

TMDL Decision Document

TMDL: Northeast Regional Mercury TMDL

Status: Final

Date of U.S. EPA Decision: December 20, 2007

Impairment/Pollutant: Mercury

Background: The seven northeast states (CT, ME, MA, NH, NY, RI and VT) issued a draft TMDL on April 11, 2007. A public comment period was held from April 11, 2007 to June 8, 2007. The states submitted the final TMDL to EPA with a letter dated October 24, 2007. Because the states span two different EPA regions, EPA Region 1 is making the approval decision on the portion of the TMDL that applies to waters in the six New England states (CT, ME, MA, NH, RI and VT) and EPA Region 2 is making the approval decision on the portion that applies to waters in New York State.

TMDL REVIEW ELEMENTS

1. Description of Waterbody, Pollutant of Concern, Pollutant Sources and Priority Ranking

Identification of Waters

The TMDL is for inland waters within the seven states (CT, ME, MA, NH, NY, RI and VT) impaired by mercury primarily from atmospheric deposition. Waters included in the TMDL are listed or described for each state in Appendix A of the TMDL. Connecticut, Maine, and New Hampshire all have statewide fish consumption advisories, and use this as a basis for listing all freshwaters on their respective Section 303(d) lists as impaired due to mercury. All freshwaters in these three states are therefore included in the TMDL, except for certain waters known to have significant mercury contributions from local sources identified in Appendix A. Massachusetts, Rhode Island and Vermont also have statewide advisories, but only list waters on their Section 303(d) lists that have been assessed and found to be impaired. New York does not have a statewide advisory, but has identified a large number of waters as impaired for fish consumption due to atmospheric deposition of mercury. The names and ID numbers for each water in Massachusetts, Rhode Island, Vermont and New York included in the TMDL are listed in Appendix A. Table 5-1 in the TMDL report indicates the number of waters and river miles included in the TMDL for each state.

Pollutant of Concern

The pollutant of concern is mercury. Mercury is a multimedia global pollutant. Mercury is

emitted to the air, transported and then deposited to the soil and beds of rivers, lakes and streams, where a number of biological and chemical processes occur in the soils, waterbodies, and sediments that cause mercury to react with organic materials to form methylmercury, a highly toxic form of mercury. Methylmercury builds up, or bioaccumulates, in the bodies of animals, so fish at the top of the aquatic food chain are likely to contain higher mercury concentrations than fish lower on the food chain. Humans and wildlife are exposed to unsafe levels of methylmercury by eating contaminated fish.

Pollutant Sources

Sources considered by the states in the development of this TMDL include atmospheric mercury deposition, municipal wastewater treatment plants, non-municipal wastewater discharges, and stormwater. The states identified 97.9% of the total mercury load as coming from atmospheric deposition. Both natural and anthropogenic sources contribute to the atmospheric deposition mercury load. The TMDL document identifies natural sources as contributing 25% to the atmospheric deposition mercury load, while the remaining 75% is from worldwide anthropogenic sources.

Specific point sources identified by the states as contributing to the mercury load to waters covered by the TMDL are listed in Appendix C of the TMDL report. These sources include publicly owned treatment works (POTWs), and discharges from industries such as pulp and paper mills, chlor-alkali plants, and manufacturers of lighting equipment, chemicals, and metals.

For the purpose of describing the sources of pollutant loads and estimating the 1998 (baseline) total source load, the states considered the mercury loading from stormwater to be included in the estimate of loading from atmospheric deposition. This is because the vast majority (if not all) of the mercury in stormwater originates from atmospheric deposition. More information on how stormwater is addressed in the TMDL document is provided in the Wasteload Allocation section below (Section 5).

Priority Ranking

Priority ranking is addressed on page 12 of the TMDL document. While the priority given to mercury-impaired segments on Section 303(d) lists varies among the seven states, all states have demonstrated that restoring mercury-impaired waters is a high priority through their regionally coordinated actions to reduce mercury sources to the environment over the last decade. The states consider the mercury TMDL a continuation of this priority work.

Key Assumptions Made in TMDL Development

The northeast mercury TMDL takes a regional approach to mercury-impaired waters. Some key assumptions in the approach help to provide the basis for a TMDL encompassing a large number of mercury-impaired waterbodies in seven states. To support the regional scope of the TMDL, a statistical analysis (analysis of covariance) was conducted to examine the variation in fish mercury concentrations across the states. Such an analysis was conducted to show that the fish tissue concentration is not biased toward one state, and ultimately, that a regional approach is appropriate. In comments on the draft TMDL, EPA commented that the states should include

more information in the TMDL document to demonstrate that the regional approach is appropriate. EPA and several commenters also suggested that the states consider whether there may be areas that differ significantly from the rest of the region in terms of fish tissue concentrations, local sources, or other factors, and if so, to consider separating the single regional TMDL into sub-regions or separate TMDLs. Table 4-1 was subsequently added to the final TMDL. This table shows key results of the analysis and illustrates that fish tissue mercury concentrations did not vary significantly by state when length is accounted for.

