

Name of Toolbox Element— Biologically Available Phosphorus (BAP)

1. Introduction / Overview

U.S. EPA and Washington Department of Ecology (Ecology) developed a Total Maximum Daily Load (TMDL) for nutrients and oxygen demanding materials designed to minimize the anthropogenic affects on dissolved oxygen in Lake Spokane (Ecology, Revised February 2010). The TMDL established wasteload allocations (WLA's) for Washington dischargers, which are illustrated on Table 5 of the TMDL. The WLA's are for Ammonia (NH₃-N), Total Phosphorus (Total P), and Carbonaceous Biological Oxygen Demand (CBOD). These WLA's were established for each discharger based on TMDL CE-QUAL-W2 Model Scenario 1 (PSU, January 29, 2010).

The TMDL also provides for "Delta Elimination" and "Target Pursuit Actions" in recognition that currently available advanced treatment technologies may not be able to meet the WLA's established in the TMDL. One of the Target Pursuit Actions provided for in the TMDL is to demonstrate that a certain stable fraction of the total phosphorus (Total P) discharged in treated effluent is not bioavailable in the river environment for a time sufficient to consider it not bioavailable and not available to produce dissolved oxygen impact on Lake Spokane. If Ecology agrees with the results of the research on this concept, the pounds of phosphorus that are not bioavailable will be recognized as contributing (load reductions) toward achieving the Total P wasteload allocation listed in Table 5 of the TMDL and removed from the calculated contributed load for permit compliance purposes.

Specific language regarding this provision is provided in Section S5 of the final NPDES Permit for Inland Empire Paper Company (Permit Number WA-000082-5, dated September 29, 2011): "The delta elimination plan may also include: A demonstration that a certain stable fraction of the phosphorus discharged from the facility is not bio-available in the River environment and is not a nutrient source. This demonstration must consider findings and recommendations from the University of Washington/WERF bioavailability lab study and the DO TMDL Implementation Advisory Committee. The demonstration may also include results from subsequent monitoring and modeling of bio-available phosphorus. Ecology will recognize the demonstration, that a certain stable fraction of the phosphorus discharged from the facility is not bioavailable in the River environment and is not a nutrient source through a modification to the Spokane River DO TMDL. Ecology will incorporate any revised WQBELs based on the modified DO TMDL by the second permit cycle, or earlier."

The CE-QUAL-W2 model used to develop the approved TMDL, includes assumptions related to the types of phosphorus in wastewater effluent that is biologically available to algae in Lake Spokane. As currently modeled, the assumed phosphorus fractions are made up of two components:

- **Soluble Reactive Phosphorus (SRP)** or Ortho-Phosphorus (Ortho-P) which is immediately available for algal growth
- **Carbonaceous Biochemical Oxygen Demand (CBOD) phosphorus** which is initially unavailable for algal growth, but is assumed to mineralize into SRP at a rate set equal to the CBOD decay rate.

These assumptions were based on existing municipal treatment plant performance and limited pilot testing data from various advanced phosphorus removal wastewater treatment processes.

The NPDES permit holders discharging effluent into the Spokane River partnered with the Washington State Department of Ecology (Ecology) and the Water Environment Research Foundation (WERF) to fund a study that was conducted by the University of Washington to establish the fraction of Total P that is biologically available to algae in Lake Spokane. The initial study was completed in February 2011, and the study results were published by Professor Michael Brett, and Graduate Student Bo Li (hereafter referred to as the Phase 1 BAP Study). Results of the Phase 1 BAP Study and other research indicate that the assumed wastewater effluent phosphorus speciation in the model (SRP vs CBODP) may not accurately reflect the bioavailability of phosphorus in tertiary treated effluent in the Spokane River-Lake Spokane system.

2. Toolbox Concept

After a scientific relationship(s) is determined to establish the fraction of Total P that is biologically available, NPDES permits can be revised to reflect the amount of Total P that can be discharged from a facility while not decreasing dissolved oxygen in Lake Spokane, in accordance with Scenario 1 of the Spokane River CE-QUAL-W2 model.

3. Data Collection, Sampling, and Research Needed

After the Phase 1 BAP study was concluded, a number of questions and comments on the study methods and study results were provided by the Environmental Protection Agency and by the Washington State Department of Ecology. These review comments led the dischargers to convene a BAP Workshop on May 5, 2012. The purpose of the workshop was to discuss the results of the Phase 1 BAP study, to review the questions and comments provided on the Phase 1 BAP study, and to define a scope of work for a Phase 2 BAP study, which would be conducted over a 12-month period ending in June 2013. The goal for the Phase 2 BAP study is to answer the questions and comments

provided by the agencies on the Phase 1 study, and to provide a solid scientific basis for including the BAP fractions in future NPDES permit conditions, and to provide an adequate scientific basis for refinement of the assumptions for BAP fractions in the future Spokane River CE-QUAL-W2 modeling.

A draft scope of work for the Phase 2 BAP study has been submitted to Ecology for review and approval. A copy of the draft scope of work is attached to this draft Toolbox Element for reference.

Since the fraction of Total P that is biologically available will likely vary for every treatment facility, it is anticipated that effluent from each facility will have to be tested for BAP to establish the fraction that is appropriate for use in the CE-QUAL-W2 model and adjustment of the NPDES permits.

4. CE QUAL W2 Modeling Requirements for BAP

To be developed after agreement on items 1 through 3.

5. Permit Provisions

To be developed after modeling is completed.