "natural conditions" findings have been made on our standards web page to ensure that the public is aware and notified of natural conditions,

It should be noted that it is possible, at some locations in the State, that the natural condition will not support, and never has supported a designated beneficial use. In such circumstances, ODEQ will modify the designated use to properly adjust the beneficial use to better reflect the existing use of the water segment.

Proposed Conservation Measures

ODEQ is aware that EPA is considering several conservation measures associated with its approval of the State water quality standards revisions. EPA has inquired whether ODEQ would participate in these conservation measures if they are pursued. To begin with, ODEQ notes that most of these conservation measures pursue information on the future *implementation* of the State's standards. They are best categorized as efforts

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intended to identify additional information supporting the use of our standards once they are in place.

Since Oregon has a strong interest in these federal initiatives, ODEQ will, resources allowing, participate in the proposed conservation measures as described in EPA's Biological Evaluation: Temperature Monitoring and Use Designations (2.5.1) and the Two Year Review (2.5.2).

Dissolved Oxygen and Spawning

The revised Oregon rules clarified spawning locations and timing for anadromous fish and Lahontan Cutthroat Trout. Due to a lack of site specific data for species other than these, and since temperature criteria for spawning were not established for other species, no similar clarification was made for resident trout (i.e., rainbow, redband, Westslope cutthroat and coastal cutthroat) or char (bull trout) spawning. However, the dissolved oxygen criteria contain provisions that continue to apply to resident trout and char spawning areas. ODEQ will use the following dates to apply the dissolved oxygen spawning criteria (throughout the range where the Oregon maps indicate trout rearing, redband trout and core cold water habitat uses are identified).

Resident Trout Spawning (Redband, Rainbow, Westslope and Coastal Cutthroat)

- *For waters designated as trout rearing, or redband trout use, spawning is deemed to occur from January 1 – May 15 each year;*

- *For waters designated as core cold water habitat, or bull trout spawning and rearing use, resident trout spawning is deemed to occur from January 1 – June 15 each year; and*

- *For trout rearing waters upstream from core cold water habitat, spawning is also deemed to occur from January 1 – June 15 each year.*

Char (Bull Trout) Spawning

The following dates apply to all reaches designated as having "bull trout spawning and rearing use" within the specified basin or subbasin:

Basin	Subbasin	Spawning Period	Source of Information
South Willamette		Aug 15 – May 30	ODFW
John Day		Sept 1 – April 30	ODFW
Umatilla		Sept 1 – April 30	ODFW

Walla Walla		Sept 1 – April 30	ODFW
Grand Ronde	Upper G. R.	Sept 1 – April 15	ODFW
	Wallowa	Sept 1 – May 15	ODFW
	Wenaha	Aug 15 – March 31	ODFW
Imnaha		Aug 15 – May 31	ODFW
Hood		Aug 15 – May 15	USFWS
Deschutes		Aug 15 – May 15	USFWS
Powder		Aug 15 – May 15	USFWS
Malheur		Aug 15 – May 30	USFWS
Klamath		Aug 15 - May 30	USFWS

This timing information will be circulated to ODEQ field staff responsible for implementing the dissolved oxygen criteria. ODEQ will continue to refine all of these designations as more information is developed on resident trout and char spawning activities.

Oregon looks forward to EPA's review and approval of our water quality standards. If you require any additional information or clarification of these rules, please contact me or have your staff call Mark Charles, water quality standards manager at (503) 229-5589.

Sincerely,

Michael T. Llewelyn, Administrator
Water Quality Program

Cc: Stephanie Hallock - ODEQ
Mark Charles - ODEQ
Paula van Haagen - EPA
Mary Lou Soscia - EPA

Appendix 2

Appendix 3. June 8, 2010 DEQ Memorandum, Application of Dissolved Oxygen Criteria to "Salmon and Trout Rearing and Migration" Beneficial Use and "Redband or Lahontan Cutthroat Trout" Beneficial Use

Appendix 3

MEMORANDUM

To: Jennifer Wigal, Water Quality Standards and Assessment; Annette Liebe, Surface Water Management; Gene Foster, Watershed Management; Neil Mullane, Water Quality Division Administrator; Water Quality Staff

