# Procedure for Determining Reasonable Potential for Copper Using the Biotic Ligand Model



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# Disclaimer

This document represents Oregon DEQ's current directions to staff on how to implement the water quality standard for copper in individual NPDES Permits. This procedure is not final agency action and does not create any rights, duties, obligations, or defenses, implied or otherwise, in any third parties. This procedure should not be construed as rule, although some of it describes existing state and federal laws. The recommendations contained in this directive should not be construed as a requirement of rule or statute. Oregon DEQ anticipates revising this document from time to time as conditions warrant.

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# 1 Background

a. A new Oregon aquatic life water quality standard for copper was approved by EPA in January 2017. The new standard states that the copper criteria are to be based on the Biotic Ligand Model (BLM), which is a metal bioavailability model that uses water characteristics to develop site-specific instantaneous water quality criteria. The following discussion provides an overview of the procedures to determine if the discharge from a permitted facility has a reasonable potential to cause or contribute to exceedances of the model-based criteria.

b. The Oregon copper rule[1] states "BLM results from Instantaneous Water Quality Criteria (IWQC) based on sufficient measured input parameter data are more accurate and supersede results based on estimates or default values." IWQC are the protective criteria for Clean Water Act Purposes calculated by the copper BLM from a set of input parameters from a water sample. Ideally, complete sets of input parameter data measured from the effluent and ambient environment upstream of the discharge are available to calculate the applicable IWQC.

| Required BLM input parameters: |
|---|
| Temperature (°C) |
| pH (Standard Units) |
| Dissolved Organic Carbon (DOC) (mg/L) |
| Calcium (mg/L) |
| Magnesium (mg/L) |
| Sodium (mg/L) |
| Potassium (mg/L) |
| Sulfate (mg/L) |
| Chloride (mg/L) |
| Alkalinity (mg/L $CaCO_3$ equivalent) |

c. For the purposes of a reasonable potential analysis (RPA) using the BLM, these data sets would be collected over a long enough period to characterize the range of both upstream ambient receiving waterbody and effluent copper water chemistry conditions and include the most bioavailable conditions. While it is the intention of DEQ to evaluate a full set of model input values for the effluent and receiving water, data sets for current permitted facilities will be limited for ambient and effluent input parameters. DEQ will substitute conservative estimates or default values for input parameters that are not available in order to determine protective instantaneous copper criteria and to complete the copper reasonable potential analysis. Substitution of input parameters will be completed based on this procedure using available guidance materials.

# 2 Purpose

a. The purpose of this document is to provide DEQ staff a procedure and methodology for evaluating the potential of a point source discharge permittee to exceed the water quality standards for copper. The current water quality criteria for copper are listed in OAR 340-041-8033 table 30 and endnote N. See appendix A for a flow chart of responsibilities.

[1] OAR 340-041-8033 endnote N

# 3 Applicability

a. DEQ has identified copper subject matter experts (SME) who coordinate with water quality permitting and standards staff to refine and implement this methodology. While performing the analysis, refer to specific instructions embedded into the reasonable potential analysis worksheet.

    i. Copper SME completes the reasonable potential analysis and provide a memo to permit writers that includes results of the analysis, fact sheet language and permit requirements.

    ii. State and federal regulations require that a reasonable potential analysis for pollutants of concern must be conducted for all proposed and existing industrial and domestic NPDES individual point source discharge permittees. The number and type of pollutants for which the reasonable potential analysis must be conducted will vary with the size, type and potential hazard of the facility. Refer to the monitoring matrix and other permit development tools.

    iii. Reasonable potential to exceed the water quality criteria for copper must be determined for a facility if any one of the following applies:

        1. The facility is required to monitor for copper under existing permit conditions.

        2. When DEQ determines that copper is a pollutant of concern.

            (a.) See figure 2-3 in the RPA IMD for determining reasonable potential.

