NEIWPCC
New England Interstate Water Pollution Control Commission

Fostering Collaboration on Water Issues
Training Environmental Professionals
Coordinating Water Research
Educating the Public

OCT 28 2008

Mr. Stephen Johnson
USEPA Headquarters
Ariel Rios Building
1200 Pennsylvania Avenue, N.W.
Mail Code: 1101A
Washington, DC 20460

Re: Clean Water Act Section 319(g) Petition

Dear Administrator Johnson:

In accordance with Section 319(g) of the Clean Water Act, the New England states and New York State have prepared a petition requesting a management conference to address waterbodies impaired by atmospheric deposition of mercury. This collaborative effort, coordinated by the New England Interstate Water Pollution Control Commission, reflects the consensus within our states over how to address an important regional priority. We respectfully submit the petition to U.S. EPA for your consideration.

Our states' strong commitment to mercury reduction has eliminated almost all in-region sources of mercury. U.S. EPA approved the Northeast Regional Mercury TMDL in December 2007. We have demonstrated in that TMDL that between 1998 and 2002 the Northeast states have reduced in-region deposition of mercury by over 70 percent. Further, we have enforceable controls in place to meet the remaining reduction goals. Yet water quality impairments due to atmospheric deposition of mercury still exist, and elevated mercury levels in certain fish species remain a great concern. A significant reduction in the mercury reaching our waters from sources outside the region is essential. The Northeast states are using the Section 319(g) Petition and associated management conference as the tool to implement the TMDL and control out-of-region sources of mercury pollution.

It is our belief that eliminating our fish consumption advisories deserves to be a national priority addressed through federal programs that will meet the reduction targets in the Northeast Regional Mercury TMDL. We appreciate EPA's consideration of this petition and look forward to working with you to set up the management conference.

Sincerely,

Alicia Good, Rhode Island DEM
Chair, NEIWPCC Executive Committee

Ronald Poltak
Executive Director, NEIWPCC

Cc:
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UNITED STATES OF AMERICA
ENVIRONMENTAL PROTECTION AGENCY

In re: Clean Water Act § 319(g) Petition of the States of Connecticut, Maine, New Hampshire, New York, Rhode Island, Vermont, and the Commonwealth of Massachusetts	)))))	No. ________

CLEAN WATER ACT § 319(g) PETITION

The States of Connecticut, Maine, New Hampshire, New York, Rhode Island, Vermont and the Commonwealth of Massachusetts (Petitioning States), pursuant to 33 U.S.C. § 1329(g), hereby petition the Administrator to convene an Interstate Management Conference (Conference) of all states contributing significant nonpoint source mercury pollution to the Petitioning States' waters. "The purpose of such Conference shall be to develop an agreement among such States to reduce the level of pollution…resulting from nonpoint sources and to improve the water quality…" It is the Petitioning States' goal for the conference to meet designated uses and water quality standards for mercury within their region through the implementation of plant-specific Maximum Achievable Control Technology (MACT) limits for mercury by EPA under Section 112(d) of the Clean Air Act. MACT is expected to control power plant emissions by 90 percent using cost-effective and available technologies.

1. The Petitioning States' waters, fish and other fauna are highly contaminated with mercury. Mercury, particularly methylmercury – the form of mercury found in fish – is an extremely potent neurotoxin. Infants, children,

pregnant women, and women of child-bearing age are most at risk from this widespread poison.

2. Each of the Petitioning States has Clean Water Act (CWA) designated uses of fishing and fish consumption for most of their waters. Mercury pollution prevents compliance with these designated uses and with water quality criteria implementing these uses. Consequently, each of the Petitioning States has issued advisories limiting the types and amounts of fish that can be eaten, which constitutes an impairment of waters under Sec. 303(d) of the CWA.

3. Each of the Petitioning States has water quality criteria for mercury in water and/or in fish that, in part, implement water quality standards consistent with Sec. 303(a) of the CWA. Further, states are required under Sec. 303(d) of the CWA to develop Total Maximum Daily Load (TMDL) analyses for all impaired waters. Hence, in fulfilling these legal requirements of the CWA, each Petitioning State is subject to the Northeast Regional Mercury TMDL (TMDL) for mercury impairments in inland waters, which was approved by EPA on December 20, 2007.

4. The TMDL identified mercury from atmospheric deposition as the primary cause of the impairment. Compliance with the TMDL requires a 74 to 91 percent reduction in fish tissue mercury concentrations. For the Petitioning States to meet the reduction targets of the regional mercury TMDL, atmospheric deposition of mercury in the Petitioning States will have to be reduced by at least 98 percent relative to 1998 levels. An interim goal of reducing the deposition of mercury by at least 75 percent by 2010 has been established. The TMDL goals will

be reevaluated at that time to assure its full implementation and compliance. A copy of the TMDL and EPA's approval document are attached as Exhibits A and B.

5. According to a March 2008 Northeast States for Coordinated Air Use Management (NESCAUM) study, based on data from 2002, U.S. sources contribute approximately 30 percent of the atmospheric mercury deposition in the Northeast region. In-region sources contribute approximately one-half of the atmospheric mercury deposition from U.S. sources within the Petitioning States, although individual state contributions vary. Approximately 48 percent of the Petitioning States' atmospheric mercury deposition from U.S. sources originates from states outside of the region. The out-of-region states with the most significant contributions (and each state's portion of the deposition attributable to U.S. sources in 2002)[*] are:

Commonwealth of Pennsylvania (21.7%)

State of New Jersey (5.6%)

State of Ohio (5.5%)

State of West Virginia (3.9%)

State of Maryland (3.7%)

State of Michigan (2.0%)

Commonwealth of Virginia (1.5%)

State of Indiana (1.3%)

State of Kentucky (1.2%)

[*] Percentages listed in this paragraph and in paragraphs 21, 26, 31, 36, 41, 46, and 51, are based on 2002 data and refer to the portion of atmospheric mercury deposition from U.S. sources that each state contributes to deposition in the region or a particular state.

State of North Carolina (1.1%)

State of Illinois (0.9%)

Other studies are consistent with the findings of this report in terms of the amount and relative importance of atmospheric mercury deposition to the Petitioning-State region from out-of-region sources in the U.S. A copy of the March 2008 NESCAUM Report is attached as Exhibit C.

6. Each Petitioning State has and is implementing stringent programs to control and eliminate in-state sources of mercury pollution to meet TMDL requirements. But because out-of-region mercury significantly contributes to mercury pollution in the Petitioning States, the Petitioning States' programs alone cannot bring the Petitioning States into compliance with water quality standards and the regional TMDL. The Conference of the New England Governors and Eastern Canadian Premiers (NEG-ECP) is an organization of the governors of the six New England states and the premiers of the five Eastern Canadian provinces. The governors and premiers collaborate on regional issues and take action on policy areas including the environment, energy, economic development, trade, security, and ocean issues. In 1998, a regional Mercury Action Plan (MAP) developed by representatives of the states and provinces was approved by the NEG-ECP. The MAP identifies steps to address those aspects of the mercury problem in the region that are within the region's control or influence and sets an overall regional goal to virtually eliminate the discharge of anthropogenic mercury into the environment to ensure that serious or irreversible damage attributable to these sources is not

inflicted upon human health and the environment. The MAP set forth goals of 50 percent reduction of regional mercury emissions by 2003, and 75 percent reduction by 2010. In 2003, it was reported that the goal of 50 percent had been exceeded with reductions achieved amounting to approximately 55 percent. When considering only the New England states plus New York State, the emissions reduction in the same time period was approximately 70 percent. This overall reduction was primarily due to an 87 percent reduction in emissions from municipal waste combustors (MWCs), a 97 percent reduction in emissions from medical waste incinerators (MWIs), and a 100 percent reduction in emissions from chlor-alkali facilities.

7. Out-of-region U.S. sources of atmospheric mercury contribute significantly to, and share responsibility for, the toxic mercury in the Petitioning States' fish and wildlife, and the potential effects on the humans who consume them. The significant mercury pollution from out-of-region sources contributes to both violations of State water quality standards and EPA's methylmercury fish tissue criterion, and must be significantly reduced to meet the regional TMDL.

8. EPA classifies atmospheric deposition as nonpoint source water pollution. See http://www.epa.gov/OWOW/NPS/qa.html (atmospheric deposition is nonpoint source pollution).

9. The sources of atmospheric mercury deposition fall within § 319, 33 U.S.C. § 1329.

10. Therefore, the Petitioning States are not meeting CWA requirements regarding mercury as a result, in whole or in part, of nonpoint sources from other States.

11. Further, the CWA's fundamental goal of "fishable" waters, and the Petitioning States' designated uses of fishing and fish consumption are not being met, at least in part, because of significant nonpoint mercury pollution from other States originating from atmospheric emissions transported to and deposited within the Petitioning States.

12. Section 319(g)(1) provides that: (1) if any portion of navigable waters, in a State which is implementing an approved 319 plan (2) "is not meeting applicable water quality standards or the goals and requirements of this chapter" (3) "as a result, in whole or in part, of pollution from nonpoint sources in another State," (4) "such [receiving] State may petition the Administrator to convene, and the Administrator shall convene, a management conference of all States which contribute significant pollution resulting from nonpoint sources to such portion." The Conference's purpose "shall" be to forge an agreement to reduce the sources of nonpoint source pollution from the source state(s).

13. The Administrator's duty is not discretionary, but mandatory. Section 319(g) repeatedly uses the word "shall." The Administrator must convene a Conference, and the Conference's purpose is clearly established.

14. Each Petitioning State has an approved § 319 plan covering portions of its navigable waters, including portions impaired by mercury pollution.

15. The Northeast Regional Mercury TMDL relied on a regional fish tissue mercury database compiled from agencies and organizations in the participating states. The dataset contains mercury measurements for 64 freshwater fish species with yellow perch and brook trout being the most prevalent species. For the purpose of the TMDL, length-standardized mercury concentrations were calculated for four species: smallmouth bass, largemouth bass, walleye, and yellow perch. The standard length and mean and 90th percentile mercury concentrations for standard length fish are shown in the table below. For all fish species, mean and 90th percentile concentrations exceed EPA's recommended methylmercury fish tissue criterion of 0.3 mg/kg.

Standard Lengths and Mercury Concentrations of Selected Freshwater Fish Species in the Northeast

Species	Standard Length (cm)	Mean Hg Concentration (mg/kg) at Standard Length*	90th percentile Hg Concentration (mg/kg) at Standard Length
Smallmouth bass (*Micropterus dolomieu)*	32	0.69	1.14
Largemouth bass (*Micropterus salmoides*)	36	0.61	1.05
Yellow perch (*Perca flavenscens*)	20	0.38	0.69
Walleye (*Sander vitreus*)	45	0.60	0.93

16. While both the in-region and out-of-region states (petitioning and non-petitioning) have made changes to their mercury reduction programs since the 2002 timeframe upon which the 2008 NESCAUM study and report are based, the benefits of those changes may not be reflected in the study. Also, because full

implementation of mercury management programs has not yet occurred, and anticipated improvements will not attain mercury standards in the Petitioning States, this petition remains necessary. A key goal for the Conference will be to ascertain the adequacy of both in-region and out-of-region mercury reduction programs and initiatives in meeting CWA requirements for mercury impairments in the Petitioning States.

Connecticut

17. The State of Connecticut has mercury water quality criteria for protection of aquatic life and for protecting human health. These criteria are shown in the table below. Connecticut does not monitor water for mercury, but monitors mercury in fish tissue.

	Aquatic Life				Human Health	
	Freshwater		Saltwater		Consumption of Water and Organisms µg/l	Consumption of Organisms Only µg/l
	Chronic µg/l	Acute µg/l	Chronic µg/l	Acute µg/l		
Criterion	0.77	1.4	0.94	1.8	0.05	0.051

18. Connecticut's designated use of fishing and fish consumption is impaired by mercury pollution. Its Department of Public Health uses 0.1 parts per million (mg/kg) as a threshold for issuing fish consumption advisories. In the spring of 1997, a statewide consumption advisory was issued due to mercury in fish tissue attributed to atmospheric deposition. As a result of this blanket advisory, Connecticut's designated use of fish consumption is not fully met. Further, several

water bodies in Connecticut have fish with particularly high mercury levels and separate advisories. The designated use of fish consumption clearly is not met in these particular waters.

19. Approximately 42 percent of Connecticut's mercury deposition from U.S. sources is from in-state sources.

20. Connecticut passed legislation in 2002 that implements a phase-out of mercury-added products, requires product labeling, bans the sale or distribution of certain mercury products, requires manufacturers to initiate collection programs, establishes best management practices for dentists, and limits the sale of elemental mercury. Connecticut also has stringent emissions standards for solid waste combustors. Legislation passed in 2003 requires Connecticut's two coal-fired electric power generating facilities to reduce mercury emissions by 90 percent from the amount of mercury in the coal burned, starting in 2008. Connecticut further implemented regulations for these two coal-fired electric power generating facilities effective May 29, 2007, creating a "state mercury mass emissions cap." This cap limits emissions from existing and any new coal-fired electric generating unit to 106 pounds of mercury per calendar year for the period beginning January 1, 2010, through December 31, 2017. The cap is further lowered to 42 pounds of mercury per calendar year beginning January 1, 2018.

21. Out-of-region sources are significant contributors of atmospheric mercury deposition in Connecticut. Such pollution prevents Connecticut from meeting the CWA's goals. The Non-Petitioning States with the most significant

contributions to atmospheric mercury deposition to Connecticut (and each state's portion of the deposition attributable to U.S. sources in 2002) are:

Commonwealth of Pennsylvania (11.4%)

State of New Jersey (7.3%)

State of Maryland (3.1%)

State of West Virginia (1.6%)

State of Ohio (1.6%)

Commonwealth of Virginia (1.5%)

Maine

22. Maine has mercury water quality criteria for protection of aquatic life and a fish tissue criterion for protecting human health. These criteria are shown in the table below.

	Aquatic Life				Human Health
	Freshwater		Saltwater		Consumption of Organisms Only (Fish Tissue Criterion) mg/kg
	Chronic µg/l	Acute µg/l	Chronic µg/l	Acute µg/l	
Criterion	0.91	1.7	1.1	2.1	0.2

23. Maine has ample documentation of widespread violations of these criteria with 1,800 data points at over 200 lakes. Mercury in fish tissue is 0.62 mg/kg at the 50th percentile. High mercury levels are also found in fish-eating birds.

24. Approximately 30.3 percent of mercury deposition in Maine from U.S. sources is from in-state sources.

25. Maine has a comprehensive mercury reduction and elimination program that addresses air emissions, water discharges, products and waste. In-state facilities are currently limited to 35 lbs. (15.9 kg) of mercury emissions per facility per year and that limit drops to 25 lbs. (11.4 kg) in 2010. Facilities emitting over 10 lbs./year must have submitted a mercury reduction plan by September 2008. Wastewater discharges are regulated with effluent limits and mandatory mercury reduction plans. Amalgam separator installation is mandatory with no affected facilities known to be out of compliance. Products are regulated where comprehensive restrictions exist for most switches, relays and measuring devices, and consumer products. Remaining products in commerce (such as fluorescent lamps) require labeling, notification and appropriate disposal (recycling). Appropriate disposal restrictions apply to both businesses and households.

26. Out-of-region sources are significant contributors of atmospheric mercury deposition in Maine. Such pollution prevents Maine from meeting the CWA's goals. The Non-Petitioning States with the most significant contributions to atmospheric mercury deposition to Maine (and each state's portion of the deposition attributable to U.S. sources in 2002) include:

Commonwealth of Pennsylvania (15.5%)

State of Ohio (4.3%)

State of Maryland (3.3%)

State of West Virginia (3.2%)

State of New Jersey (3.0%)

State of Michigan (2.0%)

State of Indiana (1.6%)

Commonwealth of Virginia (1.5%)

State of North Carolina (1.5%)

State of Kentucky (1.4%)

State of Illinois (1.3%)

Massachusetts

27. Massachusetts has mercury water quality criteria for the protection of aquatic life and a fish tissue criterion for protecting human health. These criteria are shown in the table below.

	Aquatic Life				Human Health
	Freshwater		Saltwater		Consumption of Organisms Only (Fish Tissue Criterion) mg/kg
	Chronic µg/l	Acute µg/l	Chronic µg/l	Acute µg/l	
Criterion	0.77	1.4	0.94	1.8	0.3

28. Violation of Massachusetts's fish tissue criterion is widespread throughout the state. Fish consumption advisories (based on the FDA advisory of 0.5 mg/kg for sensitive populations) have been posted for fish from over 100 fresh water bodies. The Department of Public Health has also posted advisories for certain saltwater fish found in Massachusetts waters.

29. Approximately 51.1 percent of mercury deposition from U.S. sources in Massachusetts is from in-state sources.

30. Massachusetts has taken precise steps to quantify in-state mercury sources and impose maximum controls on such sources. Massachusetts' Mercury Management Act requires end-of-life recycling of mercury-containing products, prohibits disposal of mercury in trash and wastewater, bans the sale of specific products containing mercury, directs schools and state government to stop purchasing mercury-containing items, establishes a program for removing switches from vehicles, and requires manufacturers both to notify the state of products with mercury content and to establish end-of-life collection and recycling programs. Massachusetts also has regulations for coal-fired power plants that required 85 percent capture of mercury in coal burned by the beginning of 2008 and require 95 percent capture by October 1, 2012.

31. Out-of-region sources are significant contributors of atmospheric mercury deposition in Massachusetts. Such pollution prevents Massachusetts from meeting the CWA's goals. The Non-Petitioning States with the most significant contributions to atmospheric mercury deposition to Massachusetts (and each state's portion of the deposition attributable to U.S. sources in 2002) include:

Commonwealth of Pennsylvania (8.3%)

State of New Jersey (3.5%)

State of Maryland (2.8%)

State of West Virginia (1.5%)

State of Ohio (1.5%)

Commonwealth of Virginia (1.2%)

New Hampshire

32. New Hampshire has mercury water quality criteria for protection of aquatic life and for protecting human health. These criteria are shown in the table below.

	Aquatic Life				Human Health	
	Freshwater		Saltwater		Consumption of Water and Organisms µg/l	Consumption of Organisms Only µg/l
	Chronic µg/l	Acute µg/l	Chronic µg/l	Acute µg/l		
Criterion	0.77	1.4	0.94	1.8	0.05	0.051

33. Every water body in New Hampshire is listed as impaired for fish consumption due to a statewide fish consumption advisory for mercury. Fish consumption is a designated use for all of these waters.

34. Approximately 32.9 percent of New Hampshire's mercury deposition from U.S. sources is from in-state sources.

35. New Hampshire has no medical waste incinerators. It has two municipal waste incinerators with aggressive mercury controls. New Hampshire legislation puts restrictions on the mercury content of batteries, establishes notification requirements for manufacturers of mercury-added products, and bans the sale of mercury fever thermometers and toys, games, cards, ornaments, or novelties that contain mercury. New Hampshire requires 80 percent reduction of mercury emissions from coal-fired power plants using scrubber technology by July 1, 2013. New Hampshire is taking all prompt, reasonable steps to control in-state sources. In sum, at least a significant portion of nonpoint mercury pollution

originates from other states. This pollution prevents New Hampshire from meeting its designated use of fish consumption.

36. Out-of-region sources are significant contributors of atmospheric mercury deposition in New Hampshire. Such pollution prevents New Hampshire from meeting the CWA's goals. The Non-Petitioning States with the most significant contributions to atmospheric mercury deposition to New Hampshire (and each state's portion of the deposition attributable to U.S. sources in 2002) include:

Commonwealth of Pennsylvania (12.9%)

State of New Jersey (3.7%)

State of Maryland (3.6%)

State of Ohio (3.0%)

State of West Virginia (2.6%)

Commonwealth of Virginia (1.5%)

State of North Carolina (1.3%)

State of Michigan (1.2%)

State of Indiana (1.0%)

State of Kentucky (0.9%)

New York

37. New York has mercury water quality criteria for protection of aquatic life, human health, and wildlife. These criteria are shown in the table below.

	Aquatic Life (Freshwater)		Human Health		Wildlife µg/l
	Chronic µg/l	Acute µg/l	Consumption of Water µg/l	Consumption of Organisms µg/l	
Criterion	0.77	1.4	0.7	0.0007	0.0026

38. New York has designated uses of fishing and fish consumption for virtually all of its waters. Health advisories for mercury prevent these uses from being met. The health advisory threshold for fish tissue is 1.0 mg/kg. New York has amply documented increasingly widespread violations of this advisory. The bulk of these violations are in areas of the state that are remote and susceptible to out-of-state emissions, particularly from Mid-western sources. Hence, New York's designated uses of fishing and fish consumption are not being met and this is due, at least in part, to out-of-state nonpoint sources.

39. Approximately 30.2 percent of New York's mercury deposition from U.S. sources is from in-state sources.

40. New York requires a 50 percent decrease in mercury emissions from coal-fired power plants by January 1, 2010, and then will implement a unit-based limit for each power plant facility that will result in an estimated 90 percent decrease from current levels. A law adopted in September 2005 prohibits the sale and distribution of many mercury-added products and requires manufacturers and trade associations dealing in mercury-added products to report certain information to the state.

41. Out-of-region sources are significant contributors of atmospheric mercury deposition in New York. Such pollution prevents New York from meeting the CWA's goals. The Non-Petitioning States with the most significant contributions to atmospheric mercury deposition to New York (and each state's portion of the deposition attributable to U.S. sources in 2002) include:

Commonwealth of Pennsylvania (28.9%)

State of Ohio (7.6%)

State of New Jersey (6.5%)

State of West Virginia (5.1%)

State of Maryland (4.0%)

State of Michigan (2.7%)

State of Indiana (1.7%)

Commonwealth of Virginia (1.6%)

State of Kentucky (1.5%)

State of North Carolina (1.2%)

State of Illinois (1.1%)

Rhode Island

42. Rhode Island has mercury water quality criteria for protection of aquatic life and for protecting human health. These criteria are shown in the table below.

	Aquatic Life				Human Health	
	Freshwater		Saltwater		Consumption of Water and Organisms µg/l	Consumption of Organisms Only µg/l
	Chronic µg/l	Acute µg/l	Chronic µg/l	Acute µg/l		
Criterion	0.77	1.4	0.94	1.8	0.14	0.15

43. Fishing and fish consumption are designated uses in all Rhode Island waters. Rhode Island data demonstrate that fish in 19 ponds and 3 river segments exceed the health advisory for mercury and prevent these designated uses from being met. These waters are listed as impaired for mercury. Atmospheric deposition is the most significant, if not only known source of mercury to these 19 mercury-impaired ponds and reservoirs. These sources include those from outside the New England region.

44. Approximately 19.9 percent of mercury deposition from U.S. sources in Rhode Island is from in-state sources.

45. Rhode Island has taken significant steps to control in-state mercury sources. Out-of-state sources are partially, if not primarily, responsible for their mercury impairments. The Mercury Reduction and Education Act requires the phase-out of mercury-added products, labeling, collection plans, bans on certain products, and elimination of mercury from schools. Legislation now requires removal and collection of mercury switches from automobiles.

46. Out-of-region sources are significant contributors of atmospheric mercury deposition in Rhode Island. Such pollution prevents Rhode Island from meeting the CWA's goals. The Non-Petitioning States with the most significant

contributions to atmospheric mercury deposition to Rhode Island (and each state's portion of the deposition attributable to U.S. sources in 2002) include:

Commonwealth of Pennsylvania (9.0%)

State of New Jersey (4.9%)

State of Maryland (2.8%)

State of Ohio (1.6%)

Commonwealth of Virginia (1.4%)

State of West Virginia (1.3%)

Vermont

47. Vermont has mercury water quality criteria for protection of aquatic life and for protecting human health. These criteria are shown in the table below. The most recent (2000) Vermont Water Quality Standards also reference the FDA mercury advisory limit of 1.0 mg/kg to determine whether fish advisories are needed and hence whether the designated use of fishing can be met.

	Aquatic Life (Freshwater)		Human Health	
	Chronic µg/l	Acute µg/l	Consumption of Water and Organisms µg/l	Consumption of Organisms Only µg/l
Criterion	0.012	2.4	0.14	0.15

48. Four Vermont water bodies are in violation of the chronic aquatic life standard. These water bodies are representative of other Vermont waters, indicating that approximately 15 percent of all Vermont water bodies larger than 20

acres are in violation. Vermont has significant documentation of widespread violations of the FDA limit. Approximately 10 percent of all Vermont fish tested exceed the 1.0 mg/kg mercury level. Vermont has issued advisories prohibiting or limiting the consumption of certain fish under certain circumstances. This includes limits on eating fish from specific water bodies. Fishing is a designated use of all the waters subject to these advisories.

49. Approximately 3.2 percent of Vermont's mercury deposition from U.S. sources is from in-state sources.

50. Vermont has no coal burning plants, municipal incinerators or medical waste incinerators. Vermont has a mercury labeling and recycling law, thus reducing to the greatest practical amount sources of mercury from light bulbs and other mercury-containing products. In short, there are few if any in-state sources, and maximum controls govern those that do exist. No other practical in-state steps can be taken to assure compliance.

51. Out-of-region sources are significant contributors of atmospheric mercury deposition in Vermont. Such pollution prevents Vermont from meeting the CWA's goals. The Non-Petitioning States with the most significant contributions to atmospheric mercury deposition to Vermont (and each state's portion of the deposition attributable to U.S. sources in 2002) include:

Commonwealth of Pennsylvania (18.9%)

State of Ohio (5.1%)

State of New Jersey (4.7%)

State of Maryland (4.5%)

State of West Virginia (3.5%)

State of Michigan (1.9%)

State of North Carolina (1.6%)

Commonwealth of Virginia (1.5%)

State of Indiana (1.5%)

State of Kentucky (1.3%)

State of Illinois (0.9%)

Contributing States

52. The Commonwealths of Pennsylvania and Virginia, and the States of New Jersey, Ohio, West Virginia, Maryland, Michigan, Indiana, Kentucky, North Carolina, and Illinois each contribute significant nonpoint source mercury pollution that, in whole or in part, prevents the goals of the Clean Water Act from being met in each of the Petitioning States.

WHEREFORE, the Petitioning States respectfully request the Administrator to:

A. Promptly convene a Management Conference of all relevant states, including both the Petitioning States and each of the above-listed Contributing States that contribute significant mercury pollution to the Petitioning States' waters;

B. Determine the degree to which the Contributing States are contributing significant nonpoint source mercury pollution to the Petitioning States' waters;

C. Develop an agreement among the Contributing States that will assure improvement of the Petitioning States' water quality and compliance with Clean Water Act requirements and each Petitioning State's water quality standards by implementing plant-specific MACT limits for mercury under Section 112(d) of the Clean Air Act to control power plant emissions by 90 percent by cost-effective and available technologies;

D. Include Petitioning States at all meetings and in making all determinations; and,

E. Provide all other appropriate relief.

Dated: October 15, 2008

Commissioner Gina McCarthy
Connecticut Department of Environmental Protection

Commissioner David P. Littell
Maine Department of Environmental Protection

Commissioner Laurie Burt
Massachusetts Department of Environmental Protection

Commissioner Thomas S. Burack
New Hampshire Department of Environmental Services

Commissioner Alexander B. Pete Grannis
New York State Department of Environmental Conservation

W. Michael Sullivan

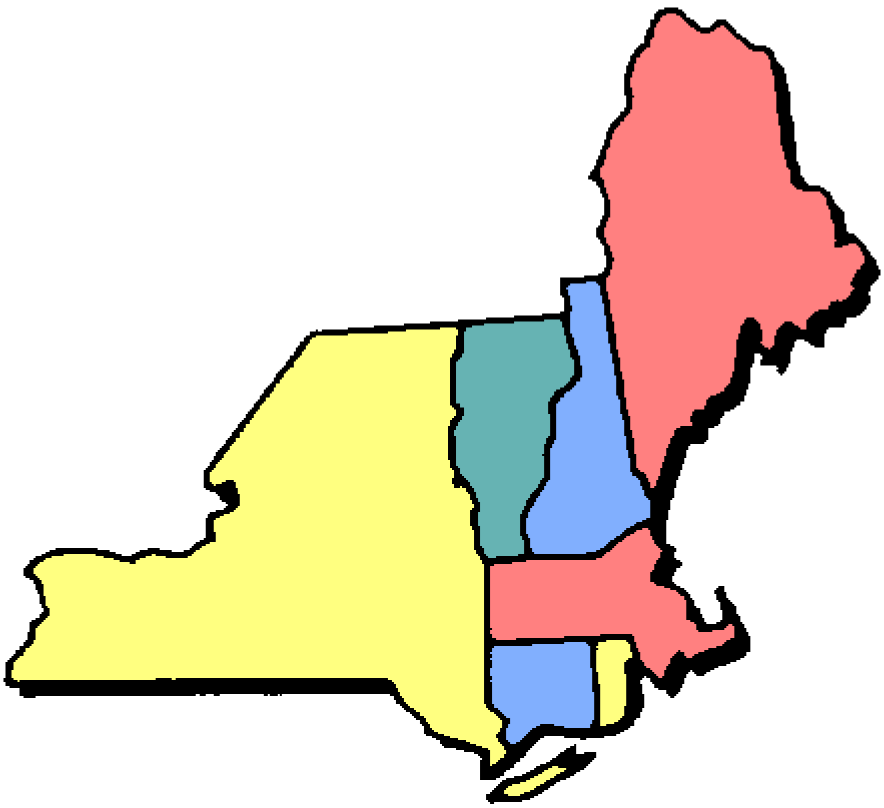
Director W. Michael Sullivan
Rhode Island Department of Environmental Management

Laura Q. Pelosi

Commissioner Laura Q. Pelosi
Vermont Department of Environmental Conservation

Exhibit A: Northeast Regional Mercury Total Maximum Daily Load

Northeast Regional Mercury Total Maximum Daily Load



Connecticut Department of Environmental Protection
Maine Department of Environmental Protection
Massachusetts Department of Environmental Protection
New Hampshire Department of Environmental Services
New York State Department of Environmental Conservation
Rhode Island Department of Environmental Management
Vermont Department of Environmental Conservation
New England Interstate Water Pollution Control Commission

October 24, 2007

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Acknowledgements

This TMDL was developed by a technical committee made up of representatives of each of the Northeast states and the New England Interstate Water Pollution Control Commission (NEIWPCC). Team members include Traci Iott and Paul Stacey (Connecticut DEP); Andrew Fisk and Barry Mower (Maine DEP); Rick Dunn, Russell Isaac, and C. Mark Smith (Massachusetts DEP); Gregg Comstock, Robert Estabrook, and Peg Foss (New Hampshire DES); Jay Bloomfield, Dick Draper, Ron Entringer, and Scott Quinn (New York State DEC); Scott Ribas and Elizabeth Scott (Rhode Island DEM); Tim Clear and Neil Kamman (Vermont DEC); and Beth Card and Susannah King (NEIWPCC). The team acknowledges the support of the NEIWPCC Executive Committee, as well as support from their agencies, and assistance from other divisions and agencies in the development of the TMDL. The team also acknowledges the assistance of the Northeast States for Coordinated Air Use Management (NESCAUM), who provided vital information for this effort.

The TMDL was modeled closely after the Minnesota Pollution Control Agency's Minnesota Statewide Mercury Total Maximum Daily Load and thus many of the concepts and ideas are applied in this document. The Northeast Regional Mercury TMDL project team acknowledges the excellent work put forth by Minnesota and thanks them for their contribution to reducing mercury in the environment.

Executive Summary

Mercury is a potent neurotoxin that poses risks to human health. Exposure to this toxic metal occurs when humans consume fish that contain mercury's most toxic form, methylmercury. The majority of mercury in the environment is released into the air, but it reaches waterbodies through atmospheric deposition. In order to protect their populations from the harmful effects of mercury, states issue fish consumption advisories that provide information on the types and quantities of fish that can be safely consumed. Six of the seven Northeast states have statewide fish consumption advisories for mercury for all freshwaters. However, fish consumption advisories are intended to be temporary until pollution can be reduced to levels that allow for safe fish consumption.

