TMDLs Where Mercury Loadings Are Predominantly From Air Deposition

September 2008

Overview

The attached document is part of EPA's continuing efforts to provide information on approaches and tools for addressing mercury-impaired waters under Clean Water Act Section 303(d).[1] In March 2007, EPA issued a memorandum outlining the 5m approach for listing waters impaired by mercury primarily from atmospheric deposition. Under the voluntary 5m approach, states with comprehensive mercury reduction programs in place may defer development of TMDLs for waters impaired by mercury primarily from atmospheric deposition. Such waters could also be placed in a subcategory "5m" of the state's impaired waters list.

In the 5m memorandum, EPA indicated that the Agency would provide information to assist states in developing mercury TMDLs as a companion to the 5m listing approach. States with comprehensive mercury reduction programs are encouraged to consider the 5m approach if applicable to their situation. At the same time, development of TMDLs continues to remain an important approach for addressing mercury-impaired waters.

EPA is providing the attached document to assist states, EPA regional staff, and other stakeholders in identifying approaches for the development of mercury TMDLs. Compiled in a "checklist" format, the document focuses on the elements of mercury TMDLs where mercury loadings are predominantly from air deposition; however, the tools and approaches described here may be useful in other situations where the pollutant loadings are primarily from air deposition. In addition, states have begun to develop mercury TMDLs on scales other than waterbody-specific, given the large number of mercury-impaired waters in some states. The document (also referred to as a "checklist") identifies the elements of TMDLs and other considerations for developing mercury TMDLs at different geographic scales: waterbody-specific, regional or statewide, and multiple states.

The checklist is organized around the elements in the EPA guidance for TMDL approvals *Guidelines for Reviewing TMDLs under Existing Regulations* issued in 1992. The checklist identifies the elements of TMDLs that are either required in existing regulations or recommended in existing guidance, and specifically how those elements could be applied to mercury TMDLs on various geographic scales. The document also draws largely on and cites approaches and best practices used in approved mercury TMDLs. EPA encourages states to consult with their EPA regional contacts to determine whether an approach used in an approved TMDL is appropriate to include in another TMDL. Some provisions or best practices in approved TMDLs, particularly specific elements or approaches not discussed in this document or other EPA guidance, may be case-specific or may not be appropriate in another situation.

[1] This document is not a rule and is not legally enforceable. As indicated by the use of non-mandatory language such as "may", "should", and "we recommend," it provides recommendations and does not impose any legally binding requirements. Similarly, the term "checklist" does not imply that each element must be met, but rather consists of a list of recommended elements for consideration. This document does not replace existing established laws or regulations governing listing of impaired waters or development of TMDLs under Section 303(d). Use of the term "must" denotes information required by existing regulations.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

1. Identification of Waterbodies, Pollutant Sources

Waterbody scale:

As described in existing guidance regarding elements of TMDLs, mercury TMDLs should include the following elements[2]*:*

- Identification of specific waterbody and pollutant (mercury, methylmercury) addressed by the TMDL.

- Identification of the pollutant sources (point and nonpoint sources), including quantity and locations(s), and NPDES permitted-sources within the waterbody, including regulated stormwater sources (also see Section 4 of this document on identifying point source loadings).

- Source assessment, including amount of mercury from air deposition, and contribution from point and legacy sources, e.g., sediments (also see Section 5 on identifying nonpoint source loadings). Although a comprehensive source assessment can be challenging, states are encouraged to consider the best available data in identifying mercury sources, and to describe how mercury sources were identified.

- Linkage to 303(d) list/Integrated Report (i.e., identify waterbody and impairment as it appears on the 303(d) list, the listing cycle, and priority ranking of the waterbody).

- Identification of other assumptions and basis for the assumptions (e.g., watershed area, land use/land cover, population, future growth, distribution of sources and loadings, including air deposition, etc.).

Regional, statewide, and multi-state scales[3]:

Best practices for applying the above elements to mercury TMDLs on scales other than the waterbody-scale include the following:

- Clear identification of the geographic area and specific waterbodies covered and not covered by the TMDL.

- Description of factors such as land use, water quality, fish tissue data, sources, and loadings within each region in order to support a regional approach, and site- or region-specific rationale for how and why waterbodies can be grouped.[4]

[2] Note: Unless otherwise noted, "existing guidance" in this document refers primarily to EPA's guidance for TMDL approvals, *Guidelines for Reviewing TMDLs under Existing Regulations issued in 1992*. Although some information is repeated from the 1992 guidance, this table does not replace that guidance.

[3] For some TMDL elements, there may be questions about whether there is an adequate level of detail in a particular regional or broad-scale TMDL. States are encouraged to work with their EPA regional counterparts early in the TMDL development process to determine the appropriate level of detail for such TMDLs.

[4] See Northeast Mercury TMDL for examples of rationale for including, as well as excluding, particular waterbodies.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

Regional, statewide, and multi-state scales, cont.

- If there are differences in sources, loadings, or fish mercury levels across the state, states are encouraged to separate waterbodies into groups according to those differences, i.e., groupings may include waterbodies that are similar in fish mercury levels, source distribution, and other factors such as (but not limited to) land use/land cover, presence of wetlands, drying and re-wetting cycles, water chemistry, and soil type that may affect methylation rates and bioavailability of mercury.[5] Areas with significantly higher mercury levels or local sources may be treated as a separate region with a separate TMDL calculation or excluded from the regional TMDL and a separate TMDL developed. Alternatively, states may include certain waterbodies with higher mercury levels than other areas within the regional TMDL if there is a reasonable site-specific rationale for including such waterbodies.