FROM: Marilyn Fonseca, Community and Program Assistance

Cc: File

Subject: Application of DO criteria to "salmon and trout rearing and migration" beneficial use and "redband or lahontan cutthroat trout" beneficial use

Date: June 8, 2010

This memo updates DEQ's application of the dissolved oxygen criteria to the "salmon and trout rearing and migration" beneficial use and the "redband or lahontan cutthroat trout" beneficial use for Clean Water Act purposes, including the NPDES permit program, the TMDL program and the assessment program. Salmon and trout rearing and migration and redband or lahontan cutthroat trout were described as beneficial fish uses in the water quality standards revision approved by EPA in March 2004. These are subcategories of the more general fish and aquatic life use. The water quality standards revision approved by EPA in March 2004 included several subcategories of fish and aquatic life uses, including bull trout spawning and juvenile migration and core cold water habitat. This memo doesn't address those beneficial uses, it only addresses application of the DO criteria to salmon and trout rearing and migration and redband or lahontan cutthroat trout.

In previous 303(d) assessments DEQ used the ecoregion map from Omernik (1986) to determine where the cold water DO criteria apply and where the cool water DO criteria apply. The ecoregions were divided into "generally typical" and "most typical" areas. DEQ used these areas to apply the cold water DO criteria or the cool water DO criteria per pages 3 and 4 of the 1998 water quality standards clarification letter to EPA. The approach described in the 1998 letter provided many challenges, among them the limited availability of the 1986 ecoregion map. A newer version of the ecoregion map (A Woods, S Bryce, J Omernik, Level III and IV Ecoregions of Oregon, published in 2003, is available at: ftp://ftp.epa.gov/wed/ecoregions/or/or_eco.html).

This new map will be used by DEQ to apply the DO criteria since the new ecoregion map is available electronically. The designations under the 1986 map and the 2003 were compared and some adjustments were made to retain consistency between the two maps. The resulting map is attached. The cold water dissolved oxygen criterion and cool water dissolved oxygen criterion will be applied as described below, to the salmon and trout rearing and migration beneficial use and the redband and lahontan cutthroat trout beneficial use.

Appendix 3

Application of the cold water dissolved oxygen criterion OAR 340-041-0016(2). The language in the rule reads: *"For water bodies identified by the Department as providing cold-water aquatic life, the dissolved oxygen may not be less than 8.0 mg/l as an absolute minimum."*

This criterion will be applied on an ecoregion scale (see attached map) as follows: Coast Range ecoregion – all; Cascades ecoregion – all; Willamette Valley - Willamette Valley Foothills; Eastern Cascades Slopes and Foothills ecoregion - Ponderosa Pine/Bitterbrush Woodland, Pumice Plateau Basins, Fremont Pine/Fir Forest, Southern Cascade Slope, Grand Fir Mixed Forest, Pumice Plateau; Blue Mountains - John Day/ Clarno Highlands, Maritime-Influenced Zone, Melange, Wallowas/Seven Devils Mountains, Canyons and Dissected Highlands, Continental Zone Highlands, Mesic Forest Zone, Subalpine-Alpine Zone, Cold Basins; Klamath Mountains – all.

Application of the cool water dissolved oxygen criterion OAR 340-041-0016(3). The language in the rule reads: *"For water bodies identified by the Department as providing cool-water aquatic life, the dissolved oxygen may not be less than 6.5 mg/l as an absolute minimum."*

