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Draft Technical Support Document:

Implementing the 2018 Recommended Aquatic Life Water Quality Criteria for Aluminum

Notice: This draft question and answer document is intended for states and authorized tribes that wish to adopt and implement the U.S. Environmental Protection Agency's (EPA's) recommended *Final Aquatic Life Ambient Water Quality Criteria for Aluminum*. Pursuant to 40 CFR 131.11(b), when establishing numerical criteria designed to protect designated uses, states and authorized tribes should base those criteria on (i) 304(a) guidance; (ii) 304(a) guidance modified to reflect site-specific conditions; or (iii) other scientifically defensible methods. Because the EPA's Section 304(a) aluminum aquatic life criteria are recommendations, and not requirements, states and authorized tribes should consider the advantages and potential challenges of each approach to adopting the recommended criteria, as well as other approaches that may not be described in this document. This document addresses state and tribal adoption of numeric aluminum criteria under 131.11(b)(1)(i) and (ii).

The national 304(a) recommended aluminium criteria are water-chemistry dependent, and criteria values will vary from site to site based on the values of water chemistry parameters at the site. States and authorized tribes may choose to adopt these criteria into their water quality standards using a performance-based approach.[1] This approach involves a two-step process. First, the state or authorized tribe would adopt criteria and a methodology for deriving site-specific criteria values (both of which the EPA must first approve). Then, after EPA approval, the state or authorized tribe would apply the methodology at specific waterbodies to derive site-specific criteria values for each waterbody. After the EPA approves the state's or authorized tribe's methodology, additional approval of the site-specific criteria values derived on a waterbody-by-waterbody basis would not be required. That is, once the state's or authorized tribe's chosen method of adopting the criteria is approved by the EPA, the state or authorized tribe may use the method to derive site-specific criteria values that are used for other Clean Water Act purposes[2] without additional Agency review. In some cases, more than one method may be appropriate, as explained in Question 1 of this document.

The EPA could update this document as new information becomes available. While this document cites statutes and regulations that contain requirements applicable to water quality standards, it does not impose legally binding requirements on the EPA, states, authorized tribes, other regulatory authorities, or the regulated community and its content might not be appropriate in a particular situation based upon the circumstances. The EPA, state, tribal, and other decision makers retain the discretion to adopt approaches on a case-by-case basis that differ from those provided in this document as appropriate and consistent with statutory and regulatory requirements. In addition to this document, the EPA has other documents which provide considerations and recommendations on implementing the aluminum criteria and can be found at the Agency's aluminum website: https://www.epa.gov/wqc/aquatic-life-criteria-aluminum.

[1] The EPA first described the performance-based approach in the preamble to *EPA Review and Approval of State and Tribal Water Quality Standards* (65 FR 24641, April 27, 2000). "A performance-based approach relies on adoption of a process (i.e., a criterion derivation methodology) rather than a specific outcome (i.e., concentration limit for a pollutant) consistent with 40 CFR 131.11 & 131.13. When such a "performance-based'' approach is sufficiently detailed and has suitable safeguards to ensure predictable, repeatable outcomes, EPA approval of such an approach can also serve as approval of the outcomes as well. If a particular State or Tribe's approach is not sufficiently detailed or lacks appropriate safeguards, then EPA review of a specific outcome is still necessary." (65 FR 24648).

[2] For example, serving as the basis to derive water quality-based effluent limits for National Pollutant Discharge Elimination System (NPDES) permits, identifying impaired and threatened waters for waterbody assessments under Section 303(d) of the Act, and developing total maximum daily loads (TMDLs) for impaired or threatened waters.

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Background: Adopting and Implementing the 2018 Recommended Aquatic Life Water Quality Criteria for Aluminum

On December 21, 2018, the EPA issued the final updated ambient water quality criteria national recommendations to protect aquatic life from the toxic effects of aluminum.[3] The criteria document recommends two primary methods for deriving instantaneous site-specific acute and chronic concentration values for aluminum that would be considered protective of aquatic life, given the conditions of pH, total hardness and dissolved organic carbon (DOC) at the site. For states or authorized tribes that have chosen to adopt the recommended criteria, the EPA recommends two methods to derive the acute and chronic numeric criterion values:

(1) Calculate the criteria values for each waterbody or waterbody segment that has aquatic life as a designated use by entering the pH, total hardness and DOC values into the EPA's Aluminum Criteria Calculator V2.0;[4] or,
(2) Use the lookup tables provided in the criteria document to find the values associated with the specific conditions of pH, total hardness and DOC.