- States may wish to conduct a statistical analysis to support any assumption that waterbodies may be grouped, i.e., that waterbody properties (e.g., land use, pollutant sources, fish tissue concentrations) are similar, and to ensure that there are not any groups of waterbodies or individual waterbodies that should be addressed separately from the other waterbodies (e.g., separate TMDL calculation) due to significantly higher mercury levels and/or local sources that may be contributing to localized exceedances.[6]

- In a multi-state approach, states should take into account differences across multiple states.

[5] It is beyond the scope of this document to provide complete references on all of the factors that may affect mercury methylation, demethylation, and bioavailability. The following is one publication providing an overview of some of the factors affecting mercury methylation: Benoit, J., C. Gilmour, A. Heyes, R.P. Mason, C. Miller. 2003. Geochemical and Biological Controls Over Methylmercury Production and Degradation in Aquatic Ecosystems. In: "Biogeochemistry of Environmentally Important Trace Elements", ACS Symposium Series #835, Y. Chai and O.C. Braids, Eds. American Chemical Society, Washington, DC. pp. 262-297. see http://www.serc.si.edu/labs/microbial/pubs/Benoit%20et%20al.%20ACS%202003.pdf. Also see Ullrich, Susanne M., Tanton, Trevor W. and Abdrashitova, Svetlana A. 2001. Mercury in the Aquatic Environment: A Review of Factors Affecting Methylation. Critical Reviews in Environmental Science and Technology, 31:3, pp. 241- 293. see http://www.informaworld.com/smpp/content~db=all~content=a727072783~tab=content

[6] An example of a regional-scale fish tissue database, and a statistical analysis to demonstrate similarity in fish tissue concentration, is described in the Northeast Regional Mercury TMDL at http://www.neiwpcc.org/mercury/MercuryTMDL.asp.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

2. Water Quality Standards and TMDL Target

Waterbody, regional, and statewide scales:

- TMDLs must describe applicable water quality standards (WQS), including designated uses, numeric and narrative criteria, and antidegradation policy (40 C.F.R. 130.7(c)(1)).

  - Depending on impairment being addressed by the TMDL, existing criteria may include human health, aquatic life, and wildlife criteria.
  - The state's existing numeric mercury criterion may be a water column concentration or fish tissue value. Note that in 2001, EPA issued a recommended fish tissue criterion of 0.3 mg/kg methlymercury, which some states have adopted or modified to reflect local conditions.
  - TMDLs must identify a numeric TMDL target, a quantitative value used to attain and maintain the applicable WQS, including designated uses, as necessary to calculate the load allocation and wasteload allocation (40 C.F.R. 130.2(i)).

- Where a fish tissue target is used for the TMDL, appropriate justification for using a fish tissue target should be included, considering existing numeric and narrative criteria as well as designated uses.[7] For example, where a state has a narrative criterion such as "no toxics in toxic amounts", and where a state considers there to be an impairment of a designated use due to presence of a fish consumption advisory, it may be appropriate to use a fish tissue target to interpret a narrative standard. The TMDL should include a demonstration of how meeting the fish tissue target will achieve water quality standards (40 C.F.R. 130.7(c)) (linkage analysis).[8],[9]

[7] As described in the Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act ("2006 IR Guidance"), when deciding whether to identify a segment as impaired, states need to determine whether there are impairments of designated uses and narrative criteria, as well as the numeric criteria. The guidance notes that, while numeric human health criteria for ambient water column concentrations of pollutants are a basis for determining impairment, the attainment of such criteria does not always mean that designated uses are being protected. For example, a segment can be meeting numeric ambient water quality criteria, but not attaining the designated uses because fish or shellfish tissue concentrations exceed levels that are protective of human health or levels used as the basis for fish consumption advisories. See the 2006 IR Guidance for additional information on listing waters with fish or shellfish consumption advisories at http://www.epa.gov/owow/tmdl/2006IRG/#documents

[8] The Minnesota "Statewide" Mercury TMDL and Northeast Regional Mercury TMDL are based on fish tissue targets and include an analysis demonstrating that meeting the TMDL fish tissue target will meet existing water column criteria (see http://proteus.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html and http://www.neiwpcc.org/mercury/MercuryTMDL.asp.)

[9] The draft methylmercury criterion implementation guidance describes considerations regarding translating between a fish tissue and water column value, translating between mercury and methylmercury in water, and the use of bioaccumulation factors. The draft guidance is available at http://www.epa.gov/waterscience/criteria/methylmercury/guidance-draft.html.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs
➢ Examples of targets used in some TMDLs include the following: • Some recent mercury TMDLs have been developed based on the EPA recommended methylmercury fish tissue criterion, or on a fish tissue criterion modified to reflect local fish consumption patterns.[10] • Some TMDLs have used numeric water column targets derived from a target fish tissue concentration (e.g., Georgia, Oregon). [11] • Some have used a numeric fish tissue target which is the level of mercury that triggers a fish consumption advisory.[12] **Multi-state scale:** ➢ In addition to the above elements, TMDLs must identify water quality standards for each state and be established at a level to attain and maintain the WQS in each state. The TMDL should demonstrate how TMDL will achieve the WQS in each state; where the standards are different, the TMDL document should include a separate TMDL calculation for each standard.

[10] The Minnesota and San Francisco Bay mercury TMDLs provide examples of a fish tissue target (0.2 mg/kg) modified to reflect local fish consumption rates (see San Francisco Bay mercury TMDL at http://www.waterboards.ca.gov/sanfranciscobay/water_issues/programs/TMDLs/sfbaymercury/sr080906.pdf.)