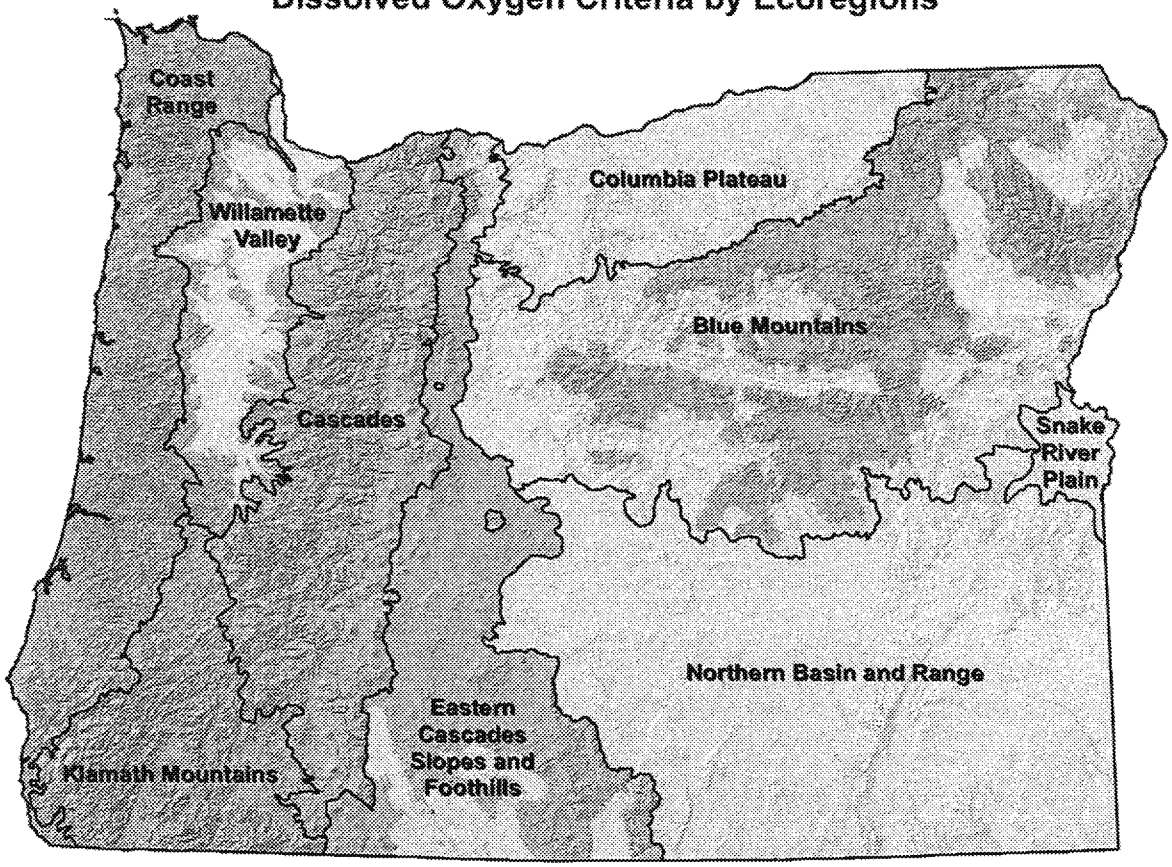
This criterion will be applied on an ecoregion scale (see attached map) as follows: Willamette Valley - Portland/Vancouver Basin, Willamette River and Tributaries Gallery Forest, Prairie Terraces; Eastern Cascades Slopes and Foothills - Oak/Conifer Foothills, Klamath/Goose Lake Basins, Klamath Juniper Woodland; Columbia Plateau – all; Blue Mountains - John Day/Clarno Uplands, Canyons and Dissected Uplands, Continental Zone Foothills, Blue Mountain Basins, Deschutes River Valley; Snake River Plain – all; Northern Basin and Range – all.

Approved: Neil Mullane Date: 6/11/10

Neil Mullane, Water Quality Division Administrator

Appendix 3

Dissolved Oxygen Criteria by Ecoregions



DEQ
State of Oregon Department of Environmental Quality

Dissolved Oxyen Designation

Cold

Cool

Designation for Redband or Lahontan Cutthroat Trout and Salmon and Trout Rearing and Migration only.

0 25 50 75 100 Miles

Ecoregions Source: Thorson, T.D., Bryce, S.A., Lammers, D.A., Woods, A.J., Omernik, J.M., Kagan, J., Pater, D.E., and Comstock, J.A. *Ecoregions of Oregon*. Reston, Virginia, U.S. Geological Survey, 2003.

Map Produced: June 16, 2010

N W E S

Appendix 3

Appendix 3

Appendix 4. Toxic Substance Human Health and Aquatic Life Criteria Used for the 2012 Integrated Report

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Appendix 4

Toxic Substance Human Health and Aquatic Life Criteria Used for the 2012 Integrated Report

The following table combines the aquatic life criteria from OAR 340-041 Table 20 and the human health toxic substance criteria from OAR 340-041 Table 40. These criteria are applied for the 2012 Integrated Report. The aquatic life toxic criteria in this table do not reflect EPA's Jan. 31, 2013 approval and disapproval actions on Oregon's aquatic life criteria which were revised and adopted by the Environmental Quality Commission (EQC) in 2004. The EQC has not officially adopted this table and it does not replace OAR 340-041Table 20 or OAR 340-041 Table 40.