            (b.) For facilities with and average dry weather design flow less than 1.0 MGD the copper SME should evaluate whether or not copper is "known" or expected to be present in significant concentrations.

                a. Consult direct support for minor facilities that discharge to a 303(d) listed water body.

            (c.) For industrial facilities, copper is a pollutant of concern if:

                a. The industrial activities or Effluent Guidelines indicate copper is a pollutant of concern.

                b. The industrial facility has comingled storm water in the process discharge and does not have a separate storm water general permit (1200-Z)[2].

    iv. If applicable, the permit writer will submit a request to the copper SME for determination of reasonable potential to exceed the water quality criteria.

        1. Multiple inputs are required for the copper biotic ligand model to generate an instantaneous water quality criteria. Individual point source discharge permittees must provide concurrent[6] samples of the required input parameters and copper

[2] Copper has been identified by the NPDES storm water program as a pollutant of concern which is included in all storm water general permits.

from the upstream ambient receiving waterbody and effluent streams. For initial evaluation, permittees must provide a minimum of monthly sets of samples for the discharge season(s) collected over a two-year period.

2. Smaller data sets may be used by the SME when limited data is available or a smaller data set is determined to be sufficient through best professional judgement.

3. See monitoring section for requirements in subsequent permit renewals.

b. All data intended to be used to evaluate copper using the BLM will be submitted to DEQ using the specified electronic data delivery method.

# 4 Methodology

a. In accordance with Mixing Zone IMD's Part 1[3] and Part 2[4] acute criteria must be met at the edge of the zone of initial dilution (ZID) and chronic criteria at the regulatory mixing zone (RMZ). The standard methodology for determining whether a discharge has a reasonable potential to cause or contribute to exceedances of toxic water quality criteria is to first determine the applicable acute and chronic criteria, and then to determine whether the expected concentrations of the toxic pollutant in the effluent have a reasonable potential to exceed these criteria during site specific scenarios. BLM generated instantaneous water quality criteria are developed using input parameter data covering a range of environmental (for receiving waterbody ambient) and operational (for effluent) conditions. From these data sets, DEQ derives acute and chronic instantaneous water quality criteria that are protective of water quality beneficial uses.

b. To derive sets of instantaneous water quality criteria, measured or conservative estimates of mixed concentrations of BLM input parameters must be determined. The reasonable potential analysis will use a simple mass-balance equation to determine the mixed concentration of the BLM input parameters for the ZID, the RMZ, and for complete mix.

    i. For detailed instructions on inputs and outputs used for the biotic ligand model refer to specific instructions embedded into the reasonable potential analysis worksheet

c. General procedure:

    i. Permittees provide two years of monthly samples for copper and all required BLM input parameters.

    ii. Dilutions used in the mixed value calculations are identified by the mixing zone SME and represent a conservative value developed using low flow conditions for the ZID and RMZ. Dilutions for the complete mix scenario are calculated using the 7Q10 or an alternate low flow value.

    iii. Calculate concentration of copper and each required input parameters by mass balance for each set of monthly samples for three evaluation points:

[3] Regulatory Mixing Zone Internal Management Directive Part One: Allocating Regulatory Mixing Zones May 2012
[4] Regulatory Mixing Zone Internal Management Directive Part Two: Reviewing Mixing Zone Studies June 2013

1. Edge of ZID
2. Edge of RMZ
3. At 100% mix

iv. Calculate the IWQC using the BLM model for each set of samples and evaluation points.

v. Compare the mixed copper concentration to the corresponding IWQC for that sampling date.

1. Edge of ZID (acute IWQC)
2. Edge of RMZ (chronic IWQC)
3. At 100% mix (chronic IWQC)

vi. If any copper concentration exceeds the corresponding IWQC, there may be a reasonable potential to exceed the IWQC.