[11] The mercury TMDLs for waterbodies in Georgia (e.g., Ochlockonee) and Oregon's Willamette Basin Mercury TMDL provide examples of TMDLs in which a water column target was developed from a fish tissue value using bioaccumulation factors (see http://www.epa.gov/Region4/mercury/documents/OchlockoneeHgFinalTMDL.pdf and http://www.deq.state.or.us/wq/TMDLs/docs/willamettebasin/willamette/chpt3mercury.pdf. The Willamette Basin TMDL, for example, used a basin-specific aquatic food web biomagnifications model to develop a water column target based on a fish tissue value.

[12] Mercury TMDLs for waterbodies in Louisiana, including a TMDL for the coastal bays and Gulf waters of Louisiana, used a TMDL target based on the levels which trigger a fish consumption advisory. See example at http://www.epa.gov/waters/tmdldocs/6hgLATMDLsReport_05Jun28.pdf.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

3. Loading Capacity – Linking Water Quality and Pollutant Sources

Waterbody scale:

- TMDLs must identify loading capacity and reductions needed to meet water quality standards (40 C.F.R. §130.2(f)).

- As described in existing guidance on TMDL elements, TMDLs should provide documentation of the approach used to establish linkage between the numeric target and mercury sources, the basis for any assumptions, the strengths and weaknesses of the approach, and the results of any modeling. Examples of some assumptions in approved mercury TMDLs include percent runoff/delivery of air deposition from watershed to waterbody, and applicability of the assumptions to the various land uses in the watershed. Below are some additional considerations in conducting a linkage analysis.
  - A linkage analysis may include water quality modeling or other analytical approaches, although modeling is not required. [13]
  - Selecting a water quality model depends on the type of questions to be answered and may range from simple mass balance approach to more complex models. Types of models that may apply to mercury TMDLs include steady-state, dynamic, and spatially-detailed models.[14] Results of air deposition modeling, as well as runoff models, may also be used as input to water quality models in a linked approach.
  - Data on which linkage analysis is based (e.g., waterbody characteristics, sources, fish tissue data) should be included.

- Where a fish tissue target is used, one approach (but not the only approach) to the linkage analysis may be use of a reduction factor or principle of proportionality to determine the percent reduction needed to meet fish tissue target. This approach has been used in many approved mercury TMDLs.[15]
  - Such an approach may be used if it is appropriate for this waterbody and circumstances (e.g., steady-state conditions, mercury predominantly from air deposition) and the appropriate rationale for any assumptions is included.[16]
  - To the extent relevant information is available, the baseline against which reductions would be measured should be most representative of current conditions and consistent with the timeframe for air and water quality data.

- For a fish tissue target, states are encouraged to include the following items as part of the linkage analysis documentation. Examples of each of these can be found in approved mercury TMDLs:
  - A description of the fish tissue data (number of samples, concentration, locations, etc.);

[13] See the Ochlockonee Watershed Mercury TMDL and other Georgia mercury TMDLs for example of linked water quality modeling approach at http://www.epa.gov/Region4/mercury/documents/OchlockoneeHgFinalTMDL.pdf.

[14] See draft methylmercury criterion implementation guidance for types of water quality models applicable to mercury TMDLs and factors to consider when selecting a model at http://www.epa.gov/waterscience/criteria/methylmercury/pdf/guidance-draft-ch6.pdf.

[15] See Minnesota "Statewide" Mercury TMDL for example of reduction factor approach at http://proteus.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html.

[16] For further discussion on proportional or linear relationship between air deposition and fish tissue mercury, see Mercury Maps at http://www.epa.gov/waterscience/models/maps/; also see Florida mercury TMDL pilot study report regarding factors that may affect linearity at ftp://ftp.dep.state.fl.us/pub/labs/assessment/mercury/tmdlreport03.pdf)

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

Fish tissue target, cont.

- Identification of the specific fish species, or multiple species, if using a trophic-weighted approach for multiple species and trophic levels; [17]
- Identification of statistic used to calculate the baseline concentration and target (e.g., which percentile), and the rationale for the target level and fish species used, and
- How target accounts for geographic and temporal variability (e.g., use of standard length fish to account for differences due to fish size).[18]

Regional, statewide, or multi-state scales:

The linkage analysis should include the same items described above, but should be applicable to all of the waterbodies covered by the TMDL. Below are best practices to consider when applying the linkage analysis to scales other than waterbody-specific:

- The TMDL should describe how the WQS will be achieved in all of the waterbodies included in the TMDL.
- Consistent with existing guidance on TMDL elements and as described in Element 1 above, the TMDL should provide data and analysis to demonstrate the basis for grouping waterbodies, e.g., should show geographic distribution of water and/or fish tissue mercury concentrations in order to justify an assumption that mercury concentrations and/or fish mercury levels and mercury loadings from sources are similar within a group of waterbodies or region of the state.
- Maps and/or tables showing groupings of waterbodies, as well as other factors used in grouping waterbodies, such as fish tissue sample locations and concentrations, land use properties, and ecoregions, are encouraged.
- TMDL should describe how the assumptions are relevant to the various land uses or other watershed properties in each of the geographic areas covered by the TMDL. The TMDL should demonstrate how the target accounts for geographic or other differences across waterbodies and is adequately protective, such that the TMDL is designed to ensure that all waterbodies within an area or region will achieve water quality standards.
- On a multi-state scale, the approach would be similar to regional or statewide approach. However, it is especially important given the larger area to provide geographic data showing how waterbodies from multiple states can be treated similarly and addressed in a single TMDL calculation, as well as to identify any waterbodies or areas that should be treated as a separate group (e.g., separate TMDL calculation) or excluded from the TMDL document. In addition, the TMDL should describe how the WQS for the waterbodies in each of the states would be met.