Effective Human Health and Aquatic Life Criteria for CWA Purposes (Based on Tables 20 and 40)

No.	Pollutant	CAS No.	Carcinogen	Human Health Criteria: *Water + Organism (µg/L)*	Human Health Criteria: *Organism Only (µg/L)*	Freshwater Acute Criteria (CMC) *µg/L*	Freshwater Chronic Criteria (CCC) *µg/L*	Marine Acute Criteria (CMC) *µg/L*	Marine Chronic Criteria (CCC) *µg/L*
1	Acenaphthene	83329	n	95	99	--	--	--	--
2	Acrolein	107028	n	0.88	0.93	--	--	--	--
3	Acrylonitrile	107131	y	0.018	0.025	--	--	--	--
4	Aldrin	309002	y	0.0000050	0.0000050	3	--	1.3	--
5	Alkalinity			--	--	--	20,000	--	--
6	Ammonia	7664417		--	--	*All criteria are pH and temperature dependent See document USEPA January 1985 (Fresh Water) See document USEPA April 1989 (Marine Water)*			
7	Anthracene	120127	n	2800	4000	--	--	--	--
8	Antimony	7440360	n	5.1	64	--	--	--	--
9	Arsenic (inorganic)	7440382	y	2.1	2.1 (freshwater) 1.0 (saltwater)	--	--	--	--
The arsenic criteria are expressed as total inorganic arsenic. The "organism only" criteria are based on a risk level of approximately of 1.1 x 10-5, and the "water + organism" criterion is based on a risk level of 1 x 10-4.									
10	Arsenic (tri)			--	--	360	190	69	36
11	Asbestos	1332214	y	7,000,000 fibers/L	--	--	--	--	--
The human health risks from asbestos are primarily from drinking water, therefore no "organism only" criterion was developed. The "water + organism" criterion is based on the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act.									
12	*Barium*	7440393	n	1000	--	--	--	--	--
The human health criterion for barium is the same as originally published in the 1976 EPA Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value was also published in the 1986 EPA Gold Book. Human health risks are primarily from drinking water, therefore no "organism only" criterion was developed. The "water + organism" criterion is based on the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act.									
13	Benzene	71432	y	0.44	1.4	--	--	--	--
14	Benzidine	92875	y	0.000018	0.000020	--	--	--	--
15	Benz(a)anthracene	56553	y	0.0013	0.0018	--	--	--	--
16	Benzo(a)pyrene	50328	y	0.0013	0.0018	--	--	--	--
17	Benzo(b)fluoranthene 3,4	205992	y	0.0013	0.0018	--	--	--	--
18	Benzo(k)fluoranthene	207089	y	0.0013	0.0018	--	--	--	--