The calculator was derived using a multiple linear regression (MLR) technique to model the interactive effects of three parameters on the bioavailability and toxicity of aluminum to aquatic life,[5] and the lookup tables were created using results from the calculator. Throughout this document, we use the term *input parameters* to refer to site-specific concurrently measured values of pH, total hardness and DOC that a state or authorized tribe may use to derive numeric values of the criteria magnitude (*outputs*) that represent local conditions, using the aluminum criteria calculator or the lookup tables.

Regardless of the method used to derive site-specific criteria values, the state or authorized tribe will need input parameters for pH, total hardness and dissolved organic carbon at each site of interest.[6] These parameters affect the bioavailability of aluminum and its toxicity to aquatic life; however, the interactive effect of these three parameters—pH, total hardness and dissolved organic carbon (DOC)—is not linear.[7]

- For example, if the concentrations of total hardness and DOC are held constant, aluminum is most bioavailable (and therefore, most toxic) at values of high and low pH; and aluminum is least bioavailable near values of neutral pH (again, when total hardness and DOC are held constant).

[3] In accordance with the provisions of Section 304(a) of the Clean Water Act, the EPA periodically revises ambient water-quality criteria to reflect the latest scientific knowledge. For information related to EPA's December 2018 recommended aquatic life criteria for aluminum in freshwater, see: https://www.epa.gov/wqc/2018-final-aquatic-life-criteria-aluminum.
[4] For a link to the criteria document (with lookup tables in Appendix K) and the aluminum criteria calculator (v2.0), see https://www.epa.gov/wqc/aquatic-life-criteria-aluminum#2018.
[5] Two models, one for invertebrates and one for vertebrates, were used to normalize freshwater aluminum toxicity values. These separate models correspond to effects on invertebrates and vertebrates due to differing effects of pH, total hardness and DOC on aluminum bioavailability and toxicity, and therefore enable instantaneous criteria magnitude values to be calculated as a function of the unique chemistry conditions at a given site, at the time at which pH, total hardness and DOC were measured.
[6] Methods using local data are preferred over other methods of deriving site-specific criteria; however, estimated values for DOC may be used in the absence of local data, as described in Question 2.
[7] For more information about the relationships between the pH, total hardness, DOC, and the bioavailability of aluminum to aquatic life, please see the 2018 aluminum criterion document at: https://www.epa.gov/sites/production/files/2018-12/documents/aluminum-final-national-recommended-awqc.pdf.

- Likewise, as the concentration of DOC increases (and pH and total hardness are held constant), aluminum becomes less toxic because the aluminum binds to the DOC, making the metal less bioavailable.

Although pH and DOC are the main factors driving aluminum bioavailability and toxicity, total hardness also has an effect. By knowing the pH, total hardness and DOC in a waterbody, one may derive the numeric criterion values for aluminum, for the acute exposure (i.e., the criterion maximum concentration, CMC) and the chronic exposure (i.e., the criterion continuous concentration, CCC), that will be protective of aquatic life.

1. What flexibility does a state or authorized tribe have when adopting the EPA's recommended aluminum criteria into its water quality standards, and what are the advantages and potential challenges of each approach?

A state or authorized tribe may adopt an EPA-recommended method to establish numeric aluminum criteria protective of aquatic life or may modify the Agency's recommendations to propose an alternative method that reflects site-specific conditions that are not already incorporated into the MLR models which underpin the aluminum criteria calculator that the EPA developed. The EPA regulations also allow States and authorized tribes to adopt scientifically defensible criteria that differ from the EPA's recommendations, if the criteria are protective of designated uses (in the case of these recommended criteria, the designated use is aquatic life).[8] The EPA's Section 304(a) aluminum aquatic life criteria are recommendations, and not requirements. States and authorized tribes should consider the advantages and potential challenges of each approach, as well as other approaches that may not be described in this document.