# 5 Data analysis

a. Determine reasonable potential for pollutant to exceed water quality criteria using a paired data set. This analysis assumes discharge permittees submit all 24 samples[5] of copper and required BLM input parameters measured in the field for effluent and upstream ambient receiving waterbody.

i. Data requirements:

[5] Due to variability in local water chemistry conditions, there needs to be enough data to capture the most sensitive or bioavailable conditions. The data should capture both seasonal and inter-annual variability which must be balanced with the length of a permit cycle.

| Paired Data Set[6] | |
|---|---|
| **Ambient Data** | **Effluent Data** |
| • Concurrent BLM input parameters for the ambient upstream<br>• Must be collected upstream[7] of the discharge location<br>• Data must be collected at the same time and location for all BLM input parameters (ambient and effluent)<br>a. pH<br>b. DOC<br>c. Temperature<br>d. Dissolved[8] major ions or Conductivity<br>e. Dissolved and total copper<br>• 24 months[9] of data are available and concurrent with effluent data | • Concurrent BLM input parameters for the effluent stream<br>• Data must be collected at the same time and location for all critical BLM input parameters:<br>a. pH<br>b. DOC<br>c. Temperature<br>d. Dissolved[8] major ions or Conductivity<br>e. Dissolved and total copper<br>• 24 months[9] of data are available and concurrent with ambient upstream data |

ii. Calculate[10] the BLM input parameter concentrations at edge of ZID, RMZ and complete mix for each paired data set.

iii. Enter the respective input parameter concentrations into the biotic ligand model software to calculate a set of instantaneous water quality concentrations.

1. See *Implementation of the Freshwater Aquatic Life Water Quality Standards for Copper and Software instructions* for guidance on entering data into the copper biotic ligand model software.

2. Compare each days IWQC to the corresponding effluent copper concentration by dividing the mixed concentration (ZID, RMZ, 100%) by the IWQC. The result is a toxic unit.

3. Toxic units greater than 1.0 indicate reasonable potential to exceed the water quality criteria.

[6] Paired data refers to concurrent samples that have been taken from two locations (upstream ambient and effluent) within 24 hours of each other.
[7] Preferred upstream location is one that does not include permitted discharges, major confluences and is appropriate for safe sampling procedures. Alternate locations may be considered for safety, accessibility or existing monitoring stations that collect appropriate data. Best professional judgement may be used for upstream locations that are not preferred or alternate locations and must be representative of the conditions at or near the outfall, rationale must be included in the permit fact sheet.
[8] Dissolved results are preferred, total recoverable results may be used.
[9] Smaller data sets may be used if the data is adequate to represent the variability of the stream and seasonal conditions; rationale must be included in the permit fact sheet.
[10] Calculations are described and listed in detail in the copper BLM RPA worksheet.

b. Determine reasonable potential for pollutant to exceed water quality criteria using an incomplete data set. This analysis incorporates the use of established defaults and statistical estimates in place of missing BLM input parameters

i. Note that this scenario is for situations where some data are available but not complete (e.g. have effluent data but no ambient data, or have paired ambient and effluent data set but are missing input parameters). In the event that the data set is paired, but is less than 24 samples, an analysis will be done only with the data available (e.g. if only 18 data sets are available, then the analysis is run with only 18 with no use of defaults to make up the remaining six samples). The presence of paired copper data is the deciding factor in whether a data set will be included in an analysis.

ii. Data requirements:

| **Incomplete Data Sets[11]** | |
|---|---|
| **Ambient Data** | **Effluent Data** |
| • When ambient data is concurrent, but missing input parameters:<br>a. Use either an average of parameters measured from other sample days, or if entire parameter is missing use ambient default.<br>b. If there is no temperature or pH data use 10th percentile from closest representative data source.<br>c. If data is non-detect: use defaults if MRL is above default, or use ½ DL if MRL is below default.<br>• When concurrent ambient data is not available:<br>a. Conservative values may include statistical estimates, geo-region defaults, or downstream representative data. | • When effluent data is concurrent, but missing input parameters:<br>a. Use either an average of parameters measured from other sample days, or if entire parameter is missing use ambient default (exception for DOC, see below).<br>b. If there is no temperature or pH data, use 10th percentile from DMR data<br>c. If data is non-detect: use defaults if MRL is above default, or use ½ DL if MRL is below default.<br>• Where concurrent effluent data is not available:<br>a. Conservative values may include statistical estimates, geo-region defaults, or representative data from similar facility. |

iii. Calculate the BLM input parameter concentrations at edge of ZID, RMZ and complete mix for each data set.