No.	Pollutant	CAS No.	Carcinogen	Human Health Criteria: *Water + Organism (µg/L)*	Human Health Criteria: *Organism Only (µg/L)*	Freshwater Acute Criteria (CMC) *µg/L*	Freshwater Chronic Criteria (CCC) *µg/L*	Marine Acute Criteria (CMC) *µg/L*	Marine Chronic Criteria (CCC) *µg/L*
19	BHC Alpha	319846	y	0.00045	0.00049	--	--	--	--
20	BHC Beta	319857	y	0.0016	0.0017	--	--	--	--
21	BHC Gamma (Lindane)	58899	n	0.17	0.18	2.0	0.08	0.16	--
22	Bromoform	75252	y	3.3	14	--	--	--	--
23	Butylbenzyl Phthalate	85687	n	190	190	--	--	--	--
24	Cadmium	7440439		--	--	3.9*	1.1*	43	9.3
**The freshwater criteria are hardness dependent (100 mg/L used).*									
25	Carbon Tetrachloride	56235	y	0.10	0.16	--	--	--	--
26	Chlordane	57749	y	0.000081	0.000081	2.4	0.0043	0.09	0.004
27	Chloride	16887006		--	--	860,000	230,000		
28	Chlorine	7782505		--	--	19	11	13	7.5
29	Chlorobenzene	108907	n	74	160	--	--	--	--
30	Chlorodibromomethane	124481	y	0.31	1.3	--	--	--	--
31	Chloroethyl Ether bis 2	111444	y	0.020	0.05	--	--	--	--
32	Chloroform	67663	n	260	1100	--	--	--	--
33	Chloroisopropyl Ether bis 2	108601	n	1200	6500	--	--	--	--
34	*Chloromethyl ether, bis*	542881	y	0.000024	0.000029	--	--	--	--
35	Chloronaphthalene 2	91587	n	150	160	--	--	--	--
36	Chlorophenol 2	95578	n	14	15	--	--	--	--
37	*Chlorophenoxy Herbicide (2,4,5,-TP)*	93721	n	10	--	--	--	--	--
The Chlorophenoxy Herbicide (2,4,5,-TP) criterion is the same as originally published in the 1976 EPA Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value was also published in the 1986 EPA Gold Book. Human health risks are primarily from drinking water, therefore no "organism only" criterion was developed. The "water + organism" criterion is based on the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act.									
38	*Chlorophenoxy Herbicide (2,4-D)*	94757	n	100	--	--	--	--	--
The Chlorophenoxy Herbicide (2,4-D) criterion is the same as originally published in the 1976 EPA Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value was also published in the 1986 EPA Gold Book. Human health risks are primarily from drinking water, therefore no "organism only" criterion was developed. The "water + organism" criterion is based on the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act.									
39	Chlorpyrifos	2921882		--	--	0.083	0.041	0.011	0.0056
40	Chromium (Hex)	18540299		--	--	16	11	1100	50
41	Chromium (Tri)			--	--	1700	210	--	--
Freshwater criteria hardness dependent (100 mg/L used)									
42	Chrysene	218019	y	0.0013	0.0018	--	--	--	--
43	Copper	7440508	n	1300×	--	18*	12*	2.9	2.9
× Human health risks from copper are primarily from drinking water, therefore no "organism only" criterion was developed. The "water + organism" criterion is based on the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act. **Freshwater criteria hardness dependent (100 mg/L used)*									
44	Cyanide	57125	n	130×	130×	22	5.2	1	1
× The cyanide criterion is expressed as total cyanide (CN)/L.									
45	DDD 4,4'	72548	y	0.000031	0.000031	--	--	--	--

Appendix 4

No.	Pollutant	CAS No.	Carcinogen	Human Health Criteria: *Water + Organism (µg/L)*	Human Health Criteria: *Organism Only (µg/L)*	Freshwater Acute Criteria (CMC) *µg/L*	Freshwater Chronic Criteria (CCC) *µg/L*	Marine Acute Criteria (CMC) *µg/L*	Marine Chronic Criteria (CCC) *µg/L*
46	DDE 4,4'	72559	y	0.000022	0.000022	--	--	--	--
47	DDT 4,4'	50293	y	0.000022	0.000022	1.1	0.001	0.13	0.001
48	Demeton	8065483		--	--	--	0.1	--	0.1
49	Dibenz(a,h)anthracene	53703	y	0.0013	0.0018	--	--	--	--
50	Dichlorobenzene(m) 1,3	541731	n	80	96	--	--	--	--
51	Dichlorobenzene(o) 1,2	95501	n	110	130	--	--	--	--
52	Dichlorobenzene(p) 1,4	106467	n	16	19	--	--	--	--
53	Dichlorobenzidine 3,3'	91941	y	0.0027	0.0028	--	--	--	--
54	Dichlorobromomethane	75274	y	0.42	1.7	--	--	--	--
55	Dichloroethane 1,2	107062	y	0.35	3.7	--	--	--	--
56	Dichloroethylene 1,1	75354	n	230	710	--	--	--	--
57	Dichloroethylene trans 1,2	156605	n	120	1000	--	--	--	--
58	Dichlorophenol 2,4	120832	n	23	29	--	--	--	--
59	Dichloropropane 1,2	78875	y	0.38	1.5	--	--	--	--
60	Dichloropropene 1,3	542756	y	0.30	2.1	--	--	--	--
61	Dieldrin	60571	y	0.0000053	0.0000054	2.5	0.0019	0.71	0.0019
62	Diethyl Phthalate	84662	n	3800	4400	--	--	--	--
63	Dimethyl Phthalate	131113	n	84000	110000	--	--	--	--
64	Dimethylphenol 2,4	105679	n	76	85	--	--	--	--
65	Di-n-butyl Phthalate	84742	n	400	450	--	--	--	--
66	Dinitrophenol 2,4	51285	n	62	530	--	--	--	--
67	*Dinitrophenols*	25550587	n	62	530	--	--	--	--
68	Dinitrotoluene 2,4	121142	y	0.084	0.34	--	--	--	--
69	Dioxin (2,3,7,8-TCDD)	1746016	y	5.1E-10	5.1E-10	--	--	--	--
70	Diphenylhydrazine 1,2	122667	y	0.014	0.020	--	--	--	--
71	Endosulfan	115297		--	--	0.22	0.056	0.034	0.0087
72	Endosulfan Alpha	959988	n	8.5	8.9	--	--	--	--
73	Endosulfan Beta	33213659	n	8.5	8.9	--	--	--	--
74	Endosulfan Sulfate	1031078	n	8.5	8.9	--	--	--	--
75	Endrin	72208	n	0.024	0.024	0.18	0.0023	0.037	0.0023
76	Endrin Aldehyde	7421934	n	0.030	0.030	--	--	--	--
77	Ethylbenzene	100414	n	160	210	--	--	--	--
78	Ethylhexyl Phthalate bis 2	117817	y	0.20	0.22	--	--	--	--
79	Fluoranthene	206440	n	14	14	--	--	--	--
80	Fluorene	86737	n	390	530	--	--	--	--
81	Guthion	86500		--	--	--	0.01	--	0.01
82	Heptachlor	76448	y	0.0000079	0.0000079	0.52	0.0038	0.053	0.0036
83	Heptachlor Epoxide	1024573	y	0.0000039	0.0000039	--	--	--	--
84	Hexachlorobenzene	118741	y	0.000029	0.000029	--	--	--	--