The states also assumed that the mercury levels in fish would be reduced in proportion to the reductions in mercury deposition, based on the following supporting assumptions described in Section 5.5 of the TMDL document:

- a. A reduction in emissions results in a proportional reduction in the rate of deposition.
- b. A reduction in deposition results in a proportional reduction in mercury loading to waterbodies.
- c. Within a given waterbody, a reduction in mercury loading in the water results in a proportional reduction in mercury concentrations in fish tissue.

These assumptions are consistent with the assumptions of several steady state ecosystem scale models used in the U.S. EPA Mercury Maps report (U.S. EPA, 2001a), including the Mercury Cycling Model and the IEM-2M Watershed Model. When atmospheric deposition is the main source of mercury to a given waterbody, at steady state (i.e., over long timeframes) these models predict a linear response between changes in deposition, ambient concentrations in water and sediments, and fish mercury levels. Using the relationships presented in these models and the Mercury Maps report, the northeast states derived a relationship between a baseline deposition value, a target fish tissue concentration, and a baseline fish tissue concentration (see equations on p. 17 of the TMDL document). The methodology used by the northeast states to establish the TMDL, i.e., using a fish tissue mercury concentration reduction factor to establish the loading capacity, relies on the principle of proportionality used in these equations and the U.S. EPA models.

Assessment: EPA concludes that the TMDL document adequately describes the waterbodies, pollutant of concern, pollutant sources, and priority ranking. EPA finds that the states' use of proportionality is consistent with assumptions contained in EPA mercury studies, and the states' use of this assumption in the establishment of the TMDL is reasonable given the current absence of more precise modeling (at a large spatial scale) of the link between mercury emissions and fish tissue concentrations. Finally, EPA believes that the analysis showing that fish mercury concentrations are comparable across the region supports the states' conclusion that the regional approach is appropriate. In addition, because the TMDL focuses only on those waters where atmospheric deposition is the predominant source and excludes waters that are known to have significant contributions from local sources, and because the northeast states have efforts underway to address mercury on a region-wide basis, EPA finds that using a regional approach for developing the TMDL in this case is reasonable.

2. Description of the Applicable Water Quality Standards and Numeric Water Quality Targets

Numeric and Narrative Mercury Standards

Section 3 of the TMDL Report describes the applicable water quality standards for the seven states. The water quality standards for Maine and Massachusetts include a methylmercury fish tissue criterion of 0.2 and 0.3 ppm, respectively, for human health protection. The remaining states (Connecticut, New Hampshire, New York, Rhode Island and Vermont) have human health water column criteria for total mercury that consider exposure to mercury through consumption of water and organisms as well as consumption of organisms only (the latter criteria are included in Table 3-1 of TMDL Report). Each state also has water column mercury criteria for the protection of aquatic biota (and New York also has a water column criterion for the protection of wildlife), but human health concerns generally result in more stringent controls.

In addition to their water quality standards programs, the states issue fish consumption advisories. Fish tissue values are used for developing the consumption advisories. New Hampshire, Rhode Island and Vermont use a fish tissue concentration value of 0.3 ppm, while Connecticut has a value of 0.1. In developing the TMDL, these states used the above consumption advisory fish tissue concentrations as the TMDL targets. Connecticut's target is based on the establishment of a 0.1 ppm fish tissue concentration by the Connecticut Department of Public Health (See Appendix B of the TMDL Report). The 0.3 ppm value used by New Hampshire, Rhode Island and Vermont is U.S. EPA's recommended fish tissue criterion for methylmercury (U.S. EPA, 2001b). New York chose to use the U.S. EPA's recommended criterion of 0.3 ppm as its TMDL target as well. The states indicated in the response to comments on the draft TMDL document that use of these fish tissue targets in the TMDL is appropriate, in part, because attainment of these targets will protect designated uses (fish consumption).

Since the states have varying fish tissue target values the TMDL is calculated to meet targets of 0.1 ppm (CT), 0.2 ppm (ME) and 0.3 ppm (MA, NH, NY, RI, VT).

