COBBOSSEE LAKE, Kennebec County, Maine

Total Maximum Daily Load (TMDL)

Effective Date: October 12, 1999

Maine Department of Environmental Protection

State House Station #17, Augusta, Maine 04333

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INTRODUCTION

This cover letter addendum to the 1995 COBBOSSEE Lake TMDL report: *Restoration Through Reduction of Non-point Sources of Phosphorus*, as prepared by Bill Monagle (February 1995) from the Cobbossee Watershed District, is based on past EPA review (20 April 1999 correspondence) and follow-up conference calls on: (1) 17 May 1999 with EPA (Jennie Bridge and Alison Simcox) and ME-DEP (Jeff Dennis, Roy Bouchard, Dave Halliwell); and (2) 1 June 1999 with EPA (Mark Vorhees and Al Basile) relative to requested reviews of the EPA Region I draft *Practical Approach for Lake Phosphorus TMDL Development*. This submittal, for EPA review and approval under section 303(d) of the Clean Water Act (CWA) and EPA's implementing regulations at 40 C.F.R., constitutes the final TMDL for top priority-ranked Cobbossee Lake, with phosphorus as the pollutant of concern.

As agreed upon during past EPA Region I conference calls, the original 1995 final report was not revised per se, with the exception of the preparation of an errata sheet (corrections provided by Bill Monagle) to reconcile slight differences in phosphorus load allocations numbers between the text (page 6) and Table 3 (page 11). We recognize the extended efforts of the Cobbossee Watershed District and the excellence of the original 1995 TMDL report, in terms of technical approach (modeling) and description of phosphorus sources, complete with supplemental implementation plans with tangible targets for phosphorus reduction actions.

We also recognize that this initial TMDL report is based on over twenty years of lake restoration work by the Cobbossee Watershed District and ME-DEP and should be viewed as an ideal and not as a standard by which to judge ensuing TMDL efforts, which may necessarily be based on considerably less information. In this context and to illustrate, the ME-DEP lakes assessment section of the Division of Environmental Assessment, in association with the ME-DEP Division of Watershed Management, perceive the following three possible TMDL development levels:

I Simplified TMDL modeling approach based on total phosphorus loading and response models (e.g., Dillon and Rigler 1975), including general land-use classification (forest, agriculture, urban) estimates and direct application of phosphorus loading coefficients (e.g., Reckhow et al. 1980), as recommended by Basile and Vorhees (1999).

II TMDL development incorporating Level I, in addition to ME-DEP watershed survey information, which may include volunteer derived data, to refine and detail land-use estimates of total phosphorus loading and identify individual NPS sources and BMPs (Dennis et al. 1992).

III TMDL developed by incorporating Levels I and II above, including a generally higher level of detail. This level may also include site (or NPS type-) specific phosphorus loading estimates and follow-up implementation plans for BMPs and adaptive forms of watershed management. Level III TMDLs will typically represent longer term watershed studies (i.e., Cobbossee Lake TMDL, Monagle 1995) and/or management plans, incorporating phosphorus loading data developed over many years.

The Maine Department of Environmental Protection's approach to developing Total Maximum Daily Loads (TMDLs) for select 303(d) listed priority lakes target phosphorus as the major pollutant of concern. This approach follows US-EPA Region I interim final guidance (see Basile and Vorhees, July 1999) and employs features that

mesh with our existing Watershed Management (NPS) and Lake Assessment programs. ME-DEP plans to primarily use the Level I approach, with elements of higher level studies incorporated, depending on availability of information, feasibility, and expected benefits. The following addendum to the original 1995 Cobbossee Lake TMDL report primarily addresses concerns expressed by EPA during their initial review and serves to clarify information required for EPA to "determine the Statutory and Regulatory adequacy of the submitted TMDL."

Description of Waterbody and Drainage Basin Overview

Cobbossee Lake (MIDAS #5236) is a very large (5,238 surface acres and 32.2 square mile watershed) and complex waterbody which drains (in part) seven towns (Monmouth, Wales, Manchester, Winthrop, Readfield, West Gardiner, and Litchfield) in south-central Maine (DeLorme Atlas map page 12). It is a fairly deep lake with a maximum depth of 100 feet and a mean depth of 37 feet and is relatively non-colored (18 SPUs). Cobbossee Lake has a hydraulic retention time of 1.07 (flushes annually), and the direct drainage area is 32.34 square miles.