[17] See the Water Quality Criterion for the Protection of Human Health: Methlymercury, January 2001, at http://www.epa.gov/waterscience/criteria/methylmercury/document.html and the draft methylmercury criterion implementation guidance regarding use of a trophic-weighted approach in developing a fish tissue criterion, at http://www.epa.gov/waterscience/criteria/methylmercury/pdf/guidance-draft-ch3.pdf.

[18] See Minnesota and Northeast Regional mercury TMDLs for examples of the use of a standard length fish at http://www.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html and http://www.neiwpcc.org/mercury/MercuryTMDL.asp.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

4. Linking Water Quality and Pollutant Sources - Point Source Loadings

Waterbody scale:

- As described in existing guidance on TMDL elements, the TMDL should identify specific point sources covered by the TMDL, including NPDES-permitted stormwater sources, and the total point source loadings.

- The following are best practices to consider in determining the total point source loading of mercury:

  - States are encouraged to use data on point source loadings most representative of current conditions where relevant information is available.

  - Where facility- or category-specific mercury discharge data is available and of appropriate quality, states are encouraged to consider such data, and develop estimates of mercury loadings applicable to each category of sources (e.g.., wastewater treatment plants, power plants, stormwater, and other potential mercury dischargers), rather than calculating a single average for all types of dischargers.

  - Where source-specific data is not available, states are encouraged to develop representative estimates for loadings for each source category, either by limited sampling, or by using published estimates for a particular source category or land use.

  - States should indicate how they have accounted for mercury contributions from NPDES-permitted stormwater sources in the estimate of total mercury loadings. Contributions from NPDES-permitted sources should be included in the point source estimate, and contributions from non-NPDES permitted stormwater sources may be included in the estimate of nonpoint source loadings. States are encouraged to estimate contributions from specific NPDES-permitted sources such as MS4s. Except in areas where there are specific industrial activities known or likely to discharge mercury, or where mercury is mainly from past mining activity, EPA expects that mercury contributions from stormwater sources likely originated primarily from air deposition. (also see Element #6, WLA).

  - Maps showing location of key sources, land-use, and other waterbody characteristics are encouraged.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

Regional, statewide, or multi-state scales:

In addition to the waterbody-specific considerations, best practices for estimating point source mercury loadings include the following:

- Where waterbodies are grouped into regions and a separate TMDL calculation is developed for each region, the TMDL(s) should include a separate total point source load for each region or group of waterbodies. As in the waterbody-specific approach, consider calculating total point source load for each region or group of waterbodies by using facility- or category-specific estimates of loadings for individual sources and/or categories of sources present in that region or group of waterbodies.

  States are encouraged to identify any individual waterbodies, groups of waterbodies, or areas with higher than typical mercury point source discharges that need to be accounted for or treated differently from other waterbodies (e.g., separate TMDL calculation, or individual WLA) from other areas. Where waterbodies are grouped, it is recommended that states indicate why it is reasonable to assume that no individual point sources are likely to cause or contribute to localized exceedances of the water quality standard. [19]

  As with the waterbody-scale approach, states should indicate how they have accounted for mercury contributions from NPDES-permitted stormwater sources in the estimate of total mercury loadings. Ideally, the estimate of contributions from NPDES-permitted sources should be separate from the estimate of contributions from non-NPDES permitted sources. Where there is insufficient data on individual sources in order to provide separate estimates of the contributions from NPDES-permitted and non-NPDES permitted stormwater sources on a regional, statewide, or multi-state scale, states should provide a rationale for not including such estimates. (Also see Section 6 below on the WLA.)

[19] See draft methylmercury criterion implementation guidance regarding approach for implementing the criterion in NPDES permits at http://www.epa.gov/waterscience/criteria/methylmercury/pdf/guidance-draft-ch7.pdf
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Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

5. Linking Water Quality and Pollutant Sources - Nonpoint Source Loadings

Waterbody scale:

- Existing guidance on TMDL elements has suggested that load allocations may range from gross estimates to more precise estimates. Updated deposition modeling results are available that may allow for more refined estimates of deposition than in the earlier mercury TMDLs, which in turn can be used to support development of the load allocation. EPA encourages states to consider the most recent and best available data.

- As described in existing guidance, the TMDL should include estimates of nonpoint source loadings, including air deposition loadings. Best practices to consider in developing such estimates include the following:
  - As with point sources, maps showing the location of key sources or source areas are encouraged.
  - Loading estimates should account for direct deposition (deposition directly to the waterbody), indirect deposition (i.e., deposition to the watershed which then enters the waterbody via runoff), wet and dry deposition, as well as any nonpoint sources other than those containing loadings from air deposition (e.g., runoff from waste sites, legacy sources). States may wish to use runoff models to estimate mercury loadings to the waterbody from the watershed.[20]
  - Estimates of mercury loadings resulting from atmospheric deposition should account for total deposition to the waterbody from all sources, including sources within a state as well as from outside a state.
  - States may wish to separate out the contributions from in-state, out-of state, global, legacy sources (including legacy deposition), and natural sources, as well as contributions from specific categories of local air sources. While not necessary for developing the load allocation (LA), parsing out the contributions to the air deposition loading may be helpful in developing an implementation plan. Results of the Regional Modeling System for Aerosols and Deposition (REMSAD) or the Community Multiscale Air Quality modeling system (CMAQ) using a source "tagging" approach are expected to be available and may assist in identifying contributions from within state, out-of-state, and particular sources or source categories.[21]

[20] See Georgia mercury TMDLs (e.g., Ochlockonee) for example of TMDL which uses a runoff model (Watershed Characterization System) combined with a fate and transport model (WASP5) to determine mercury loadings from the watershed, and accounts for both wet and dry deposition.