This Total Maximum Daily Load (TMDL) document outlines a strategy for reducing mercury concentrations in fish in Northeast fresh waterbodies so that water quality standards can be met. This will require reductions from mercury sources within the Northeast region, U.S. states outside of the region, and global sources. In the Northeast, the majority of mercury pollution is a result of atmospheric deposition. Thus, the TMDL is based primarily on reduction of atmospheric deposition, which can be achieved through reductions in anthropogenic mercury emissions.

Impaired Waters

In the Northeast, over 10,000 lakes, ponds, and reservoirs, and over 46,000 river miles are listed as impaired for fish consumption primarily due to atmospheric deposition of mercury. Many of these waterbodies are listed due to statewide fish consumption advisories for mercury. Section 303(d) of the Clean Water Act requires that states develop TMDLs for impaired waters by establishing the allowable pollutant loading from all contributing sources at a level necessary to achieve the applicable water quality standards. The TMDL allocates load between point sources (wasteload allocation) and nonpoint sources (load allocation).

Existing and Target Fish Tissue Concentrations

A regional fish tissue database was used to calculate mean, 80^{th}, and 90^{th} percentile mercury concentrations for standard length fish. Four fish species were considered, but smallmouth bass was chosen as the target fish. The 80^{th} and 90^{th} percentile mercury concentrations for a standard length (32 cm) smallmouth bass are 0.860 ppm and 1.14 ppm, respectively. The TMDL was calculated as the 90^{th} percentile mercury concentration for smallmouth bass, which equates to the 96^{th} percentile of all fish. Although the 90^{th} percentile fish concentration has been chosen as the TMDL target, in order to address uncertainty, all TMDL calculations are shown for the range from the 80^{th} to 90^{th} percentile fish tissue concentration. Because this TMDL is for seven states with different criteria for fish tissue mercury, the EPA fish tissue criterion for methylmercury of 0.3 ppm is used as the initial target fish tissue concentration for the regional TMDL. Two states, Connecticut and Maine, use fish tissue criteria more stringent than 0.3 ppm that will be achieved in later stages of TMDL implementation. TMDL calculations based on these criteria are provided in Appendix B. It should be noted that the goal of this TMDL is to use adaptive implementation to achieve a target of 0.3 ppm for Massachusetts, New Hampshire, New York, Rhode Island, and Vermont; 0.2 ppm for Maine, and 0.1 ppm for Connecticut. Such an approach will allow all of the Northeast states to meet or exceed their designated uses.

Mercury Sources

In a general sense, regional sources of mercury pollution include wastewater discharges and atmospheric deposition. The mercury wastewater load was estimated using a regional median mercury effluent concentration calculated from all appropriate available mercury effluent data in the region and the sum of

design flows for NPDES permitted facilities in the region (excluding facilities that primarily discharge cooling water or discharge to marine waters). Based on a regional median effluent concentration of 7.7 ng/l and sum of design flows of 13,322 MGD, the wastewater load is estimated to be 141 kg/yr.
The 1998 Northeast Regional Mercury Emissions Inventory provides estimates of mercury emissions from a number of sources in the Northeast and is considered the baseline for purposes of establishing needed reductions. 1998 was prior to the enactment of significant mercury reduction requirements in the region and therefore represents an appropriate baseline to correspond with measured fish tissue concentrations. Total emissions for the region are reported as 12,494 kg/yr. Modeling of 1998 mercury emissions data produces an estimate of the amount of mercury deposited to the region from regional, national, and international sources. Based on this modeling, the baseline mercury atmospheric deposition load to the region is 6,506 kg/yr, with 4,879 kg attributable to anthropogenic sources.

Calculation of TMDL

The steps used to calculate the TMDL are outlined in Table ES-1. Using the existing fish concentration 1.14 ppm, and the initial target fish tissue mercury concentration of 0.3 ppm, a reduction factor of 0.74 was calculated. It should be noted that the TMDL was calculated in a way that sets multiple target endpoints that are geographically based. The goal of this TMDL is to use adaptive implementation to achieve a target of 0.3 ppm for Massachusetts, New Hampshire, New York, Rhode Island, and Vermont; 0.2 ppm for Maine, and 0.1 ppm for Connecticut. The total existing source load was calculated from the point source load (wastewater discharges) and nonpoint source load (atmospheric deposition based on modeling of mercury emissions), and is equal to 6,647 kg/yr. The TMDL was then calculated using the total source load and the reduction factor. The wasteload allocation was determined by keeping the wastewater contribution equal to the same percentage as it was in the total source load. The load allocation was calculated by subtracting the wasteload allocation from the TMDL and then was divided between natural[1] and anthropogenic sources. Because over 97 percent of the total load is due to atmospheric deposition, reductions focus on the load allocation. Necessary reductions were divided into three phases, 1998-2003, 2003-2010, and 2010 on, and were also allocated between in-region and out-of-region sources.

[1] Natural sources of mercury include volcanoes, geologic deposits, and volatization from the ocean.

Table ES-1: Summary of the Northeast Regional Mercury TMDL

	Value (80th percentile)	Value (90th percentile)	Unit	Source
Background Information				
Area of the Region (includes CT, MA, ME, NH, NY, RI, VT)	307,890		km^2	NESCAUM
Proportion of Deposition due to Anthropogenic Sources	0.75			Kamman and Engstrom 2002
TMDL Base Year	1998			
TMDL Phase I Implementation Period	1998-2003			
TMDL Phase II Implementation Period	2003 -2010			
TMDL Phase III Implementation Period	2010 on			
Water Quality Goal				
Target Fish Mercury Concentration	0.30		ppm	EPA Fish Tissue Criterion
Existing Level in Fish (32 cm Smallmouth Bass)	0.86	1.14	ppm	NERC Dataset, RIDEM
Reduction Factor (RF) [(Existing Level - Target Level)/Existing Level]	0.65	0.74		
Base Year Loadings				
Point Source Load (PSL) - Wastewater Discharge	141		kg/yr	PCS data
Modeled Atmospheric Deposition	5,405		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Modeled Natural Atmospheric Deposition[1]	526		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Modeled Anthropogenic Atmospheric Deposition, Anthropogenic Nonpoint Source Load (ANPSL)	4,879		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Natural Nonpoint Source Load (NNPSL) Atmospheric Deposition (Based on Deposition is 25% Natural and 75% Anthropogenic)	1,626		kg/yr	
Total Nonpoint Source Load (NPSL) [ANPSL + NNPSL]	6,506		kg/yr	
Total Source Load (TSL) [NPSL + PSL]	6,647		kg/yr	
Percentage of TSL due to PSL	2.1%			
Loading Goal				

[1] The global contribution to the atmospheric deposition modeling includes some natural sources of mercury. The modeled natural atmospheric deposition is subtracted from the total modeled atmospheric deposition to avoid double counting of the natural contribution.

Loading Goal [TSL x (1-RF)]	2,319	1,749	kg/yr	
TMDL				
Wasteload Allocation (WLA) [Keep at 2.1% of TSL]	49	37	kg/yr	
Load Allocation (LA) [Loading Goal - WLA]	2,269	1,712	kg/yr	
Natural Load Allocation[1] (NLA)	1,626	1,626	kg/yr	
Anthropogenic Load Allocation (ALA) [LA - NLA]	643	86	kg/yr	
Overall Reductions to Meet TMDL				
Necessary In-Region Atmospheric Deposition Reductions to Meet ALA	1,816	2,055	kg/yr	
Necessary Out-of-Region Atmospheric Deposition Reductions to Meet ALA	2,420	2,738	kg/yr	
Percent Reduction in Anthropogenic Atmospheric Deposition Necessary to Meet ALA	86.8%	98.2%		
TMDL Implementation Phase I (50%)				
In-Region Portion of ANPSL	2,092		kg/yr	NESCAUM, based on modeling of 1998 emissions inventory
In-Region Reduction Target (50% from baseline)	1,046		kg/yr	
Necessary In-Region Atmospheric Deposition Reductions to meet Phase I Target	1,046		kg/yr	
In-Region Atmospheric Deposition Reductions Achieved in Phase I	1,549		kg/yr	NESCAUM, based on modeling of 1998 and 2002 emissions inventories
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Phase I Target	0		kg/yr	
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Final TMDL	267	506	kg/yr	
Out-of-Region Portion of ANPSL	2,787		kg/yr	NESCAUM, based on modeling of 1998 emissions inventory
Out-of-Region Reduction Target (50% from baseline)	1,394		kg/yr	

[1]Deposition due to natural sources remains the same over time, so the natural load allocation is equal to the existing natural deposition.

Necessary Out-of-Region Atmospheric Deposition Reductions to Meet Phase I Target	1,394		kg/yr	
Additional Out-of-Region Atmospheric Deposition Reductions to Meet Final TMDL	1,026	1,345	kg/yr	
TMDL Implementation Phase II (75%)				
In-Region Portion of ANPSL	2,092		kg/yr	NESCAUM, based on modeling of 1998 emissions inventory
In-Region Reduction Target (75% from baseline)	523		kg/yr	
Necessary In-Region Atmospheric Deposition Reductions to meet Phase II Target	1,569		kg/yr	
In-Region Atmospheric Deposition Reductions Achieved in Phase I	1,549		kg/yr	NESCAUM, based on modeling of 1998 and 2002 emissions inventories
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Phase II Target	20		kg/yr	
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Final TMDL	247	486	kg/yr	
Out-of-Region Portion of ANPSL	2,787		kg/yr	NESCAUM, based on modeling of 1998 emissions inventory
Out-of-Region Reduction Target (75% from baseline)	697		kg/yr	
Necessary Out-of-Region Atmospheric Deposition Reductions to Meet Phase II Target	2,090		kg/yr	
Additional Out-of-Region Atmospheric Deposition Reductions to Meet Final TMDL	330	648	kg/yr	
TMDL Implementation Phase III				
The Phase III timeline and goal will be set following re-evaluation of mercury emissions, deposition, and fish tissue concentrations in 2010. At the onset of Phase III, remaining reductions will be addressed as follows: Major air point sources will be addressed through the application of more stringent control technology requirements and/or emission limits, economically and technically feasible/achievable, taking into account advances in the state of air pollution controls and the application of transferable technologies used by other sources, to achieve maximum emission reductions. Emissions from area sources will be controlled to the maximum extent feasible using best management practices and pollution prevention approaches. It should be noted that the goal of this TMDL is to use adaptive implementation to achieve a target of 0.3 ppm for Massachusetts, New Hampshire, New York, Rhode Island, and Vermont; 0.2 ppm for Maine, and 0.1 ppm for Connecticut. Such an approach will allow all of the Northeast states to meet or exceed their designated uses.				

Regional TMDL Atmospheric Deposition Goal

To meet the initial TMDL target of 0.3 ppm, the mercury TMDL for the region is 1,750 kg/yr, or 4.8 kg/d. This is divided into a wasteload allocation of 38 kg/yr and a load allocation of 1,712 kg/yr. The load allocation for natural sources is 1,626 kg/yr, leaving an anthropogenic load allocation of 86 kg/yr. Implementation of this goal is divided into three phases. Phase I, from 1998 to 2003, sets a goal of 50 percent reduction, from in-region and out-of-region sources, from the 1998 baseline. With in-region reductions of 1,549 kg/yr achieved as of 2002, the in-region reduction goal has been exceeded. Phase II, from 2003 to 2010, sets a goal of 75 percent reduction. This leaves 20 kg/yr for in-region reductions necessary to meet this target. In 2010, mercury emissions, deposition, and fish tissue concentration data will be re-evaluated in order to assess progress and set a timeline and goal for Phase III to make remaining necessary reductions to meet water quality standards. Not enough data are currently available to accurately assess reductions achieved by out-of-region sources.

Adaptive Implementation

The TMDL is structured to separately show loading goals for in- and out-of-region sources and is expected to be implemented adaptively in order to evaluate the calculated necessary percent reduction from anthropogenic sources. The Northeast states have already reduced deposition by approximately 74 percent between 1998 and 2002 and have reasonable assurances (including product legislation and emissions controls) in place to assure attainment of Phase II goals on an adaptive basis. To meet out-of-region goals, Northeast states recommend EPA implement plant-specific MACT limits for mercury under Section 112(d) of the Clean Air Act to control power plant emissions by 90 percent by cost-effective and available technologies. The Northeast region’s ability to achieve the calculated TMDL allocations is dependent on the adoption and effective implementation of national and international programs to achieve necessary reductions in mercury emissions. Given the magnitude of the reductions required to implement the TMDL, the Northeast cannot reduce in-region sources further to compensate for insufficient reductions from out-of-region sources.

Abbreviations

ALA – Anthropogenic Load Allocation

ANCOVA – Analysis of Covariance

ANOVA – Analysis of Variance

ANPSL – Anthropogenic Nonpoint Source Load

C – Concentration

CAA – Clean Air Act

CAMR – Clean Air Mercury Rule

CEC – Commission for Environmental Cooperation

CT DEP – Connecticut Department of Environmental Protection

d – Day

dscm – Dry Standard Cubic Meter

EFMC – Existing Fish Mercury Concentration

EGU – Electrical Generating Unit

EPA – United States Environmental Protection Agency

Hg – Chemical symbol for mercury

ICI – Industrial/Commercial/Institutional

kg - Kilogram

l – Liter

lb - Pound

LA – Load Allocation

MACT – Maximum Achievable Control Technology

MAP – Mercury Action Plan

MassDEP – Massachusetts Department of Environmental Protection

ME DEP – Maine Department of Environmental Protection

mg – Milligram

MGD – Million Gallons per Day

MMP – Mercury Minimization Plan

MOS – Margin of Safety

MTF – Mercury Task Force

MWC – Municipal Waste Combustor

MWI – Medical Waste Incinerator

NARAP – North American Regional Action Plan

ng - Nanogram

NEG-ECP – Conference of the New England Governors and Eastern Canadian Premiers

NEI – National Emissions Inventory

NEIWPCC – New England Interstate Water Pollution Control Commission

NERC – Northeastern Ecosystem Research Cooperative

NESCAUM – Northeast States for Coordinated Air Use Management

NEWMOA – Northeast Waste Management Officials' Association

NH DES – New Hampshire Department of Environmental Services

NLA – Natural Load Allocation

NNPSL – Natural Nonpoint Source Load

NPDES – National Pollutant Discharge Elimination System

NPSL – Nonpoint Source Load

NSRC – Northeastern States Research Cooperative

NYS DEC – New York State Department of Environmental Conservation

oz - Ounce

PDNS – Proportion of Deposition due to Natural Sources

POTW – Publicly Owned Treatment Works

ppb – Parts per Billion

ppm – Parts per Million

PSL – Point Source Load

Q - Flow

RF – Reduction Factor

RI DEM – Rhode Island Department of Environmental Management

SSI – Sewage Sludge Incinerator

TBtu – Trillion British Thermal Units

TFMC – Target Fish Mercury Concentration

TMDL – Total Maximum Daily Load

TSL – Total Source Load

VT DEC – Vermont Department of Environmental Conservation

UNEP – United Nations Environment Programme

WLA – Wasteload Allocation

WWTF – Wastewater Treatment Facility

yr – Year

Definition of Terms

Atmospheric Deposition – the mass transfer of gaseous, aerosol, or particulate contaminant species from the atmosphere to the earth's surface

de minimis – insignificant; a Latin expression meaning "of minimum importance"

Dry Deposition – mass transfer of gaseous, aerosol, or particulate contaminant species from the atmosphere to the earth's surface in the absence of precipitation

Fish Consumption Advisory – guidelines issued by state public health agencies on amounts of and frequency that certain fish can be eaten; can be statewide, regional, or waterbody-specific.

Gaseous Mercury – mercury occurring in the dry-phase, as either reactive gaseous mercury (Hg^{2+}) or gaseous elemental mercury (Hg^0)

Nonpoint Source Pollution – diffuse sources of pollution to water from land use or atmospheric deposition of pollutants

Northeast States – Connecticut, Maine, Massachusetts, New Hampshire, New York State, Rhode Island, and Vermont

Point Sources – wastewater discharges and all other pollutant sources that enter the receiving water through a pipe or channel

Standard Length Fish – a term used to mean that fish tissue concentrations have been adjusted to a standard length, in this case the dataset wide mean length

TMDL – total maximum daily load – the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards

Wet Deposition – mass transfer of dissolved gaseous or particulate contaminant species from the atmosphere to the earth's surface via precipitation

1 Introduction

1.1 Water Quality and Health Concerns

Mercury is a toxic metal that is released to the environment through natural and human processes. Most commonly, the gaseous and particulate forms are released to the atmosphere, which are then deposited onto land and water in precipitation. Once in the water, the mercury can be converted to its most toxic form, methylmercury, which accumulates in fish and aquatic organisms. Humans are exposed to methylmercury and subject to its associated health effects when they consume contaminated fish. The challenge posed by mercury is significant, and the New England Interstate Water Pollution Control Commission (NEIWPCC) and its member states[1] are increasingly involved in this complicated issue.

In the Northeast, fish consumption advisories that have resulted from elevated levels of mercury in certain fish species are of great concern. The vast majority of this mercury can be attributed to atmospheric deposition. The major challenge that the Northeast states face is the lack of available options to control out-of-state sources of atmospheric deposition, despite nearly a decade of work that has resulted in regional reductions in mercury emissions and discharges of approximately 70 percent. The mercury TMDL provided in this document has been developed by the Northeast states in an effort to address mercury impaired waters and region-wide fish consumption advisories. The ultimate goal of the Northeast states is to control all sources of mercury, both in-region and out-of-region, to levels where water quality standards for fish consumption are met.

1.2 TMDL Requirements and Process

The TMDL process is straightforward: states are required by the Clean Water Act to identify water bodies that are failing to meet their water quality standards. The regulations then require that any impaired waterbody be analyzed to determine the daily amount, or load, of a pollutant it can assimilate without violating the state's applicable water quality standards. That daily load is then broken down into an amount attributed to point sources and nonpoint sources, and specifies where and when reductions will be made so the load is not exceeded.

Specifically, Section 303(d) of the Federal Clean Water Act requires each state to (1) identify waters for which effluent limitations normally required are not stringent enough to attain water quality standards, and (2) to establish TMDLs for such waters for the pollutant of concern. TMDLs may also be applied to waters threatened by excessive pollutant loadings. The TMDL establishes the allowable pollutant loading from all contributing sources at a level necessary to achieve the applicable water quality standards. A TMDL must account for seasonal variability and include a margin of safety (MOS) to account for uncertainty of how pollutant loadings may impact the receiving water's quality.

The TMDL report and attached documents are submitted to the U.S. Environmental Protection Agency (EPA) as a TMDL under Section 303(d) of the Federal Clean Water Act, 40 CFR 130.7. The regulations do not in anyway preclude multi-state or regional TMDLs and in-fact EPA Regions 1 and 2 have had success in approving TMDLs that are prepared by more than one state. In accordance with those same regulations, it is understood that the Regional Administrator shall approve or disapprove the loadings provided not later than 30 days. It is also understood that if the Regional Administrator disapproves the loadings he shall establish loadings within 30 days of the disapproval. The states are aware that if the

[1] NEIWPCC'S member states include Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

Regional Administrator approves the loadings being submitted in the attached documents, they are then required to incorporate those loadings into their water quality management plans.

2 Background Information

2.1 Fish Consumption Advisories

States issue fish consumption advisories to inform the public about the recommended fish consumption levels for their waters. Advisories provide information on limiting or avoiding consumption of particular species of fish from specific waterbodies, a group of waterbodies, or an entire state. Nationwide, 48 states currently have fish consumption advisories in place, including all of the Northeast states.

For the most part, fish consumption advisories are issued by each state's public health agency and vary from state to state. All of the New England states have statewide advisories for all freshwaters and New York State has waterbody-specific advisories as well as regional advisories, including blanket advisories for all waters in the Adirondack and Catskill regions. A summary of statewide fish consumption advisories for sensitive and general populations is shown in Table 2-1 below.

Table 2-1 Summary of Statewide Fish Consumption Advisories[1] for Freshwaters

State	Sensitive[2] Population	General Population
CT	No more than 1 meal/month of fish other than trout caught in any Connecticut fresh waterbody; no limits on consumption of trout.	1 meal/week for all freshwater fish other than trout caught in any Connecticut fresh waterbody; no limits on consumption of trout.
MA	Avoid eating fish from any fresh waterbodies.	Limit consumption of affected species to 2 meals/month.
ME	For all freshwater fish other than brook trout and land locked salmon, do not eat any meals; for trout and salmon, 1 meal/month.	For all freshwater fish other than brook trout and land locked salmon, 2 meals/month; for trout and salmon, 1 meal/week.
NH	1 meal/month of freshwater fish (8 oz for pregnant and nursing women, 3 oz for children under 7); when eating bass and pickerel, limit consumption to fish 12 inches or less in length.	Four 8 oz meals/month of freshwater fish; when eating bass and pickerel, limit consumption to fish 12 inches or less in length.
NY	Do not eat any fish from specific listed waterbodies. Avoid pickerel, northern pike, smallmouth bass, largemouth bass, walleye, and yellow perch from Adirondack Mountain and Catskill Mountain waters.	Except where otherwise provided in listed waters, no more than 1 meal/week of fish taken from New York State freshwaters.
RI	Do not eat any fish from Rhode Island ponds, lakes, or rivers.	1 meal/month of most freshwater fish, avoid bass, pickerel, and pike.
VT	walleye – eat none lake trout, smallmouth bass, chain pickerel, American eel – 1 meal/month largemouth bass, northern pike – 2 meals/month brook trout, rainbow trout, brown trout, yellow perch – 3-4 meals/month brown bullhead, pumpkin seed – no advisory all other freshwater fish – 2-3 meals/month	walleye – 1 meal/month lake trout, smallmouth bass, chain pickerel, American eel – 3 meals/month largemouth bass, northern pike – 6 meals/month brook trout, rainbow trout, brown trout, yellow perch, brown bullhead, pumpkin seed – no advisory all other freshwater fish – 9 meals/month

[1]Some advisories are based on mercury *and* other fish contaminants.
[2]Sensitive populations are defined as follows:
CT: Women who are pregnant, women who plan to become pregnant within one year, women who are nursing, children under six
MA: Pregnant women, women of child-bearing age, nursing mothers, children under 12
ME: Pregnant and nursing women, women who may get pregnant, children under 8
NH: Pregnant and nursing women, women who may get pregnant, children under 7
NY: Women of childbearing age, infants, children under 15
RI: Young children, women who are pregnant, nursing, or planning to have a baby in the coming year
VT: Women of childbearing age (particularly pregnant women, women planning to get pregnant, and breastfeeding mothers) and children under 6

2.2 Section 319 Nonpoint Source Assessments and Categorization of Atmospheric Deposition as a Nonpoint Source

A great majority of the nation's remaining water quality problems can be attributed to nonpoint source pollution. The 2000 U.S. EPA National Water Quality Inventory Report found that nonpoint source pollution is the leading source of impairment to the nation's rivers, lakes, and coastal waters (U.S. EPA

2002). Section 319 was added to the Clean Water Act in the amendments of 1987 in order to address nonpoint source pollution. Section 319 highlights three main strategies for addressing polluted runoff by: (1) requiring states to prepare assessments of nonpoint source problems; (2) requiring that states develop management programs to address the problems identified in these assessments; and (3) creating a grant program that allows EPA to fund state programs for nonpoint source assessment and control. Furthermore, the state assessment reports are required to identify waters impaired or threatened by nonpoint source pollution, to identify the categories, subcategories, or individual sources contributing to the nonpoint source pollution problem, and to recommend the best management practices or measures to be used to control each category or subcategory of source (Clean Water Act, Section 319(a)(b)(h)and(i)).

Section 319 addresses nonpoint sources of water pollution. EPA publications classify atmospheric deposition as nonpoint source water pollution with statements such as: "Atmospheric deposition and hydromodification are also sources of nonpoint source pollution"(U.S. EPA 1994). Out-of-state mercury sources, namely coal-fired power plants, therefore fall within Section 319. Currently, New York State and each of the New England states has an approved Section 319 plan covering portions of its navigable waters, including portions impaired by mercury pollution.

2.3 Massachusetts' TMDL Alternative and EPA Justification for Disapproval

Over the past several years, the Northeast states have worked closely with EPA Region 1 on several TMDL innovations projects, including a project to develop regional recommendations for accurately reporting impaired waters in Category 4b of the Integrated Report. The Integrated Report is a single document that integrates the reporting requirements of Clean Water Act Sections 305(b) and 303(d). States place their waters in one of five categories based on what available data say about the condition of the waterbody. Category 4b includes impaired waters that do not require a TMDL because other pollution control requirements are stringent enough to implement the applicable water quality standard and is more recently 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,* which was issued by EPA on July 29, 2005. The New England States and New York State all provided input on this approach through the TMDL innovations process, and endorsed the concept. In fact, the approach used by the Massachusetts Department of Environmental Protection (MassDEP) described below was similarly used by the Maine Department of Environmental Protection (ME DEP) and Rhode Island Department of Environmental Management (RI DEM) in their 2004 303(d) submissions. For the 2004 listing cycle, none of the approaches were approved by EPA.

In 2004 the Commonwealth of Massachusetts submitted to EPA a document titled "A TMDL Alternative Regulatory Pathway Proposal for the Management of Selected Mercury Impaired Waters." The document was a supplement to MassDEP's 2004 Integrated List and sought to document that other pollutant control requirements were in place such that water quality standards would be met and development of a TMDL would not be required. Massachusetts described how it was effectively implementing a comprehensive management plan to address in-state sources of mercury and that a combination of federal, regional, and state controls on mercury were and are the most effective way of addressing water quality impairments due mainly to atmospheric deposition. Examples of these in-state controls include but are not limited to pollution prevention programs and regulatory controls on mercury emitters such as municipal waste combustors, dentists, and schools. The plan focused on a goal of virtual elimination of mercury sources in Massachusetts and the entire New England region.

In a letter dated June 21, 2006, EPA disapproved MassDEP's alternative regulatory pathway to move 90 lakes and ponds impaired solely by atmospheric deposition from Category 5 to Category 4b of the state's Integrated List of Waters. EPA cited that the estimates in the proposal and its own estimates indicate that a significant percentage of mercury from atmospheric deposition comes from international sources for which there are no state or federal controls. As a result EPA determined that the approach did not meet the necessary requirements for demonstrating that the actions taken will result in the attainment of water quality standards in a reasonable amount of time. Specifically, in its response to MassDEP, EPA stated the following:

> *"EPA regulations require states to list water quality segments still requiring TMDLs where certain controls including other pollution control requirements 'required by local, State, or Federal authority' are insufficient to achieve applicable water quality standards. (See 40 CFR §130.7 (b)1(iii))."*
>
> *"While Massachusetts describes its strong mercury reduction program, as well as the New England wide mercury reduction efforts, Massachusetts has not demonstrated that other pollution control requirements exist that are sufficient to implement the Commonwealth's water quality standards for mercury within a reasonable amount of time. See 40 CFR 130.7(b)(1)(iii). In spite of the strong state, regional, and federal mercury reduction efforts, it will be difficult to achieve water quality standards, due in part to the contributions from non-U.S. sources (i.e., the global reservoir)."*

It was determined by EPA in its disapproval documentation that the "best way to address mercury impaired waters is within the context of the 303(d) listing process…" As such, the states in the Northeast have put their energies and efforts into that process with this regional TMDL.

2.4 Section 303(d) Listing for Mercury Impaired Waters – Category 5m

Waters are to be listed in Category 5 of the Integrated Water Quality Monitoring and Assessment Report if "available data and/or information indicate that at least one designated use is not being supported or is threatened, and a TMDL is needed (U.S. EPA 2005a)." This category represents Clean Water Act Section 303(d) – waters that are listed as impaired and are to be reviewed and approved by EPA.

On March 8, 2007, EPA released guidance on utilizing a modified Category 5, known as Category 5m, for waters on the 303(d) list that are impaired primarily by atmospheric deposition of mercury. The guidance on Listing Waters Impaired by Atmospheric Mercury Under Clean Water Action Section 303(d) describes use of subcategory "5m" as a voluntary approach to listing waters impaired by mercury from atmospheric sources. Category 5m is EPA's recognition that even if a state has a comprehensive mercury management approach, when water quality impairments are primarily caused by atmospheric deposition, in-state controls alone cannot lead to attainment. Category 5m could serve as a placeholder for states to defer TMDL development until later in the schedule. The approach, however, does not and cannot statutorily remove the obligation for a TMDL to be developed at some point in time, and EPA literature on this approach specifically notes that the agency is not suggesting that TMDLs are inappropriate tools for mercury impairments.

The information regarding Category 5m shared at the annual meeting of the Association of State and Interstate Water Pollution Control Administrators in August 2006 specified that multi-state efforts toward regional goals or targets are encouraged. It is in the spirit of regional cooperation and goal setting that this TMDL has been prepared and it is done so with the understanding that the Clean Water Act requires it.

2.5 Northeast Regional Commitment to Reducing Regional Sources of Mercury

The Conference of the New England Governors and Eastern Canadian Premiers (NEG-ECP) is an organization of the governors of the six New England states and the premiers of the five Eastern Canadian provinces[1]. The governors and premiers collaborate on regional issues and take action on policy areas including the environment, energy, economic development, trade, security, and ocean issues.

In June 1997, the NEG-ECP charged its Committee on the Environment to develop a regional Mercury Action Plan (MAP). Subsequently, a draft framework for the MAP was developed by representatives of the states and provinces, and then finalized and agreed upon by the NEG-ECP in June 1998. The MAP identifies steps to address those aspects of the mercury problem in the region that are within the region's control or influence and sets an overall regional goal to virtually eliminate the discharge of anthropogenic mercury into the environment to ensure that serious or irreversible damage attributable to these sources is not inflicted upon human health and the environment (Committee on the Environment of the Conference of the New England Governors and Eastern Canadian Premiers 1998).

The six action items set forth in the MAP: 1) established a regional task force to implement the plan; 2) specified emissions limits for major mercury sources that are considerably more stringent than federal requirements; 3) supported pollution prevention efforts to reduce mercury use in products and increase collection and recycling of mercury-added products where environmentally preferable alternatives do not exist; 4) directed state and provincial agencies to implement outreach and education programs about mercury; 5) supported coordination of mercury research and environmental monitoring efforts to track results; and 6) called for retirement of the U.S. federal mercury stockpile. Implementation of the MAP has been very successful. All of the New England states have developed and implemented numerous legislative and regulatory actions to address mercury sources.

In accordance with the MAP, a regional Mercury Task Force (MTF) was formed by representatives of the New England states and Eastern Canadian provinces. This group meets annually and reports on progress in meeting the goals of the MAP. The MAP originally set forth a goal of 50 percent reduction of regional mercury emissions by 2003, and then in 2001 set another interim goal of 75 percent reduction by 2010. In 2003, the MTF reported that the goal of 50 percent had been exceeded with reductions achieved amounting to approximately 55 percent[2] (Conference of New England Governors and Eastern Canadian Premiers 2003). This overall reduction was primarily due to an 84 percent reduction in emissions from municipal waste combustors (MWCs), a 98 percent reduction in emissions from medical waste incinerators (MWIs), and a 93 percent reduction in emissions from chlor-alkali facilities (NESCAUM and the New England Governors and Eastern Canadian Premiers Mercury Task Force 2004). The 2005 status report indicates that substantial progress has already been made toward the 2010 goal (The Conference of New England Governors and Eastern Canadian Premiers Mercury Task Force and The Committee on the Environment of the Conference of New England Governors and Eastern Canadian Premiers 2005).