There are **two major inflows** to Cobbossee Lake, draining into the southern and south-western portions of the lake. The first is ***Jock Stream***, which drains a large agriculturally dominated watershed to the south of the lake. The second major inflow drains via ***Jug Stream***, at the southwest, and captures a large watershed inhabited primarily by the town of Winthrop and major water bodies including: ***Annabessacook Lake*** (and the Cochnewagon Lake and the Wilson-Dexter-Berry ponds complex); Maranacook Lake (and Torsey Lake) to the north; and the Upper-Lower Narrows and Carlton ponds complex to the northeast. To the north of Cobbossee Lake is a relatively smaller drainage, including Little Cobbossee Lake and Shed Pond.

The **outflow** of Cobbossee Lake is Cobbossee Stream, located in the northeastern portion of the lake. Cobbossee Stream drains the Hutchinson- Jimmie ponds complex from the north and the Woodbury-Sand-Baker-Jimmy pond complex

from the south (Tacoma lakes system), before turning to the east (Horseshoe Pond) and flowing into Pleasant Pond and then proceeding northeast and draining into the Kennebec River in the town of Gardiner. There is a state-owned boat launch site located on the southwest shore of Cobbossee Lake in East Monmouth, which provides access for the general public.

Description of Applicable Water Quality Standards

ME-DEP's *functional definition* of nuisance algae blooms include episodic occurrence of Secchi disk transparencies (SDTs) < 2 meters for lakes with low levels of apparent color (< 30 SPU) and for higher color lakes where low SDT readings are accompanied by elevated chlorophyll-a levels.

According to current (July 1994) Maine Revised Statutes (Title 38, Article 4-A) for Maine Department of Environmental Protection Standards for Classification of Lakes and Ponds, Class GPA (Great Ponds Class A) "shall have a stable or decreasing trophic state," based on appropriate measures (e.g., total phosphorus content), "subject only to natural fluctuations and shall be free of culturally induced algae blooms which impair their use and enjoyment." Furthermore, "no change of land use in the watershed of a Class GPA water body may, by itself or in combination with other activities, cause water quality degradation that would impair the characteristics and designated uses of downstream GPA waters or cause an increase in their trophic state."

Again, from a functional perspective, we view *clearly negative trends* in seasonal SDT means or minima as an indication of increasing trophic state condition. This interpretation uses historic documented conditions as the primary basis for comparison. Given this context of "impaired use and enjoyment," along with a realistic interpretation of Maine's goal-oriented Water Quality Standards, we have determined that episodic, non-cyanophyte based algae blooms, limited to the fall or spring periods only, will not be considered as non-attainment for GPA waters.

Statutory and Regulatory Requirements of TMDLs

1. Loading Capacity

A. Based on a summary of statewide Maine lakes water quality data for clear (non-colored or <26 SPU) lakes, the (interim) target of 15 µg/l (5,904 kg P/yr in Cobbossee Lake) is deemed sufficient to meet Maine DEP water quality goals of *no sustained and repeated blue-green summer-time algae blooms* due to NPS pollution or cultural eutrophication. In fact, this represents a fairly conservative goal, as a range of 15-17 µg/l (5,904-6,691 kg P/yr in Cobbossee Lake) may not necessarily result in the planktonic growth of algae which causes Secchi disk transparency to be less than 2.0 meters, based on limnological data for most Maine lakes. According to Monagle (1995), Cobbossee Lake first experienced a summer-long bloom in 1992, when phosphorus concentrations were 17.5 µg/l (6,888 kg P/yr). [*see also Margin of Safety provisions*]

B. Expressing a phosphorus TMDL in terms of maximum allowable *annual* loading, rather than total maximum *daily* load, is deemed appropriate for Cobbossee Lake for several reasons, including: (1) cultural eutrophication in lakes in general is a function of loadings that occur over longer time periods and nutrient loadings that occur throughout the year must be accounted for to ensure protection of lake water quality; and (2) nutrients that enter a lake in the fall or winter may still be available for algae growth the following summer, variable both with lake flushing rates, on the order of a year or more, and lake bottom sedimentation loading and release rates (Rippey et al. 1997).