[11] Unpaired data set includes a mixture of concurrent, missing and estimated samples taken from upstream ambient and effluent locations. Missing ambient and effluent samples are replaced using substitutions or geo region defaults designated in the *Implementation of the Freshwater Aquatic Life Water Quality Standards for Copper*. Effluent data may be estimated using summary data from facility discharge monitoring reports.

iv. Enter the respective input parameter concentrations into the biotic ligand model software to calculate a set of instantaneous water quality concentrations.

1. When effluent DOC values are not available for domestic facilities, use 9.0 mg/L

(a.) Rationale: 10th percentile of POTW data from Table D-5 of EPA Report - Draft Technical Support Document: Recommended Estimates for Missing Water Quality Parameters for Application in EPA's Biotic Ligand Model https://www.epa.gov/sites/production/files/2016-02/documents/draft-tsd-recommended-blm-parameters.pdf

v. Compare each day's IWQC to the corresponding effluent copper concentration by dividing the mixed concentration (ZID, RMZ, 100%) by the IWQC. The result is a toxic unit. Toxic units greater than 1.0 indicate reasonable potential to exceed the water quality criteria

1. The copper SME should carefully evaluate the data when less than 10% of the toxic units are greater than 1.0.

2. When the data is inconclusive the copper team will indicate that copper is a pollutant of concern and include monitoring for 24 concurrent data sets as described in section 8 (Monitoring).

c. Determine reasonable potential for pollutant to exceed water quality criteria using a 'no data' set

i. Data Requirements:

| **No Data Set** | |
|---|---|
| **Ambient Data** | **Effluent Data** |
| • Ambient data is not available<br>a. Use the default action values or substitution criteria[12] to calculate the instantaneous water quality criteria.<br>i. This only needs to be done once, subsequent entries will be equal. | • The criteria will be calculated based solely on the ambient data. |

ii. No data set (calculate instantaneous water quality criteria for reasonable potential determination).

1. Calculate[13] the BLM input parameter concentrations at edge of ZID, RMZ and complete mix.

(a.) When effluent DOC values are not available for domestic facilities, use 9.0 mg/L.

[12] See Input Parameter Substitution and Estimation Procedures to Derive BLM Criteria (IWQC) in Endnote N(1).
[13] Calculations are described and listed in detail in the copper BLM RPA worksheet.

a. Rationale: 10th percentile of POTW data from Table D-5 of EPA Report - Draft Technical Support Document: Recommended Estimates for Missing Water Quality Parameters for Application in EPA's Biotic Ligand Model https://www.epa.gov/sites/production/files/2016-02/documents/draft-tsd-recommended-blm-parameters.pdf

iii. Enter the respective input parameter concentrations into the biotic ligand model software to calculate a set of instantaneous water quality concentrations.

iv. Compare each days IWQC to the corresponding effluent copper concentration by dividing the mixed concentration (ZID, RMZ, 100%) by the IWQC. The result is a toxic unit.

v. Toxic units greater than 1.0 indicate reasonable potential to exceed the water quality criteria.

1. The copper SME should carefully evaluate the data when less than 10% of the toxic units are greater than 1.0.

2. When the data is inconclusive the copper team will indicate that copper is a pollutant of concern and include monitoring for 24 concurrent data sets as described in section 8 (Monitoring).

# 6 Develop effluent limits using appropriate methods

a. When data analysis results in reasonable potential to exceed the water quality criteria the copper SME will follow guidance in the Oregon DEQ IMD for Reasonable Potential analysis for final determinations.

i. Use the $10^{th}$ percentile of the IWQC calculated for the ZID and RMZ criteria to be used in limit development.