In August 2003, the MTF adopted a regional goal that 50 percent of dental offices in the region would install amalgam separators by the end of 2005. This goal has been exceeded and the MTF has established new goals of 75 percent separation installation by the end of 2007 and 95 percent by the end of 2010. In 2005, it was estimated that states had the following rates of amalgam separator installation: Connecticut – 65 percent, Maine – 95 percent, Massachusetts – 74 percent, New Hampshire – 95 percent, Rhode Island – 25 percent, and Vermont 15 percent (The Conference of New England Governors and Eastern Canadian

[1] New Brunswick, Newfoundland & Labrador, Nova Scotia, Prince Edward Island, and Québec
[2] The MAP Regional Reductions of 55 percent from 1998 emissions and the 74 percent reductions shown in Section 7.7.2 for the Phase I implementation for in-region differ because the MAP looks at reductions for the New England states and the Eastern Canadian provinces, whereas this TMDL covers the New England states and New York.

Premiers Mercury Task Force and the Committee on the Environment of the Conference of New England Governors and Eastern Canadian Premiers 2005). Installation of amalgam separators is instrumental in reducing mercury in wastewater.

While New York State is not a member of the NEG-ECP, they were active participants in the 1998 regional mercury study and in the development of the MAP. New York State remains committed to reducing mercury in their state and has established its own Mercury Task Force to coordinate mercury issues within their state. Additionally, New York State participates in regional efforts coordinated by NEIWPCC, the Northeast States for Coordinated Air Use Management (NESCAUM), and the Northeast Waste Management Officials' Association (NEWMOA). Similar to the New England states, New York State has enacted legislation to control use of mercury in products, require installation of amalgam separators, and has set strict emissions limits for MWCs. As a result, mercury emissions in New York State from this sector decreased more than 85 percent from 1998 to 2002, contributing to a decrease of approximately 63 percent in overall state mercury emissions in the same time period.

As of 2006, all of the Northeast states have passed legislation to address mercury in products. Individual laws and requirements vary by state, but legislation addresses bans on disposal of mercury-added products, bans on sale or distribution of mercury-added novelties and measuring devices, requirements for installing amalgam separators, requirements for labeling of mercury-added products, prohibition of primary and secondary schools purchasing or using mercury, removal of mercury switches from automobiles, and requirements on recycling of mercury-added products. Connecticut, Massachusetts, Maine, New Hampshire, and New York have all passed legislation to reduce mercury emissions limits from coal-fired utilities. Detailed information on individual state legislation and programs is provided in Section 10.1. Controls on mercury-containing products contribute to reductions in mercury in wastewater and mercury emissions from MWCs and MWIs.

The Northeast has also been the center of a number of mercury-related research efforts. Project such as the Biodiversity Research Institute's *Mercury Connections* (Evers 2005), the Hubbard Brook Research Foundation's *Mercury Connections* (Driscoll, et al. 2007), and EPA's *Connecticut River Fish Tissue Study* (Hellyer 2006) have documented the mercury problem in the Northeast and the efforts that have taken place in the region to reduce mercury.

Because the Northeast states have made nationally significant reductions to in-state sources of mercury as a result of their regional action plan, and have collectively developed a peer-reviewed dataset of fish tissue contaminants, it was determined that a regional TMDL would be the most effective strategy to work toward eliminating the need for fish consumption advisories in the Northeast.

2.6 Control of In-State Sources not Sufficient to Meet Water Quality Standards

Using 1998 emissions data, atmospheric deposition modeling undertaken by NESCAUM estimates that 43 percent of the anthropogenic mercury deposited in the Northeast is attributed to sources within the region. The remaining 57 percent can be attributed to sources outside of the region, from other U.S. states and international sources. When modeling was undertaken with 2002 emissions data, it was estimated that 19 percent of anthropogenic mercury deposited in the region originated from within the region and 81 percent can be attributed to out-of-region sources. As discussed in the previous section, the Northeast states are already aggressively addressing mercury sources within their region, and they have additional enforceable controls coming into effect that will demonstrate reductions are continuing in addition to the reductions shown here by the 2002 data. But, in-region reductions are not sufficient to make the fish safe to eat. More stringent national and international controls are necessary to reduce out-of-region sources to the level that will allow for safe fish consumption.

3 Applicable Water Quality Standards and Fish Tissue Criteria

Two of the Northeast states, Maine and Massachusetts, have adopted methylmercury fish tissue criteria as part of their water quality standards. For all toxic pollutants not otherwise listed, Massachusetts uses the recommended criteria published by EPA pursuant to Section 304(a) of the Clean Water Act. This holds true for mercury, so Massachusetts uses the EPA methylmercury fish tissue criterion of 0.3 ppm. Connecticut, New Hampshire, New York, Rhode Island, and Vermont use water quality standards that consider exposure to mercury through fish consumption expressed as a water column concentration. In addition, Connecticut has narrative criteria for protection of human health that reference criteria established by the state department of public health. Although not all states have adopted a fish tissue criterion as part of their water quality standards, each state has a fish tissue concentration that they consider as a part of their basis for developing fish consumption advisories. Water quality criteria and fish consumption advisory values are shown in Table 3-1 below.

Table 3-1 Water Quality Criteria and Fish Consumption Advisory Values for Mercury

	CT	ME	MA	NH	NY	RI	VT
Fish tissue concentration (ppm)	0.1	0.2 *	0.3 *	0.3	1.0	0.3	0.3
Water quality criterion (µg/l)	0.051	NA	NA	0.051	0.0007	0.15	0.15

*These numbers are fish tissue concentrations that have been adopted as fish tissue criteria in state water quality standards. The numbers for the other states in this row are the fish tissue concentrations that these states consider as part of their basis for developing fish consumption advisories.

Although not all states have adopted water quality criteria based on fish tissue concentrations, this TMDL analysis is based on use of a fish tissue concentration. Because fish tissue concentrations take into account bioaccumulation, they are more protective than water column concentrations. Use of a target fish tissue concentration of 0.1, 0.2, or 0.3 ppm will ensure that state water quality criteria based on water column concentrations are met.

A water column concentration (WCC) can be calculated from a fish tissue criterion (FTC) and bioaccumulation factor (BAF) through the following equation:

$$FTC = BAF \times WCC$$

A 2004 study of mercury biogeochemistry in Vermont and New Hampshire lakes (Kamman, et al. 2004) provides bioaccumulation factors ranging from 52,481/L to 1,023,293/L for yellow perch fillets with respect to epilimnetic total mercury. Analysis of regional fish tissue data indicates that smallmouth bass mercury concentrations can be approximately 1.5 to two times higher than for yellow perch (Kamman, et al. 2005). Therefore, using the high end of the range for yellow perch, bioaccumulation factors for smallmouth bass would range from 1,534,940/L to 2,046,586/L. Using the highest fish tissue concentration of 0.3 mg/kg and the above range for bioaccumulation factors for smallmouth bass, a WCC range of 0.0001 to 0.0002 µg/l is obtained. The range of WCCs calculated is lower than any of the WCCs used by the states. Therefore, use of a fish tissue criterion as a TMDL target ensures that water column criteria will be met if the TMDL fish tissue target is met.

3.1 Assessment of Fish Contaminants

For the most part, for listing purposes, states do not assess waters by measuring mercury in the water column, but rather monitor mercury in fish tissue. For states with methylmercury fish tissue criteria, if fish samples do not meet the criterion, the waterbody is listed as impaired for fish consumption. Where states do not have fish tissue criteria, specific waters or all waters for which fish consumption advisories have been issued are considered to be impaired for fish consumption use, subject to the state's assessment and listing methodology. For the purpose of this TMDL, fish tissue concentrations in wet-weight fillets are considered the TMDL endpoint.

4 Fish Tissue Mercury Concentrations

4.1 Fish Tissue Monitoring Dataset

In 2000, the Northeast States Research Consortium (NSRC), then a program of the USDA Forest Service Northeastern Research Station, sponsored the establishment of a Northeast North American mercury workgroup (known as the Northeastern Ecosystem Research Cooperative (NERC) Mercury Consortium) to compile and analyze as large an assembly of mercury data as practical, from a wide variety of environmental matrices, focusing on freshwater ecosystems. A fish tissue database that covers the NSRC study region (Connecticut, Maine, Massachusetts, New Hampshire, New York, Vermont, eastern Ontario, Quebec, and the Canadian Atlantic Provinces) was assembled as part of this initiative (Evers and Clair 2005).

A group of scientists from the NERC Mercury Consortium assembled existing fish mercury databases from agencies and organizations in the study area, resulting in a database that spans the geographic range from 39.5 to 54.7 N latitude and 53.9 to 79.5 W longitude, which includes Connecticut, Maine, Massachusetts, New Hampshire, New York, and Vermont. Contributing datasets originated from monitoring programs carried out by provincial and state governments for the purpose of risk assessment, random probability surveys conducted within the United States, and other datasets derived from large-scale research initiatives. NERC scientists collected geo-referenced datapoints from 24 research and monitoring projects to create an aggregate 19,815 datapoints (Kamman, et al. 2005).

In order to be retained in the dataset, fish data had to meet a number of requirements. Only fish mercury measurements analyzed using cold-vapor atomic absorption or cold-vapor atomic fluorescence spectroscopy were retained. The fish had to be collected in 1980 or later. Data from the Great Lakes and St. Lawrence River were excluded because these waterbodies were outside the focus of the NSRC assessment. Only mercury concentrations derived from fish fillets or whole fish were retained (Kamman, et al. 2005).

The dataset was subject to a series of validation checks to ensure data quality, including checks to detect outlier, mis-transcribed, or incorrect datapoints. Validity checks identified a number of datapoints with values that were either excessively high, presented in the wrong unit of measure, or mis-attributed to the wrong species. These datapoints were either corrected or removed from the database. Of the 19,178 original records submitted to the database, 15,305 met screening criteria, passed validity checks, and were retained (Kamman, et al. 2005).

The final dataset contains mercury measurements for 64 freshwater fish species with yellow perch and brook trout being the most prevalent species. Data were only analyzed for the 13 species that either had 1000 or more mercury measurements, or were present in nine or more of the projects. The numbers of datapoints per state and arithmetic mean mercury concentrations for these 13 species are shown in Table 4-1. (Kamman, et al. 2005)

As the NERC dataset did not include data from Rhode Island, fish tissue data from this state were obtained so that they could be included in the TMDL. Rhode Island had data available for five of the species that were included in the NERC dataset. These data are also shown in Table 4-1.

Table 4-1 Number of Fillet Mercury Samples Included and Arithmetic Mean Mercury Concentrations for Fish Species Analyzed

Species	Count of fillet mercury samples by state								Arithmetic mean mercury concentration (ppm)
Common name	CT	MA	ME	NH	NY	RI	VT	Total	
Yellow perch		60	221	828	1250	99	434	2892	0.391
Largemouth bass	1	70	18	200	44	170	18	521	0.532
Lake trout				14	369		44	427	0.405
Smallmouth bass	4	24	19	172	61	5	46	331	0.641
Chain pickerel			7	148	5		16	176	0.564
Brown bullhead	1	34	5	41	19	49	26	175	0.152
Walleye					64		64	128	0.416
White perch			32	43	15	32	6	128	0.870
White sucker	31		16	43	22			112	0.237
Brown trout	5			10	34		11	60	0.165
Brook trout			22	27			6	55	0.168
Northern pike				1	22		24	47	0.461
Landlocked salmon			3	8	10			21	0.319

The NERC dataset is clearly appropriate for the development of a regional mercury TMDL due to its geographic coverage and the fact that is has already gone through both validation and peer-review processes. For the purpose of this TMDL, length-standardized mercury concentrations were calculated for four species, using a subset of the NERC dataset that excluded data from the Canadian provinces. The four species considered were smallmouth bass, largemouth bass, walleye, and yellow perch. Mean, 80th, and 90th percentile mercury concentrations for standard length fish were calculated for each of the four fish species. Characteristics for these fish are shown in Table 4-2 below.

Table 4-2 Standard Lengths and Mercury Concentrations of Selected Freshwater Fish Species in the NERC dataset

Species	**Standard Length (cm)**	**Mean Hg Concentration (ppm) at Standard Length***	**80th percentile Hg Concentration (ppm) at Standard Length**	**90th percentile Hg Concentration (ppm) at Standard Length**
Smallmouth bass (*Micropterus dolomieu)*	32	0.69	0.86	1.14
Largemouth bass (*Micropterus salmoides*)	36	0.61	0.90	1.05
Yellow perch (*Perca flavenscens*)	20	0.38	0.52	0.69
Walleye (*Sander vitreus*)	45	0.60	0.82	0.93

*Standard lengths were derived as dataset-wide mean lengths. Means shown in this table differ from those in Table 4-1 because arithmetic means are shown in Table 4-1 and length-standardized means are shown in Table 4-2.

4.2 Areas of Elevated Concentration

In the Northeast, there are known localized areas where elevated fish tissue concentrations, as compared to background regional levels, have been observed (Evers, et al. 2007). Typically, areas of elevated concentration are associated with natural conditions, such as enhanced watershed sensitivity, in combination with anthropogenic factors including water-level manipulation, enhanced deposition of acid-forming precursors, and enhanced mercury deposition. These areas include the western Adirondack Mountains in New York, the Upper Connecticut River in New Hampshire and Vermont, the middle and lower Merrimack River in New Hampshire, the Upper Androscoggin River in Maine and New Hampshire, and the Western Upper Kennebec River in Maine (for more details, see Evers, et al. 2007). These sensitive areas are included in this TMDL, as implementation is expected to result in decreases in fish tissue concentrations in these areas. However, the response may vary from the rest of the region, so these areas will be more closely monitored during the implementation period. It is expected that monitoring will be conducted through regular state fish tissue monitoring programs (at the level that funding allows) as well as regional research projects. Because these areas are more sensitive to mercury deposition, it is possible that they may experience faster decreases in fish tissue concentrations. Adaptive implementation will allow for changes to the reductions planned for these areas if necessary.

In addition, areas of elevated concentration can be a result of high levels of localized atmospheric deposition. This is the case for an area in northeastern Massachusetts where fish mercury concentrations are elevated as a result of high deposition in that area. Fish from this area are not included in the regional dataset and the regional TMDL will not cover this area. Waterbodies located in this area are identified in Table A-1 in Appendix A. However, it is anticipated that implementation of this TMDL will significantly reduce fish concentrations in this area and may possibly achieve standards in the future. MassDEP intends to closely monitor these waters and if necessary, address this area separately in the future.

5 Northeast Regional Approach

The entire Northeast region is impacted by local, regional, and global mercury deposition sources and shares the common problem of large contributions of mercury deposition from sources outside of the region. As a result, the region already has a long history of working together on mercury reduction efforts such as the NEG-ECP MAP. Although mercury deposition is not necessarily uniform across the entire region (see Figure 6-3), a shared interest in addressing mercury deposition and demonstrated success in regional efforts makes the case for a regional-scale TMDL. Furthermore, as detailed in Section 5.3, once the effect of fish length is accounted for, fish concentrations are relatively uniform across the region.

5.1 Impaired Waters

In the Northeast, there are a total of 10,192 lakes, ponds, and reservoirs, 24 river segments, and an additional 46,199 river miles impaired for fish consumption primarily due to atmospheric deposition of mercury. The breakdown for each state is shown below in Table 5-1.

Connecticut, Maine, and New Hampshire all have statewide advisories, and use this as a basis for listing all freshwaters as impaired for fish consumption due to mercury. Massachusetts, Rhode Island, and Vermont also have statewide advisories, but they only list waters that have been assessed and found to be impaired on their lists of impaired waters. New York State does not have a statewide advisory, but has a large number of waterbodies listed as impaired for fish consumption due to atmospheric deposition of mercury.

Appendix A contains the list of waterbodies covered by the TMDL for Massachusetts, New York, Rhode Island, and Vermont, based on those states' Impaired Waters Lists. The appendix also includes the language from Connecticut's, Maine's, and New Hampshire's lists that explains using the statewide advisory as a basis for listing. In these three states, there are a small number of waters that are impaired by mercury that is caused by a source other than atmospheric deposition. These waters are therefore not covered by this TMDL and are listed in the Appendix A as exceptions to the state's listing of all freshwaters. For all states, only water designated as rivers, streams, lakes, reservoirs, and impoundments are included and waters designated as marine, estuarine, or ocean are not included. More details on these designations are provided in Appendix A.

Table 5-1 Northeast Waterbodies Impaired Primarily by Atmospheric Deposition of Mercury

State	Lakes, Ponds, and Reservoirs	Rivers
Connecticut	2,259	5,376 miles
Maine	5,782	31,199 miles
Massachusetts	99[1,2]	0[3]
New Hampshire	1,945[4]	9,624 miles
New York	67[5]	14 segments
Rhode Island	19	0[6]
Vermont	21[7]	10 segments
Total	**10,192**	**46,199 miles; 24 segments**

[1]Those impaired solely due to atmospheric mercury deposition.
[2]20 of these waterbodies (see Appendix A for specific waterbodies) are not covered by this TMDL because they are located in local mercury deposition hotspots and will be addressed separately by MassDEP.
[3]Massachusetts has additional river segments impaired due to local mercury sources that are not covered by this TMDL.
[4]Includes impoundments.
[5]Includes five segments of Lake Champlain counted as separate waterbodies.
[6]Rhode Island has additional river segments impaired due to mercury. However, it has not yet been determined whether local sources not covered by this TMDL contribute to the impairment.
[7]Includes eleven segments of Lake Champlain counted as separate waterbodies.

In addition to the impaired waters listed in Appendix A, the TMDL may, in appropriate circumstances, also apply to waterbodies that are listed for mercury impairment in subsequent Clean Water Act Section 303(d) Lists of Impaired Waters. For such waterbodies, this TMDL may apply if, after listing the waters for mercury impairment and taking into account all relevant comments submitted on the Impaired Waters List, a state determines with EPA approval of the list that this TMDL should apply to future mercury impaired waterbodies.

5.2 Priority Ranking of Impaired Waterbodies

Of the seven states included in this TMDL, two states have included priority rankings for mercury-impaired waters on their 303(d) and Integrated Lists. New York State denotes waterbodies of high priority for TMDL development, but none of the New York State waterbodies included in this TMDL were denoted as high priority. Vermont prioritizes all impaired waterbodies as high (TMDL development in one to three years), medium (four to eight years), or low (eight or more years). All of the Vermont waterbodies included in this TMDL are categorized as high priority for TMDL development. While not all states have specifically designated priority rankings for their mercury impaired waters in their 303(d) reports or Integrated lists, they have all demonstrated that mercury reduction is a high priority through their regionally coordinated actions to reduce mercury sources to the environment by over 70 percent since 1998. This regional mercury TMDL is a continuation of this priority work.

5.3 Selection of Existing Fish Mercury Concentration Based on Standard Size Fish

To best utilize the extensive NERC dataset and make the strongest comparisons of fish mercury concentrations from different waterbodies and sampling years, mercury concentrations are calculated for a standard-length fish. Mercury concentration increases with both age and length, so when comparing mean concentrations from all fish, it is important to account for this relationship. Calculated fish mercury concentrations were statistically adjusted, using analysis of covariance (ANCOVA) to a nominal "standard-length" fish. The standard length was derived as the dataset-wide mean length for the species, and concentrations of standard-length fish were estimated using least-squares means, accounting for the Type III model sums-of-squares (Kamman, et al. 2005). From a statistical standpoint, this is the most appropriate approach in that variance in fish mercury attributable to length is minimized at the dataset-wide mean length. It is recognized that many fish will be above the standard length and therefore higher in mercury. This is addressed by basing this TMDL analysis on the 90thpercentile of the distribution of all length-standardized fish evaluated. This is more protective than using a mean or median concentration value.

In developing this TMDL, the states considered using four different species of fish for calculating necessary reductions (see Table 4-2). After examining data for all four species, it was decided that smallmouth bass should be the target fish, as it is the species that bioaccumulates mercury most efficiently (based on comparison of mean, 80th, and 90th percentile concentrations) and is ubiquitously distributed amongst the Northeast states. Use of this species will allow for the highest common level of protection. The majority of the fish in the regional dataset were collected in the early to mid 1990s and therefore concentrations used in this TMDL may be somewhat higher than if fish collection coincided with the 1998 timeframe of the emissions and deposition data. To address this uncertainty, the existing fish concentration is presented as a range from the 80th to 90th percentile mercury concentration. However, the target for purposes of implementing this TMDL is considered to be the 90th percentile mercury concentration. As shown in Table 4-1, the 80th and 90th percentile mercury concentrations based on the standardized length for smallmouth bass are 0.860 and 1.14 ppm, respectively[1].

In order to justify the choice of regional target fish species, arithmetic mean tissue concentrations and counts of fish-tissue datapoints by state and by species where fish lengths were reported were examined (Table 4-1). This analysis indicated that while walleye may have been the optimum species to use due to its high concentration (and therefore conservative TMDL target), this species is only represented in two states (Vermont and New York), and therefore, a poor representative of the region. By contrast, yellow perch are sampled nearly everywhere, but are typically lower in fillet mercury. Had yellow perch been used as the endpoint species for this TMDL, there would not be assurance that higher-mercury fish would achieve compliance with water quality standards once the TMDL was implemented. Smallmouth bass are both relatively uniformly sampled across the states, and also quite high in fillet mercury, rendering this species nearly ideal as a target endpoint for this TMDL. Furthermore, when length-standardized mercury concentrations are examined, smallmouth bass have the highest mean and 90th percentile concentrations of all fish species analyzed.

In addition, to ensure that data from one state would not bias the region wide TMDL target, variation in fillet-mercury concentrations by state was also examined. To do this analysis, the effect of fish length on fish mercury was accounted for. Accounting for the effect of fish length is critical in that fish mercury varies with length, and the lengths of fish represented by state monitoring databases is variable (ANOVA $F_{325,5}$=31.8, $p<0.001$). Therefore this analysis of covariance was used to test the hypothesis that fish

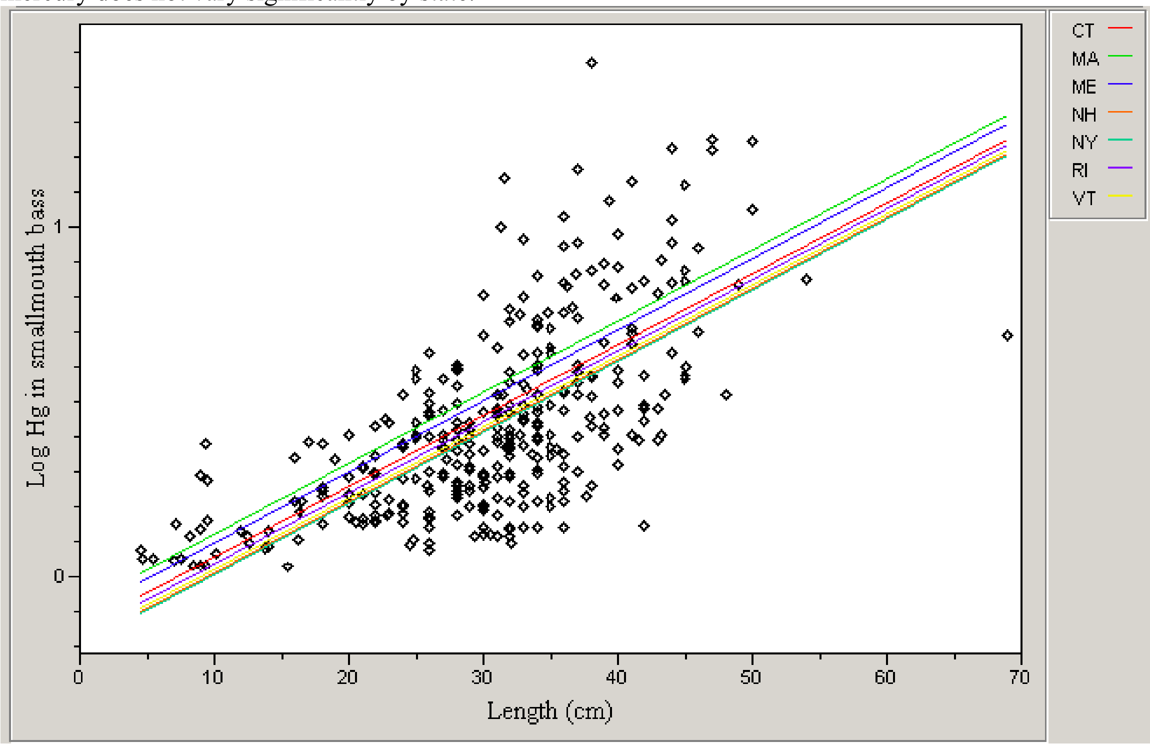
[1] No data from Rhode Island were included in the NERC dataset. However, Rhode Island data were examined and it was found that they are well-aligned with the NERC dataset. If Rhode Island data were included in the NERC dataset, it would not have changed the existing fish tissue concentration used in the TMDL.

mercury varied as a function of the state in which the fish were originally sampled, while accounting for the effect of length, with the null hypothesis that fish mercury did not vary by state. Fish mercury data were log-transformed to account for non-normality in this parameter.

Smallmouth bass fillet mercury did not vary by state (p=0.2250) despite significant variation with length ($p<0.001$; overall ANCOVA $F_{325,6} = 38.2$, $P<0.001$). The analysis captured fully 42 percent of the variance observed within the smallmouth bass fillet mercury dataset. This relationship can be seen in Figure 5-1. This analysis, coupled with the information shown by Table 4-1, indicates that smallmouth bass are relatively uniform in fillet mercury across the jurisdictions, are the highest-mercury fish for which data are available from most states subject to this TMDL, and are therefore most suited for the application of a regional TMDL. The lack of variation in fish tissue concentrations across the states (when length is accounted for) indicates that a regional-scale TMDL is appropriate.

Figure 5-1. Relationship of Fish Length and Fillet Mercury Concentration (log ppm) for Smallmouth Bass, by State

Regression lines were calculated by ANCOVA and show that when the effect of fish length is accounted for, fish mercury does not vary significantly by state.



The goal of this TMDL is to protect human health, and therefore the existing and target fish concentrations were selected with this in mind. However, it should be noted that there are also concerns associated with mercury and piscivirous wildlife such as loons, eagles, and otters. Fish that feed high on the food web, such as the smallmouth bass, are more reflective of obligate apex piscivores like loons and eagles, therefore by targeting the TMDL to smallmouth bass, both ecological and human health are protected by ensuring that the prey upon which obligate piscivores feed will be low enough in mercury to preclude risk to the most mercury-sensitive of aquatic biota.

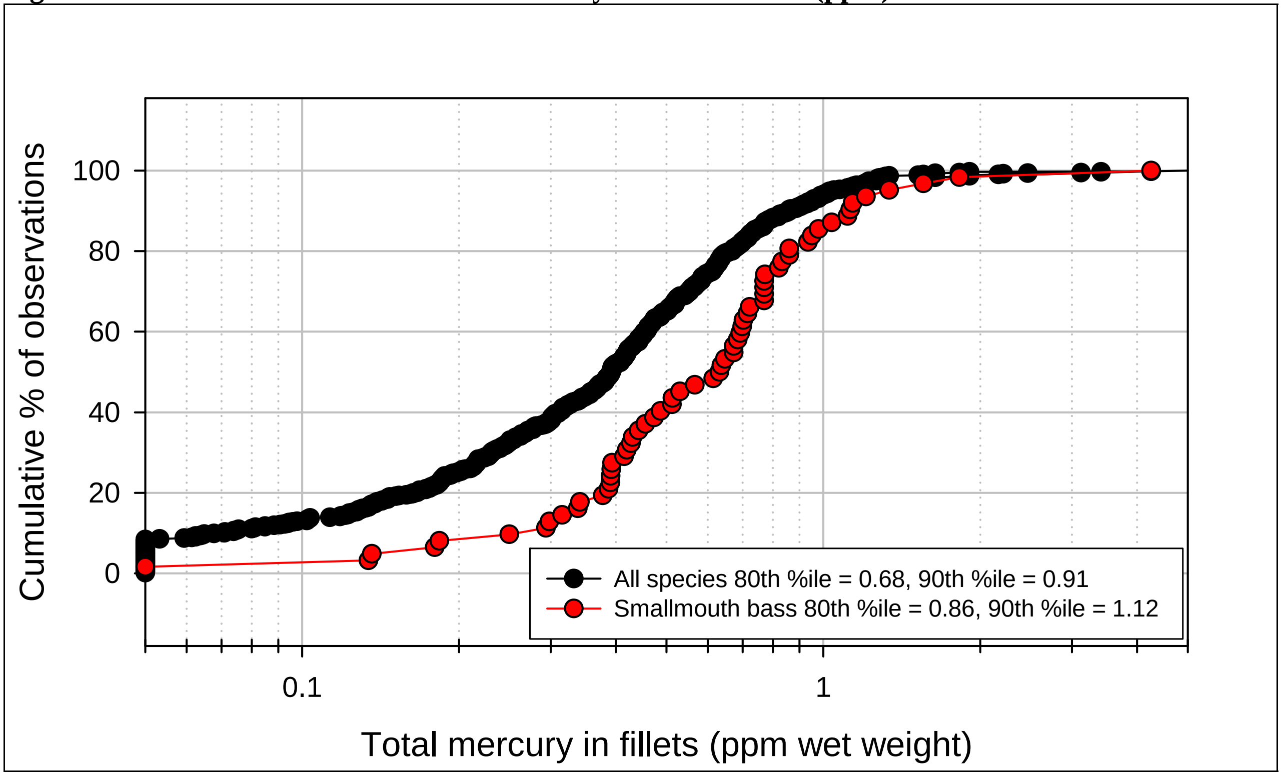
5.4 Target Fish Mercury Concentration

As discussed previously, the Northeast states consider different fish mercury concentration guidance values as part of their basis for establishing fish consumption advisories. These numbers range from 0.1 ppm for Connecticut to 1.0 ppm for New York State. Different issues are weighed when establishing fish consumption advisories than those considered in setting a regional TMDL. For example, eating fish has health benefits and those benefits are weighed against the health risks posed by mercury contamination. The risks from contamination for children and women of childbearing age differ from those posed to men and older women and the health benefits of eating fish may also differ for these age groups. In developing a TMDL, the issue being considered is minimizing contamination in fish as the benefit, and the costs of preventing the contamination as the risk. Based on these considerations for the regional TMDL, 0.3 ppm is used as the initial overall regional target fish mercury concentration to be consistent with EPA's methylmercury fish tissue criterion and meet fish tissue goals in Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. It should be noted that the goal of this TMDL is to use adaptive implementation to achieve a target of 0.3 ppm for Massachusetts, New Hampshire, New York, Rhode Island, and Vermont; 0.2 ppm for Maine, and 0.1 ppm for Connecticut. Such an approach will allow all of the Northeast states to meet or exceed their designated uses.

Figure 5-2 shows the cumulative distribution of length-standardized smallmouth bass mercury concentrations based on data within the NERC dataset, in comparison to those for all fish species. The 80th percentile value of 0.86 ppm mercury for smallmouth bass corresponds to the 90th percentile concentration for all fish species, whereas the 90th percentile value of 1.14 ppm mercury for smallmouth bass corresponds to the 96th percentile concentration for all fish species. As such, by targeting the 90th percentile range of smallmouth bass concentrations, 96 percent of fish should ultimately meet the fish tissue target.

Implementation of this TMDL will serve as a first step toward eliminating fish consumption advisories in the Northeast states. For purposes of demonstrating compliance with individual states' water quality standards, it is noted that to meet water quality standards in both Maine and Connecticut, calculations require reductions in anthropogenic mercury deposition greater than 100 percent. The calculation of needed reductions is affected by a number of variables, including the percentage of deposition due to anthropogenic sources, and there are a range of accepted values associated with this parameter. Various studies have found this percentage to be between 75 and 85 percent. Use of a lower percentage results in a greater percent reduction from anthropogenic sources, whereas a higher percentage has the opposite effect. Because of these ranges and other reasonable and prudent assumptions made about values for a number of parameters, adaptive management will be used when implementing the reductions necessary to meet the TMDL. Throughout the final stage of implementation, the states will re-evaluate progress made toward the fish tissue goals and will determine if adjustments need to be made in the ultimate goals that have been set, or how they can be achieved in accordance with the timeline set forth in the implementation plan.