2. **Wasteload Allocations (WLAs) --** This TMDL addresses only non-point and background sources of pollution, as point sources of pollution are not found in Cobbossee Lake. Hence, WLAs are set equal to zero and it is assumed that only phosphorus loadings from non-point sources will be reduced (see *Implementation Plan and Reasonable Assurances*).

3. **Load Allocations (LAs) –** See description of Pollutant Sources on Page 6 (EPA Review) and item 6 in original TMDL document (Monagle 1995).

4. **Margin of Safety (MOS) --** Implicit assumptions which contribute to the provision of an adequate margin of safety include the following:

   a. Use of the Vollenwieder (1969) empirical model, as modified by Dillon 1974 and Dillon and Rigler (1974a, 1974b, 1975), and Kirchner and Dillon (1975), taking into account regionally applicable phosphorus retention coefficients (Larsen and Mercier 1976).

   b. Inherent variability in estimating levels of biologically-available total phosphorus. For example – point vs. non-point pollution models and character of substrates – erosional material vs. parking lots, barnyards, lawns, or golf courses.

   c. According to Monagle (1995, pp. 13 and 16), “a conscientous effort to be conservative was made when assigning treatment effectiveness to each BMP,” and “for structural BMPs requiring intensive maintenance, the treatment factor was selected from the low range of those reported.”

   d. At 15 ppb phosphorus concentrations in Cobbossee Lake, there is low probability that Maine water quality standards will be further violated, and in combination with an alum treatment in Annabessacook Lake, water quality in Cobbossee Lake would be greatly improved (perhaps in the range of 12-13 ppb total phosphorus).

5. Seasonal Variation—Cobbossee Lake (5,238 surface acres, 32.2 square mile watershed) has an average depth of 11-meters and a hydraulic retention time of 1.07 flushes/year. ME-DEP lakes assessment biologists use 5 or more flushes/year as a “rule-of-thumb” cutoff for including seasonal variation as a major concern in evaluating lake phosphorus loads. Hence, there is little need to consider seasonal variation in phosphorus loadings to Cobbossee Lake.

6. Description of Pollutant Sources

a. Atmospheric deposition was accounted for in both Appendices A (Sub-watershed P-loadings) and B (Town P-loadings) as 236.17 kg P (0.11 kg P/ha/yr x 2,147 ha).

b. *Estimates of phosphorus loadings originating from septic systems* (groundwater***)*** is accounted for in the low and high density residential data columns in Tables 1-3, pages 7,9, and 11 of the original 1995 TMDL report.

c. Internal recycling of phosphorus may be an issue for Cobbossee Lake and should be considered in establishing a Margin of Safety in order to account for the uncertainty of how identified pollutant loadings impact Cobbossee Lake water quality. According to Bill Monagle (personal communication), the relative contribution due to internal recycling of phosphorus in Cobbossee Lake was intrinsically addressed through use of the empirically derived Dillon and Rigler model. Bill Monagle concluded (page 28 in the original 1995 TMDL report) that "re-addressing the internal recycling component of the annual phosphorus load (via alum treatment) to Annabessacook Lake will greatly enhance efforts to reduce other non-point sources." (also see *Margin of Safety* provisions)

Phosphorus loading reductions, as part of a TMDL, need address internal recycling only if implementation plans are being considered which incorporate in-lake manipulations to control internal phosphorus sources. For example, reduction of total phosphorus load (internal or external) should satisfy model predicted lake responses. ME-DEP recommends that export coefficients for lake internal recycling of phosphorus be removed from the general EPA model (Basile and Vorhees 1999) and be treated separately (see Nurnberg 1984 and 1988). Simple estimation of the lake area contributing to internal recycling based on anoxic areas (D.O. < 1.5 mg/L during one or more seasons) is highly variable in nature, and not generally applicable to Maine lakes. Not all lakes in Maine characterized by seasonally anoxic water quality conditions have elevated levels of internal

phosphorus recycling. This subject of variability in internal recycling of phosphorus in lakes requires additional qualifying information (Riley and Prepas 1985, Rippey et al. 1997), which is currently being collected and analyzed through ongoing studies with the University of Maine, Orono.