The EPA's national 304(a) recommended aluminum criteria to protect aquatic life in freshwater ecosystems will vary from site to site based on the values of water chemistry parameters at the site. The derivation of site-specific criteria values relies on the adoption of both the criteria and implementation of a site-specific criterion derivation *methodology* rather than a specific *outcome* (i.e., a constant concentration or criteria magnitude value for a pollutant). Using a performance-based approach, the state or authorized tribe would adopt the water-chemistry dependent criteria and a derivation methodology (both of which EPA must first approve). With sufficient data inputs for pH, total hardness and DOC, the site-specific criteria magnitude values generated by following the methodology are predictable and repeatable. Therefore, once a performance-based approach is approved under CWA Section 303(c), the state or authorized tribe may derive and implement site-specific criteria values without additional Agency review. See question 3 below for information on adoption of implementation methods to support these criteria. States or authorized tribes may consider adopting any of the approaches below as a methodology. More information on performance-based approaches to water quality standards—including the elements the EPA expects to see in any submission of such an approach—may be found in *EPA Review and Approval of State and Tribal Water Quality Standards* (65 FR 24641, April 27, 2000).[9]

[8] In establishing numerical criteria to protect designated uses, states and authorized tribes should base those values on: 304(a) guidance; 304(a) guidance modified to reflect site-specific conditions; or other scientifically defensible methods. (40 CFR 131.11(b)(1)). Additionally, if a waterbody has multiple designated uses with different criteria for the same pollutant, states and authorized tribes should protect the most sensitive use, in accordance with 40 CFR 131.11(a).

[9] For more information, see 40 CFR 131.21(c) State and Tribal Water Quality Standards, "Alaska Rule" (proposed June 1999 and effective May 30, 2000) and EPA Review and Approval of State and Tribal Water Quality Standards, 65 Fed. Reg. 24641 (April 27, 2000) (codified at 45 C.F.R. 131.21(c)).

If a state or authorized tribe chooses to adopt the recommended aluminum criteria into its water quality standards, the EPA recommends choosing one, or a combination,[10] of the following approaches (see Table 1):

(1) adopting by reference to the applicable sections of the 304(a) criteria document (e.g., Section 4.1, Appendix K);
(2) adopting by reference to the Aluminum Criteria Calculator [V2.0] (note: Future versions of the calculator may require the state or authorized tribe to update their standards to incorporate the revised calculator by reference.);
(3) adopting the criteria value lookup tables[11]; or,
(4) adopting relevant ecoregional criteria default values.

[10] For example, approaches (2) and (3) can be adopted together (the calculator can be used to derive numeric criteria values (*outputs*) when input parameters (i.e., pH, total hardness or DOC measures or estimates) are not displayed in the lookup tables). Also, ecoregional criteria default values may be adopted in addition to any of the first three listed approaches. When adopting a combination of approaches, the state or authorized tribe should specify the conditions under which each method should be applied.

[11] If the state or authorized tribe chooses to adopt lookup tables into their water quality standards, they should include information on interpolating or rounding data when input parameter values for pH, total hardness, or DOC fall between values listed in the lookup tables.

Table 1: Comparison of approaches to adopting the recommended aluminum criteria

Approach to adopting the recommended criteria	Advantages	Potential Challenges
(1) adopting the applicable sections of the 304(a) criteria document (which includes the criteria value calculator and criteria value lookup tables).	This approach may provide the greatest amount of background information and context for the criteria and may also provide the greatest flexibility to states and authorized tribes because it allows multiple ways to calculate criteria values.	This approach may be difficult to implement due to individual states' or authorized tribes' legal and administrative requirements (e.g., whether a state's or tribe's regulations allow them to use incorporation by reference).
(2) adopting the aluminum criteria calculator [V2.0] (or similar method to calculate outputs based on the underlying MLR model equations).	This is likely the most adaptable and concise approach. Future updates to the criteria value calculator would likely be accompanied by guidance.	The calculator may be viewed as a "black box," compared to the lookup tables that might be more familiar to some users. Future versions of the calculator may require the state or authorized tribe to update their standards to incorporate the revised calculator by reference.
(3) adopting the criteria value lookup tables.	This may be more transparent than adopting only the criteria value calculator because the lookup tables do not require access to a computer. The tables are included in Appendix K of the publicly-available criteria document and may be helpful when communicating to the public about the criteria implemented at a given site.	The state or authorized tribe may need to develop a standard procedure to determine which values for pH, total hardness, or DOC to use if measured values are *between* the range of input parameter values provided in the lookup table. For example, a state or authorized tribe may decide to always use the nearest value in the table for each input parameter or may decide to use the value which would yield the most protective criteria.
(4) adopting relevant ecoregional[12] criteria default values.	This would allow states and authorized tribes to apply consistent criteria throughout an ecoregion. This approach does not require a state to identify site-specific input parameters because the criteria values are the same for all sites within the ecoregion, calculated based on representative water quality parameters. Defaults may also help to increase transparency of criteria for the public if they are adequately explained. This approach may be used in combination with the criteria calculator or lookup tables, for example as backup criteria for waterbodies with insufficient input parameters.	This approach may be too general for areas with complex geology. That is, the approach, used without the calculator or lookup tables, does not allow for the use of site-specific ambient data (input parameters for a specific site of interest) even though there may be site-specific exceptions within a region.