Figure 5-2: Cumulative Distribution of Mercury Concentrations (ppm) in Northeast Fish



5.5 Proportionality of Mercury Reductions

At this time, there is no precise modeling (at least not at a large spatial scale involving multiple waterbodies) of the link between emissions and mercury bioaccumulation or the effect of a given emissions reduction on fish tissue concentrations. While study results are converging on an understanding of likely reductions in fish tissue mercury given reductions in proximal mercury emissions sources, the state of science is not yet such that this relationship can be described with confidence. Therefore it is reasonable to rely on certain assumptions regarding the relationships between mercury emissions, deposition, and fish tissue concentrations. There is sufficient empirical evidence to show that emissions reductions cause reductions in fish tissue concentrations, which validates the assumptions used in this TMDL.

The TMDL is based on an assumption that a decrease in mercury emissions will result in a proportional decrease in mercury deposition, a decrease in mercury deposition will result in a proportional decrease in mercury loading to waterbodies, and ultimately, a decrease in mercury loading in waterbodies will result in a proportional decrease in mercury concentrations in fish. This follows the analyses presented by the EPA *Mercury Maps* Model, which is based on steady state formulations of the Mercury Cycling Model (MCM) and IEM-2M Model (U.S. EPA 2001). In environmental systems, steady state means that concentrations may vary from season to season or year to year, but that long term averages are constant.

Several dynamic, ecosystem scale models such as the Mercury Cycling Model (MCM) and IEM-2M assume that, at steady state (i.e., over long time scales), reductions in fish mercury concentrations will be proportional to reductions in mercury inputs. When atmospheric deposition is the main source of mercury to a given waterbody, these models predict a linear response between changes in deposition, ambient concentrations in water and sediments, and fish mercury levels. Below, an approach is outlined for deriving a simplified relationship between percent reductions in air deposition load and fish tissue concentrations at steady state that draws on this same assumption of long-term proportionality from more complex modeling frameworks.

The standard steady state bioaccumulation equation is:

$$C_{fish_{t1}} = BAF \bullet C_{water_{t1}}$$

where C_{fisht1} and $C_{watert1}$ are methylmercury contaminant levels in fish and water at time t1, respectively and BAF is the site specific bioaccumulation factor, which is constant for a given age/length and species of fish in a specific waterbody.

For a future time, t2, when mercury concentrations have changed but all other parameters remain constant, the equation can be written as:

$$C_{fish_{t2}} = BAF \bullet C_{water_{t2}}$$

where C_{fisht2} and $C_{watert2}$ are methylmercury contaminant levels in fish and water at time t2, respectively and C_{fisht2} is for a fish that is the same age, length, and species as for C_{fisht1}.

Combining the equations produces:

$$\frac{C_{fish_{t1}}}{C_{fish_{t2}}} = \frac{C_{water_{t1}}}{C_{water_{t2}}}$$

Because methylmercury water column concentrations are proportional to mercury air deposition load to a watershed, this equation can be rewritten as:

$$\frac{C_{fish_{t1}}}{C_{fish_{t2}}} = \frac{L_{air_{t1}}}{L_{air_{t2}}}$$

where L_{airt1} and L_{airt2} are the air deposition mercury loads to a waterbody at time t1 and t2, respectively.

It is reasonable to predict that, based on this relationship, mercury fish concentrations will likely be reduced from current levels in proportion to load reductions for the watershed. For waterbodies in which air deposition is the only significant source, fish tissue mercury concentration reductions will likely be directly proportional to air deposition reductions over the long term.

Because these relationships are based on steady states, we do not expect that a proportional relationship between atmospheric deposition reductions and fish tissue reductions will be observed immediately. However, it is expected this response will be seen over the long term, once systems have reached steady state. While it is acknowledged that there is a time lag between mercury being deposited on land and that mercury reaching waterbodies, it is assumed that the terrestrial system will eventually reach a new steady state with atmospheric deposition, and total loading of mercury to surface water will be proportional to atmospheric deposition.

The effects of the approach have been evaluated by Kamman, et al. (2006) for the region. The rate of change in fish mercury will vary among Northeast waterbodies due to different conditions that affect the production of methylmercury and bioaccumulation of methylmercury. These factors include watershed area, productivity, acidification status, sulfate loading, and water-level manipulation. However, empirical evidence is mounting that biological mercury concentrations are reduced in proportion to emissions and resultant deposition reductions (Evers, et al. 2006 and Florida Department of Environmental Protection 2003).

6 Source Assessment

6.1 Northeast States Emissions Inventory

In 1998, NESCAUM prepared *Atmospheric Mercury Emissions in the Northeastern States* to refine the emissions inventory figures developed by EPA for the Northeast region in conducting their national evaluation of atmospheric mercury emissions in accordance with the requirements of the 1990 Clean Air Amendments. Refinements were made based on facility-specific information collected by state air quality agencies, including stack test data, fuel use rates, air pollution control devices, and other operational parameters (NESCAUM 2005). The inventory quantifies mercury emissions representative of the year 1998 for combustion, manufacturing, and area sources in New England, New York State, and New Jersey. The study was a combined effort of the state and provincial air, waste, and water management agencies in the Northeast states and eastern Canadian provinces and was intended to serve as an information resource to these agencies and as a foundation for future regional initiatives, including the development of a coordinated action plan to reduce the environmental and public health impacts of mercury (NESCAUM 1998).

The inventory is divided into direct and area sources. Direct sources, which include combustion and manufacturing sources, typically release emissions from a stack and are large enough to be associated with a specific geographic location. Area sources are typically small, but there may be a large number of them, and they are not usually associated with emissions from a stack. Area sources include categories such as fossil fuel residential heating, fluorescent lamp breakage and recycling, laboratory use, dental use, and crematories. As seen in Figure 6-1, approximately 87 percent of the mercury emissions inventory in the Northeast states can be attributed to direct sources. About 9 percent of the direct emissions are due to manufacturing sources, with the remainder being attributed to the various combustion sources. The largest combustion sources were municipal waste combustors (MWCs) at 56 percent and electric utility boilers at 12 percent (NESCAUM 1998). Table 6-1 provides a full summary of emissions by category. NESCAUM's regional inventory included New Jersey, but emissions data reported here include only New England and New York State. The emissions sources for the region can be compared to the major sources of national mercury emissions in a similar time period, as seen in Figure 6-2.

Figure 6-1 Breakdown of Major Sources of Northeast Regional Mercury Emissions in 1998 (NESCAUM 1998)

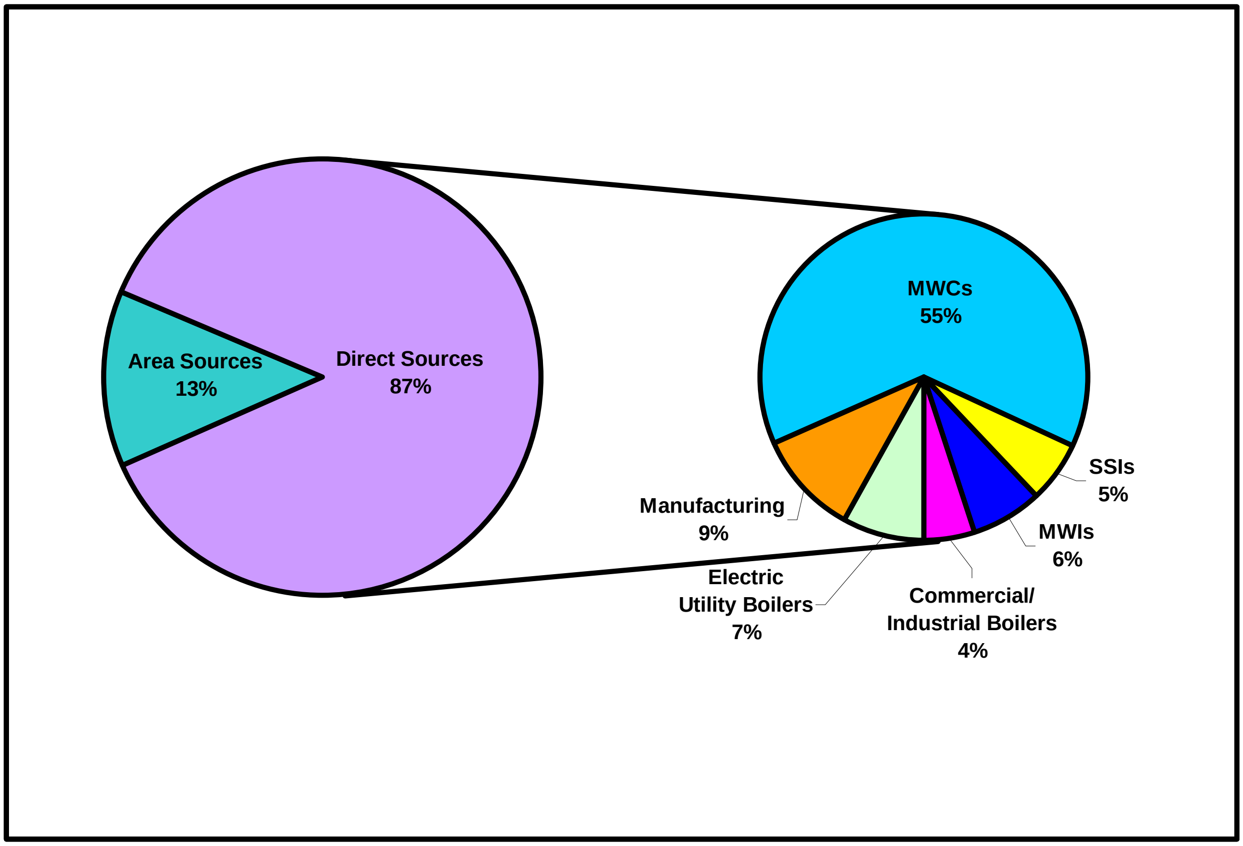


Figure 6-2 Major Sources of National Mercury Emissions in 1996 (Driscoll, et al. 2007)

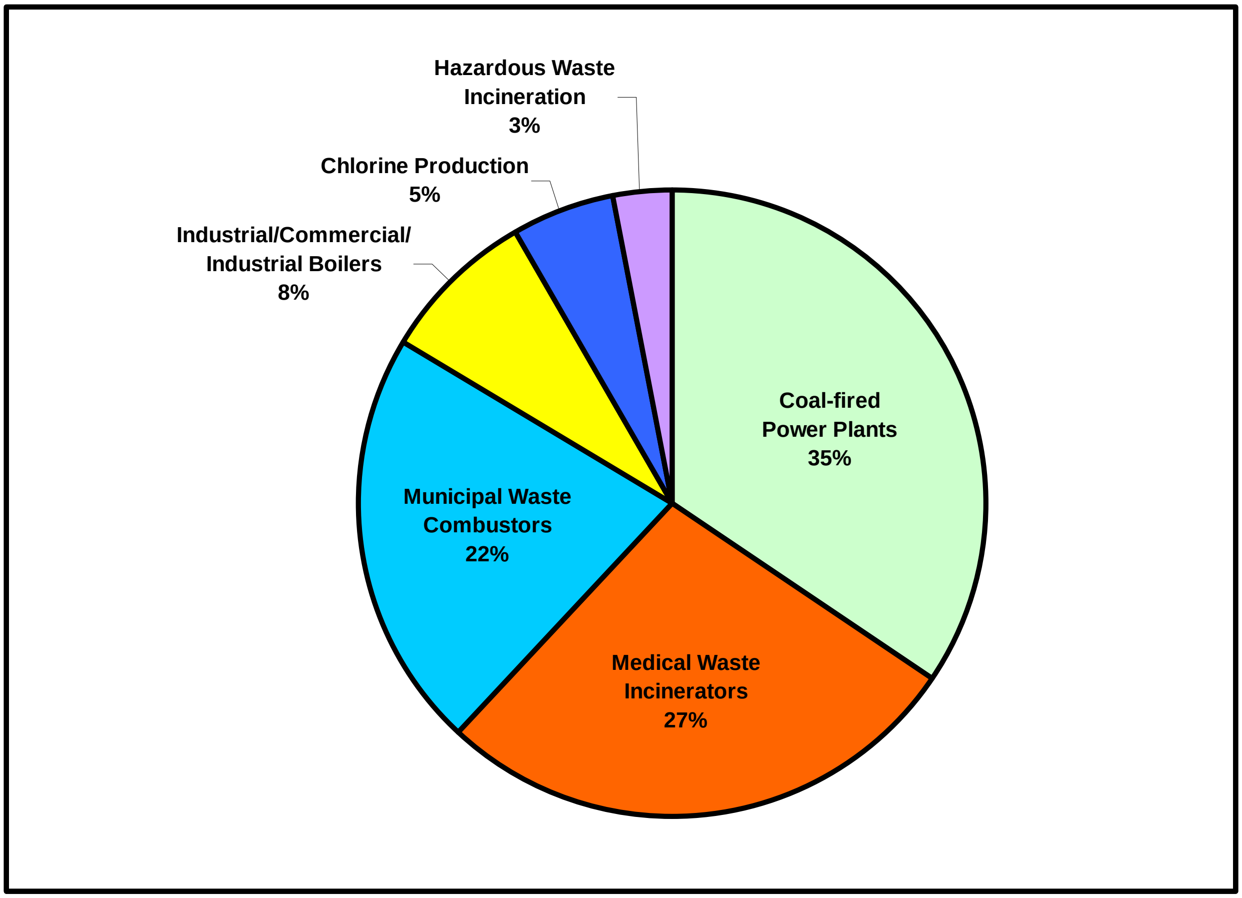


Table 6-1 1998 Northeast[1] Regional Mercury Emissions Inventory

Mercury Source Categories	Emissions Estimate (kg/yr)	Percent of Inventory
Direct Sources		
Combustion Sources		
Municipal Waste Combustors	6,896	55.2
Sewage Sludge Incinerators	657	5.3
Medical Waste Incinerators	758	6.1
Commercial/Industrial Boilers Total	552	4.4
Fossil Fuel-Fired	449	3.6
Wood-Fired	103	0.8
Electric Utility Boilers Total	864	6.9
Coal-Fired	697	5.6
Oil-Fired	142	1.1
Natural Gas-Fired	18	0.1
Wood-Fired	7	0.1
Total Combustion Sources	9,727	77.9
Manufacturing Sources		
Secondary Mercury Production	319	2.6
Cement Manufacturing	305	2.4
Lime Manufacturing	15	0.1
Steel Foundries	17	0.1
Chlor-Alkali Facilities	460	3.7
Misc. Industrial Processes	3	0.02
Total Manufacturing Sources	1,119	9.0
Total Direct Sources	**10,846**	**86.8**
Area Sources		
Residential Heating	575	4.6
Industrial Processes	1,073	8.6
Electric Lamp Breakage & Recycling	379	3.0
General Lab Use	48	0.4
Dental Preparation and Use	70	0.6
Crematories	70	0.6
Latex Paint	506	4.0
Total Area Sources	**1,648**	**13.2**
Total Emissions	**12,494**	**100**

[1] NESCAUM's original Northeast inventory included New Jersey, but data presented here are for New England and New York State only.

6.2 Atmospheric Deposition Modeling

NESCAUM has performed atmospheric deposition modeling using the Regional Modeling System for Aerosols and Deposition (REMSAD). This is a Eulerian grid model that includes atmospheric transport and chemistry. The REMSAD model uses tagging, which allows tracking of emissions through space and time. Tags can be individual sources, source types, and source regions (Graham, et al. 2006). NESCAUM conducted two modeling runs, one using 1998 emissions inventory for the Northeast region and one using 2002 emissions inventory for the Northeast region. Both modeling runs used 1996 meteorology data and 1999 or 2001 out-of-region emissions data depending on the source type (e.g. area sources vs. electric-generating units). Boundary conditions were obtained from the global mercury model GEOS-CHEM. The Northeast region, as defined by NESCAUM, includes the New England states, New York State, and New Jersey, whereas this TMDL defines the Northeast region as the New England states and New York State. Consequently, NESCAUM's modeling separated contributions from New England and New York State/New Jersey as one unit, but did not separate the contributions of New York State and New Jersey. NESCAUM was able to provide estimates of the separate contributions of New York State and New Jersey by splitting each of the contributing source categories based on location and amount of emissions, and then apportioned the deposition from the model runs accordingly (John Graham, electronic mail, December 19, 2006). The model results shown below for U.S. sources account only for anthropogenic sources of mercury and do not include atmospheric deposition of mercury from natural sources. Results for global sources include a natural component, which is further discussed below.

Table 6-2 Modeled Mercury Atmospheric Deposition (kg/yr) in 1998 and 2002 for the Northeast[1] Region

Source	Northeast States	Rest of the U.S.	Global Sources[2]	Total
1998 Modeled Total Deposition	2,092	1,207	2,106	5,405
1998 Modeled Natural Deposition	0	0	527	527
1998 Modeled Anthropogenic Deposition	2,092	1,207	1,580	4,879
2002 Modeled Total Deposition	543	791	2,106	3,440
2002 Modeled Natural Deposition	0	0	527	527
2002 Modeled Anthropogenic Deposition	543	791	1,580	2,914

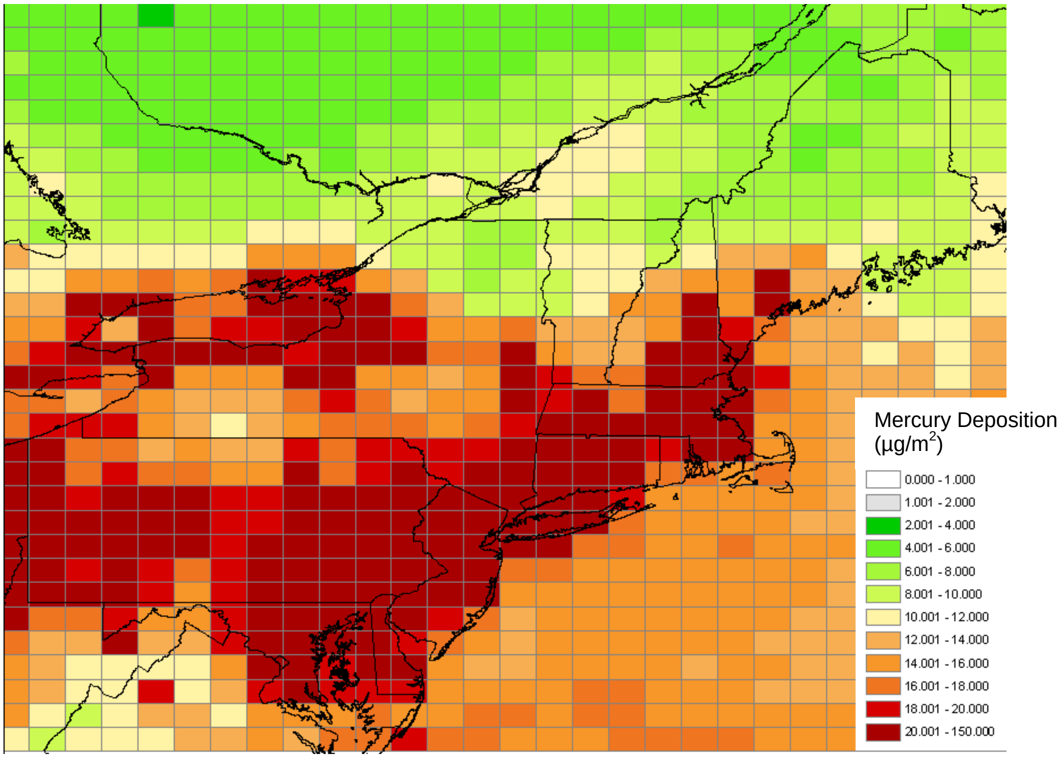
[1]Northeast region includes the New England states and New York State.
[2]Global sources include recirculating historical emissions from the U.S.

The global source estimate includes approximately 253 kg/yr (2,106 kg/yr x 0.12) attributable to primary natural sources. This value is based on the global modeling that the boundary conditions were derived from, where approximately 12 percent of the inventory was from primary natural emissions. The global source contribution also includes recirculating natural source emissions from the U.S. Based on the assumption used in this TMDL that deposition is 75 percent anthropogenic and 25 percent natural (Kamman and Engstrom 2002, further discussed in Section 7.2), the contribution of recirculating natural source emissions is set at 13 percent, so that the contributions of primary natural emissions and recirculating natural source emissions sum to 25 percent. Based on this assumption, recirculating natural source emissions are equal to 274 kg/yr (2,106 kg/yr x 0.13). No other natural sources were accounted for in the regional deposition modeling. When global natural sources are subtracted from the total deposition results, the total anthropogenic deposition is 4,879 kg/yr for 1998 and 2,914 kg/yr for 2002. In order to avoid double counting of natural mercury deposition, modeled natural deposition was excluded from TMDL calculations. Modeled anthropogenic deposition was used as a base from which to estimate total regional natural mercury deposition based on regional studies that estimate regional deposition is 25 percent natural and 75 percent anthropogenic (Kamman and Engstrom 2002). This is further discussed in Section 7.2.

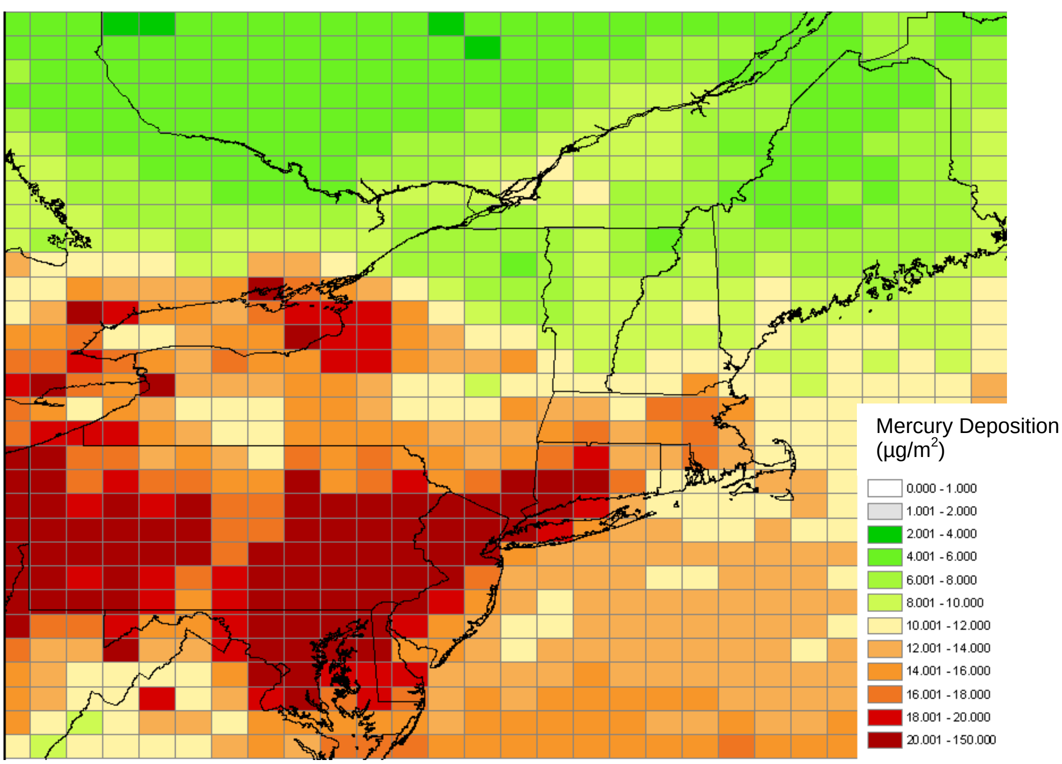
Figure 6-3 shows maps of the regional modeled mercury deposition for 1998 and 2002. Although deposition is not uniform across the region, because elevated mercury levels are a problem across the region, the states emphasize that the regional approach is appropriate as discussed in detail in Section 5.

Figure 6-3 Total Regional Modeled Mercury Deposition in 1998 and 2002 based on REMSAD Modeling

1998 Modeled Mercury Deposition



2002 Modeled Mercury Deposition



6.3 Point Sources to Water

There are 3,119 National Pollutant Discharge Elimination System (NPDES) permitted facilities discharging to the waters of New England and New York State. These include publicly owned treatment works (POTWs), as well as industries such as pulp and paper mills, chlor-alkali plants, and manufacturers of lighting equipment, chemicals, and metals.

To estimate the point source mercury load for the region, mercury monitoring data and design flow data were used. All available point source mercury monitoring data from 1988 to 2005 were obtained from the participating states. With one exception, only data that were collected using EPA Method 1631 were included in the analysis. Rhode Island had a small amount of data that were collected under EPA Method 245.1, but were determined to be acceptable for inclusion in this dataset. The treatment plants were able to achieve a method detection limit that was much lower than what is normally achieved with this method and the mean concentrations for the two facilities fell into the range of the other facilities in the dataset.

For any facility with multiple measurements, all data points were averaged to calculate a mean mercury concentration for each facility. These mean values were all combined into one dataset and the median mercury concentration for the region was calculated. This value, 7.7 ng/l, was used as a typical point source mercury concentration for the region. Facilities discharging to coastal waters were excluded from design flow calculations, but concentration data from coastal facilities were retained because the amount of available mercury effluent data is small and there is no reason to believe that mercury effluent concentrations would differ between facilities discharging to marine and fresh waters. Because regional mercury loading from wastewater sources is a very small amount compared to the total mercury loading to the region, combining all mercury point sources into one regional median is an appropriate approach.

Design flow data for all NPDES permitted facilities in the region were obtained from EPA Region 1, New York State Department of Environmental Conservation (NYS DEC), and Vermont Department of Environmental Conservation (VT DEC). Facilities that primarily discharge cooling water were not included in point source mercury load estimates because their discharges do not contain appreciable amounts of mercury. Facilities that discharge to marine waters were also excluded because this TMDL targets only freshwaters. A median value was calculated from the available data and used as an estimate for any facilities for which design flow data were not available. The known and estimated design flows for all regional facilities were then summed together. This value was used with the regional point source concentration estimate of 7.7 ng/l to estimate the total point source load. The breakdown of effluent concentrations and design flows by state is shown below in Table 6-3. The mean mercury effluent concentrations used in calculating the regional median concentration are shown in Appendix C.

Table 6-3 Mercury Point Sources to Water

State	Number of Facilities w/ Data	Mean Concentration (ng/l)	Median Concentration (ng/l)	Sum of Design Flows (MGD)
CT	0	12.1	7.7	7,105
ME	182	17.3	7.3	515
MA	5	22.9	7.7	1,791
NH	0	12.1	7.7	138
NY	50	17.8	9.8	3,622
RI	2	17.0	17.0	56
VT	10	1.3	1.3	95
Northeast Region	249	12.1	7.7	13,322

***Because no effluent data were available for New Hampshire, and Connecticut only had data collected under EPA Method 245.1, the regional median and means are used as estimates for these states.

7 Development of a Regional Total Maximum Daily Load

7.1 TMDL Formulation

The TMDL formulation used for this regional mercury TMDL is similar to the Minnesota Statewide Mercury TMDL, approved by EPA March 27, 2007, which employs a total source load (TSL) and reduction factor (RF) to define the desired TMDL. In general, the three-step process to determine a TMDL is to (1) determine the existing load for point and nonpoint sources; (2) define the target loads; and (3) calculate load reduction factors necessary to achieve the target values. The total source load (TSL) and reduction factor (RF) are then combined to give the TMDL for the area of concern as shown in Equation 1.

Equation 1: $TMDL = TSL \cdot (1-RF)$

where: TMDL is the total maximum daily load (kg/yr) that is expected to result in attainment of the target fish mercury concentration specified in Section 5.3

TSL is the existing total source load (kg/yr), and is equal to the sum of the existing point source load (PSL) and the existing nonpoint source load (NPSL) and

RF is the reduction factor required to achieve the target fish mercury concentration (see Section 7.3 for calculations)

Once the TMDL is calculated in accordance with Equation 1, the allowable load can then be allocated among the point sources, nonpoint sources and an explicit MOS (if necessary) in accordance with the conventional TMDL formula shown as Equation 2 below.

Equation 2: $TMDL = WLA + LA + MOS$

where: WLA = Wasteload Allocation or point sources

LA = Load Allocation or nonpoint sources

MOS = Margin of Safety

Each of the terms used in Equations 1 and 2 are further discussed in Sections 7.2 through 7.7 followed by a presentation of the final TMDL in Section 8.

7.2 Calculation of Existing Total Source Load (TSL)

Calculation of the existing Total Source Load (TSL) of mercury, in kg/yr, is presented below in Equation 3 and is the sum of the existing point source and nonpoint source loadings.

Equation 3: TSL = PSL + NPSL

The calculation for the PSL is presented below in Equation 4 and is estimated for the region based on the total design flow of wastewater treatment facilities and the median effluent mercury concentration. The PSL is the product of the regional median mercury concentration in effluent and the sum of design flows for each permitted facility in the region.

Equation 4: $PSL = C_{med} \cdot \sum Q_i$

where: C_{med} = Median mercury concentration in effluent of NPDES permitted discharges

Q_i = Design flow of each NPDES permitted discharge (excluding cooling water and marine discharges)

C_{med} is derived from all appropriate available point source mercury monitoring data obtained from the participating states, and is equal to 7.7 ng/l (see Table 6-3). The sum of regional design flows, excluding facilities that primarily discharge cooling water or discharge to coastal waters, is 13,322 MGD (see Table 6-3). Based on Equation 4 and the data presented in Table 6-3, the existing PSL is 141 kg/yr.

It should be noted that the calculated point source load is considered to be overestimated. Many of the waterbodies that are covered by this TMDL do not have any point source discharges and therefore are not affected by the regional point source load. In addition, actual flows are considerably lower than design flows, so use of design flows in the calculation inflates the point source load.

When stormwater is addressed in a TMDL, it is generally included with the point source load and subsequently included in the wasteload allocation. However, most mercury in stormwater comes from atmospheric deposition. In this TMDL, regulated stormwater is included in the WLA and unregulated stormwater is included in the LA. Because the majority of mercury in stormwater originates from atmospheric deposition, reductions of mercury loading in stormwater will be addressed through controls on atmospheric deposition.

The nonpoint source load (NPSL) calculation, as presented below in Equation 5, reflects the contributions of natural (NNPSL) and anthropogenic (ANPSL) sources of mercury deposition.

Equation 5: NPSL = NNPSL + ANPSL

The only significant nonpoint source can be attributed to atmospheric deposition. Other contributions, such as land application of municipal sewage sludge, are assumed to be insignificant. As discussed in

Section 6.2, the modeled anthropogenic atmospheric mercury deposition (ANPSL) for 1998 is 4,879 kg/yr.