Appendix 4

No.	Pollutant	CAS No.	Carcinogen	Human Health Criteria: *Water + Organism (µg/L)*	Human Health Criteria: *Organism Only (µg/L)*	Freshwater Acute Criteria (CMC) *µg/L*	Freshwater Chronic Criteria (CCC) *µg/L*	Marine Acute Criteria (CMC) *µg/L*	Marine Chronic Criteria (CCC) *µg/L*
85	Hexachlorobutadiene	87683	y	0.36	1.8	---	---	---	---
86	*Hexachlorocyclo-hexane-Technical*	608731	y	0.0014	0.0015	---	---	---	---
87	Hexachlorocyclopentadiene	77474	n	30	110	---	---	---	---
88	Hexachloroethane	67721	y	0.29	0.33	---	---	---	---
89	Indeno(1,2,3-cd)pyrene	193395	y	0.0013	0.0018	---	---	---	---
90	Iron	7439896		---	---	---	1000	---	---
91	Isophorone	78591	y	27	96	---	---	---	---
92	Lead	7439921		---	---	82*	3.2*	140	5.6
**The freshwater criteria are hardness dependent (100 mg/L used)*									
93	Malathion	121755		---	---	---	0.1	---	0.1
94	*Manganese*	7439965	n	---	100	---	---	---	---
The "fish consumption only" criterion for manganese applies only to salt water and is for total manganese. This EPA recommended criterion predates the 1980 human health methodology and does not utilize the fish ingestion BCF calculation method or a fish consumption rate.									
95	Mercury	7439976		---	---	2.4	0.012	2.1	0.025
96	*Methoxychlor*	72435	n	100*	---	---	0.03	---	0.03
** The human health criterion for methoxychlor is the same as originally published in the 1976 EPA Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value was also published in the 1986 EPA Gold Book. Human health risks are primarily from drinking water, therefore no "organism only" criterion was developed. The "water + organism" criterion is based on the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act.*									
97	Methyl Bromide	74839	n	37	150	---	---	---	---
98	Methyl-4,6-dinitrophenol 2	534521	n	9.2	28	---	---	---	---
99	Methylene Chloride	75092	y	4.3	59	---	---	---	---
100	Methylmercury (mg/kg)	22967926	n	---	0.040 mg/kg	---	---	---	---
This value is expressed as the fish tissue concentration of methylmercury. Contaminated fish and shellfish is the primary human route of exposure to methylmercury									
101	Mirex	2385855		---	---	---	0.001	---	0.001
102	Nickel	7440020	n	140	170	1400*	160*	75	8.3
**The freshwater criteria are hardness dependent (100 mg/L used).*									
103	*Nitrates*	14797558	n	10000	---	---	---	---	---
The human health criterion for nitrates is the same as originally published in the 1976 EPA Red Book which predates the 1980 methodology and did not utilize the fish ingestion BCF approach. This same criterion value was also published in the 1986 EPA Gold Book. Human health risks are primarily from drinking water, therefore no "organism only" criterion was developed. The "water + organism" criterion is based on the Maximum Contaminant Level (MCL) established under the Safe Drinking Water Act.									
104	Nitrobenzene	98953	n	14	69	---	---	---	---
105	*Nitrosamines*	35576911	y	0.00079	0.046	---	---	---	---
106	*Nitrosodibutylamine, N*	924163	y	0.0050	0.022	---	---	---	---
107	*Nitrosodiethylamine, N*	55185	y	0.00079	0.046	---	---	---	---
108	Nitrosodimethylamine, N	62759	y	0.00068	0.30	---	---	---	---
109	Nitrosodi-n-propylamine, N	621647	y	0.0046	0.051	---	---	---	---
110	Nitrosodiphenylamine, N	86306	y	0.55	0.60	---	---	---	---
111	*Nitrosopyrrolidine, N*	930552	y	0.016	3.4	---	---	---	---