[12] For more information on how ecoregions are defined, see https://www.epa.gov/eco-research/ecoregions

After adopting the recommended aluminum criteria methodology, and obtaining EPA's approval, the state or authorized tribe may derive site-specific criteria values (i.e., criteria magnitude values) for acute and chronic criteria that correspond to a given ecoregion or set of site-specific conditions for pH, total hardness and DOC. The EPA recommends that states and authorized tribes derive criteria values that will protect aquatic life over the full range of conditions throughout the year (i.e., accounting for the variability of pH, total hardness and DOC). Question 3 provides more information about how to derive final criteria values that will protect aquatic life throughout the range of seasonal and flow conditions at a site, including those conditions when aluminum is most toxic.

To promote transparent and repeatable outcomes, the EPA recommends that states and authorized tribes consider making the input parameters, along with the calculations and the resulting values for aluminum criteria, publicly available on-line. A map showing the extent of the site to which the criteria values apply would also be helpful, if available, to communicate those criteria values to the public. States and authorized tribes may also include detailed methods in an appendix to their water quality standards or in a Continuing Planning Process document, as required by 40 CFR 130.5(b)(6). This provision requires that states include a process for establishing and assuring implementation for new or revised water quality standards.

2. How often and over what time period should a state or authorized tribe collect input parameter data? What if DOC data are insufficient?

The EPA recommends that states and authorized tribes concurrently collect water chemistry data for pH, total hardness and DOC throughout the year to ensure that the collected data are representative of the temporal and spatial variability for each waterbody or waterbody segment. Conditions of pH, total hardness and DOC may vary within a waterbody throughout the year, thereby affecting the bioavailability of aluminum over time.[13] To ensure the criteria will be protective during the times when aluminum is most bioavailable (and most toxic), the EPA recommends that the state or authorized tribe collect, if possible, *24 months of monthly sampling data* for the three input parameters. This approach will help to account for both intra- and inter-annual variability of the input parameters. The EPA recognizes that not all states and authorized tribes will collect this amount of data prior to calculating site-specific aluminum criteria values. Data may be collected for greater than or less than 24 months, and at a frequency greater than or less than monthly. However, higher quality and more consistently collected data will provide more information to establish scientifically defensible criteria that are protective of the designated use. If data collected is insufficient to establish local DOC values, the EPA recommends that default DOC values may be used with concurrently collected data for pH and total hardness. Lastly, ecoregional default values may be used in the absence of local data.

A state or authorized tribe may use the collected or default parameter values as inputs to the aluminum criteria calculator or when using lookup tables to determine the recommended aluminum concentrations for acute and chronic criteria values which correspond to each set of input parameters. That is, if monthly data are provided as inputs to the calculator or lookup tables, then corresponding instantaneous criteria values will be generated for each month data was provided. Then, for permitting or assessment purposes, the state or authorized tribe can analyze the range of monthly instantaneous criteria values to identify criteria values that will be protective under conditions when aluminum is most bioavailable and most toxic to aquatic life. A state or authorized tribe

[13] For example, as DOC increases and pH is constant, aluminum is less bioavailable because it binds to the DOC instead of being bioavailable for uptake into aquatic organisms. Similarly, as total hardness increases and pH is constant, aluminum is less bioavailable because other ions in solution compete with the aluminum ions for uptake into aquatic organisms. That is, as concentrations of calcium and magnesium (i.e., the components of hardness) increase, the relative bioavailability of aluminum decreases.

may find that, depending on the amount and quality of the data, different time periods and conditions throughout the year are best protected by different criteria values. That is, the state or authorized tribe may choose a single set of acute and chronic criteria values which are protective throughout the year or may decide to apply two or more different sets of acute and chronic criteria values appropriate to the different time periods and conditions for permitting and assessment purposes (e.g., seasonal criteria).