[21] Examples of mercury TMDLs that include estimates of deposition using REMSAD include the Northeast regional mercury TMDL and the mercury TMDLs for the coastal bays and Gulf waters of Louisiana at http://www.epa.gov/waters/tmdldocs/6hgLATMDLsReport_05Jun28.pdf. For further information on the REMSAD model, see "User's Guide to the Regional Modeling System for Aerosols and Deposition (REMSAD), Version 7." ICF International, San Rafael, California, available at www.remsad.com. Information on the CMAQ model can be found at http://www.epa.gov/asmdnerl/CMAQ/. Examples of other air and water modeling tools are described in the draft Methylmercury Criterion Implementation Guidance and in the Air Deposition handbook at http://www.epa.gov/owow/airdeposition/handbook.html. Note that neither this document, nor other EPA guidance, should be construed to imply that states should use a specific air or water quality model.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

5. Linking Water Quality and Pollutant Sources - Nonpoint Source Loadings, cont.

Waterbody scale, cont.:

- Data to estimate deposition may include model results, such as the REMSAD and/or CMAQ models, deposition monitoring data (e.g., Mercury Deposition Network (MDN) data where available), and/or sediment core data.[22,23] Dry deposition is typically modeled, as techniques are not widely available for measuring dry deposition directly. Wet deposition may be estimated via modeling, direct measurements (e.g., MDN) or a combination of modeling and monitoring. Indirect deposition via runoff has typically been estimated via watershed models.

➢ As described under #4 (point source loadings), where possible, the TMDL should include estimates of the contributions from air deposition to permitted stormwater sources and account for such loadings in the point source load estimate, rather than the nonpoint source load estimate. Contributions from nonpermitted stormwater sources may be included in the nonpoint source loading estimate.

Regional, statewide, or multi-state scales:

Same as waterbody-specific; in addition, best practices for determining nonpoint source loadings on other scales include the following:

➢ Consistent with existing guidance regarding identification and location of pollutant sources, the TMDL should include information on the geographic distribution of air deposition, i.e., whether deposition is uniform across the state or region within the state, as well as whether there are any areas with local sources and significantly higher local deposition that need to be accounted for (e.g., separate loading estimate).

➢ Where waterbodies are grouped into regions, the TMDLs should include a calculation of the total nonpoint source load (air deposition load) for each region or group of waterbodies. In a multi-state approach, the TMDL should indicate the geographic distribution of sources across multiple states, and identify any state or local differences, and how the TMDL accounts for such differences (e.g., separate loading estimates, separate TMDL calculation, etc.).

[22] Information on the Mercury Deposition Network is available at http://nadp.sws.uiuc.edu/mdn/.

[23] See Minnesota mercury TMDL for example of the use of sediment core data to estimate mercury deposition. Also see: Kamman, N. and Engstrom, D. 2002. Historical and present fluxes of mercury to Vermont and New Hampshire lakes inferred from 210Pb dated sediment cores. Atmospheric Environment 36 (2002) 1599–1609.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

6. Wasteload Allocation (WLA)

Waterbody scale:

- TMDLs must include wasteload allocations which identify the portion of the loading capacity allocated to individual existing and future point sources. (40 C.F.R. §130.2(h), 40 C.F.R. §130.2(i))

- Consistent with the 2006 decision by the U.S. Court of Appeals, allocations should be expressed as a daily load.[24] Because mercury levels in fish represent bioaccumulation over longer periods of time, it may be appropriate to express allocations in mercury TMDLs as both an annual and daily load.[25] If appropriate, states may also express allocations using other averaging periods, such as seasonal, in addition to a daily load.

- In determining the WLAs, factors such as the relative contribution of point sources compared to nonpoint sources may be considered. Where point sources are contributing a very small amount of the total mercury load, allocation proportional to their relative contribution is typical in approved mercury TMDLs. In approved mercury TMDLs where point sources are very small relative to air deposition, WLAs have been implemented as either criteria-end-of-pipe, or as waste minimization plans with followup monitoring.; most mercury TMDLs have identified the latter as the approach for implementing the WLA.[26]

- In some cases, it may be acceptable to have an aggregate WLA for a group of point sources. When the source is a minor discharger of the pollutant of concern or if the source is contained within an aggregated general permit, it may be appropriate, depending on the circumstances, to assign an aggregate WLA to a group of facilities as has been done in some approved mercury TMDLs.[27],[28]
  - The TMDL should explain why an aggregate WLA is reasonable. An aggregate WLA may be appropriate in mercury TMDLs if the mercury is predominantly from air deposition, and the contributions from individual point sources are very small.

[24] See Establishing TMDL "Daily" Loads in Light of the Decision by the U.S. Court of Appeals for the D.C. Circuit in Friends of the Earth, Inc. v. EPA, et al., No. 05-5015, (April 25, 2006) and Implications, for NPDES Permits at http://www.epa.gov/owow/tmdl/dailyloadsguidance.html. Note that, as described in the latter memo, the Court decision regarding daily loads does not imply that NPDES permit limits be expressed in daily terms. For mercury TMDLs where point sources are very small compared to loadings from air deposition, states continue to have the option of implementing the WLA in permits through mercury minimization plans where appropriate.

[25] Approved mercury TMDLs with acceptable approaches for determining daily loads include the Minnesota and Northeast regional TMDLs. States may also use statistical approaches for determining daily loads as described in EPA's Technical Support Document for Water Quality Control (1991).

[26] See Ochlockonee Basin, GA, mercury TMDL and other Georgia mercury TMDLs at http://www.epa.gov/Region4/mercury/documents/OchlockoneeHgFinalTMDL.pdf.

[27] See Ochlockonee Basin, GA mercury TMDL and other Georgia mercury TMDLs.