Based on results of several paleolimnological studies in the Northeast, background or natural mercury deposition estimates range from 15 percent to 25 percent of circa year 2000 deposition fluxes (Perry, et al., 2005, Norton, et al. 2004, Seigneur, et al. 2003, Kamman and Engstrom 2002, Lorey and Driscoll 1998, and Norton, et al. 1997). These values are consistent with other published values from the upper Midwest and elsewhere. For the purposes of this TMDL, the paleolimnological studies are used to conclude that the proportion of deposition due to natural sources (PDNS) in the Northeast is 25 percent of the total deposition load. Natural sources cannot be controlled and are expected to remain at the same long-term average; therefore all mercury reductions must come from anthropogenic sources. The NPSL and NNPSL can be calculated from Equations 6 and 7 below.

$$\text{Equation 6: NPSL} = \text{ANPSL} / (1-\text{PDNS})$$

$$\text{Equation 7: NNPSL} = \text{NPSL} \cdot \text{PDNS}$$

Based on these equations, an ANPSL of 4,879 kg/yr, and a PDNS of 0.25, NPSL is equal to 6,506 kg/yr and NNPSL is equal to 1,626 kg/yr. Knowing the PSL and NPSL, the 1998 TSL can be calculated in accordance with Equation 3 as shown below:

$$\text{1998 TSL} = 141\text{ kg/yr} + 6{,}506\text{ kg/yr} = 6{,}647\text{ kg/yr}$$

Based on these values, existing point source loads represent 2.1 percent and existing nonpoint source loads represent 97.9 percent of the 1998 TSL.

7.3 Reduction Factor (RF)

The calculation for the RF is presented below in Equation 8 and is based on the reductions required to achieve the target fish mercury concentrations.

$$\text{Equation 8: RF} = (\text{EFMC} - \text{TFMC}) / \text{EFMC}$$

where: EFMC = the existing fish mercury concentration for the selected fish species

TFMC = the target fish mercury concentration for meeting water quality standards

As discussed in Section 5.2, the EFMC for this study is 1.14 ppm which represents the 90th percentile concentration based on standardized length for smallmouth bass. As discussed in Section 5.3, the initial TFMC is equal to 0.3 ppm, with subsequent TFMCs of 0.2 ppm and 0.1 ppm. Inserting these values into Equation 8 results in the RFs shown in the table below[1].

[1] As was noted previously, all TMDL calculations are shown for the range of 80th to 90th percentile fish tissue concentrations to address uncertainty. For purposes of TMDL implementation, the target is the 90th percentile fish tissue concentration.

TFMC (ppm)	RF 80th percentile	RF 90th percentile
0.3	0.65	0.74
0.2	0.77	0.82
0.1	0.88	0.91

7.4 TMDL Calculation

As previously mentioned, the TSL is equal to 6,647 kg/yr (see Section 7.3). Inserting the TSL and the RFs calculated in Section 7.3 into Equation 1 yields the TMDLs shown in the table below. This is the total allowable loading of mercury that, over time, is expected to result in meeting the target mercury fish concentrations.

TFMC (ppm)	TMDL 80th Percentile (kg/yr)	TMDL 90th percentile (kg/yr)
0.3	2,320	1,750
0.2	1,547	1,167
0.1	773	583

7.5 Wasteload Allocation (WLA)

According to Equation 2, the calculated permissible load (TMDL) of mercury that will not cause the applicable water quality standards to be exceeded is the sum of the wasteload allocation (point sources), load allocation (nonpoint sources), and an explicit MOS, if applicable. As explained in Section 7.7, an implicit MOS is used for this study which infers an explicit MOS of zero. Therefore the TMDL is equal to the sum of the WLA and LA. As discussed in Section 7.2, point sources primarily consist of discharges from NPDES wastewater treatment facilities and the only significant nonpoint source is atmospheric deposition. Consequently, the total load is apportioned between wastewater and atmospheric loads.

The WLA includes the contributions from regulated stormwater sources, which includes mercury primarily from atmospheric sources as small contributions from local sources within the watershed and natural sources. Although the contribution of stormwater to mercury loading is unknown, the vast majority of mercury from stormwater that contributes to the impairment of these waters originates from air sources and should be controlled accordingly. Regulated stormwater is considered to be part of the de minimis WLA, and will be addressed through the controls on atmospheric deposition sources that are required to meet the load allocation. The states anticipate that once atmospheric deposition reductions are met, the only remaining regulated stormwater contributions would be solely attributed to natural sources and run-off from localized non-atmospheric sources. Given the states' commitment to virtual elimination of mercury, this residual stormwater contribution is considered to be a minute part of the WLA.

The states are already engaged in controlling stormwater pollution using best management practices (BMPs) in accordance with Clean Water Act §402(p) and 40 CFR 122.44(k) and any residual mercury in stormwater that originates from non-atmospheric sources can be addressed by these programs. The six minimum measures associated with permits for municipal separate storm sewer systems (MS4s) will contribute toward reducing mercury loading by reducing stormwater volume and sediment loading.

As discussed in Section 7.2, the existing point source load for the entire region is 2.1 percent of the TSL for mercury, which is small (as compared to the LA) and expected to further decline based on enacted mercury products legislation and increasing required use of dental amalgam separators throughout the region. According to EPA's *Draft Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion*, point source discharges are considered insignificant if the loading or cumulative loading of all point sources to the receiving water are expected to account for a small or negligible portion of the total mercury loadings (U.S. EPA 2006a). All significant decreases in mercury loading to the region will come from reductions in atmospheric deposition (i.e., load allocation).

This TMDL places much emphasis on the fact that the states have agreed to a goal of virtual elimination of mercury. As is stated in Section 2.5 of the TMDL, as of 2006, all of the Northeast states have passed legislation to address mercury in products and require installation of dental amalgam separators. Individual laws and requirements vary by state, but legislation addresses bans on disposal of mercury-added products, bans on sale or distribution of mercury-added novelties and measuring devices, requirements for labeling of mercury-added products, prohibition of primary and secondary schools purchasing or using mercury, removal of mercury switches from automobiles, and requirements on recycling of mercury-added products. The end result of all these mercury reduction efforts is that a smaller quantity of mercury makes its way into the waste stream and less mercury is discharged from wastewater treatment facilities. These efforts undoubtedly increase the likelihood of successfully implementing the WLA. Because these reduction efforts are ongoing, the states feel there is little else that could be done through the NPDES program that could further ensure that the WLA will not be exceeded. However, states will conduct investigations, as appropriate, on a permit by permit basis, to prevent localized exceedances of the WLA . As a result, the WLA is set at 2.1 percent of the TMDL, which is equivalent to the values shown in the table below.

TFMC (ppm)	WLA 80th percentile (kg/yr)	WLA 90th percentile (kg/yr)
0.3	49	37
0.2	33	25
0.1	16	12

The WLA in this TMDL is regional and is not specific to each particular state or source. Instead of allocating the WLA among sources, mercury reduction will be accomplished through mercury minimization plans (MMPs) and the continuation of region-wide mercury reduction efforts as described above. MMPs help ensure that discharges have no reasonable potential to cause or contribute to an exceedance of water quality standards. EPA believes that a requirement to develop a MMP may provide dischargers with sufficient information to voluntarily and economically reduce mercury discharges (EPA 2006a). Evaluation of progress at the Phase II milestone will determine if mercury minimization plans and additional monitoring at point sources should be prescribed for dischargers that do not already have those programs in place. All new or increased discharges will be required to stay below the regional WLA.

7.6 Load Allocations

7.6.1 Load Allocation Calculations

Subtracting the WLAs calculated in Section 7.5 from the TMDLs calculated in Section 7.4 in accordance with Equation 2, and assuming an explicit MOS of zero for reasons discussed in Section 7.7, yields the regional mercury LAs shown in the table below.

TFMC (ppm)	LA 80th percentile (kg/yr)	LA 90th percentile (kg/yr)
0.3	2,269	1,712
0.2	1,513	1,141
0.1	756	571

However, as discussed in Section 7.2, 1,626 kg of the TSL is due to natural sources of mercury and cannot be controlled (this number represents the natural load allocation or NLA). The anthropogenic load allocation (ALA) can be calculated using Equation 9 below.

Equation 9: ALA = LA – NLA

Using this equation with the LAs shown above and NLA of 1,626 yields the ALAs shown in the table below. This represents the range of anthropogenic atmospheric deposition goals for the Northeast states, to be achieved through reductions in both in-region and out-of-region sources.

TFMC (ppm)	ALA 80th percentile (kg/yr)	ALA 90th percentile (kg/yr)
0.3	643	86
0.2	-113[1]	-485
0.1	-870	-1,056

7.6.2 Necessary Reductions to Meet LA

In order to meet the ALA, the necessary reductions in anthropogenic atmospheric deposition can be calculated through equation 10 below:

Equation 10: Percent reduction in anthropogenic deposition = [100 · (ANPSL – ALA)/ANPSL]

Using this equation, the necessary reductions are shown in the table below.

TFMC (ppm)	Necessary Percent Reduction in Anthropogenic Deposition 80th percentile	Necessary Percent Reduction in Anthropogenic Deposition 90th percentile
0.3	87%	98%
0.2	102%	110%
0.1	118%	122%

Necessary reductions to meet the LA are divided into in-region and out-of-region contributions. Reductions are divided into three phases, Phase I from 1998 to 2003, Phase II from 2003 to 2010, and Phase III beginning in 2010 with an end date to be determined in 2010. The timeline and goals for Phases

[1] It is noted that to meet water quality standards in both Maine and Connecticut, calculations require reductions in anthropogenic mercury deposition greater than 100 percent, resulting in negative anthropogenic load allocations. However, these calculations are affected by a number of variables including the percentage of deposition due to anthropogenic sources, and there is a range of accepted values associated with this number. Various studies have found this percentage to be between 75 and 85 percent. Use of a lower percentage results in a greater percent reduction from anthropogenic sources, whereas a higher percentage has the opposite effect. Because of this uncertainty, adaptive management will be used when implementing the reductions necessary to meet the TMDL. Throughout Phase III, the states will re-evaluate progress made towards the 0.2 and 0.1 goals and will determine if adjustments need to be made in the ultimate goals that have been set, or how they can be achieved in accordance with the timeline set forth in the implementation plan.

I and II are set to correspond with the NEG-ECP regional MAP. In 2010, mercury emissions, deposition, and fish tissue concentration data will be re-evaluated with current information. This information will be used to set an end date and reduction goal for Phase III, which will represent completion of necessary reductions to meet water quality standards. Based on updated data, the final TMDL goal may differ from the percents reduction presented in this document. If this occurs, the TMDL goals will be revised and updated.

Based on the calculated percents reduction in anthropogenic sources, necessary mercury reductions amount to values shown in the table below.

TFMC (ppm)	Necessary Reductions in Anthropogenic Deposition 80th percentile (kg/yr)	Necessary Reductions in Anthropogenic Deposition 90th percentile (kg/yr)
0.3	4,236	4,793
0.2	4,993	5,364
0.1	5,749	5,935

Based on the amount of atmospheric deposition attributed to in-region and out-of-region sources by NESCAUM's modeling, the necessary reductions can be divided between in-region and out-of-region sources. These reductions are shown in the tables below.

TFMC (ppm)	Necessary In-Region Reductions in Anthropogenic Deposition 80th percentile (kg/yr)	Necessary In- Region Reductions in Anthropogenic Deposition 90th percentile (kg/yr)
0.3	1,816	2,055
0.2	2,141	2,300
0.1	2,465	2,545

TFMC (ppm)	Necessary Out-of Region Reductions in Anthropogenic Deposition 80th percentile (kg/yr)	Necessary Out-of-Region Reductions in Anthropogenic Deposition 90th percentile (kg/yr)
0.3	2,420	2,738
0.2	2,852	3,064
0.1	3,284	3,390

The goal for Phase I (1998-2003) is a 50 percent reduction, or 1,046 kg/yr from in-region sources and 1,394 kg/yr from out-of-region sources. As of 2002, in-region sources had been reduced by 1,549 kg/yr, so the in-region goal for Phase I was exceeded. Not enough data are currently available to accurately assess reductions achieved by out-of-region sources. The goal for Phase II (2003-2010) is a 75 percent reduction, or 1,569 kg/yr from in-region sources and 2,090 kg/yr from out-of-region sources. Based on in-region reductions achieved as of 2002, in-region reductions of 20 kg/yr are necessary to meet the Phase II goal.

Once Phase II goals are successfully met, in-region and out-of-region sources will need to be reduced by the amounts shown in the table below. However, as discussed above, mercury emissions, deposition, and fish concentration data will be re-evaluated at the completion of Phase II in 2010. If necessary, reductions for meeting the target fish concentration will be revised based on updated data. As further discussed in Section 9, TMDL goals will be implemented in an adaptive fashion.

TFMC (ppm)	Remaining In-Region Reductions after Phase II 80^{th} Percentile (kg/yr)	Remaining In-Region Reductions after Phase II 90^{th} Percentile (kg/yr)
0.3	247	486
0.2	572	731
0.1	896	976

TFMC (ppm)	Remaining Out-of-Region Reductions after Phase II 80^{th} Percentile (kg/yr)	Remaining Out-of-Region Reductions after Phase II 90^{th} Percentile (kg/yr)
0.3	330	648
0.2	762	974
0.1	1,194	1,300

The Northeast region's ability to achieve the calculated TMDL allocations is dependent on the adoption and effective implementation of national and international programs to achieve necessary reductions in mercury emissions. Given the magnitude of the reductions required to implement the TMDL, the Northeast cannot reduce in-region sources further to compensate for insufficient reductions from out-of-region sources. This is further discussed in detail in Section 10.

7.7 Margin of Safety

Regulations require that a MOS is included in a TMDL to account for uncertainty that may be present in the calculations. A MOS can either be explicit (e.g., additional percentage load reduction), implicit in the calculations, or a combination of the two. For this mercury TMDL, the MOS is implicit because of the following conservative assumptions used to develop this TMDL:

- The 90^{th} percentile fish mercury concentration based on a standard length smallmouth bass was used. Smallmouth bass has the highest concentrations of the four species selected for calculation (see Table 4-2). The vast majority of fish have concentrations lower than this. According to Equation 1, the higher the EFMC, the higher the RF and the lower the TMDL. As many people eat a combination of fish, some at lower trophic levels than smallmouth bass, use of the 90^{th} percentile smallmouth bass incorporates a margin of safety into the analysis.
- Atmospheric sources of mercury in the Northeast are categorized as 25 percent natural (Kamman and Engstrom 2002), but could range from 15 to 25 percent, based on a number of regional studies. Given the Northeast region's location downwind of mercury sources and the fact that available sediment cores are largely from more rural sites less impacted by direct air emissions sources, the percentage of baseline deposition attributable to natural sources across the region is likely lower than the 25 percent used in this analysis. Use of a lower value, such as 15 percent, would have resulted in lower required reductions in anthropogenic sources.
- The transformation of mercury to methylmercury is dependent on sulfur, so it is believed that reductions in sulfur deposition will lead to reduced methylation of mercury. As ongoing federal and state programs are reducing sulfur emissions and deposition, methylation of mercury should also decrease. As the TMDL does not account for this potential reduction in mercury bioaccumulation, proposed mercury reductions based on the TMDL may be overestimated and therefore provide an extra level of protection.
- The EPA fish tissue criterion and state fish tissue criteria that are being used as TMDL targets are based on concentrations of methylmercury, but the states are actually measuring total mercury in fish instead of methylmercury. It is assumed that approximately 90 percent of total mercury in fish is methylmercury, so if states are meeting a concentration of 0.1, 0.2, or 0.3 ppm total

mercury, the concentration of methylmercury is actually about ten percent lower than this value, allowing for another level of protection.

7.8 Seasonal Variation and Critical Conditions

Seasonal variations and "...critical conditions for stream flow, loading, and water quality parameters" are discussed in 40 CFR 130.7(c)(1). The regulation provides that: *"for pollutants other than heat, TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical WQS with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality. Determinations of TMDLs shall take into account critical conditions for stream flow, loading, and water quality parameters"*. Mercury deposition and concentrations in water vary due to seasonal differences in rain and wind patterns, but this variation is not relevant because mercury concentrations in fish represent accumulation over their life spans. Factors such as size and waterbody conditions have greater effect on mercury concentrations than seasonal variation.

There are some factors, such as water chemistry and water level fluctuations that make conditions more favorable for mercury accumulation in fish. However, these are not short term critical conditions, but rather factors that contribute to the accumulation of mercury in fish over long periods of time. More information is provided on sensitive areas and critical conditions in Section 4.2.

7.9 Daily Load

Because this TMDL addresses mercury accumulation in fish over long periods of time, annual loads are more appropriate for expressing mercury loading goals. Therefore, the calculations and compliance with this TMDL are based on annual loads. However, in order to comply with current EPA guidance, the TMDL is also expressed as a daily load.

8 Final TMDL

The conventional equation for a TMDL is as follows: TMDL = WLA+LA+MOS. As described in Section 7.7, the MOS is implicit for this TMDL, and therefore, it is not necessary to include an explicit MOS in the calculations. Calculation of the WLA and LA are described in Sections 7.5 and 7.6 respectively. The final TMDLs for the Northeast region are shown below for both annual and daily loads. The values shown correspond to use of the 80th to 90th percentile existing mercury concentrations in smallmouth bass to calculate the TMDL as discussed in Section 5.2. The target of the TMDL is 90th percentile.

TFMC	TMDL Annual Load 80th Percentile	TMDL Annual Load 90th Percentile
0.3	TMDL (2,319 kg/yr) = WLA (49 kg/yr) + LA (2,269 kg/yr)	TMDL (1,749 kg/yr) = WLA (37 kg/yr) + LA (1,712 kg/yr)
0.2	TMDL (1,546 kg/yr) = WLA (33 kg/yr) + LA (1,513 kg/yr)	TMDL (1,166 kg/yr) = WLA (25 kg/yr) + LA (1,141 kg/yr)
0.1	TMDL (773 kg/yr) = WLA (16 kg/yr) + LA (756 kg/yr)	TMDL (583 kg/yr) = WLA (12 kg/yr) + LA (571 kg/yr)

TFMC	TMDL Daily Load 80th Percentile	TMDL Daily Load 90th Percentile
0.3	TMDL (6.4 kg/d) = [WLA (49 kg/yr) + LA (2,269 kg/yr)]/365	TMDL (4.8 kg/d) = [WLA (37 kg/yr) + LA (1,712 kg/yr)]/365
0.2	TMDL (4.2 kg/d) = [WLA (33 kg/yr) + LA (1,513 kg/yr)]/365	TMDL (3.2 kg/d) = [WLA (25 kg/yr) + LA (1,141 kg/yr)]/365
0.1	TMDL (2.1 kg/d) = [WLA (16 kg/yr) + LA (756 kg/yr)]/365	TMDL (1.6 kg/d) = [WLA (12 kg/yr) + LA (571 kg/yr)]/365

The WLA is defined for this mercury TMDL as 2.1 percent of the TMDL to ensure that water point source mercury loads remain small and continue to decrease.

9 Implementation

This regional TMDL will be implemented using adaptive implementation in order to ensure calculated reduction targets are appropriate as measured mercury fish tissue concentrations decline. It is expected that states will continue fish tissue monitoring at the same level that has been conducted in recent years, provided that sufficient funding is available. If monitoring shows that fish tissue concentrations have declined to levels that meet water quality standards before the calculated percent reduction in anthropogenic loadings is achieved, targets will be adjusted based on that monitoring.

Implementation has been divided into three phases. The timeline and goals for the first two phases align with the NEG-ECP Regional MAP. Phase I is from 1998 to 2003 with a goal of 50 percent reduction and Phase II is from 2003 to 2010 with a goal of 75 percent reduction. The goal of Phase III will be to make any further necessary reductions to meet the target fish mercury concentrations. However, the exact timeline and reduction goal for this phase cannot be determined until mercury emissions, deposition, and fish tissue concentrations are re-evaluated in 2010. The goal for Phase III may or may not match the percent reduction that current calculations show. To meet the necessary reductions required in Phase III, major air point sources will be addressed through the application of more stringent control technology requirements and/or emission limits, economically and technically feasible/achievable, taking into account advances in the state of air pollution controls and the application of transferable technologies used by other sources to achieve maximum emission reductions. Emissions from area sources will be controlled to the maximum extent feasible using best management practices and pollution prevention approaches.

9.1 State and Regional Implementation

9.1.1 Implementation of Wasteload Allocation

In 2005, it was estimated that approximately 72 percent of dentists in New England had installed amalgam separators. As the point source load for this TMDL was based on data from 1988 to 2005, the regional point source load has most likely already significantly decreased as a result of amalgam separator installation. As of 2006, all of the Northeast states have legislation or regulations that require installation of amalgam separators, which will further reduce mercury loads in wastewater. As of 2006, all of the Northeast states have comprehensive mercury products legislation. This will result in additional reductions in mercury concentrations in wastewater by reducing mercury input from household uses. As was discussed in Section 7.5, this TMDL places much emphasis on the fact that the states have agreed to a goal of virtual elimination of mercury. Individual laws and requirements vary by state, but legislation addresses bans on disposal of mercury-added products, bans on sale or distribution of mercury-added novelties and measuring devices, requirements for installing amalgam separators, requirements for labeling of mercury-added products, prohibition of primary and secondary schools purchasing or using mercury, removal of mercury switches from automobiles, and requirements on recycling of mercury-added products. The end result of all these mercury minimization efforts is that a smaller quantity of mercury makes its way into the waste stream and less mercury is discharged from wastewater treatment facilities. More details on state reduction plans can be found in Appendix D. These efforts undoubtedly increase the likelihood of successfully implementing the waste load allocation. Because these reduction efforts are on-going the states feel there is little else that could be done through the NPDES program that could further ensure that the WLA will not be exceeded. However, states will conduct investigations, as appropriate, on a permit by permit basis, to prevent localized exceedances of the WLA.

Reductions in the mercury load in stormwater are expected to be achieved through reductions in atmospheric deposition, the primary source of mercury in stormwater. Regulated stormwater is considered to be part of the de minimis WLA, and will be addressed through the controls on atmospheric deposition sources that are required to meet the load allocation. The states anticipate that once atmospheric deposition reductions are met, the only remaining regulated stormwater contributions would be solely attributed to natural sources and run-off from localized non-atmospheric sources. This residual stormwater contribution is considered to be a minute part of the WLA.

The states are already engaged in controlling stormwater pollution using best management practices (BMPs) in accordance with Clean Water Act §402(p) and 40 CFR 122.44(k) and any residual mercury in stormwater that originates from non-atmospheric sources can be addressed by these programs. The six minimum measures associated with permits for municipal separate storm sewer systems (MS4s) will contribute toward reducing mercury loading by reducing stormwater volume and sediment loading.

The WLA in this TMDL is regional and is not specific to each particular state or source. Instead of allocating the WLA among sources, mercury reduction will be accomplished through mercury minimization plans (MMPs) and the continuation of region-wide mercury reduction efforts as described above. MMPs help ensure that discharges have no reasonable potential to cause or contribute to an exceedance of water quality standards. EPA believes that a requirement to develop a MMP may provide dischargers with sufficient information to voluntarily and economically reduce mercury discharges (EPA 2006a). Evaluation of progress at the Phase II milestone will determine if mercury minimization plans and additional monitoring at point sources should be prescribed for dischargers that do not already have those programs in place. All new or increased discharges will be required to stay below the regional WLA.

9.1.2 Adaptive Implementation of Load Allocation

EPA’s Clean Air Mercury Rule (CAMR) became effective May 18, 2006. All states that received a mercury budget under CAMR are required to either comply with the rule or develop their own rule. Because they do not have any coal-fired utilities, Rhode Island and Vermont did not receive a mercury budget under CAMR and are therefore not required to develop a state plan (NACAA 2007). The five remaining Northeast states have chosen to develop their own rules. None of the Northeast states will participate in the interstate trading that is allowed under CAMR. Table 9-1 provides a summary of state rules. Implementation of these state-based rules will go a long way toward meeting the deposition goals set by this TMDL, as coal-fired utilities are one of the most significant sources of emissions in the region.

Table 9-1 Northeast State Mercury Control Programs for Coal-Fired Utilities

State	Rule
CT	On or after July 1, 2008, coal-fired utilities are required to meet an emissions rate equal to or less than 0.6 lbs of mercury per trillion British thermal units (TBtu) or meet a rate equal to 90 percent reduction, whichever is more readily achievable. On or before January 1, 2012, CT DEP will conduct a review of mercury emission limits applicable to affected units and may adopt regulations to impose more stringent limits.
ME	Currently all coal-fired utilities and other facilities in Maine have a mercury emissions limit of 50 lbs/yr. Recently enacted legislation changes the limit to 35 lbs/yr in 2007 and 25 lbs/yr in 2010. A mercury reduction plan would also be required for any facility emitting more than 10 lbs/yr.
MA	Phase I, which takes effect January 1, 2008, requires that each facility capture at least 85 percent of mercury in the coal burned, or emit no more than 0.0075 lbs of mercury per net gigawatt-hour of electricity generated. Phase II, which takes effect October 1, 2012, requires that facilities capture at least 95 percent of the mercury in coal burned, or emit no more than 0.0025 lbs of mercury per net gigawatt-hour of electricity generated.
NH	An Act Relative to the Reduction of Mercury Emissions provides for 80 percent reduction of mercury emissions from coal-burning power plants by requiring installation of scrubber technology no later than July 1, 2013 and provides economic incentives for earlier installation and greater reductions in emissions.
NY	Phase I requires a 50 percent decrease by January 1, 2010 and Phase II will implement a unit-based limit for each power plant facility. This will result in an estimated 90 percent decrease from current levels, which will result in total emissions of 150 lbs/yr or less.

In addition to enforceable controls on coal-fired utilities, the next phase of the NEG-ECP MAP focuses on working toward reductions from four other sectors: sewage sludge incinerators (SSIs), MWCs, area sources, and residential heating/commercial and industrial oil combustion. SSIs will be addressed by the now mandatory installation of amalgam separators in all Northeast states and reducing use of mercury-added products by consumers and the health care sector. Reductions will be achieved from MWCs by pollution prevention efforts, mercury-added product legislation, and possibly enhanced pollution controls. Emissions from area sources are likely to decrease as a result of pollution prevention initiatives. Limited data on the residential heating/commercial and industrial oil combustion sectors make it difficult to set emissions targets for this sector, but emissions can be reduced through modifications to fuels combusted, shifting to lower mercury oils, energy conservation efforts, and increased use of renewable energy sources.

Through the NEG-ECP MTF process, New England states have made a commitment toward the virtual elimination of mercury. As mentioned previously, while New York State is not a member of the NEG-ECP, they too have made a state-wide commitment to reduce mercury. These goals and commitments are complimentary to this TMDL. Between 1998 and 2002, regional mercury deposition was reduced by approximately 74 percent. Since 2002, a number of mercury reduction programs have been implemented and many regulations have passed, to further reduce regional mercury deposition. However, as updated deposition modeling has not been undertaken, these reductions are not yet quantifiable. The regional emissions inventory and deposition modeling will be updated in 2010. With the implementation of reduction programs and legislation since 2002, and full implementation of legislation that has been passed, the Northeast states are addressing all mercury sources within their control. More information on state mercury reduction efforts is provided in Appendix D.

This TMDL includes an in-region implementation plan that takes into account the significant reductions already made by the Northeast states and the need for updated emissions inventory and deposition modeling at the end of Phase II. An appropriate implementation plan based on that updated information will be developed for Phase III. Because the Northeast states are already addressing all mercury sources within their control, additional controls are not expected of in-region sources as part of the implementation for Phases I and II. In order for this TMDL to be fully implemented, greater reductions are needed from out-of-region sources.

9.2 Adaptive National Implementation

As this TMDL has shown, there is a need to make significant reductions in anthropogenic emissions of mercury in order to meet states' water quality standards. The Northeast states demonstrate below through their assurances that significant regional reductions have already been met and continuing reductions will be made. Research undertaken by states has shown that significant reductions in mercury emissions translate into timely and significant reductions in fish tissue concentrations. As described further in Section 10.1, MassDEP has seen timely and significant decreases in fish tissue mercury concentrations with a decrease in local mercury emissions (Hutcheson, et al. 2006). Timely reductions will yield immediate public health and environmental quality improvements for the Northeast states.

CAMR became effective May 18, 2006. The first phase of the rule, which will be achieved in 2010, will reduce emissions nationwide by about 21 percent. The second phase will reduce emissions by about 70 percent and will be achieved sometime after 2018. This phasing of the national CAMR is insufficient to meet the adaptive implementation of this TMDL. The rule established a cap-and-trade program, which will allow power plants to purchase emissions reduction allowances from other power plants and potentially bank these allowances to meet compliance requirements in future years.

Prior to the finalization of CAMR, EPA was considering two options for controlling mercury emissions from coal-fired power plants. The first option would mean EPA would, pursuant to Section 112(n) of the CAA, set National Emission Standards for Hazardous Air Pollutants (HAPs) for power plants and adopt a Maximum Achievable Control Technology (MACT) standard for mercury. The second option would revise EPA's December 2000 determination that regulation of power plants under Section 112(n) was "necessary and appropriate." With the finalization of CAMR, EPA chose the second option and used Section 111 of the CAA to set standards for mercury emissions. EPA determined that regulation of mercury under a cap-and-trade program was sufficient to protect public health.

As the Northeast states have argued in the Opening Brief of Government Petitioners dated January 11, 2006 in the matter of *State of New Jersey, et al. vs. United States Environmental Protection Agency*, the implementation of a strict plant-specific MACT for mercury under section 112(d) of the CAA would result in at least 90 percent control of mercury emissions by cost-effective and available technologies. Further, enacting a MACT standard under section 112(d) would require compliance within three years of the effective date of the standard.

This TMDL adds a second dimension to the legal arguments presented by the Northeast states in the lawsuit mentioned above by calculating for the first time the extent of reductions needed to meet water quality standards in the region's listed waters and remove fish consumption advisories. This TMDL further establishes the need for emissions reductions over much shorter timeframes. Research conducted in Massachusetts shows that mercury emission reductions can quickly translate into reductions in fish tissue concentrations.

The Northeast states are recommending adaptive implementation of this TMDL and that a strict 90 percent MACT standard enacted under section 112(d) be promulgated to meet the national implementation requirements of the TMDL for Phase II (2003-2010, 75 percent reduction). As discussed previously, this TMDL calls for a 98 percent reduction in order to meet the initial target fish tissue concentration. However, the TMDL will be implemented adaptively, so that as regional and national controls are implemented, the response in fish tissue as a result of emissions and deposition reductions will be monitored. If necessary, reduction goals will be modified based on the response seen in fish tissue monitoring.

A significant portion of mercury deposited in the Northeast originates from global sources. While the federal government cannot place controls on these sources, the government can reduce the mercury entering other countries by prohibiting sale of the country's stockpiles of mercury. The Northeast states recommend that sale of United States stockpiles of mercury are prohibited in order to reduce mercury emissions and deposition from international sources.

10 Reasonable Assurances

This regional TMDL for mercury allocates the reduction of pollutant sources to waterbodies throughout the Northeast between point sources, which have been classified as de minimis, and nonpoint sources. States are required to provide reasonable assurance that those nonpoint sources will meet their allocated amount of reductions, which can be much more challenging than documenting reasonable assurances for point source reductions. The actions that provide these assurances take place at the state, national, and international level and are described below.

10.1 State Level Assurances

There are a variety of ways in which a state or states can provide reasonable assurances. These include the implementation of pollution control measures, developing and implementing nonpoint source control plans and, if available, other state regulations and policies governing such facilities. As described in Section 2.3 and Appendix D, the Northeast has a strong commitment to reducing mercury in the environment. The New England states participate in the NEG-ECP MTF and are committed to the regional MAP. As part of the MAP, the New England states have adopted emission limits for large MWCs that are three times more stringent than what EPA requires. This has already resulted in a 90 percent reduction in emissions from this sector. Mercury products legislation adopted in all Northeast states will further reduce these emissions. The MAP also requires a limit for MWIs that is ten times more stringent than EPA requirements. All of the states, including New York State (which is not part of the MTF), have aggressive programs for mercury reduction. The MAP is an adaptive management plan with a goal of virtual elimination. The states' success in meeting MAP goals demonstrates the ability of the Northeast states to make meaningful mercury reductions.