Linking Fish Tissue Concentrations to Standards

Since Connecticut, New Hampshire, New York, Rhode Island and Vermont have water column criteria for mercury, it is necessary to determine whether or not the fish tissue targets will also assure that the numeric water column criteria are met for these states. The TMDL Report makes this comparison using a bioaccumulation factor (BAF) to directly relate the target concentration of mercury in fish tissue, expressed as mg/kg or ppm, to the expected concentration in the water column, expressed as ug/L. The TMDL Report indicates that a reasonable BAF for this regional area is in the range of 1,534,940/L to 2,046,585/L. Using the highest fish tissue concentration target of 0.3 ppm and the range of BAFs yields water column concentrations of 0.0001 to 0.0002 ug/L. These concentrations are lower than all of the state water column criteria, which range

from 0.0007 to 0.15 ug/L. Therefore, these calculations demonstrate that the water quality standards will be met when the fish tissue concentration targets are achieved.

Assessment: EPA finds that the TMDL Report adequately describes the applicable water quality standards and relevant criteria of each state. EPA believes that the TMDL Report provides a reasonable justification for the use of the state-specific fish tissue values of 0.1, 0.2 and 0.3 ppm as the water quality targets for the TMDL. EPA agrees that the TMDL Report adequately explains why it is reasonable to use these fish tissue values as the water quality target for the respective states, by indicating that the values have either been adopted as State water quality criteria or can be used to assure that applicable numeric water column criteria and designated uses will be met.

3. Loading Capacity - Linking Water Quality and Pollutant Sources

Overview of TMDL Methodology

The states determined the loading capacity for the region using the following steps: 1) determination of the existing point and nonpoint source loads, which are summed to determine the total existing source load; 2) calculation of the reduction factor needed to achieve the target fish tissue concentration; and 3) calculation of the allowable mercury load by applying the reduction factor to the total source load. As described further below, the reduction factor is based on the reductions needed to achieve the fish tissue target of 0.3 ppm in each state, except for ME and CT, where the fish tissue targets are 0.2 ppm and 0.1 ppm respectively. The year 1998 was selected as the baseline for determining needed reductions. This year was chosen because the bulk of the fish tissue data used in the TMDL are centered around 1998, and it is prior to the enactment of significant mercury reduction requirements in the region.

Total Source Load

The Total Source Load (TSL) is the sum of the existing point and nonpoint source loads for the entire region. The total point source load is 141 kg/yr and the total nonpoint source load is 6,506 kg/yr, giving a total source load of 6,647 kg/yr. Section 7.2 of the TMDL report describes the calculation of the total source load, and is summarized below.

Point Source Load

The existing point source load was calculated by multiplying the median effluent concentration of NPDES permitted discharges by the sum of the design flows of each NPDES discharge. As shown in Table 6-3, the median concentration used to calculate the point source load is 7.7 ng/l, and the sum of the design flow is 13,322 MGD. Multiplying the median concentration by the sum of the design flows gives an existing point source load of 141 kg/year.

To determine the median concentrations and design flows, the states used available point source monitoring data from 1998 to 2005. Only data using EPA method 1631 were used, except for Rhode Island, which had data comparable to those using method 1631. Data from facilities with multiple samples were averaged to calculate a mean mercury concentration for each facility. For NH, which had no facility effluent data, and CT, which had data using another mercury

analytical method, the regional means and median concentrations were used to estimate the loadings from facilities in these states. Appendix C of the TMDL report lists the mean mercury concentrations at NPDES-permitted facilities used in calculating the baseline point source load. Facilities that discharge primarily cooling water are not expected to discharge mercury and were not included in the point source loading estimate. Facilities that discharge to coastal waters were also excluded from the total point source loading estimates, since the TMDL is for freshwater only; however, concentration data from coastal facilities was used in calculating the median and mean effluent concentrations. As discussed further in the WLA section of this decision document, the contributions from stormwater are not known but are expected to be predominantly from atmospheric sources, and were not used in calculating the median and mean point source effluent concentrations. Stormwater contributions were assumed to be included in the nonpoint source loadings for the purpose of this calculation and to avoid double-counting.

Nonpoint Source Load

The nonpoint source loading is considered to consist exclusively of loadings of mercury attributed to atmospheric deposition. The TMDL report indicates that other potential sources such as land application of municipal sewage are insignificant. The loading from atmospheric deposition is calculated as the sum of natural and anthropogenic mercury deposition.