[28] For areas subject to the Water Quality Guidance for the Great Lakes, it may be necessary to take into account provisions on mixing zones when considering an aggregate WLA. States should consult their EPA regional contacts in such situations.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

6. Wasteload Allocation (WLA), cont.

- The TMDL should indicate how the aggregate WLA will be implemented in individual permit decisions and how permits will be consistent with the WLA. EPA recommends that the TMDL specifically indicate that, at the time of permit issuance, the permit authority will determined that there is no localized exceedance of water quality standards. The TMDL should also indicate that the sum of existing, new or increased dischargers must not exceed the WLA.

- Where there is sufficient data on point source discharges, such as where individual point sources are known to or likely to discharge mercury levels greater than that in their source water (based on volume of discharge), an individual WLA may be most appropriate. For sources known not to discharge mercury, or not likely to discharge mercury based on small flow volumes, it may be appropriate to provide an aggregate WLA (see Georgia mercury TMDL examples).

➢ NPDES-permitted stormwater discharges are subject to the WLA. See C.F.R. 130.2(h)[29] As described in Section 4, states should identify and account for mercury loadings from NPDES-permitted stormwater sources in calculating total point source load where information on mercury contributions from those sources is available. Similarly, where there is information on individual sources, States are encouraged to provide a specific WLA for NPDES-permitted stormwater sources such as MS4s. The TMDL should explain the assumptions relating to stormwater that would be relevant to implementation of the WLA in NPDES permits. Allocations for NPDES-permitted stormwater discharges from multiple point sources may be expressed as a single categorical wasteload allocation where data and information are insufficient to assign individual WLAs. Where appropriate, TMDLs may indicate where reductions would be achieved through Best Management Practices (BMPs) in stormwater management plans.

[29] See "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs." At http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

6. Wasteload Allocation (WLA), cont.

Regional, statewide, and multi-state scales: Same as waterbody specific above; in addition, best practices to consider when developing a WLA for a mercury TMDL on a regional or larger scale include the following:

- The WLA may apply to the point sources within a group of waterbodies or area within the state. As with the waterbody specific mercury TMDLs, an aggregate WLA may be appropriate where the mercury is predominantly from air deposition, contributions from air deposition are relatively similar across waterbodies, and the contributions from individual point sources are very small.[30]

- It is especially important that the TMDL indicate how an aggregated WLA will be implemented in individual permit decisions. In determining whether an aggregate WLA is appropriate or should include a particular waterbody or point source, states should also consider whether a source is known or likely to contribute to a localized water quality standards exceedance. If the latter is unknown, EPA recommends that the TMDL specifically indicate that, at the time of permit issuance, the permit authority will determine whether there are any localized exceedances of water quality standards.

- As on the waterbody-scale, the WLA applies to NPDES-permitted stormwater sources on regional, statewide, and multi-state scales. For such large areas, where it is not possible to provide a separate estimate of the contributions from NPDES-permitted stormwater sources, it may not be possible to provide a separate WLA for those sources. However, the TMDL should indicate that the WLA applies to NPDES-permitted stormwater sources. The TMDL should also indicate the assumptions that would be relevant to implementation in NPDES permits.

- If necessary, waterbodies with significant dischargers could be excluded from the "statewide" TMDL and a separate TMDL developed for those waterbodies, or an individual WLA could be provided for such sources. Similarly, where there are differences in loadings from different point source categories, or differences in point source contributions between geographic areas, states should consider whether a separate WLA for a particular category or categories of sources (or within a geographic area) would be appropriate.

- In a multi-state approach, the TMDL should also identify how the WLA(s) will be implemented in individual permits within each state.

[30] Examples of statewide and regional-scale TMDLs with an aggregate WLA include the Minnesota "statewide" mercury TMDL and the Northeast Regional Mercury TMDL.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

7. Load Allocation (LA)

Waterbody scale:

- TMDL must include a load allocation, which identifies the portion of the loading capacity attributed to existing and future nonpoint sources and natural background. Load allocations may range from reasonably accurate estimates to gross allotments (40 C.F.R.130.2(g)).

- Where possible, load allocations should be described separately for nonpoint sources and natural background (40 C.F.R. 130.2(g)). In TMDLs where mercury loadings are predominantly from air deposition, the LA may consist entirely or largely of contributions from air deposition.

- As described under #6 above, contributions from NPDES-permitted stormwater sources that include contributions from air deposition must be included in and subject to the WLA. Contributions from air deposition in stormwater discharges not currently subject to NPDES regulation may be included in the LA.[31]

- As with WLAs, the load allocations should be expressed as a daily load; however, given bioaccumulative properties of mercury, allocations may be expressed as both an annual and daily load.

- States may wish to consider separating the LA further into in-state and out-of-state allocations, as well as contributions from particular sources or source categories. Such information is not required but may be helpful for developing a tailored implementation plan. The TMDL should clearly identify the total load allocation that needs to be achieved in order to attain water quality standards.

- As discussed in Section 5, results of air deposition modeling using a source "tagging" approach, such as the results of nationwide REMSAD or CMAQ modeling may help estimate contributions from particular sources or source categories. In some cases, a state may wish to conduct more localized analyses/modeling where there are multiple local sources.

[31] See "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit Requirements Based on Those WLAs." At http://www.epa.gov/npdes/pubs/final-wwtmdl.pdf

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs
7. Load Allocation (LA)

Regional, statewide, and multi-state scales:

In addition to waterbody specific elements, best practices include the following:

- The TMDL or TMDLs may include a single gross load allocation for a group of waterbodies or area within the state, where data shows that loadings (e.g., air deposition) are relatively uniform over that region or area.

- Areas of higher deposition compared to other areas may need to be addressed with a separate TMDL calculation and allocation.