In 2005, NESCAUM prepared *Inventory of Anthropogenic Mercury Emissions in the Northeast* to update their mercury emission inventory with 2002 emissions data. The project was partially undertaken to assist the NEG-ECP in their effort to assess progress in meeting the goals of the MAP. Table 10-1 shows that substantial reductions in mercury emissions have been made for the majority of sources. Overall, regional mercury emissions decreased by 70 percent between 1998 and 2002. The greatest decreases came from MWCs (87.0 percent) and MWIs (96.6 percent). These emissions reductions have resulted in a 74 percent reduction in atmospheric deposition of mercury, as described in Section 7.6.2.

Table 10-1 Comparison Between 1998 and 2002 Regional Mercury Emissions Inventories[1]

Mercury Source Categories	1998 Emissions Estimate (kg/yr)	Percent of 1998 Inventory	2002 Emissions Estimate (kg/yr)	Percent of 2002 Inventory	Percent Decrease
Direct Sources					
Combustion Sources					
Municipal Waste Combustors	6,896	55.2	896	23.9	87.0
Sewage Sludge Incinerators	657	5.3	382	10.2	41.9
Medical Waste Incinerators	758	6.1	26	0.7	96.6
Commercial/Industrial Boilers	552	4.4	273	7.3	50.5
Fossil Fuel-Fired	449	3.6	245	6.5	45.4
Wood-Fired	103	0.8	29	0.8	71.8
Electric Utility Boilers Total	864	6.9	864	23.0	0
Coal-Fired	697	5.6	697	18.6	0
Oil-Fired	142	1.1	142	3.8	0
Natural Gas-Fired	18	0.1	18	0.5	0
Wood-Fired	7	0.1	7	0.2	0
Total Combustion Sources	9,727	77.9	2,441	65.1	74.9
Manufacturing Sources					
Secondary Mercury Production	319	2.6	0	0	100
Cement Manufacturing	305	2.4	239	6.4	21.6
Lime Manufacturing	15	0.1	4	0.1	73.3
Steel Foundries	17	0.1	17	0.5	NA
Chlor-Alkali Facilities	460	3.7	0	0	100
Misc. Industrial Processes	3	0.02	3	0.08	NA
Total Manufacturing Sources	1,119	9.0	263	7.0	76.5
Total Direct Sources	**10,846**	**86.8**	**2,704**	**72.1**	**75.1**
Area Sources					
Residential Heating	575	4.6	637	17	-10.8
Industrial Processes	1,073	8.6	411	11	61.7
Electric Lamp Breakage & Recycling	379	3.0	179	4.8	52.8
General Lab Use	48	0.4	48	1.3	0
Dental Preparation and Use	70	0.6	66	1.8	5.7
Crematories	70	0.6	118	3.1	-68.6
Latex Paint	506	4.0	0	0	100
Total Area Sources	**1,648**	**13.2**	**1,048**	**27.9**	**36.4**
Total Emissions	**12,494**	**100**	**3,752**	**100**	**70.0**

[1] This direct comparison of total emissions is meant to be a rough guide. Several factors, such as new source categories and methodological changes, should be taken into account in the interpretation of the overall emissions decreases in the region. Further work is needed for a true comparison of emission reductions. More information is provided in NESCAUM 2005.

In addition to region-wide reductions that provide reasonable assurances, each state has a number of mercury reductions programs. These programs are described below for each of the Northeast states.

Connecticut

In 1990, the Connecticut General Assembly adopted the Toxics in Packaging Act that required elimination of mercury from most packaging within two years. In 1992, Connecticut was one of the first states to pass a law restricting the level of mercury in alkaline batteries. The Universal Waste Rule, which was adopted in 2001, outlines management practices for four specific waste streams, including thermostats and lamps, to reduce mercury in the solid waste stream. Also in 2001, Connecticut DEP provided mercury education and training to used car dealers, auto recyclers, State of Connecticut fleet operations, and City of Hartford fleet operations. Between February 2000 and February 2001, over 283 lbs of mercury and mercury compounds were removed from school science laboratories.

In 2002 Connecticut enacted comprehensive legislation, An Act Concerning Mercury Education and Reduction, targeting the virtual elimination of discharges of anthropogenic mercury to the environment by establishing a program to eliminate non-essential uses of mercury in consumer, household, and commercial products. The first provisions were effective in 2002 and it was fully implemented in 2006. Mercury-containing products such as novelties, fever thermometers, and dairy manometers were banned from sale. After July 1, 2006 the sale or distribution of other mercury-added products containing more than one hundred grams or 100 parts per million of mercury is prohibited, unless the product is specifically exempted from the statutory phase-out requirements, or the department grants a modified or conditional exemption. In addition, manufacturers of mercury-added products are required to meet a number of other provisions under the law to notify, label and provide collection systems. CT DEP works closely with the Interstate Mercury Education and Reduction Clearinghouse to coordinate these actions on a regional basis.

The law also places restrictions on the sale and distribution of elemental mercury and its use. Under this authority the Department adopted best management practices on the use and handling of mercury in dental offices, among other practices, requiring the installation of amalgam separators to trap and remove mercury amalgam from their wastewater discharges.

In 2000, CT DEP revised their air regulations to require stringent controls on resources recovery facilities. Sources subject to the regulation were required to meet an emission limit of 0.80 mg/dry standard cubic meter (dscm) (an 85 percent reduction) by December 2000 and to reduce to 0.028 mg/dscm by June 2002. As discussed in Section 9.1, Connecticut has passed legislation that will decrease emissions from coal-fired power plants by at least 90 percent.

Maine

Maine has a law that bans the disposal of mercury-added products and requires that all mercury-added products are recycled. As of January 1, 2002 the sale of mercury fever thermometers is banned in Maine, mercury-added products must be labeled to clearly inform the purchaser or consumer that mercury is present, and the product must be disposed of properly. All dental offices were required to install amalgam separators by December 31, 2004. As of January 1, 2006 the sale of mercury-added thermostats is banned. Effective July 1, 2006 mercury-added barometers, esophageal dilators, flow meters, hydrometers, hygrometers, manometers, pyrometers, sphygmomanometers, and thermometers cannot be sold in Maine. Also effective the same day, mercury switches or relays cannot be sold individually or as a product component. Incineration and landfill disposal of cathode ray tubes was banned after January 1, 2006. An Act to Regulate Use of Batteries Containing Mercury was signed into law in March 2006 and provides for labeling of button cell batteries that contain mercury, prohibits disposal of these batteries in landfills and incinerators, and requires retailers to provide for take back of these batteries from customers. An Act to Limit Human Exposure to Mercury has a goal to transition to mercury-free dentistry. An Act to Require that Hazardous Waste be Removed from Junked Vehicles includes a requirement for removal of mercury switches.

As described in Section 9.1, currently all facilities in Maine have a mercury emissions limit of 50 lbs/yr. Recently enacted legislation makes the limit more strict and requires a mercury reduction plan for any facility emitting more than 10 lbs/yr. In addition, all facilities with a wastewater discharge are subject to the requirements of *Interim Effluent Limitations and Controls for the Discharge of Mercury, 06-096 CMR 519* (effective February 5, 2000) which require effluent limits be established and that all facilities develop and implement a mercury pollution prevention plan. All facilities in the state are in compliance with this rule.

Massachusetts

The Mercury Management Act, passed in 2006, requires end-of-life recycling of mercury-containing products, prohibits disposal of mercury in trash and wastewater, bans the sale of specific products containing mercury, directs schools and state government to stop purchasing mercury-containing items, establishes a program for removing switches from vehicles, and requires manufacturers both to notify the state of products with mercury content, and to establish end-of-life collection and recycling programs. In April 2006, regulations took effect that require most dental practices and facilities in Massachusetts to install and operate amalgam separator systems, recycle mercury-containing amalgam wastes, and periodically certify their compliance with the requirements. Prior to the regulations, MassDEP implemented a voluntary program with the Massachusetts Dental Society to encourage early installation and use of amalgam separators by dentists.

The Municipal Waste Combustor Rule required facilities with a capacity greater than 250 tons/day to meet an emissions standard of 28 μg/dcsm by December 2000 and to develop material separation plans for products containing mercury. Massachusetts also has strict controls on mercury emissions from coal-fired power plants. These regulations are described in more detail in Section 9.1

MassDEP recently conducted a study to examine changes in fish tissue mercury concentrations in an area of Northeastern Massachusetts with elevated mercury deposition due to local emissions sources. Over the study period, local mercury emissions decreased by 87 percent, and as a result, fish tissue mercury concentrations decreased an average of 25 to 32 percent (Hutcheson, et al. 2006). Consistent decreases were seen 48 months after emissions controls were put in place. This response time was much shorter than was expected. The results of this study emphasize the point that decreases in mercury emissions can result in timely decreases in fish mercury concentrations.

New Hampshire

New Hampshire legislation puts restrictions on the mercury content of batteries and establishes notification requirements for manufacturers of mercury-added products. New Hampshire has a ban on the sale of toys, games, cards, ornaments, or novelties that contain mercury and mercury fever thermometers. No school can use or purchase elemental mercury, mercury compounds, or mercury-added instructional equipment and materials in a primary or secondary classroom. Legislation required all dental practices to install amalgam separators by October 2005.

Any MWC with a design capacity to burn 100 tons/day or more must reduce emissions to achieve no more than 0.028 mg/dscm or at least 85 percent control efficiency. All MWIs must achieve an emissions limit of 0.055 mg/dscm. As described in Section 9.1, New Hampshire recently passed legislation to limit mercury emissions from coal-fired power plants.

New York

A law adopted in September 2005 prohibits the sale and distribution of some mercury-added products including thermostats, barometers, esophageal dilators, bougie tubes, gastrointestinal tubes, flow meters, hydrometers, hygrometers, psychrometers, manometers, pyrometers, sphygmomanometers, thermometers, and switches and relays. The law also requires manufacturers and trade associations dealing in mercury-added products to report certain information to NYS DEC. Regulations effective in May 2006 prohibit the use of non-encapsulated elemental mercury in dental offices and require dentists to recycle any elemental mercury or dental amalgam waste generated in their offices. Dental facilities are required to install, properly operate, and maintain mercury amalgam separation and collection equipment. Although not mandated by law, New York State is working on pollution prevention efforts for health care facilities, an automobile switch collection and recycling project, and a dairy manometers identification and removal program.

New York State has an emission limit for large MWCs (greater than 250 tons/day) of 28 µg/dscm or 85 percent removal, whichever is less stringent. Regulations were recently passed for coal-fired utilities, the details of which are provided in Section 9.1

Rhode Island

The Mercury Reduction and Education Act requires the phase-out of mercury-added products, labeling, collection plans, bans on certain products, and elimination of mercury from schools. No mercury fever thermometers can be sold after January 1, 2002. After January 1, 2003, no mercury-added novelty can be sold in Rhode Island, unless its only mercury component is one or more mercury-added button cell battery. No school can use or purchase for use bulk elemental or chemical mercury or mercury compounds for use in primary or secondary classrooms. After January 1, 2006 mercury-added products can only be disposed of through recycling or disposal as hazardous waste. Legislation now requires removal and collection of mercury switches from automobiles. RI DEM currently has a voluntary self certification program for installation of amalgam separators, and legislation that passed in 2006 requires dental offices to install amalgam separators by July 2008.

Rhode Island has a mercury emissions limit of 0.055 mg/dscm for all MWIs.

Vermont

Vermont passed the nation's first mercury labeling law in 1997 and then passed Comprehensive Management of Exposure to Mercury in 2005, with amendments in 2006. This law establishes a comprehensive approach to reducing the exposure of citizens to mercury released in the environment through mercury-added product use and disposal, including requirements that manufacturers of mercury-added products provide notice to the agency and report on total mercury contained in certain products, a ban on the distribution or offering for sale of mercury-added novelties, fever thermometers, thermostats, and dairy manometers, and other devices, and to modify the existing labeling requirements for mercury-added products and packaging by expanding the types of products subject to labeling. It also bans the disposal of mercury-added products such as thermostats, thermometers, automobile switches, and bulbs in landfills and incinerators, requires source separation of discarded mercury-added products, and requires solid waste management facilities to inform customers of disposal bans and collection programs for mercury-added products. The law also prohibits purchase and use of mercury-added products and elemental mercury in primary and secondary schools. Dental practices are required to follow mercury waste management practices as established by the State of Vermont and Vermont State Dental Society and to install dental amalgam separators by January 2007. Hospitals are required to submit a mercury reduction plan to the agency every three years.

10.2 National and International Assurances

The Northeast region's ability to achieve the calculated TMDL allocations is dependent on the adoption and effective implementation of national and international programs to achieve necessary reductions in mercury emissions. Given the magnitude of the reductions required to implement the TMDL, the Northeast cannot reduce in-region sources further to compensate for insufficient reductions from out-of-region sources. While EPA and the federal government are involved in the programs described below, further efforts are necessary to assure that the goals of this TMDL are met. Specifically, it is Northeast States' position that the data and analyses in this TMDL demonstrate that:

(A.) CAMR will be insufficient to achieve the reduction needed to achieve the water quality goals set forth in this TMDL,
(B.) EPA must implement significant reductions from upwind out-of-region sources, primarily coal-fired power plants; and
(C.) MACT provisions of section 112(d) of the CAA should be adopted as the mechanism for implementing this TMDL.

Further, the States note that EPA has the authority to revise CAMR or otherwise require the necessary reduction on a national scale to meet the goals set by this TMDL.

National assurances are also found within EPA's obligation under both section 112 of the CAA and the loading reduction requirements of the TMDL provisions in section 303(d) of the Clean Water Act to act to immediately reduce the emission of mercury from these sources. The timeline for the reduction goals of this TMDL are set forth in Section 9.

CAMR, which regulates mercury emissions from Electrical Generating Units (EGUs) under section 111(d) of the CAA, requires an eventual reduction in mercury emissions of 70 percent at full implementation of the rule, sometime after 2018. CAMR is a two-phase rule, with the first phase requiring reductions in mercury of approximately 20 percent coming as a co-benefit of reductions in sulfur dioxide and nitrous oxides to be made by 2010. Between 2010 and 2018, the CAMR provides for a cap and trade program that is proposed to make further reductions with eventual reductions of 70 percent sometime after 2018.[1]

For further national assurances, the Northeast states are recommending adaptive implementation of this TMDL and that a strict 90 percent MACT standard be enacted under section 112(d) be promulgated to meet the national implementation requirements of the TMDL for Phase II (2003-2010). As discussed previously, this TMDL calls for an 87 percent reduction in order to meet the initial target fish tissue concentration. However, the TMDL will be implemented adaptively, so that as regional and national controls are implemented, the response in fish tissue as a result of emissions and deposition reductions will be monitored. If necessary, reduction goals will be modified based on the response seen in fish tissue monitoring.

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[1] The Northeast states have filed a suit (*State of New Jersey, et al. vs. United States Environmental Protection Agency*) against U.S. EPA challenging CAMR's legality – how its limits were calculated and the establishment of the trading program.

Additional national mercury reduction programs include the National Vehicle Mercury Switch Recovery Program, which will cut mercury emissions by up to 75 tons over the next 15 years by removing mercury-containing light switches from scrap vehicles before they are flattened, shredded, and melted to make new steel. EPA was a founder of Hospitals for a Healthy Environment (H2E), a movement to promote environmental sustainability in health care. Among H2E's goals is the virtual elimination of mercury waste.

The Commission for Environmental Cooperation (CEC) is an international organization created by Canada, Mexico, and the United States under the North American Agreement on Environmental Cooperation. It was established to address regional environmental concerns, help prevent potential trade and environmental conflicts, and promote effective enforcement of environmental law. The CEC has developed the North American Regional Action Plan (NARAP) on Mercury with the goal of reducing man-made mercury releases to North America through international and national initiatives. The NARAP has provisions regarding risk management approaches to address mercury emissions, processes, operation, and products; waste management; and research, monitoring, modeling, inventories, and communication activities.

The United Nations Environment Programme (UNEP) established its Mercury Programme in 2003. The program has a long-term objective "to substantially reduce or eliminate uses and anthropogenic releases of mercury through the implementation of national, regional and global actions, thereby significantly reducing global adverse impacts on health and the environment"(United Nations Environment Programme 2006). Among other actions, the UNEP Mercury Programme will assist countries to identify and understand mercury problems in their countries and implement actions to mitigate them.

11 Public Participation

As this is a regional TMDL that covers seven states, the public participation process was dictated by each state's procedure for public notice of a TMDL. The TMDL was posted on NEIWPCC's website, as well as the websites of each of the participating state agencies. Many states posted notices of the TMDL in local newspapers. Table 11-1 provides information about the public participation actions undertaken by each of the states.

Table 11-1 Public Participation Actions Undertaken by the Northeast States

	CT	ME	MA	NH	NY	RI	VT
Notice of TMDL on state agency website	X	X	X	X	X	X	X
TMDL posted on state agency website	X	X	X	X	X	X	X
Notice of TMDL posted in newspaper	X		X	X	X	X	X
Public meeting held			X	X	X	X	X
Press release issued			X	X	X	X	X
Notices sent to target groups with potential interest in TMDL				X	X		

Following the April 11, 2007 release of the draft TMDL, articles were published in several local, regional, and national publications including the *Boston Globe*, *New York Times*, *Greenwire*, and *Water Policy Report*. There was a 59-day comment period during which eight public meetings were conducted throughout the region. The schedule and locations for the public meetings are listed below:

April 25, 2007 – Providence, RI
April 30, 2007 – Worcester, MA
May 1, 2007 – Boston, MA

May 2, 2007 – Syracuse, NY
May 3, 2007 – White Plains, NY
May 4, 2007 – Ballston Spa, NY
May 10, 2007 – Concord, NH
May 11, 2007 – Waterbury, VT

A total of 30 people attended the eight public meetings. NEIWPCC and the states received comments from 14 different groups. Following the comment period, the TMDL technical team considered all comments received, prepared a response to comments document (see Appendix E), and made necessary revisions to the TMDL.

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Appendix A: Northeast Waters Impaired Primarily by Atmospheric Deposition of Mercury

Connecticut

Connecticut's 2006 list of Waterbodies Not Meeting Water Quality Standards contains the following language regarding listing of waters based on statewide fish consumption advisories for mercury: "In addition to those waters included on the list, all waterbodies where statewide fish consumption advisories have been established due to atmospheric deposition of mercury from sources outside of state jurisdictional borders are implicitly included in EPA Category 5 ("303(d) listed"). Specific fish consumption advisories established as a result of local pollution sources (i.e. releases of polychlorinated biphenyls – PCBs or chlordane) are individually listed in Appendix C-4."

Because the Northeast Regional TMDL only covers freshwaters, all waters that are not designated as "E" (for estuary) by the state of Connecticut are included, with the exception of the waterbodies listed below that are known to have significant mercury contributions from more localized sources.

- Unnamed tributary to the Oyster River (Milford)-02 (CT5000-55_02)
- Wyassup Lake (North Stonington) (CT-1001-00-1-L1_01)
- Dodge Pond (East Lyme) (CT2205-02-1-L1_01)
- Little River (Sprague)-02 (CT3805-00_02)
- Papermill Pond (Sprague) (CT3805-00-3-L6_01)
- Versailles Pond (Sprague) (CT3805-00-3-L7_01)
- Compensating Res. (L.McDonough) (Barkhamsted/New Hartford) (CT4308-00-1-L2_01)
- Silver Lake (Berlin/Meriden) (CT4601-00-1-L2_01)
- Konkapot River-01 (CT6004-00_01)
- Success Lake (Bridgeport) (CT7103-00-2-L3_01)
- Stillman Pond (Bridgeport) (CT-7103-00-2-L4_01)

Maine

In their 2006 Integrated List, Maine DEP lists waters impaired by atmospheric deposition of mercury in Category 5C: Waters Impaired by Atmospheric Deposition of Mercury. Regional or National TMDL may be Required. The description for this category is as follows:

"Impairment caused by atmospheric deposition of mercury and a regional scale TMDL is required. Maine has a fish consumption advisory for fish taken from all freshwaters due to mercury. Many waters, and many fish from any given water, do not exceed the action level for mercury. However, because it is impossible for someone consuming a fish to know whether the mercury level exceeds the action level, the Maine Department of Human Services decided to establish a statewide advisory for all freshwater fish that recommends limits on consumption. Maine has already instituted statewide programs for removal and reductions of mercury sources. The State of Maine is participating in the development of regional scale TMDLs for the control of mercury."

As this TMDL only applies to freshwaters, only Maine waters designated as rivers, streams, and lakes are included. Any designated as marine and estuarine are not included. The Maine Integrated List does not single out any waterbodies that would not be included in this TMDL due to localized sources of mercury other than atmospheric deposition.

Massachusetts

Based on Massachusetts Year 2006 Integrated List of Waters: Final listing of condition of Massachusetts's waters pursuant to Sections 303(d) and 305(b) of the Clean Water Act. Freshwaters listed were found to be impaired solely as a result of atmospheric deposition. Waters where other potential sources could exist were excluded.

Table A-1: Massachusetts Freshwaters Impaired Solely by Atmospheric Mercury[1]

Waterbody	Town	Segment ID
Aaron River Reservoir	Cohasset/Hingham	MA94178
Ames Pond*	Tewksbury	MA83001
Ashumet Pond	Mashpee	MA96004
Assabet River Reservoir	Westborough	MA82004
Lake Attitash*	Amesbury	MA84002
Baldpate Pond*	Boxford	MA91001
Bare Hill Pond	Harvard	MA81007
Big Pond	Otis	MA31004
Boons Pond	Stow	MA82011
Buffumville Lake	Charlton	MA42005
Burr's Pond	Seekonk	MA53001
Chadwicks Pond*	Haverhill	MA84006
Chebacco Lake	Hamilton	MA93014
Lake Cochichewick*	N. Andover	MA84008
Cornell Pond	Dartmouth	MA95031
Crystal Lake*	Haverhill	MA84010
Lake Dennison	Winchendon	MA35017
Duck Pond	Wellfleet	TBD
East Brimfield Reservoir	Brimfield	MA41014
Echo Lake	Milford/Hopkinton	MA72035
Flint Pond	Tyngsborough	MA84012
Forest Lake*	Methuen	MA84014
Forge Pond	Westford/Littleton	MA84015
Fosters Pond*	Andover	MA83005
Gales Pond	Warwick	MA35024
Gibbs Pond	Nantucket	MA97028
Great Pond	Wellfleet	TBD
Great Herring Pond	Bourne/Plymouth	MA94050
Great South Pond	Plymouth	MA94054
Haggetts Pond*	Andover	MA84022
Hamblin Pond	Barnstable	MA96126
Hickory Hills Lake	Lunenburg	MA81031
Holland Pond	Holland	MA41022
Hood Pond	Ipswich	MA92025
Hoveys Pond*	Boxford	MA84025
Johns Pond	Mashpee	MA96157

[1] Those identified by an asterisk are located in a mercury hot spot area and are not covered by this TMDL. Implementation of this TMDL may result in significant reductions in fish mercury concentrations or possibly achieve standards in this area at a future date.

Waterbody	Town	Segment ID
Johnsons Pond*	Groveland/Boxford	MA84027
Kenoza Lake*	Haverhill	MA84028
Knops Pond/Lost Lake	Groton	MA84084
Lake Lashaway	N. Brookfield/E. Brookfield	MA36079
Lewin Brook Pond	Swansea	MA61011
Locust Pond	Tyngsborough	MA84031
Long Pond	Dracut/Tyngsborough	MA84032
Long Pond	Rochester	MA95097
Lowe Pond*	Boxford	MA92034
Martins Pond	N. Reading	MA92038
Mashpee Pond	Mashpee/Sandwich	MA96194
Massapoag Lake	Sharon	MA73030
Massapoag Pond	Dunstable/Groton/Tyngsborough	MA84087
Miacomet Pond	Nantucket	MA97055
Mill Pond	Burlington	MA92041
Millvale Reservoir*	Haverhill	MA84041
Monponsett Pond	Halifax	MA62119
Nabnasset Pond	Westford	MA84044
Newfield Pond	Chelmsford	MA84046
Lake Nippenicket	Bridgewater	MA62131
Noquochoke Lake	Dartmouth	MA95113; MA95170; MA95171
North Watuppa Lake	Fall River	MA61004
Nutting Lake	Billerica -2 segments	MA82088; MA82124
Otis Reservoir	Otis/Tolland/ Blandford	MA31027
Pentucket Pond*	Georgetown	MA91010
Lake Pentucket*	Haverhill	MA84051
Peters Pond	Sandwich	MA96244
Plainfield Pond	Plainfield	MA33017
Pomps Pond*	Andover	MA83014
Pontoosuc Lake	Lanesborough/Pittsfield	MA21083
Populatic Pond	Norfolk	MA72096
Pottapaug Pond Basin	Petersham	MA36125
Quabbin Reservoir	Petersham/Pelham/Ware Hardwick/Shutesbury/Belchertown/New Salem	MA36129
Quacumquasit Pond	Brookfield/E. Brookfield/Sturbridge	MA36131
Rock Pond*	Georgetown	MA91012
Lake Rohunta	Athol/Orange/New Salem	MA35070; MA35106; MA35107
Lake Saltonstall*	Haverhill	MA84059
Sheep Pond	Brewster	MA96289
Silver Lake	Wilmington	MA92059
Snake Pond	Sandwich	MA96302
Snipatuit Pond	Rochester	MA95137
Somerset Reservoir	Somerset	MA62174
Stevens Pond*	N. Andover	MA84064
Tom Nevers Pond	Nantucket	MA97097

Waterbody	Town	Segment ID
Turner Pond	New Bedford/Dartmouth	MA95151
Upper Naukeag Lake	Ashburnham	MA35090
Upper Reservoir	Westminster	MA35091
Wachusett Reservoir	Boylston/W.Boylston/Clinton/Sterling	MA81146
Waite Pond	Leicester	MA51170
Wakeby Pond	Mashpee/Sandwich	MA96346
Walden Pond	Concord	MA82109
Lake Wampanoag	Ashburnham/Gardner	M181151
Warners Pond	Concord	MA82110
Wenham Lake	Beverly	MA92073
Wequaquet Lake	Barnstable	MA96333
Whitehall Reservoir	Hopkington	MA82120
Whiting Pond	N. Attleborough/Plainville	MA52042
Wickaboag Pond	W. Brookfield	MA36166
Willet Pond	Walpole/Westwood/Norwood	MA73062

<u>New Hampshire</u>

The New Hampshire 2006 303(d) list states: "…it is important to note that all surface waters are impaired due to fish/shellfish consumption advisories issued because of elevated levels of mercury in fish and shellfish tissue. Since mercury is a pollutant that requires a TMDL, all 5000+ surface waters in New Hampshire are included on the Section 303(d) List. However, in order to keep the length of the 303(d) List in Appendix A to manageable size, surface waters impaired solely by atmospheric mercury deposition were not included."

Because this TMDL only covers freshwaters, this is applicable to all New Hampshire waters designated as RIV, LAK, or IMP, with the exception of waterbodies listed below that are known to have significant mercury contributions from more localized sources. Waterbodies designated as EST or OCN are not included.

Waters not covered due to localized sources:

- Androscoggin River, Berlin 0.350 miles (NHRIV400010605-11)
- Contoocook River, PWS, WWF, Hopkinton, 0.780 miles (NHRIV700030505-05)
- Black Brook, Manchester, 2.410 miles (NHRIV700060801-02)

<u>New York</u>

Based on Final New York State 2006 Section 303(d) List of Impaired Waters Requiring a TMDL/Other Strategy

- Salmon River Reservoir (0303-0069)
- Susquehanna River, Lower, Main Stem (0603-0016)
- Susquehanna River, Lower, Main Stem (0603-0015)
- Susquehanna River, Lower, Main Stem (0603-0013)
- Susquehanna River, Lower, Main Stem (0603-0002)
- Susquehanna River, Main Stem (0601-0182)

- Susquehanna River, Main Stem (0601-0040)
- Susquehanna River, Main Stem (0601-0020)
- Goodyear Lake (0601-0015)
- Susquehanna River, Upper, Main Stem (0601-0041)
- Chenango River, Lower, Main Stem (0602-0033)
- Chenango River, Middle, Main Stem (0602-0009)
- Chenango River, Upper, Main Stem (0602-0069)
- Unadilla River, Lower, Main Stem (0601-0003)
- High Falls Pond (0801-0274)
- Taylorville, Elmer Falls Ponds (0801-0276)
- Effley Falls Reservoir (0801-0172)
- Moshier Reservoir (0801-0194)
- Sunday Lake (0801-0195)
- Soft Maple Reservoir, Soft Maple Pond (0801-0173)
- Beaver Lake, Beaver Meadow Pond (0801-0174)
- Francis Lake (0801-0192)
- Stillwater Reservoir (0801-0184)
- Halfmoon Lake (0801-0193)
- Dart Lake (0801-0242)
- Big Moose Lake (0801-0035)
- Lower Sister Lake (0801-0004)
- Upper Sister Lake (0801-0008)
- Russian Lake (0801-0006)
- North Lake (0801-0451)
- Forked Lake (0903-0080)
- Carry Falls Reservoir (0903-0055)
- Tupper Lake (0903-0062)
- South Pond (0903-0005)
- Lake Eaton (0903-0056)
- Indian Lake (0906-0003)
- Long Pond (0905-0058)
- Cranberry Lake (0905-0007)
- Red Lake (0906-0039)
- Meacham Lake (0902-0039)
- Lake Champlain, Main Lake, North (1000-0001)
- Lake Champlain, Main Lake, Middle (1000-0002)
- Lake Champlain, Main Lake, South (1000-0003)
- Lake Champlain, South Lake (1000-0004)
- Lake Champlain, Cumberland Bay (1001-0001)
- Saranac River, Franklin Falls Pond (1003-0045)
- Middle Saranac Lake/Weller Pond (1003-0083)
- Polliwog Pond (1003-0090)
- Poultney River, Lower, and tributaries (1005-0053)
- Chase Lake, Mud Lake (1104-0135)
- Sand Lake (1104-0015)
- Spy Lake (1104-0160)
- Schroon Lake (1104-0002)
- Alder, Crane Ponds (1104-0229)
- Kings Flow (1104-0271)
- Round Pond (1104-0073)
- Rock Pond (1104-0285)

- Lake Durant (1104-0059)
- Schoharie Reservoir (1202-0012)
- Lily, Canada, Stewarts Land, West Lakes (1201-0050)
- Stoner Lakes (1201-0169)
- Ferris Lake (1201-0003)
- Amawalk Reservoir (1302-0044)
- West Branch Reservoir (1302-0022)
- Boyd Corners Reservoir (1302-0045)
- Diverting Reservoir (1302-0046)
- Bog Brook Reservoir (1302-0041)
- East Branch Reservoir (1302-0040)
- Titicus Reservoir (1302-0035)
- Cross River Reservoir (1302-0005)
- Breakneck Pond (1301-0123)
- Chodikes Pond (1301-0208)
- Rondout Reservoir (1306-0003)
- Ashokan Reservoir (1307-0004)
- South Lake, North Lake (1309-0017)
- Dunham Reservoir (1301-0262)
- Neversink Reservoir (1402-0009)
- Loch Sheldrake/Sheldrake Pond (1402-0057)
- Rio Reservoir (1401-0074)
- Swinging Bridge Reservoir (1401-0002)
- Pepacton Reservoir (1403-0002)
- Cannonsville Reservoir (1404-0001)

Rhode Island

Based on Final State of Rhode Island 2006 303(d) List of Impaired Waters

- Indian Lake (RI0008039-02)
- Watchaug Pond (RI0008039L-02)
- Meadowbrook Pond (Sandy Pond) (RI0008039L-05)
- Tucker Pond (RI0008039L-08)
- Larkin Pond (RI0008039L-11)
- Hundred Acre Pond (RI0008039L-13)
- Yawgoo Pond (RI0008039L-15)
- Alton Pond (RI0008040L-01)
- Ashville Pond (RI0008040L-04)
- Wincheck Pond (RI0008040L-06)
- Yawgoog Pond (RI0008040L-07)
- Locustville Pond (RI0008040L-10)
- Wyoming Pond (RI0008040L-11)
- Browning Mill Pond (Arcadia Pond) (RI0008040L-13)
- Boone Lake (RI0008040L-14)
- Eisenhower Lake (RI0008040L-16)
- Quidneck Reservoir (RI0006013L-04)
- Tiogue Lake (RI0006014L-02)
- J.L. Curran Reservoir (Fiskeville Reservoir) (RI0006016L-02)

Vermont

Based on Final State of Vermont 2006 303(d) List of Impaired Waters

- Poultney River, Mouth upstream to Carvers Falls (VT02-01)
- Lower Otter Creek, Mouth Upstream to Vergennes Dam (VT03-01)
- Little Otter Creek – Lower – From mouth upstream Falls/Ledge West Route 7 (VT03-07)
- Lower Dead Creek, From Mouth Upstream (VT03-09)
- Chittenden Reservoir (VT03-14L03)
- Lake Champlain – Otter Creek Section (VT04-01L01)
- Lake Champlain – Port Henry Section (VT04-01L02)
- Lake Champlain – Southern Section (VT04-02L01)
- Lake Champlain – Missisquoi Bay (VT05-01L01)
- Lake Champlain – Northeast Arm (VT05-04L01)
- Lake Champlain – Isle LaMotte (VT05-04L02)
- Lake Champlain – St. Albans Bay (VT05-07L01)
- Lake Champlain – Mallets Bay (VT05-09L01)
- Lake Champlain – Burlington Bay (VT05-10L01)
- Lake Champlain – Main Section (VT05-10L02)
- Lake Champlain – Shelburne Bay (VT05-11L01)
- LaPlatte River, At Mouth (VT05-11)
- Missisquoi River, Mouth Upstream to Swanton Dam (VT06-01)
- Lamoille River, Mouth to Clarks Falls Dam (VT07-01)
- Arrowhead Mountain Lake (VT07-03L03)
- Winooski River, Mouth to Winooski Dam (VT08-01)
- Harriman Reservoir (VT12-01L01)
- Sherman Reservoir (VT12-01L04)
- East Branch Deerfield River, Below Somerset Dam (VT12-03)
- Grout Pond (VT12-03L01)
- Somerset Reservoir (VT12-03L02)
- Upper Deerfield River, Below Searsburg Dam (VT12-04)
- Searsburg Reservoir (VT12-04L05)
- Moore Reservoir (VT16-04L01)
- Comerford Reservoir (VT16-05L01)
- Lake Salem (VT17-04L04)

Appendix B: Necessary Reductions to meet Water Quality Standards in Maine and Connecticut

Because this is a regional TMDL and the majority of states have not adopted fish tissue criteria, the initial target fish tissue concentration was set at the EPA fish tissue criterion of 0.3 ppm. Maine has adopted a fish tissue criterion of 0.2 ppm into their water quality standards, and therefore a higher level of reduction will be necessary for water quality standards to be met in that state. Connecticut's Water Quality Standards (2002) state that:

> *Surface waters and sediments shall be free from chemical constituents in concentrations or combinations which will or can reasonably be expected to: result in acute or chronic toxicity to aquatic organisms or otherwise impair the biological integrity of aquatic or marine ecosystems outside of any dredged material disposal area or areas designated by the Commissioner for disposal or placement of fill materials or any zone of influence allowed by the Commissioner, or bioconcentrate or bioaccumulate in tissues of fish, shellfish and other aquatic organisms at levels which will impair the health of aquatic organisms or wildlife or result in unacceptable tastes, odors or health risks to human consumers of aquatic organisms or wildlife…*

The Connecticut Department of Public Health has set a level of 0.1 ppm in fish tissue as the concentration at which there is a risk to humans from consumption of fish. Thus, in order for Connecticut's narrative water quality standards to be met, they must achieve a concentration of 0.1 ppm in fish tissue and therefore will need further reductions than set out for the region by this TMDL.