# 7 Communication with permit writer

a. Once the RPA is completed, the SME will prepare a memo to the permit writer communicating the rational for the RPA, required schedule B monitoring, draft fact sheet language, and schedule A limits.

b. The memo will include:

i. Schedule A Limits (if necessary)

ii. Schedule B monitoring requirement

iii. Fact sheet language

iv. Rationale for decisions

v. Notes regarding deviations from the process

# 8 Monitoring

a. For a "paired data set" when there is no reasonable potential to exceed water quality criteria, schedule B of the permit should include requirements to monitor for copper, aluminum, and all BLM inputs.

b. For an "incomplete data set" when there is no reasonable potential to exceed water quality criteria, schedule B of the permit should include requirements to monitor for copper, aluminum, and all BLM inputs.

c. For a "no data set" when there is no reasonable potential to exceed water quality criteria, schedule B of the permit should include requirements to monitor for copper, aluminum, and all BLM inputs.

d. Once a facility has submitted 24 concurrent sample sets and the evaluation determines there is no reasonable potential to exceed the water quality criteria monitoring will be:

    i. Twice per year, in alternating quarters, for at least five years or until the permit is renewed and not to exceed 24 data sets.

        1. Example: Year one (Q1 and Q3), year two (Q2 and Q4).

e. When a seasonal pattern is recognized, the copper SME can require more or less monitoring during those seasons.

f. More or less monitoring must be justified in the fact sheet.

    i. Evaluation of toxic units should be primary factor in increasing or decreasing monitoring requirements.

    ii. Permittees may propose a more conservative approach when paired results have very low toxic units.

g. If a facility is required to sample for copper BLM inputs or instream metals (Tier 1 toxics), aluminum will be added to the monitoring requirements.

    i. If copper BLM inputs or instream metals monitoring is not required, then instream aluminum monitoring would not be required for monitoring.

    ii. When aluminum monitoring is required include a note indicating that the bioavailable method should be used for ambient upstream monitoring when it is available. For effluent include total aluminum monitoring.

# 9 Special considerations

a. In the event that the permit applicant or other stakeholder proposes an alternate method for determining reasonable potential and/or use of the copper BLM, the permit writer will coordinate with the copper SME and determine any additional actions.

    i. The copper SME will complete the initial determination as described in this procedure regardless of alternate methods.

b. See special notes in the reasonable potential analysis worksheet. Dissolved copper concentrations are preferred for effluent and the ambient upstream. Total recoverable copper concentrations may be used for the effluent when dissolved concentrations are not available. Additionally, ensure guidance is followed for the development of water quality based effluent limits in regards to the use of dissolved and total recoverable metals.

    i. It is not expected that the partitioning between total and dissolved copper change for domestic discharges. For industrial facilities the partitioning between total and dissolved may be greater and dissolved metals should be required.

    ii. DEQ permit writers should not delay the development of an alternate permitting strategy in order to provide time or opportunity for additional samples to be submitted

c. Regional defaults values should not be used in place of measured data.

    i. Because the defaults use the 20th percentile, they may be less conservative in certain scenarios.

    ii. Technical justification will need to be strong in order to support the "don’t need the data" response.

    iii. Default values are in place as a back stop for missing data and may not be used in lieu of measured data.

d. Additional discharge scenarios

    i. Ocean or saline receiving water – do not run BLM.

        i. DEQ policy is to apply the fresh water criterion in estuarine environments when the 90th percentile salinity is below 1 ppt and to apply the salt water criterion when the 90th percentile salinity is greater than 10 ppt. If the salinity lies between, then DEQ policy is to apply the most stringent criterion (freshwater or saltwater).

    ii. No mixing

        i. End of pipe analysis.

        ii. Use 7Q10 for 100% mix.

e. All analysis must be conducting using approved EPA methods according to 40 CFR part 136