- A state may wish to but is not required to identify in-state and out-of-state contributions to the load allocation (or out-of-region, in the case of a multi-state approach).

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

8. Margin of Safety (MOS)

Waterbody scale:

- TMDLs must include a Margin of Safety (MOS) to account for uncertainty in relationship between pollutant loads and quality of receiving water. (CWA §303(d)(1)(C), 40 C.F.R. §130.7(c)(1)) As described in existing guidance, the MOS may be explicit (e.g., build in additional percent load reduction) or implicit (conservative assumptions in the calculations or overall approach). For an implicit MOS, the TMDL should describe the assumptions used to account for the MOS. The MOS in a TMDL is distinct from the conservative assumptions that may be incorporated in a water quality standard.

- Examples of an implicit MOS in approved mercury TMDLs include the following:
  - use of highest predicted water concentrations
  - highest fish tissue concentrations
  - highest water discharger concentrations
  - high percent of deposition which runs off into waterbody
  - impact of sulfur reductions and other water chemistry parameters on methylmercury production, e.g., methylation is dependent on sulfur, and controls under the air program to reduce sulfur emissions may also reduce the potential for methylation, thus resulting in additional reductions in mercury

Regional, statewide, and multi-state scales:

- Similar to waterbody specific; in addition, based on examples in approved mercury TMDLS, an implicit MOS could include the following:
  - use of highest reduction target for all of the regions (if there are multiple regions within the state with different reduction goals);
  - use of conservative assumptions in calculating air deposition loadings (e.g., percent contributions from natural, anthropogenic sources); and
  - use of conservative assumptions regarding contributions from specific air or water sources (e.g., emissions factors)

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

9. Critical Conditions & Seasonal Variation

Waterbody scale:

- TMDLs must take into account critical conditions for stream flow, loading and water quality parameters on the TMDL calculation (40 C.F.R. §130.7(c)(1)). For mercury, critical conditions might include impacts of land use, erosion, sulfates, DOC, and pH on mercury methylation and bioaccumulation, as well as the impacts of meteorology on mercury deposition.

- As mercury bioaccumulates over time, annual variations are usually considered more important than seasonal variations, particularly if a fish tissue target is used.

- As methylation rates may vary with factors such as temperature and oxygen levels (see Section 1), seasonal fluctuations in mercury methylation can occur and may be appropriate to consider in some cases, such as where a water column target is used. In such cases, it may also be appropriate to consider changes in mercury loading with changes in flow conditions.[32]

- States are also encouraged to indicate how, when, and where fish tissue data was collected.

Regional, statewide, and multi-state scales:

Same as waterbody-specific; in addition, as found in examples in approved TMDLs, mercury TMDLs should also take into account differences in critical conditions & sensitivity to methylation between waterbodies or regions.[33] Accordingly, states may consider grouping waterbodies/regions based on differences in factors that may affect methylation rates.

[32] A mercury TMDL for South Cottonwood River, KS, used the load duration curve methodology to account for loadings at all flow conditions (see TMDL at http://www.epa.gov/Region7/water/pdf/s_cttnwd_rvr_mercury_final022505.pdf).

[33] See Minnesota mercury TMDL at http://proteus.pca.state.mn.us/water/tmdl/tmdl-mercuryplan.html

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

10. Reasonable Assurance

All scales:

- There should be reasonable assurances supporting any assumptions regarding the ability of nonpoint sources to reduce their pollutant loadings if those assumptions will be the basis to allow less stringent wasteload allocations for point sources. 40 CFR 130.2(i) In the context of mercury TMDLs, this would be the situation if point sources are given an allocation greater than they might otherwise receive because of expected air source reductions.[34]

- Where the wasteload allocation is not predicated on expected reductions in nonpoint sources (air deposition), states are nonetheless encouraged to describe the programs that are expected to achieve the WLA and LA as the basis for implementation. Programs to be described should include both programs to address in-state sources, as well as national and international programs to address out-of-state sources. Unless such information is used to provide reasonable assurance for the wasteload allocation, this information would generally be considered part of implementation and not subject to EPA approval (also see Section 12 – Implementation)

- As discussed in Section 6 on WLAs, where a TMDL includes an aggregate allocation, states are strongly encouraged to include specific information on how individual NPDES permits, including stormwater permits, will be implemented. It is recommended that the TMDL specifically state that at the time of permit issuance, an analysis will be conducted to determine that there will be no localized exceedances of the water quality standard.

Multi-state scale: In addition to the above considerations, states are encouraged to describe mercury reduction programs in each state, as well as any coordinated multi-state mercury reduction efforts.

[34] As described earlier, this document is specific to TMDLs where mercury is predominantly from air deposition and the approaches described may not be applicable to other pollutants and situations. In many approved mercury TMDLs where point sources are a very small proportion (e.g, <1%) of the total loading relatively to air deposition, point sources have typically been held at current levels, with the point sources expected to conduct followup monitoring and implement pollutant minimization plans.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

11. Monitoring

All scales:

- As described in existing guidance on elements of TMDLs, States are encouraged to implement a multi-media monitoring program to track progress in reducing emissions and loadings from mercury source categories, and in turn, to track progress toward the TMDL target. As described in the "5m" memorandum on listing waters impaired by atmospheric mercury, recommended elements of a comprehensive mercury monitoring program include the following:
  - Air deposition and emissions monitoring (preferably speciated)[35]
  - Effluent, stormwater, water column, sediment, and fish tissue monitoring. [36]

- Where discharge data on particular sources or source categories was not available in developing the TMDL, followup monitoring by those sources is encouraged. Further monitoring can assist in refining the loading estimates and allocations, using an adaptive management approach. States are encouraged to implement as many elements of a multi-media program as possible, depending on resources.