7. **Monitoring Plan for TMDL Development and Tracking** - According to Bill Monagle and the Cobbossee Watershed District (25 August 1999 letter), they have monitored the water quality of Cobbossee Lake during the open water months since 1980, and anticipate continuing this monitoring program indefinitely. Parameters measured on a bi-weekly basis include: Secchi disk transparency, dissolved oxygen, temperature, total phosphorus, chlorophyll-a, total alkalinity, and pH. Under the present monitoring scenario, sufficient data would be acquired to adequately track inter-annual variation and long term trends in water quality.

8. **Implementation Plan and Reasonable Assurances** - Cobbossee Watershed District's track record in implementing NPS controls include the following (arranged chronologically):

   1977 -- CWD implemented restoration programs on culturally eutrophic Annabessacook Lake, Cobbossee Lake, and Pleasant Pond (Clean Lakes Program EPA Grant #s001139101, see US-EPA 1980).

   1980 – CWD initiated a comprehensive lake protection program on Cobbossee Lake, including extensive agricultural controls and water quality monitoring (EPA Clean Lakes Program grant). Thirteen manure storage facilities were constructed at a total cost of $350,000. The project was amended in 1986 to include a nutrient inactivation project (Alum treatment) on Cochnewagon Lake. As of 1991, nearly 100 percent of animal waste in the Cobbossee Lake watershed was included in agricultural waste management programs.

   1995 – CWD was awarded a Section 319 grant (MDEP NPS #95-10) to address NPS pollution in the Cobbossee Lake watershed. Components of the grant included camp road demonstration projects, a shoreline buffer strip demonstration (100 ft. by 50 ft.), watershed ecology workshops to local high

schools, and several workshops aimed at educating local officials about NPS issues.

1999 -- the CWD is conducting Section 319 NPS projects to (1) demonstrate proper camp road design and maintenance in the Tacoma lakes watersheds, and (2) study the effects of BMPs on agricultural practices in the Jock Stream watershed.

Alum treatment in Cobbossee Lake is not a feasible solution, as the lake is much too large and complex. Another significant issue, not directly accounted for, is the phosphorus load attributable from Annabessacook Lake via Jug Stream. While alum treatment in Annabessacook Lake would be feasible, it may not be considered cost-effective (in the range of ½ million dollars) at this time.

9. **Public Participation** – CWD endeavored to seek public comment on the TMDL process and project results by sponsoring the first Cobbossee Lake Conference (June 1994) at the Maine YMCA Camp on Cobbossee Lake, attended by nearly 100 individuals. This conference served to solicit citizen involvement in decision making for protection and improvement of Cobbossee Lake water quality. In general, the public ranked improved water quality as a priority and agreed with the TMDL phosphorus goals (interim goal of 15 μg/l with an ideal of 12 μg/l). This conference also spawned the initiation of a Cobbossee Lake Citizens Water Quality Committee, formed in the summer of 1994, and which continues to be very active in local issues and voluntary efforts regarding the protection of Cobbossee Lake water quality. Subsequent to this conference, and as part of the Cobbossee Lake 319 grant (ME-DEP NPS #95-10), the Cobbossee Lake TMDL was used as an information tool in a series of workshops with municipal officials (town planning board members and code enforcement officers) from member communities within the Cobbossee Lake watershed. Finally, throughout the TMDL developmental process, the public was continuously involved through the municipally appointed members of the Cobbossee Watershed District Board of Trustees.

10. Additional Comments: Some of the phosphorus load allocation numbers in the original text differed slightly from the numbers in the table (see attached Table 3 with correct numbers). According to Bill Monagle, Table 3 was amended during Cobbossee Watershed research projects which provided more robust information relative to hayland export coefficients.

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