Necessary reductions to meet water quality standards in Maine and Connecticut are shown below. Both of these calculations require reductions in anthropogenic mercury deposition greater than 100 percent. However, this number is affected by a number of variables, including the percentage of deposition due to anthropogenic sources, and there is a range of accepted values associated with this parameter. Various studies have found this percentage to be between 75 and 85 percent. Use of a lower percentage results in a greater percent reduction from anthropogenic sources, whereas a higher percentage has the opposite effect.

Because of this uncertainty, adaptive management will be used when implementing the reductions necessary to meet the TMDL.

Necessary Reductions to Meet Maine Water Quality Standards

	Value (80th percentile)	Value (90th percentile)	Unit	Source
Background Information				
Area of the Region (includes CT, MA, ME, NH, NY, RI, VT)	307,890		km^2	NESCAUM
Proportion of Deposition due to Anthropogenic Sources	0.75			Based on work by Kamman and Engstrom 2002 and Norton, et al. 2006
TMDL Base Year	1998			
TMDL Phase I Implementation Period	1998-2003			
TMDL Phase II Implementation Period	2003 -2010			
TMDL Phase III Implementation Period	2010 on			
Water Quality Goal				
Target Fish Mercury Concentration	0.20		ppm	Maine Water Quality Standards
Existing Level in Fish (32 cm Smallmouth Bass)	0.86	1.14	ppm	NERC Dataset
Reduction Factor (RF) [(Existing Level - Target Level)/Existing Level]	0.77	0.82		
Base Year Loadings				
Point Source Load (PSL) - Wastewater Discharge	141		kg/yr	PCS data
Modeled Atmospheric Deposition	5,405		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Modeled Natural Atmospheric Deposition[1]	526		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Modeled Anthropogenic Atmospheric Deposition, Anthropogenic Nonpoint Source Load (ANPSL)	4,879		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Natural Nonpoint Source Load (NNPSL) Atmospheric Deposition (Based on Deposition is 25% Natural and 75% Anthropogenic)	1,626		kg/yr	Kamman and Engstrom 2002
Total Nonpoint Source Load (NPSL) [ANPSL + NNPSL]	6,506		kg/yr	
Total Source Load (TSL) [NPSL + PSL]	6,647		kg/yr	

[1] The global contribution to the atmospheric deposition modeling includes some natural sources of mercury. The modeled natural atmospheric deposition is subtracted from the total modeled atmospheric deposition to avoid double counting of the natural contribution.

Percentage of TSL due to PSL	2.1%			
Loading Goal				
Loading Goal [TSL x (1-RF)]	1,546	1,166	kg/yr	
TMDL				
Wasteload Allocation (WLA) [Keep at 2.1% of TSL]	33	25	kg/yr	
Load Allocation (LA) [Loading Goal - WLA]	1,513	1,141	kg/yr	
Natural Load Allocation[1] (NLA)	1,626		kg/yr	
Anthropogenic Load Allocation (ALA) [LA - NLA]	-113	-485	kg/yr	
Overall Reductions to Meet TMDL				
Necessary In-Region Atmospheric Deposition Reductions to Meet ALA	2,141	2,300	kg/yr	
Necessary Out-of-Region Atmospheric Deposition Reductions to Meet ALA	2,852	3,064	kg/yr	
Percent Reduction in Anthropogenic Atmospheric Deposition Necessary to Meet ALA	102.3%	109.9%		
TMDL Implementation Phase I (50%)				
In-Region Portion of ANPSL	2,092		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
In-Region Reduction Target (50% from baseline)	1,046		kg/yr	
Necessary In-Region Atmospheric Deposition Reductions to meet Phase I Target	1,046		kg/yr	
In-Region Atmospheric Deposition Reductions Achieved in Phase I	1,549		kg/yr	NESCAUM, based on modeling of 1998 and 2002 emissions inventories
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Phase I Target	0		kg/yr	
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Final TMDL	592	751	kg/yr	
Out-of-Region Portion of ANPSL	2,787		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory

[1] Deposition due to natural sources remains the same over time, so the natural load allocation is equal to the existing natural deposition.

Out-of-Region Reduction Target (50% from baseline)	1,394		kg/yr	
Necessary Out-of-Region Atmospheric Deposition Reductions to Meet Phase I Target	1,394		kg/yr	
Additional Out-of-Region Atmospheric Deposition Reductions to Meet Final TMDL	1,458	1,671	kg/yr	
TMDL Implementation Phase II (75%)				
In-Region Portion of ANPSL	2,092		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
In-Region Reduction Target (75% from baseline)	523		kg/yr	
Necessary In-Region Atmospheric Deposition Reductions to meet Phase II Target	1,569		kg/yr	
In-Region Atmospheric Deposition Reductions Achieved in Phase I	1,549		kg/yr	NESCAUM, based on modeling of 1998 and 2002 emissions inventories
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Phase II Target	20		kg/yr	
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Final TMDL	572	731	kg/yr	
Out-of-Region Portion of ANPSL	2,787		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Out-of-Region Reduction Target (75% from baseline)	697		kg/yr	
Necessary Out-of-Region Atmospheric Deposition Reductions to Meet Phase II Target	2,090		kg/yr	
Additional Out-of-Region Atmospheric Deposition Reductions to Meet Final TMDL	762	974	kg/yr	

TMDL Implementation Phase III
The Phase III timeline and goal will be set following re-evaluation of mercury emissions, deposition, and fish tissue concentrations in 2010. At the onset of Phase III, remaining reductions will be addressed as follows: Major air point sources will be addressed through the application of more stringent control technology requirements and/or emission limits, economically and technically feasible/achievable, taking into account advances in the state of air pollution controls and the application of transferable technologies used by other sources, to achieve maximum emission reductions. Emissions from area sources will be controlled to the maximum extent feasible using Best Management Practices and Pollution Prevention approaches. It should be noted that the goal of this TMDL is to use adaptive implementation to achieve a target of 0.3 ppm for Massachusetts, New Hampshire, New York, Rhode Island, and Vermont; 0.2 ppm for Maine, and 0.1 ppm for Connecticut. Such an approach will allow all of the Northeast states to meet or exceed their designated uses.

Necessary Reductions to Meet Connecticut Water Quality Standards

	Value (80th percentile)	Value (90th percentile)	Unit	Source
Background Information				
Area of the Region (includes CT, MA, ME, NH, NY, RI, VT)	307,890		km^2	NESCAUM
Proportion of Deposition due to Anthropogenic Sources	0.75			Based on work by Kamman and Engstrom 2002 and Norton, et al. 2006
TMDL Base Year	1998			
TMDL Phase I Implementation Period	1998-2003			
TMDL Phase II Implementation Period	2003 -2010			
TMDL Phase III Implementation Period	2010 on			
Water Quality Goal				
Target Fish Mercury Concentration	0.10		ppm	Connecticut Department of Public Health
Existing Level in Fish (32 cm Smallmouth Bass)	0.86	1.14	ppm	NERC Dataset
Reduction Factor (RF) [(Existing Level - Target Level)/Existing Level]	0.88	0.91		
Base Year Loadings				
Point Source Load (PSL) - Wastewater Discharge	141		kg/yr	PCS data
Modeled Atmospheric Deposition	5,405		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Modeled Natural Atmospheric Deposition[1]	526		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Modeled Anthropogenic Atmospheric Deposition, Anthropogenic Nonpoint Source Load (ANPSL)	4,879		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Natural Nonpoint Source Load (NNPSL) Atmospheric Deposition (Based on Deposition is 25% Natural and 75% Anthropogenic)	1,626		kg/yr	Kamman and Engstrom 2002
Total Nonpoint Source Load (NPSL) [ANPSL + NNPSL]	6,506		kg/yr	
Total Source Load (TSL) [NPSL + PSL]	6,647		kg/yr	
Percentage of TSL due to PSL	2.1%			
Loading Goal				

[1] The global contribution to the atmospheric deposition modeling includes some natural sources of mercury. The modeled natural atmospheric deposition is subtracted from the total modeled atmospheric deposition to avoid double counting of the natural contribution.

Loading Goal [TSL x (1-RF)]	773	583	kg/yr	
TMDL				
Wasteload Allocation (WLA) [Keep at 2.1% of TSL]	16	12	kg/yr	
Load Allocation (LA) [Loading Goal - WLA]	756	571	kg/yr	
Natural Load Allocation[1] (NLA)	1,626	1,626	kg/yr	
Anthropogenic Load Allocation (ALA) [LA - NLA]	-870	-1,056	kg/yr	
Overall Reductions to Meet TMDL				
Necessary In-Region Atmospheric Deposition Reductions to Meet ALA	2,465	2,545	kg/yr	
Necessary Out-of-Region Atmospheric Deposition Reductions to Meet ALA	3,284	3,390	kg/yr	
Percent Reduction in Anthropogenic Atmospheric Deposition Necessary to Meet ALA	117.8%	121.6%		
TMDL Implementation Phase I (50%)				
In-Region Portion of ANPSL	2,092		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
In-Region Reduction Target (50% from baseline)	1,046		kg/yr	
Necessary In-Region Atmospheric Deposition Reductions to meet Phase I Target	1,046		kg/yr	
In-Region Atmospheric Deposition Reductions Achieved 1998-2002	1,549		kg/yr	NESCAUM, based on modeling of 1998 and 2002 emissions inventories
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Phase I Target	0		kg/yr	
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Final TMDL	916	996	kg/yr	
Out-of-Region Portion of ANPSL	2,787		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Out-of-Region Reduction Target (50% from baseline)	1,394		kg/yr	

[1] Deposition due to natural sources remains the same over time, so the natural load allocation is equal to the existing natural deposition.

Necessary Out-of-Region Atmospheric Deposition Reductions to Meet Phase I Target	1,394		kg/yr	
Additional Out-of-Region Atmospheric Deposition Reductions to Meet Final TMDL	1,891	1,997	kg/yr	
TMDL Implementation Phase II (75%)				
In-Region Portion of ANPSL	2,092		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
In-Region Reduction Target (75% from baseline)	523		kg/yr	
Necessary In-Region Atmospheric Deposition Reductions to meet Phase II Target	1,569		kg/yr	
In-Region Atmospheric Deposition Reductions Achieved in Phase I	1,549		kg/yr	NESCAUM, based on modeling of 1998 and 2002 emissions inventories
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Phase II Target	20		kg/yr	
Remaining In-Region Atmospheric Deposition Reductions Necessary to Meet Final TMDL	896	976	kg/yr	
Out-of-Region Portion of ANPSL	2,787		kg/yr	NESCAUM, based on modeling of 1998 Emissions Inventory
Out-of-Region Reduction Target (75% from baseline)	697		kg/yr	
Necessary Out-of-Region Atmospheric Deposition Reductions to Meet Phase II Target	2,090		kg/yr	
Additional Out-of-Region Atmospheric Deposition Reductions to Meet Final TMDL	1,194	1,300	kg/yr	

TMDL Implementation Phase III
The Phase III timeline and goal will be set following re-evaluation of mercury emissions, deposition, and fish tissue concentrations in 2010. At the onset of Phase III, remaining reductions will be addressed as follows: Major air point sources will be addressed through the application of more stringent control technology requirements and/or emission limits, economically and technically feasible/achievable, taking into account advances in the state of air pollution controls and the application of transferable technologies used by other sources, to achieve maximum emission reductions. Emissions from area sources will be controlled to the maximum extent feasible using Best Management Practices and Pollution Prevention approaches. It should be noted that the goal of this TMDL is to use adaptive implementation to achieve a target of 0.3 ppm for Massachusetts, New Hampshire, New York, Rhode Island, and Vermont; 0.2 ppm for Maine, and 0.1 ppm for Connecticut. Such an approach will allow all of the Northeast states to meet or exceed their designated uses.

Appendix C: Mean Mercury Concentrations at NPDES-Permitted Facilities Used in Calculating the Baseline Point Source Load[1]

State	NPDES ID	Facility Name	Hg Concentration (ng/l)
ME	ME	Vassalboro	4.53
ME	ME0000159	Fraser Paper	2.72
ME	ME0000167	Katahdin Paper Millinocket	1.70
ME	ME0000175	Katahdin Paper (GNP) East	1.60
ME	ME0000256	CMP FLA Mason Sta 019	7.81
ME	ME0000272	CMP FLP Wyman Sta 004	25.60
ME	ME0000639	Holtrachem	16.20
ME	ME0000736	Togus	11.90
ME	ME0001635	MDI Biological	40.40
ME	ME0001830	General Alum 001	13.52
ME	ME0001856	National Starch	0.87
ME	ME0001872	Domtar (GP)	9.9
ME	ME0001937	International Paper	7.07
ME	ME0002003	Lincoln Pulp & Paper 001	10.6
ME	ME0002020	GP Old Town (Ft James)	8.09
ME	ME0002054	Mead Paper Company	13.26
ME	ME0002097	Naval Security Group	12.93
ME	ME0002160	International Paper - Bucksport	<2.0
ME	ME0002216	Staley	10.93
ME	ME0002224	American Tissue (Tree Free)	2.20
ME	ME0002321	SD Warren	1.67
ME	ME0002399	First Technology/Control Devices	1.21
ME	ME0002526	Robinson Manufacturing	8.42
ME	ME0020541	Riverwood Health Care	21.90
ME	ME0021521	SD Warren (K)	12.55
ME	ME0022055	Champion (Costigan Stud Mill)	5.76
ME	ME0022519	Gardiner Water District	9.60
ME	ME0022861	Pratt & Whitney	0.72
ME	ME0023043	Penobscot Frozen Foods	11.48
ME	ME0023230	Penobscot Energy Rec. Co.	8.23
ME	ME0023302	University of New England	5.98
ME	ME0023329	Aroostook Valley Electric Co.	67.07
ME	ME0023361	Sunday River Skiway	2.66
ME	ME0023710	Beaverwood	35.92
ME	ME0036218	McCain Processing Inc.	1.97
ME	ME0090000	Downeast Corr. Ctr (Bucks Hbr.)	30.40
ME	ME0090026	U.S. Naval Comm. Sta. (Cutler)	10.80
ME	ME0090051	Winter Harbor Naval Group Act.	15.20
ME	ME0090174	Loring	6.62

[1] The Maine DEP is presently undertaking a review of the mercury effluent data submitted by facilities under its rule on **Interim Effluent Limitations and Controls for the Discharge of Mercury, 06-096 CMR 519** (effective February 5, 2000). This review is validating the submitted data and reviewing the performance trends of particular facilities. As such, some of these data may change based on the validation. These changes are not expected to affect the overall average concentrations for Maine or the region significantly.

State	NPDES ID	Facility Name	Hg Concentrations (ng/l)
ME	ME0100013	Augusta	7.66
ME	ME0100021	Bath	10.18
ME	ME0100048	Biddeford	10.01
ME	ME0100056	Bingham	4.47
ME	ME0100064	Boothbay Harbor	33.43
ME	ME0100072	Brewer	1.96
ME	ME0100102	Brunswick	38.81
ME	ME0100111	Bucksport	23.00
ME	ME0100129	Calais	5.86
ME	ME0100137	Camden	14.80
ME	ME0100145	Caribou	10.96
ME	ME0100153	Corinna	6.37
ME	ME0100161	Danforth	8.61
ME	ME0100200	Eastport Main Plant	77.72
ME	ME0100218	Falmouth	8.93
ME	ME0100226	Fort Fairfield	21.03
ME	ME0100242	PWD Gorham (Little Falls)	4.57
ME	ME0100269	Islesboro	1.88
ME	ME0100285	Kittery	5.40
ME	ME0100307	Lisbon	12.82
ME	ME0100315	Livermore Falls	13.41
ME	ME0100323	Machias	7.88
ME	ME0100391	Mechanic Falls	3.34
ME	ME0100404	Milbridge	8.94
ME	ME0100439	Milo	9.02
ME	ME0100447	Newport	3.85
ME	ME0100455	Norway	8.83
ME	ME0100463	Oakland	1.90
ME	ME0100471	Old Town	9.53
ME	ME0100498	Orono	4.52
ME	ME0100501	Dover-Foxcroft	5.28
ME	ME0100528	Pittsfield	3.15
ME	ME0100552	Rumford/Mexico	9.24
ME	ME0100561	Presque Isle	6.01
ME	ME0100587	Richmond	8.00
ME	ME0100595	Rockland	4.31
ME	ME0100609	St. Agatha	3.61
ME	ME0100617	Sanford	1.82
ME	ME0100625	Skowhegan	3.71
ME	ME0100633	South Portland	8.05
ME	ME0100641	Southwest Harbor	15.96
ME	ME0100668	Thomaston	11.17
ME	ME0100684	Van Buren	4.41
ME	ME0100692	Vassalboro (E. Vassalboro)	4.56
ME	ME0100706	Veazie	4.08
ME	ME0100731	Winter Harbor	4.05
ME	ME0100749	Winterport	19.33

Name	NPDES ID	Facility Name	Hg Concentration (ng/l)
ME	ME0100757	Wiscaset	3.48
ME	ME0100765	Yarmouth	20.91
ME	ME0100781	Bangor	6.90
ME	ME0100790	Wells	10.29
ME	ME0100803	Millinocket	6.70
ME	ME0100820	South Berwick	4.74
ME	ME0100846	Westbrook	6.48
ME	ME0100854	KSTD	5.42
ME	ME0100871	Limerick	8.87
ME	ME0100889	Ellsworth	17.63
ME	ME0100901	Northport Village Corp.	9.68
ME	ME0100935	Kennebunk	11.23
ME	ME0100951	Paris	7.20
ME	ME0100978	Jackman	2.65
ME	ME0100986	Ogunquit	6.06
ME	ME0101028	Washburn	4.83
ME	ME0101036	Freeport	10.02
ME	ME0101061	North Jay	2.13
ME	ME0101079	Mars Hill	3.31
ME	ME0101087	Ashland SD (WOO2697)	5.33
ME	ME0101095	Limestone	6.59
ME	ME0101117	Saco	5.38
ME	ME0101150	Unity	1.52
ME	ME0101176	Bethel	3.38
ME	ME0101184	Kennebunkport	7.23
ME	ME0101192	Castine	7.01
ME	ME0101214	Bar Harbor (Main Plant)	10.62
ME	ME0101222	York	4.91
ME	ME0101231	Blue Hill	7.11
ME	ME0101249	Farmington	35.14
ME	ME0101290	Houlton	2.04
ME	ME0101320	Baileyville	8.64
ME	ME0101338	Mt. Desert Otter Creek	8.33
ME	ME0101346	Mt. Desert Northeast Harbor	6.96
ME	ME0101389	Anson-Madison	3.57
ME	ME0101397	Berwick	2.38
ME	ME0101443	Hartland	4.08
ME	ME0101478	Lewiston/Auburn	6.38
ME	ME0101486	Rumford/Mexico (Rumford Point)	4.05
ME	ME0101516	Great Salt Bay Sanitary District	39.36
ME	ME0101524	Old Orchard Beach	4.32
ME	ME0101532	Belfast	10.84
ME	ME0101621	Farmington MSAD #9	85.60
ME	ME0101664	Bayville Village Corp.	26.14
ME	ME0101681	Madawaska	4.73
ME	ME0101699	Clinton	1.74
ME	ME0101702	Gardner	8.40

State	NPDES ID	Facility Name	Hg Concentration (ng/l)
ME	ME0101729	Maine Correctional Center	1.54
ME	ME0101788	Howland	2.83
ME	ME0101796	Lincoln	4.62
ME	ME0101800	Telstar High School MSAD #44	49.20
ME	ME0101826	Bonney Eagle MSAD #6	117.00
ME	ME0101842	Sabattus	2.70
ME	ME0101851	Stonington	33.36
ME	ME0101885	North Berwick	4.27
ME	ME0101915	Wilton	16.32
ME	ME0101966	Searsport	18.33
ME	ME0101982	Frenchville	3.64
ME	ME0102016	Lubec	27.29
ME	ME0102032	Guilford/Sangerville	10.21
ME	ME0102059	Scarborough	23.13
ME	ME0102067	Canton	2.57
ME	ME0102075	PWD Portland	10.43
ME	ME0102113	Brunswick Public Works Landfill	5.32
ME	ME0102121	Cape Elizabeth	12.03
ME	ME0102130	Sorrento	8.34
ME	ME0102148	Eastport Quoddy	13.06
ME	ME0102156	East Machais	3.29
ME	ME0102181	Whitneyville	3.40
ME	ME0102237	PWD Peaks Island	16.62
ME	ME0102245	Mattawamkeag	15.90
ME	ME0102253	Warren	13.53
ME	ME0102318	Grand Isle	2.19
ME	ME0102334	Norridgewock	2.08
ME	ME0102351	Skowhegan (River Road)	6.50
ME	ME0102369	Fort Kent	8.56
ME	ME0102377	Sea Meadows	5.53
ME	ME0102431	GSBSD, Damariscotta Mills	7.13
ME	ME0102466	Bar Habor (Hulls Cove)	6.53
ME	ME0102474	Bar Harbor (Degregoire)	8.98
ME	ME0102547	Mt. Desert Somesville	12.19
ME	ME0102555	Mt. Desert Seal Harbor	5.23
ME	ME0102581	Loring Water Treatment Plan	1.60
ME	ME0102652	Vassalboro (N. Main Street)	4.40
ME	ME0102661	Vassalboro (Cemetary Road)	5.45
ME	ME0102741	Biddeford Pool	7.35
ME	MEU500830	Dexter Utility District	10.81
ME	MEU501007	Seal Harbor Sand Filter (MDI)	11.56
ME	MEU501492	St. Andre Health Care	2.48
ME	MEU502345	Skowhegan (River Road)	14.74
ME	MEU503801	Ellsworth (Shore Road)	20.85
ME	MEU506634	Maine Central Railroad	6.34
ME	MEU507044	GSBSD, Damariscotta Mills	9.03
ME	MEU507581	Biddeford Pool	6.42

State	NPDES ID	Facility Name	Hg Concentration (ng/l)
ME	MEU508101	Vassalboro (N. Main Street)	5.62
ME	MEU508102	Vassalboro (Cemetary Road)	6.39
MA	MA0003905	General Electric Aircraft Eng.	0.20
MA	MA0004341	Wyman-Gordon Company	0.00
MA	MA0004731	Exelon New Boston LLC	3.81
MA	MA0100994	Gardiner WPCF	22.94
MA	MA0103284	MWRA - Deer Island POTW	19.55
NY	NY0021342	Huntington SD	39.00
NY	NY0029351	Kingston	4.00
NY	NY0022403	Little Falls	5.80
NY	NY0030546	LeRoy	2.28
NY	NY0020125	Lowville	0.50
NY	NY0026336	Niagara Falls	32.00
NY	NY0026212	NYC 26th Ward	19.00
NY	NY0026158	NYC Bowery Bay	11.00
NY	NY0026182	NYC Coney Island	9.30
NY	NY0026191	NYC Hunts Point	9.30
NY	NY0026115	NYC Jamaica	46.00
NY	NY0026204	NYC Newtown Creek	34.00
NY	NY0026174	NYC Oakwood Beach	2.70
NY	NY0026166	NYC Owls Head	18.00
NY	NY0026107	NYC Port Richmond	11.00
NY	NY0027073	NYC Red Hook	8.60
NY	NY0026221	NYC Rockaway	14.00
NY	NY0026239	NYC Tallman Island	9.60
NY	NY0026131	NYC Wards Island	7.90
NY	NY0029831	Ogdensburg	1.60
NY	NY0025780	Oneida County SD	1.00
NY	NY0027901	Orange County SD#1	3.70
NY	NY0026255	Poughkeepsie City	41.00
NY	NY0087971	Rensselaer County SD#1	16.00
NY	NY0031895	Rockland County SD#1	64.00
NY	NY0031208	Saugerties	24.00
NY	NY0022748	Suffern	9.80
NY	NY0021750	Suffolk County SD#1	9.40
NY	NY0023311	Suffolk County SD#6	41.00
NY	NY0206644	Suffolk County SD#21	11.00
NY	NY0025984	Watertown	8.70
NY	NY0021610	Webster	2.20
NY	NY0024929	Whitehall	11.60
NY	NY0026689	Yonkers	42.00
NY	NY0068225	Arkema Chemical	37.00
NY	NY0200484	Clean Water Of NY	0.54
NY	NY0072061	CWM	67.13
NY	NY0002275	Honeywell International Inc.	98.00
NY	NY0006670	Nepera	26.93
NY	NY0200867	NYC Staten Island Landfill	37.00

State	NPDES ID	Facility Name	Hg Concentration (ng/l)
NY	NY0110043	PVS Chemical Solutions, Inc	7.47
NY	NY0000132	Reynolds Metals Company	1.46
NY	NY0005801	Schenectady International - RJ	0.67
NY	NY0000973	West Valley Demonstration Project	12.00
NY	NY0007170	Wyeth Research	0.60
NY	NY0036706	Ticonderoga Village	1.68
NY	NY0004413	Ticond I.P. Mill	11.40
NY	NY0020222	Westport	2.14
NY		Port Henry A	9.37
NY		Port Henry D	9.06
RI	RI0100315	Fields Point	21.00
RI	RI0100072	Bucklin Point	13.00
VT		Shelburne 1	0.96
VT		Shelburne 2	0.51
VT	VT0100358	South Burlington	0.88
VT	VT0100153	Burlington Main	2.06
VT	VT0100226	Burlington N	2.19
VT	VT0100501	Swanton	0.66
VT		St. Albans A	1.77
VT		St. Albans D	1.72
VT	VT0101117	St. Albans Corr	0.32
VT	VT0100404	Vergennes	1.71
Mean			**16.64**
Median			**7.90**

Concentrations shown for each facility are the average of all concentration data available for that facility.

Appendix D: State Mercury Reduction Plans

All of the Northeast states are committed to mercury reduction and there are a number of written documents that describe these efforts. Below is a list of these documents with the web addresses where they can be obtained.

<u>Connecticut</u>

Toward the Virtual Elimination of Mercury from the Solid Waste Stream
http://ct.gov/dep/lib/dep/mercury/gen_info/mercury.pdf

<u>Maine</u>

Mercury in Maine – A Status Report
http://www.maine.gov/dep/mercury/mercury_in_maine.pdf

<u>Massachusetts</u>

Massachusetts Zero Mercury Strategy
http://www.mass.gov/envir/Sustainable/resources/pdf/Resources_Hg_Strategy.pdf

<u>New Hampshire</u>

New Hampshire Mercury Reduction Strategy
http://www.des.state.nh.us/NHPPP/merc20.pdf

<u>New York</u>

New York State Department of Environmental Conservation Mercury Work Group Recommendations to Meet the Mercury Challenge
http://www.dec.ny.gov/docs/permits_ej_operations_pdf/meetmercurychallenge.pdf

<u>Rhode Island</u>

Final Report of the Rhode Island Commission on Mercury Reduction and Education
http://www.dem.ri.gov/topics/pdf/hgcomrep.pdf

<u>Vermont</u>

Advisory Committee on Mercury Pollution 2007 Annual Report
http://www.mercvt.org/acmp/reports/2007_report.pdf

Appendix E: Response to Comments

Draft Northeast Regional Mercury TMDL Response to Comments

Prepared by NEIWPCC, CT DEP, ME DEP, MA DEP, NH DES, NYS DEC, RI DEM, VT DEC

The Northeast States and NEIWPCC received comments from 14 different groups on the draft Northeast Regional Mercury TMDL. The draft TMDL was released for public comment on April 11, 2007 with a public comment period ending June 8, 2007. The comments received and their responses have been organized in accordance with the sections of the draft TMDL. The number at the end of each comment corresponds to the list of commenters, which can be found at the end of the document.

In addition to a number of specific comments on the TMDL, the states and NEIWPCC received many comments that were generally supportive of the TMDL effort. The states and NEIWPCC are appreciative of the support for this effort. Comments of general support are grouped together and listed at the beginning of the document. Supportive comments that pertain to a particular section of the TMDL are listed under that section with no response given. All questions and recommendations are listed under the corresponding TMDL section with the response below. In some cases, comments are grouped together and one response is provided for this group.