Appendix 4

No.	Pollutant	CAS No.	Carcinogen	Human Health Criteria: *Water + Organism (µg/L)*	Human Health Criteria: *Organism Only (µg/L)*	Freshwater Acute Criteria (CMC) *µg/L*	Freshwater Chronic Criteria (CCC) *µg/L*	Marine Acute Criteria (CMC) *µg/L*	Marine Chronic Criteria (CCC) *µg/L*
112	Parathion	56382		---	---	0.065	0.013	---	---
113	*Pentachlorobenzene*	608935	n	0.15	0.15	---	---	---	---
114	Pentachlorophenol	87865	y	0.15	0.30	20*	13*	13	---
**The freshwater criteria are pH dependent (7.8 pH used).*									
115	Phenol	108952	n	9400	86000	---	---	---	---
116	Phosphorus Elemental	7723140		---	---	---	---	---	0.1
117	Polychlorinated Biphenyls (PCBs)	NA	y	0.0000064*	0.0000064*	2	0.014	10	0.03
** This criterion applies to total PCBs (e.g. determined as Aroclors or congeners).*									
118	Pyrene	129000	n	290	400	---	---	---	---
119	Selenium	7782492	n	120	420	260	35	410	54
120	Silver	7440224		---	---	4.1*	0.12	2.3	
**The freshwater acute criterion is hardness dependent (100 mg/L used).*									
121	Sulfide Hydrogen Sulfide	7783064		---	---	---	2	---	2
122	*Tetrachlorobenzene, 1,2,4,5-*	95943	n	0.11	0.11	---	---	---	---
123	Tetrachloroethane 1,1,2,2	79345	y	0.12	0.40	---	---	---	---
124	Tetrachloroethylene	127184	y	0.24	0.33	---	---	---	---
125	Thallium	7440280	n	0.043	0.047	---	---	---	---
126	Toluene	108883	n	720	1500	---	---	---	---
127	Toxaphene	8001352	y	0.000028	0.000028	0.73	0.0002	0.21	0.0002
128	Trichlorobenzene 1,2,4	120821	n	6.4	7.0	---	---	---	---
129	Trichloroethane 1,1,2	79005	y	0.44	1.6	---	---	---	---
130	Trichloroethylene	79016	y	1.4	3.0	---	---	---	---
131	Trichlorophenol 2,4,6	88062	y	0.23	0.24	---	---	---	---
132	*Trichlorophenol, 2, 4, 5-*	95954	n	330	360	---	---	---	---
133	Vinyl Chloride	75014	y	0.023	0.24	---	---	---	---
134	Zinc	7440666	n	2100	2600	120*	110*	95	86
**The freshwater criteria are hardness dependent (100 mg/L is used).*									

Appendix 4

Appendix 4

Appendix 5. OAR 340-041 Table 20 Water Quality Criteria

Appendix 5