- A monitoring plan should include which parameters will be monitored and frequency of monitoring. States may also wish to identify a baseline against which to measure progress. EPA recommends that states use standardized protocols for sample collection and analysis.[37] As methylation and demethylation rates may vary seasonally, states may wish to consider seasonal monitoring where a water column target is used, or in order to better understand the local conditions affecting methylation rates.

Multi-state scale:

- In addition to the above, States are encouraged to coordinate monitoring efforts and use similar techniques and design, in order to compare results across states.

[35] Information on the Mercury Deposition Network is available at http://nadp.sws.uiuc.edu/mdn/. General information on designing a deposition monitoring program is available in EPA's publication "Frequently Asked Questions About Atmospheric Deposition" at http://www.epa.gov/owow/airdeposition/handbook.html.

[36] See "Listing Waters Impaired by Atmospheric Mercury Under Clean Water Act Section 303(d): Voluntary Subcategory 5m for States with Comprehensive Mercury Reduction Programs" at http://www.epa.gov/owow/tmdl/mercury5m/

[37] EPA's draft methlymercury criterion implementation guidance describes analytical methods for measuring mercury at http://www.epa.gov/waterscience/criteria/methylmercury/

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

12. Implementation

All scales:

- An implementation plan is not a required element of a TMDL subject to EPA approval, although a TMDL implementation plan is required in some states. EPA encourages states to develop an implementation plan even where one is not required.

- EPA's memorandum on the "5m" listing subcategory includes some recommended elements of a comprehensive multi-media mercury reduction program for states to consider, including recommendations to address air sources; multimedia sources; reduction goals and targets; monitoring; public reporting and documentation, and coordination across states. States are encouraged to consider a multi-media approach to reducing mercury sources, even where air deposition is the predominant source. As described in the "5m" memorandum, some implementation activities that states may wish to consider are as follows:

  - Air sources: As described under Sections 5 and 7 above, states are not required to identify contributions from individual nonpoint sources or source categories; however, identifying such contributions can assist in developing a targeted implementation plan. For the in-state mercury air sources over which a state has control, particularly the most significant sources, implementation may include adopting appropriate emissions reduction measures using authorities other than the Clean Water Act. States should continue to carry out existing delegated and/or approved Federal air program requirements. States are encouraged to address sources not already covered by Federal standards/programs, taking into account the mix of sources contribution to local and regional deposition. States should also evaluate cumulative emissions from sources other than the highest and adopt controls as appropriate.

  - Water point sources: In the case of waters impaired by mercury predominantly from air deposition, States may consider implementing cost-effective pollutant minimization plans for waste water treatment plants and industrial discharges. A number of approved mercury TMDLs have included pollutant minimization plans for point sources.[38] For implementation of the WLA by permitted stormwater sources, see discussion under sections above on WLAs and reasonable assurance.

  - Multi-media sources: Mercury sources such as mercury in products in waste may have cross-media impacts. Examples of programs to address these sources include development and/or promotion of mercury-free alternatives where appropriate, working with industry and local governments, and public outreach and communication regarding mercury-containing products.

[38] Examples include the Ochlokonee and other Georgia TMDLs, the Minnesota "statewide" mercury TMDL, and Northeast regional mercury TMDL, among others.

Recommended TMDL Elements and Factors To Consider in Developing Mercury TMDLs

12. Implementation, cont.

All scales, cont.

- A number of states have adopted collection and recycling programs for automobile switches, thermostats, thermometers, fluorescent lights, and batteries. Some states have adopted bans or phase-outs of certain products. Other programs include efforts to reduce or eliminate mercury in schools, and discharges from hospitals and dental offices.[39]

- At the Federal level, EPA actions to address mercury are summarized in the Agency's *Roadmap for Mercury*.[40] TMDLs should take into account these actions where possible.

- There are some efforts planned to test ways to reduce or inhibit the methylation of mercury through modification of chemical factors that affect methylation (e.g., aeration). Such methods are being evaluated where mercury is primarily due to legacy sources of mercury. EPA will provide additional information on such approaches as it becomes available, and where such methods would be appropriate.

➢ Where appropriate, states may wish to use "adaptive implementation," which is an "an iterative implementation process that makes progress toward achieving water quality goals while using any new data and information to reduce uncertainty and adjust implementation activities."[41] In implementing a TMDL, states may modify activities as new information on assumptions in the TMDL, such as the proportionality assumption described in Section 3 above, becomes available. Mercury TMDLs have also used a "staged" implementation approach, in which implementation is staged over a period of time, with reduction goals to be met in several phases.[42]

Multi-state scale:

➢ In addition to the above considerations, programs to be described should include mercury reduction programs in each state, as well as any coordinated multi-state mercury reduction efforts.

[39] Examples of State mercury reduction programs can be found in the Environmental Council of States 2005 Mercury Compendium at http://www.ecos.org/section/2005_mercury_compendium.

[40] The EPA *Roadmap for Mercury* is available at http://www.epa.gov/mercury/roadmap.htm.

[41] See "Clarification Regarding "Phased" Total Maximum Daily Loads" at http://www.epa.gov/owow/tmdl/tmdl_clarification_letter.html. Also see National Research Council, 2001. Assessing the TMDL Approach to Water Quality Management . National Academy Press. Washington, DC. and Nicholas Institute for Environmental Policy Solutions, Duke University, 2007. Adaptive Implementation of Water Quality Improvement Plans; Opportunities and Challenges, at http://www.nicholas.duke.edu/institute/adaptive-water.pdf.

[42] See Northeast Regional Mercury TMDL at http://www.neiwpcc.org/mercury/MercuryTMDL.asp