Anthropogenic atmospheric deposition to the northeast region was determined using the Regional Modeling System for Aerosols and Deposition (REMSAD). Two model runs were conducted using 1998 and 2002 emissions inventories for the northeast region (defined for this TMDL as the New England states and New York). The contributions from global sources were obtained from the global GEOS-CHEM model, which was also used to determine the boundary conditions for the REMSAD model runs. The total modeled deposition includes the contribution from northeast states, the rest of the U.S., and global sources. Natural sources were not included in the modeled atmospheric deposition estimates, but were estimated as described below. As shown in Table 6-2, the total modeled anthropogenic deposition is 4,879 kg/yr for 1998 and 2,914 kg/yr for 2002.

As discussed in Sections 6.2 and 7.2, the TMDL assumes that deposition is 75% from anthropogenic sources and 25% from natural sources based on paleolimnological studies in the northeast. The studies found that background or natural mercury deposition in the northeast ranged from 15 to 25% of the deposition in 2000, and such estimates are consistent with other published studies. The states chose to use the 25% level to be conservative. By combining the total modeled anthropogenic loads for 1998 (4,879 kg/yr) and the 25% from natural sources (1,627 kg/yr), the total nonpoint source load was calculated to be 6,506 kg/yr (see p. 28 of the TMDL document).

Reduction Factor

The reduction factor is the percent reduction needed to achieve the fish tissue target of 0.3 ppm for the 90th percentile of standardized length smallmouth bass. In Maine and Connecticut, the targets are 0.2 ppm and 0.1 ppm, respectively, for the 90th percentile standard length smallmouth bass. The existing fish tissue concentration was determined to be 1.14 ppm for the 90th

percentile standardized length smallmouth bass. Based on the existing fish tissue concentration and the target concentration, the reduction factor was calculated to be 0.74 for the target of 0.3 ppm; 0.82 for the 0.2 ppm target, and 0.91 for the 0.1 ppm target. To account for uncertainty, the reduction factor is also shown for the 80th percentile standard length smallmouth bass.

The existing fish tissue concentration was determined using a fish tissue database compiled by the Northeastern Ecosystem Research Consortium. The database contains fish tissue data collected from 1980 or later; however, the specific data used in developing the TMDL was primarily from the mid-1990s to early 2000s. To be included in the dataset, data needed to meet certain quality assurance and other screening criteria described in Section 4.1 of the TMDL document. The data base included data from all states covered by the TMDL except Rhode Island; thus, additional fish tissue data from Rhode Island were obtained for the TMDL. For the regional TMDL, data were analyzed for 13 species of fish. The number of samples analyzed by species and state, and the arithmetic mean concentration for each species across all 7 states, are shown in Table 4-1 of the TMDL report.

To account for differences in mercury concentrations due to fish age and length, mercury concentrations were calculated for a standard size fish. The states chose to use a 32 cm smallmouth bass as the standard size fish. Use of a standard size fish allows for a comparison of mercury concentrations across different waterbodies and sampling years. As described in Section 5.3 of the TMDL report, a statistical analysis was conducted in order to adjust fish mercury concentrations in the dataset in terms of the standard size fish. The smallmouth bass was chosen as the target species, as it accumulates mercury most efficiently, and is distributed throughout the region. In addition, smallmouth bass are sampled uniformly across the states compared to other species, and, as a top predator fish, are also relatively high in mercury. Other fish considered as the target species were high in mercury but not sampled uniformly, or, conversely, were sampled widely but had lower mercury concentrations.

The TMDL report describes how the choice of the 90th percentile standard length smallmouth bass as the target concentration is adequately protective. The 90th percentile value of 1.14 ppm for smallmouth bass is equivalent to the 96th percentile concentration for all fish species. Thus, at least 96 percent of fish are expected to meet the fish tissue target. Because of uncertainty related to a variety of factors affecting reduction estimates, the TMDL report also shows the existing and target concentrations for the 80th percentile standard length smallmouth bass. However, to be conservative the states ultimately selected the 90th percentile for the TMDL reduction target, as noted above.

Loading Capacity

The loading capacity was calculated by multiplying the total source load by the applicable reduction factor using the 90th percentile fish tissue targets. For the states with a target of 0.3 ppm, the loading capacity is 1,750 kg/yr or 4.8 kg/day; for Maine (with a target of 0.2 ppm) the loading capacity is 1,167 kg/yr or 3.2 kg/day; for Connecticut (with a target of 0.1 ppm) the loading capacity is 583 kg/yr or 1.6 kg/day. Section 7.4 of the TMDL document presents the loading capacity as annual loads and Section 8.0 presents the daily loads.