Among the input parameters to the aluminum criteria calculator (or lookup tables), DOC data are least likely to be available. That is, states and authorized tribes may collect data for pH and total hardness more routinely than they collect data for DOC. For waterbodies that lack sufficient DOC data, but for which pH and total hardness data are available, the EPA recommends states and authorized tribes use suitable estimates of DOC concentrations, in combination with concurrently measured data for pH and total hardness. The estimated DOC and the measured pH and total hardness values can then be used together to calculate corresponding site-specific criteria values. Because aluminum is most bioavailable and most toxic at low levels of DOC, the EPA recommends using conservative estimates for DOC concentrations which will yield corresponding criteria values that are more likely to ensure protection of aquatic life from the toxic effects of aluminum. States and authorized tribes may also adopt relevant ecoregional criteria default values, as explained in Question 1, or may use other scientifically defensible approaches, including those similar to the approach used to develop the EPA's 2016 draft missing parameters document[14] to estimate input parameter values or to generate default criteria values.

3. What methods can be used to reconcile model outputs and derive criteria values that will result in protection of aquatic life at a site?

The EPA recommends that the final criteria values for each site be derived in a way that will protect aquatic life throughout the range of seasonal and flow conditions at a site, including those conditions of pH, total hardness and DOC, when aluminum is most bioavailable and toxic. There are three methods that the EPA recommends using to derive criteria values that will protect aquatic life throughout the range of seasonal and flow conditions at a given site. Method 1 needs the greatest amount of input parameter data and Method 3 needs the least.

Method 1: Identify protective criteria values by selecting one or more individual model outputs based upon spatially and temporally representative site-specific measured values for model inputs. Method 1 can be used where input datasets are complete and inputs are measured frequently enough to statistically represent changes in the toxicity of aluminum, including conditions under which aluminum is most toxic. In this case, the criteria values are determined by selecting one or more individual outputs that will be protective of aquatic life under the full range of ambient conditions, including conditions of high aluminum toxicity. Method 1 could be used to also establish criteria values to apply on a seasonal basis where the data are sufficient.

Method 2: Calculate protective criteria values from the lowest 10th percentile of the distribution of individual model outputs, based upon spatially and temporally representative site-specific measured model input values. While the 10th percentile of outputs should be protective in a majority of cases, certain circumstances may warrant use of a more stringent model output (e.g. consideration of listed species). Sufficient data to characterize the appropriate distribution of model outputs are necessary to derive a protective percentile so that the site is protected under conditions of high aluminum toxicity.

[14] *Draft Technical Support Document: Recommended Estimates for Missing Water Quality Parameters for Application in EPA's Biotic Ligand Model*, EPA-820-R-15-106, March 2016 (https://www.epa.gov/sites/production/files/2016-02/documents/draft-tsd-recommended-blm-parameters.pdf)

Method 3: Select the lowest model outputs (the lowest CMC and the lowest CCC) calculated from spatially and temporally representative input datasets that capture the most toxic conditions at a site as the criteria values. EPA recommends Method 3 be used where ten or fewer individual model outputs are available.

Either Method 2 or 3 is particularly useful when values of acute and chronic criteria need to be protective of the more toxic of site conditions to be implemented, such as for National Pollutant Discharge Elimination System (NPDES) permitting (as discussed under Question 4). In order to maximize transparency, defensibility, and regulatory certainty, states and authorized tribes should consider developing written implementation methods and make these documents available to the public. To the same end, the EPA recommends states or authorized tribes make publicly available the following on the state's or authorized tribe's website:

- Site-specific water chemistry data, including the inputs used in the aluminum criteria value calculations and resultant criteria values, and
- The geographic extent of each site.

As mentioned in Question 1, a state or authorized tribe may choose to adopt ecoregional default criteria for all or some of the waterbodies within the state or tribal jurisdiction. Where a state or authorized tribe chooses to adopt ecoregional default criteria values, the state or authorized tribe does not need a method for reconciling criteria calculator outputs (because the ecoregional default criteria values are constants that are independent of the criteria calculator).

4. How can a state or authorized tribe implement the aluminum criteria in its Clean Water Act programs?

For NPDES permitting, waterbody assessments and development of total maximum daily loads (TMDLs), states and authorized tribes can use different methods to derive site-specific criteria values (as discussed in the answer to Question 3 above). States and authorized tribes should ensure that the methods used are transparent and predictable, and that they produce repeatable outcomes.

Making information available to the public, the regulated community and other stakeholders is important to ensuring regulatory certainty and clarity, particularly when a state or authorized tribe adopts a performance-based approach. For example,

- states or authorized tribes may wish to describe how they derived the criteria values, including the data and data source used;
- the permitting authority may wish to describe in the permit factsheet or statement of basis how it used the numeric criteria values to determine reasonable potential and derive water quality-based effluent limits (WQBELs), if needed;
- states and authorized tribes may wish to describe in TMDL documents how they derived the criteria values and used them to determine TMDL targets; or,
- states and authorized tribes may wish to describe how they derived site-specific values for the aluminum criteria in assessment methodologies and integrated reports for each assessed waterbody.

Pursuant to 40 CFR 131.10(b), states and authorized tribes must take into consideration water quality standards of downstream waters when designating uses and adopting criteria for instream waters to ensure its water quality standards provide for the attainment and maintenance of the water quality standards for downstream waters. The EPA recommends that states and authorized tribes consider water chemistry conditions

downstream from a point of discharge when deriving aluminum criteria values on a site-specific basis. Because metals are generally persistent and can travel long distances downstream, calculating a criterion value using values for pH, total hardness and DOC from a location at or near a discharge point could result in a criterion value that may not be protective of other areas or downstream waters that have different values of pH, total hardness and DOC. The EPA recommends that states and authorized tribes also account for tributary sources of pH, total hardness or DOC that might affect protectiveness downstream for the aluminum discharged at an upstream point; hence it is recommended that criteria concentration calculations take into account the range of downstream effects of the discharge.

For NPDES permitting purposes, the EPA recommends that states and authorized tribes collect sufficiently representative data for pH, total hardness and DOC to ensure that conditions in the waterbody are being adequately captured downstream from the point of discharge. If a discharge is controlled so that it does not cause water quality standards to be exceeded in the receiving water under critical conditions, then it is reasonable to conclude that water quality standards should be attained under all other conditions. Criteria that will be protective for the more toxic of site conditions should be used to develop WQBELs. Once criteria values protective for the more toxic conditions are calculated, critical low flows—for the purposes of dilution of the pollutant concentration in effluent, combined with effluent concentrations of the pollutant—may be used to establish whether there is reasonable potential for the discharge to cause or contribute to an impairment and therefore a need to establish WQBELs. The *U.S. Environmental Protection Agency's NPDES Permit Writers' Manual*[15] describes the importance of characterizing critical conditions for the effluent and the receiving water. Section 4.5.1 of the *Technical Support Document for Water Quality-based Toxics Control* explains that, where adequate data exist, dynamic modeling techniques may be used in lieu of steady-state modeling using critical conditions.[16] Permit writers may also choose to establish tiered effluent limits. The EPA recommends that, in the context of permit renewals, WQBELs be reevaluated when changes to water chemistry are evident or suspected. Aluminum toxicity in receiving waters could change as the result of a newly permitted discharge or modification of an existing discharge, land-use changes or changes to hydrologic conditions; all of which may affect pH, total hardness and DOC. Additionally, site characterization is important: as the size of a site increases, the spatial and temporal variability are likely to increase. Thus, more water samples may be needed to adequately characterize the entire site.[17]

TMDL and NPDES analysis generally includes considerations for critical conditions. Implementation procedures should clearly define how permit writers will consider critical conditions related to critical low flows and the greatest bioavailability and toxicity of aluminum. This should ensure that reasonable potential is properly assessed and, if needed, appropriate permit limits are established that fully protect aquatic-life beneficial uses under the full range of environmental conditions.

[15] USEPA. 2010. *NPDES Permit Writers' Manual*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA-833-K-10-001. September 2010.

[16] USEPA. 1991. Technical Support Document for Water Quality-based Toxics Control. U.S Environmental Protection Agency, Office of Water, Washington, D.C. EPA/505/2-90-001. March 1991.

[17] For information on site characterization, see: USEPA. 1994. *Interim Guidance on Determination and Use of Water-Effect Ratios for Metals*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA-823-B-94-001. February 1994.