General Support for TMDL

Comments:

- We hope that EPA views the Northeast Regional TMDL as a unique collaborative effort which eliminates the duplication of resources that would have been necessary if each state drafted, and EPA reviewed, individual TMDLs. This truly groundbreaking effort should be used as a model of cooperation for future similar endeavors[1].

- The Adirondack Council fully supports the proposed TMDL as presented by the Department of Environmental Conservation[1].

- CCE applauds New York State, as well as the other participating states and the NEIWPCC for drafting a plan to reduce mercury in the waters of New York State and New England to eliminate fish consumption advisories caused by mercury air deposition[2].

- The Northeast Environmental Organizations therefore strongly endorse the States' ultimate goal to control *all* sources of mercury by implementing existing reduction control technologies on upwind out-of-region sources[3].

- I would like to applaud your efforts in taking a concerted approach with other Northeastern States[4].

- Overall, the Onondaga Nation strongly supports the recommendations of the draft TMDL[5].

- The Fish and Game department is in support of the regional TMDL approach in reducing mercury in the environment[6].

- The MWRA supports this TMDL, which addresses the most significant source of mercury to Massachusetts lakes and ponds: atmospheric deposition. MWRA supports the efforts of the Northeast states to require more stringent levels of mercury control in power plants emissions than is achievable by CAMR[7].

- The Northeast Environmental Organizations agree the States have made "nationally significant reductions to in-state sources of mercury as a result of their regional action plan." The Mercury TMDL is therefore the most effective strategy to reduce the ongoing wide spread mercury contamination across the Northeast, and is legally mandated by section 303(d) of the Clean Water Act[3].

- As described in our letter of May 31, we support the efforts of NEIWPCC and the northeast states to coordinate in developing an innovative TMDL approach for mercury-impaired waters. With a large number of mercury-impaired waters in the region, an approach which can most efficiently address those impairments appears to be most appropriate.[8]

- We look forward to working with NEIWPCC and the northeast states regarding how best to address our comments in order to strengthen the TMDL. We would be happy to provide technical advice or assistance where appropriate.[8]

<u>Comments and Responses Organized by Draft TMDL Section</u>

2 Background

Comment:

- Multi-state or regional TMDLs are clearly contemplated by EPA under section 303(d) of the Clean Water Act to address atmospheric deposition. The need to address the widespread impairment of the States' waters by mercury from upwind out-of-region sources calls for such a multi-state, regional approach. The States have undertaken substantial efforts to control mercury loadings from in-state sources; the Mercury TMDL demonstrates unequivocally that waters will continue to be impaired for mercury, however, as a result of upwind out-of-region emissions. The Clean Water Act provides for a regional approach to address precisely this situation; indeed, the States are obligated to submit proposed loadings that require reductions from such upwind out-of-region sources[3].

Comment:

- Include Connecticut River Fish Tissue Contaminant Study in list of TMDL references[9].

Response:

Information from this report will be added to the background information in the TMDL document and a reference to the study will be added to the list of references. However, it should be noted that the data collected as part of the Connecticut River study were not included in the fish tissue dataset used for developing the TMDL. The Connecticut River data lacked sufficient georeferencing to be included in the NERC dataset that was used for TMDL development. The fish tissue concentrations for smallmouth bass and yellow perch measured as part of the Connecticut River study aligned with the concentrations found in the NERC dataset. Inclusion of these data in the calculations of the 80th to 90th percentile existing fish concentration would not have resulted in an appreciable difference in the TMDL baseline or targets.

2.3 Massachusetts TMDL Alternative and EPA Justification for Disapproval

Comment:

- EPA's June 21, 2006, response to the TMDL Alternative proposed by Massachusetts in 2004 is significant in the context of the Mercury TMDL for the following reasons. First, EPA confirms that atmospheric deposition causes a significant portion of the mercury impairment in Massachusetts waters. Second, EPA concludes that the fact that Massachusetts has in place an effective and comprehensive management plan to address in-state sources of mercury does not remove Massachusetts's obligation to submit draft TMDL loadings that address sources beyond its borders. Third, EPA acknowledges that other pollution control requirements required under either state or federal authority are insufficient to achieve applicable water standards for mercury in Massachusetts. As a result, in order to fulfill its TMDL obligations relating to mercury impaired waters, Massachusetts must undertake a broader assessment and propose loadings for out-of-state sources. As these same obligations apply to the other New England states and New York, EPA's statements confirm the validity of the approach taken by the Mercury TMDL[3].

2.6 Control of In-State Sources not Sufficient to Meet Water Quality Standards

Comments:

- We commend New York State, the six New England states, and the New England Interstate Water Pollution Control Commission for developing a regional approach to reducing mercury emissions. We also commend these states for their efforts to significantly reduce their own mercury emissions - beyond what is required by federal law. However, we also recognize that even the crucial planned regional actions will not be enough to address the problem of mercury deposition and toxicity in the region. The TMDL strategy, in setting targets for reduction both within the region and outside the region, demonstrates the need for more aggressive action at the national level - a position that we fully endorse[10].

- Agree with the statement and assessment in Section 2.6 that control of in-state sources is not sufficient. Northeast states have made very significant mercury reductions in the last decade and EPA should be actively supporting our efforts through grants and technical assistance[9].

3 Applicable Water Quality Standards and Fish Tissue Criteria

Comment:

- <u>Water quality standards</u>: The TMDL currently does not clearly describe the individual water quality standards for mercury for each of the states, except for MA and ME, and whether the states have water column criteria. As one of the key elements of a TMDL, it is important that the regional TMDL describe for each state its mercury criteria, both water column and fish tissue. Where appropriate, the TMDL should indicate that a state is using narrative criteria to select a fish tissue criterion based on consumption advisories, and provide the state's rationale for such an interpretation. In addition, the TMDL should demonstrate that meeting the fish tissue criterion also assures that the water column criterion is met in each state[8].

Response:

Table 3-1 of the TMDL will be revised to include each state's water column criteria for mercury. Calculations will also be shown to demonstrate that meeting fish tissue criteria will ensure that water column criteria are met. Because fish tissue criteria account for bioaccumulation, they are more protective than using water column concentrations. In Connecticut, the fish tissue concentration is *not a criterion that is part of the state water quality standards, but the water quality standards contain a narrative standard for protection of human health that relies on the Department of Public Health's fish tissue guidance value and fish consumption advisories. The language of the narrative criteria is provided in Appendix B of the TMDL.*

4.1 Fish Tissue Monitoring Dataset

Comment:

- We support the use of the NERC dataset as appropriate for the development of the draft TMDL[3].

Comment:

- Fish Tissue Data: We recommend that the TMDL provide additional information on the rationale for using smallmouth bass to calculate the necessary reductions in mercury loadings for the region. The TMDL indicates in Table 4-1 that there is data showing that the concentrations in smallmouth bass are highest. The TMDL should describe what data is available on each species, numbers of samples, and how that data is distributed geographically across the states. The purpose of such information is to demonstrate that there is sufficient fish tissue data coverage for the entire region, such that it is reasonable to use the 80^{th}-90^{th} smallmouth bass fish tissue concentration as representative of all seven states[8].

Response:

The regional fish tissue dataset that was used in the TMDL analysis contained 867 datapoints for largemouth bass, 342 datapoints for smallmouth bass, 71 datapoints for walleye, and 2,527 datapoints for yellow perch. Smallmouth bass was selected as the target species because it was the species with the highest mercury concentration for which there were a reasonable number of datapoints available. We did not feel that there was a sufficient number of walleye datapoints and use of largemouth bass or yellow perch would have resulted in a less protective TMDL.

4.2 Areas of Elevated Concentration

Comments:

- We recommend that the plan explicitly recognize that areas of elevated concentration can result from a combination of greater sensitivity, due to local and upstream factors such as acidification and the presence of conditions that promote the formation of methylmercury, and greater local or upstream deposition. We also strongly recommend that the plan call for appropriate, and spatially specific reductions in mercury deposition to address these specific problematic conditions, not only locally but upstream within the watersheds of these areas of elevated concentration[10].

- Plans to meet the TMDL goals should take into account the varying susceptibility of different locations to mercury deposition and the varying vulnerability of different species and ecosystems to the formation and biological accumulation of methlymercury. We recommend that the plan develop stringent goals for reducing exposure of mercury among these most vulnerable species and ecosystems[10].

Response:

Because some areas and species are more sensitive to mercury pollution, these areas and species may also be more sensitive to reductions in mercury emissions and deposition. Therefore, these areas and species may actually respond more quickly to decreases in mercury deposition. However, the exact *response of these areas and species is not known. Therefore, these areas are targeted to be more closely monitored during the TMDL implementation period. If monitoring results indicate that more specific reduction strategies are necessary for these areas and species, they will be implemented at that time. The adaptive implementation approach will allow for changes in the approach to addressing sensitive areas if necessary. Although the necessary reductions are not known for non-fish species, implementation of the TMDL should result in significant reductions for these species. In addition, for this TMDL a high trophic level predator was chosen as the target species and use of 80th – 90th percentile size adjusted values provides a margin of safety. So, while exact calculations for these species are outside the scope of this TMDL, implementation of the TMDL will have beneficial effects for these species.*

Some areas that have been identified to have high local deposition, such as Southeast New Hampshire/Northeast Massachusetts are already being addressed through strict reductions targets on nearby coal-fired power plants, municipal waste combustors, and medical waste incinerators. It is expected that these existing controls, in conjunction with more stringent controls on out-of-region sources, will result in these areas meeting the fish tissue target concentration. Re-evaluation of the TMDL at the end of Phase II will allow for further reductions to be implemented if necessary.

Comment:

- The states need to consider the potential for confounding variables that shift the reduction burdens assigned in the Regional TMDL[11].

Response:

There are a number of factors that contribute to mercury accumulation in waterbodies in addition to the actual mercury deposition. However, many of these factors cannot be controlled. Some watersheds are naturally more sensitive due to geology and prevalence of wetlands.

Nutrients are another factor which generally affect mercury accumulation, and higher nutrient levels are normally associated with lower fish mercury levels. While there is potential to control nutrient levels, states are generally working toward achieving lower nutrient levels to improve dissolved oxygen for aquatic life and reduce the risk of algal blooms. This enhances the need for meaningful mercury controls to meet the multiple uses of waters that need to meet recreational, aquatic life, and fish consumption uses.

Because specific areas have been identified as more sensitive to mercury pollution, including impoundments subject to hydropower modification, these areas will be more closely monitored during the implementation of the TMDL. The adaptive implementation approach of the TMDL, as well as existing licenses for hydropower storage impoundments that require monitoring for mercury impacts on wildlife, will allow for changes in the approach to addressing sensitive areas if necessary and will allow for refinements as scientific data and understanding evolve.

Comment:

- In particular, Section 4.2 indicates that there are areas of elevated fish tissue mercury concentrations, and that these areas will respond differently than other areas. However, only one area in MA is excluded from the TMDL. The TMDL should indicate whether these areas of higher sensitivity will attain the TMDL target; if not, we recommend that the states consider addressing these areas separately from the rest of the TMDL (e.g., a separate TMDL calculation) or excluded from the TMDL, similar to the areas in MA[8].

Response:

Because some areas are more sensitive to mercury pollution due to factors such as water chemistry, presence of wetlands, and water level fluctuations, these areas may also be more sensitive to reductions in mercury emissions and deposition. Therefore, these areas may actually respond more quickly to decreases in mercury deposition. However, the exact response of these areas is not known. Therefore, these areas are targeted to be more closely monitored during the TMDL implementation period. If monitoring results indicate that more specific reduction strategies are necessary for these areas, they will be implemented at that time. The adaptive implementation approach will allow for changes in the approach to addressing sensitive areas if necessary.

5 Northeast Regional Approach

Comment:

- At the same time, the TMDL should provide further information regarding the basis for a single TMDL encompassing waterbodies in seven states, and how the TMDL will achieve water quality standards in each of the states. The TMDL mentions air deposition of mercury as the reason for taking a regional approach. The TMDL would be strengthened if it described why all of the waterbodies identified in the draft TMDL can be treated similarly for the purposes of a TMDL. Specifically, the TMDL should provide further details on factors in support of the regional approach, including the geographic distribution of sources, both point sources and nonpoint sources (air deposition), land use, and fish mercury levels, and identify any geographic variation in these factors. If there isn't adequate justification for the single region approach, we recommend breaking the TMDL into appropriate sub-regions, or separating out any waters/areas that may be unlikely to achieve the fish tissue target with the reductions called for in the proposed regional TMDL[8].

Response:

Because the entire region is impacted by local, regional, and global mercury deposition sources, the Northeast states and NEIWPCC feel that it is appropriate to keep the TMDL at the scale of the entire region. By targeting fish tissue concentrations, the TMDL ensures that water quality standards for mercury in the water column will be met. Calculations in the revised TMDL will demonstrate the relationship between water column concentrations and fish tissue concentrations and that the fish tissue concentration is more protective. For Connecticut, meeting the 0.1 ppm guidance value used by the Department of Public Health ensures the state's narrative criteria for protection of human health are met.

Kamman, et al. (2005) provides that although there are differences in fish tissue concentrations across states, differences in fish tissue concentrations are more strongly influenced by individual fish length than they are by jurisdiction. In the case of smallmouth bass, once the effect of length is accounted for, there is very little variation in fish concentrations among the states. This relationship can be seen in a graph that has been added to the revised TMDL.

5.1 Impaired Waters

Comments:

- Waterbodies Covered by the TMDL: It is important to identify each waterbody as it appears on the state's 303(d) list or Integrated Report. This could be done by providing a link between the waterbodies addressed by the TMDL and the category 5 listings, i.e., which 303(d) list/integrated report year is being addressed (e.g., 2006) and which impairments are being addressed. The TMDL should also indicate the priority ranking for waterbodies being addressed in the TMDL[8].

- In addition, if the TMDL covers some but not all the waters on a state's 303(d) list or integrated report, we recommend that the waters be described so it is clear which waters are covered. In particular, it would be helpful if the TMDL clarified both in Table 5-1 and Appendix A for CT, ME, and NH how the excluded waters are designated in each state's integrated list. For example, in Maine, are the waters in the category "estuarine and marine" waters excluded, and in CT, are the waters designated "E" excluded from the TMDL[8]?

- Pollutant Sources – Air Deposition: The TMDL indicates that it applies only to waterbodies impaired for mercury primarily from air deposition. We recommend the TMDL explain the process for determining that the waters covered by the TMDL are waters impaired primarily by air deposition, especially for the three states for which all waters are included in the TMDL[8].

Response:

For Massachusetts, New York, Rhode Island, and Vermont, the waters listed in Appendix A of the TMDL were taken directly from the states' most recently approved 303(d) or Integrated List. The revised TMDL will explicitly state the year of the report that is being referenced. For Connecticut, Maine and New Hampshire, the TMDL applies to all fresh waterbodies with the exception of a small number of waterbodies that will be listed in the revised TMDL. These are waterbodies where atmospheric deposition is not the primary source of mercury pollution. In Connecticut, this means all waterbodies that are not designated with an "E" (for estuary). For New Hampshire, this means any waterbodies that are designated as RIV (river), LAK (lake), or IMP (impoundment). Waterbodies designated EST (estuary) and OCN (ocean) are not included. For Maine, waterbodies designated as rivers, streams, and lakes are included. Those designated as marine and estuarine are not included.

Connecticut's Integrated List provides the following language:
"In addition to those waters included on the list, all waterbodies where statewide fish consumption advisories have been established due to atmospheric deposition of mercury from sources outside of state jurisdictional borders are implicitly included in EPA Category 5 ("303(d) listed"). Specific fish consumption advisories established as a result of local pollution sources (i.e. releases of polychlorinated biphenyls - PCBs or chlordane) are individually listed in Appendix C-4."

Maine DEP lists waters impaired by atmospheric deposition of mercury in Category 5C:
"Category 5-C: Waters Impaired by Atmospheric Deposition of Mercury. Regional or National TMDL may be Required.
5-C: Impairment caused by atmospheric deposition of mercury and a regional scale TMDL is required. Maine has a fish consumption advisory for fish taken from all freshwaters due to mercury. Many waters, and many fish from any given water, do not exceed the action level for mercury. However, because it is impossible for someone consuming a fish to know whether the mercury level exceeds the action level, the Maine Department of Human Services decided to establish a statewide advisory for all freshwater fish that recommends limits on consumption. Maine has already instituted statewide programs for removal and reduction of mercury sources. The State of Maine is participating in the development of regional scale TMDLs for the control of mercury."

The New Hampshire 303(d) list states:
"..it is important to note that all surface waters are impaired due to statewide fish/shellfish consumption advisories issued because of elevated levels of mercury in fish and shellfish tissue. Since mercury is a pollutant that requires a TMDL, all 5000+ surface waters in New Hampshire are included on the Section 303(d) List. However, in order to keep the length of the 303(d) List in Appendix A to manageable size, surface waters impaired solely by atmospheric mercury deposition were not included."

Therefore, all fresh waterbodies in Connecticut, Maine, and New Hampshire with the exception of those listed in Appendix B of the revised TMDL are included in the Northeast Regional TMDL.

Comment:

- Future listings: The draft TMDL indicates that future mercury listings would be covered by the TMDL. It would be helpful if the TMDL clarified how such future listings would be covered through the listing process, and how the states would provide for adequate public comment[8].

Response:

This TMDL applies to the impaired waterbodies that are listed in Appendix A of the TMDL document. This TMDL may, in appropriate circumstances, also apply to waterbodies that are listed for mercury impairment in subsequent state CWA § 303(d) Integrated List of Waters. For such waterbodies, this TMDL may apply if, after listing the waters for mercury impairment and taking into account all relevant comments submitted on the CWA § 303(d) list, the state determines with EPA approval of the CWA § 303(d) list that this TMDL should apply to future mercury impaired waterbodies.

5.2 Selection of Existing Fish Mercury Concentration Based on Standard Size Fish

Comment:

- Agree with choice of basing TMDL analysis on 80th and 90th percentile of distribution of standard length fish because it is more protective[9].

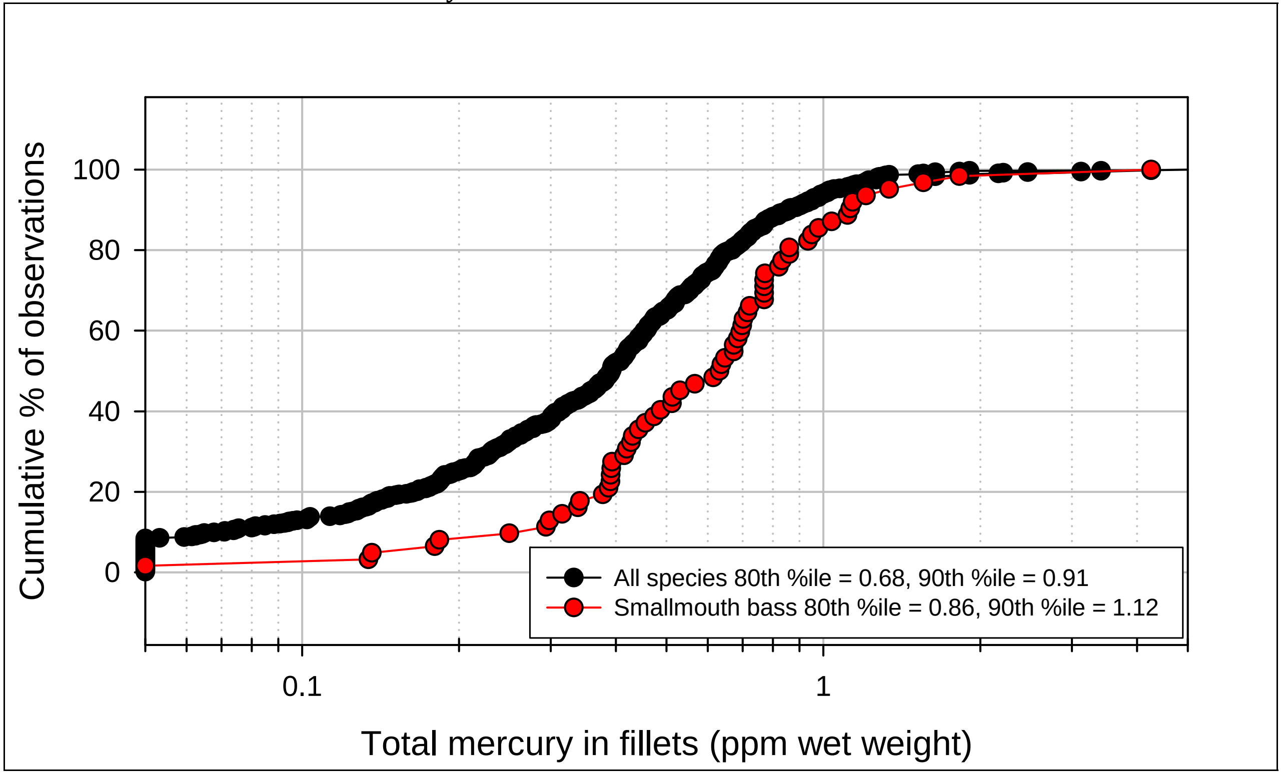
Comment:

- We also recommend that the TMDL describe how using a range of 80th-90th percentile fish tissue concentrations is adequately protective. Would waters where fish tissue levels are above the 90th percentile meet the TMDL target, or, if not, how will they be addressed (would they potentially need to be excluded and addressed separately)? What is the rationale for providing a range, rather than just the 90th (or 80th) percentile[8]?

Response:

The figure below shows the cumulative distribution of length-standardized smallmouth bass mercury concentrations based on data within the NERC dataset, in comparison to those for all fish species. Smallmouth bass was selected as the standard indicator target species for this TMDL because its use balances the competing needs of having a sufficient quantity of fish-mercury datapoints and a sufficiently high-mercury fish to provide a strongly protective TMDL. The 80th percentile value of 0.86 ppm mercury for smallmouth bass corresponds to the 90th percentile concentration for all fish species, while the 90th percentile value of 1.14 ppm mercury for smallmouth bass corresponds to the 96th percentile concentration for all fish species. As such, by targeting the range of smallmouth bass concentrations shown in the TMDL calculations, we are ensuring that fully 96 percent of fish should ultimately come into compliance with water quality standards. The graph shown below will be added to the revised TMDL.

Cumulative Distribution of Mercury Concentrations in Northeast Fish



5.3 Target Fish Mercury Concentration

Comment:

- The draft TMDL's adoption of EPA's methylmercury fish tissue criterion of 0.3 ppm as the common endpoint is reasonable. Four of the States have adopted a fish tissue concentration 0.3 ppm as the basis for fish consumption advisories, and others have stricter requirements. Given the well documented human health impacts of mercury consumption, the Northeast Environmental Organizations encourage each state to adopt the most stringent standard practicable when evaluating the endpoint TMDL levels in 2010, as called for in the Mercury TMDL[3].

Comment:

- The Northeast Regional Mercury TMDL should use a more stringent mercury fish tissue target of 0.1 ppm. CCE recommends that the more protective standard of 0.1 ppm which is already being utilized in Connecticut, be used in New York and the other Northeast states[2].

Response:

States consider a number of factors and sources of data when determining a target fish tissue concentration and do not base fish consumption advisory decisions solely on guidance concentrations. There is currently no risk-assessment basis for regionwide adoption of a 0.1 ppm criterion. A region-wide target of 0.3 ppm is viewed as a reasonable initial goal.

Comment:

- The TMDL should be revised to expressly state that NY will change its guidance values from 1.0 ppm to 0.3 ppm[5].

Response:

New York cannot commit to changing its guidance value at this time. There are a number of factors in addition to the guidance value that states consider when making decisions about fish consumption advisories, so New York's use of 1.0 ppm does not mean that fish consumption advisories are not issued unless this value is exceeded.

Comment:

- We believe that a more technically sound approach [for setting the fish tissue target] would be to consider the data from all of the relevant fish species. This would be consistent with the approach outlined in EPA's "Draft Guidance for Implementing the January 2001 Methlymercury Water Quality Criterion." That document states that "[if target populations consume fish from different trophic levels, the state or authorized tribe should consider factoring the consumption by trophic levels when computing the average methylmercury concentration in fish tissue." The agencies should revise the TMDL to implement that recommendation. By taking into account what fish people actually consume, the agencies would be developing a TMDL that is more grounded in facts and is more likely to focus on preventing real risks[12].

Response:

Not all of the states have the data available to show which types of fish their residents are consuming. These are very likely to differ across the region, by population and with time. By using a high trophic level species with a high concentration, a conservative approach is being used that will protect both general and sensitive populations. This ensures that the highest level consumers will be protected and allows for a margin of safety to be built into the TMDL. Moreover, fish that feed high on the food web, such as smallmouth bass, are more reflective of other obligate apex predators such as loons and eagles. By targeting the TMDL to 80th to 90th percentile smallmouth bass(which is the equivalent of 90th to 96th percentile of all fish), ecological health as well as human health are protected by ensuring that the prey upon which obligate piscivores feed will have low enough mercury concentrations to preclude risk to the most mercury-sensitive aquatic biota.

Comment:

- The states cannot develop and apply an ad hoc water quality criterion without the procedural safeguards of notice-and-comment rulemaking followed by EPA review and approval[11].

Response:

TMDLs are not only based on failure to meet water quality criteria, but also on impairment of a designated use. Because the necessity of fish consumption advisories indicates that the affected waterbodies are impaired for their designated use of fish consumption, a TMDL is necessary for these waters. In the case of mercury, the concentrations used to make decisions about fish consumption advisories are the appropriate criteria for deciding if a TMDL is necessary and as a goal for restoring the waterbodies to the point where the designated use is met.

While not all of the states have adopted fish tissue criteria, all of the states have adopted either fish tissue criteria or water column criteria. Because the fish tissue criterion accounts for bioaccumulation, it is actually more protective than the water column concentration and meeting the fish tissue concentration ensures that the water column concentration will be met.

Comment:

- <u>TMDL target</u>: The draft TMDL states that the target of 0.3 mg/kg was chosen because it is EPA's recommended criterion. Nonetheless, the TMDL should describe why this target is appropriate for the entire region, and how the target assures that each state's water quality standards will be attained.

In addition, the TMDL also recognizes that this target is not appropriate for CT and ME, and that the proposed TMDL would not attain water quality standards in those states. Appendix B generally describes the reductions that would be needed in CT and ME. EPA suggests that it may be more appropriate for CT and ME to adopt a TMDL based on Appendix B, rather than the regional TMDL. If so, we recommend that the final TMDL submission indicate specifically what TMDL elements, including the wasteload and load allocation, are being adopted for these two states[8].

Response:

To more clearly document that the final goal of this TMDL is for Maine and Connecticut criteria to be met, the document will highlight the necessary reductions to meet water quality standards in Maine and Connecticut. In both of those states, calculations require reductions in anthropogenic mercury deposition greater than 100 percent. The calculation of needed reductions is affected by a number of variables, including the percentage of deposition due to anthropogenic sources, and there is a range of accepted values associated with this parameter. Various studies have found this percentage to be between 75 and 85 percent. Use of a lower percentage results in a greater percent reduction from anthropogenic sources, whereas a higher percentage has the opposite effect. Because of these ranges and other reasonable and prudent assumptions made about values for a number of parameters, adaptive management will be used when implementing the reductions necessary to meet the TMDL. At the end of Phase III, the states will re-evaluate progress made toward the 0.2 and 0.1 goals and will determine if adjustments need to be made in the ultimate goals that have been set, or how they can be achieved.

As is discussed in greater detail in Section 7.6 below, because the entire region is impacted by local, regional, and global mercury deposition sources, the Northeast states and NEIWPCC feel that it is appropriate to keep the TMDL at the scale of the entire region.

5.4 Proportionality of Mercury Reductions

Comment:

- There is broad support for the assumption set forth in the Mercury TMDL that a decrease in atmospheric mercury emissions will result in a proportional decrease in mercury deposition in the Northeast, and corresponding decrease in mercury concentrations in fish living in the States' waterbodies. No less an authority than EPA has confirmed the accuracy of this assumption in its Mercury Maps model[3].

Comment:

- The states' assumption of proportionality is not borne out by the data[11].

Response:

The assumption of proportionality is based on the results of two models that were presented in the U.S. EPA Mercury Maps report. The Mercury Cycling Model and the IEM-2M Watershed Model assumed linear relationships between atmospheric deposition and fish tissue mercury concentrations, which support the assumption of proportionality. Reductions in fish tissue may not be proportional to deposition reductions in the short term, but it is expected that over the long term, when the system reaches steady state, a proportional relationship will be observed. Because the relationship may not be perfectly linear, the states have chosen to use an adaptive implementation method that will include monitoring of mercury emissions, deposition, and fish tissue data, and allow for revising of goals if the relationship between reductions in emissions, deposition, and fish tissue concentrations does not follow that of the assumptions made in the TMDL.

Comment:

- Loading capacity and critical conditions: The TMDL should provide additional information on its key assumptions in determining the loading capacity, as well as any other assumptions used in developing the TMDL. For example, what assumptions were made regarding how much of the air deposition load to land is ultimately delivered to waterbodies? We also recommend that the TMDL include an additional justification for using the principle of proportionality to determine the necessary reductions in mercury loading. Although assumptions such as proportionality have been used in other mercury TMDLs, the northeast TMDL should provide its own support for the assumptions[8].

Response:

At this time, there is no precise modeling of the link between emissions and mercury bioaccumulation or the effect of a given emissions reduction on fish tissue concentrations. Therefore it is reasonable to rely on certain assumptions regarding the relationships between mercury emissions, deposition, and fish tissue concentrations. There is sufficient empirical evidence to show that emissions reductions cause reductions in fish tissue concentrations, which validates the assumptions used in this TMDL.

Steady state in environmental systems means that concentrations may vary season to season or even year to year, but that long term averages are constant. The steady state formulation of the Mercury Cycling Model (MCM) shows a linear relationship between concentration in fish and atmospheric deposition rate. The steady state formulation of the IEM-2M model shows that given a decrease in mercury air deposition loading rate, the same decrease is seen in total soil mercury concentration, total water column mercury concentration, and predatory fish mercury concentration. Based on the steady state formulations of the MCM and IEM-2M models, a simplified model can be derived to relate percent reductions in air deposition load to percent reductions in fish tissue concentrations at steady state.

The standard steady state bioaccumulation equation is:

$$C_{fish_{t1}} = BAF \bullet C_{water_{t1}}$$

where C_{fisht1} and $C_{watert1}$ are methylmercury contaminant levels in fish and water at time t1, respectively and BAF is the site specific bioaccumulation factor, which is constant for a given age/length and species of fish in a specific waterbody

For a future time, t2, when mercury concentrations have changed but all other parameters remain constant, the equation can be written as:

$$C_{fish_{t2}} = BAF \bullet C_{water_{t2}}$$

where C_{fisht2} and $C_{watert2}$ are methylmercury contaminant levels in fish and water at time t2, respectively and C_{fisht2} is for a fish that is the same age, length, and species as for C_{fisht1}.

Combining the equations produces:

$$\frac{C_{fish_{t1}}}{C_{fish_{t2}}} = \frac{C_{water_{t1}}}{C_{water_{t2}}}$$

Because methylmercury water column concentrations are proportional to mercury air deposition load to a watershed, this equation can be rewritten as:

$$\frac{C_{fish_{t1}}}{C_{fish_{t2}}} = \frac{L_{air_{t1}}}{L_{air_{t2}}}$$

where L_{airt1} and L_{airt2} are the air deposition mercury loads to a waterbody at time t1 and t2, respectively.

Based on this relationship, mercury fish concentrations will be reduced from current levels in proportion to load reductions for the watershed. For waterbodies in which air deposition is the only significant source, fish tissue mercury concentration reductions will be directly proportional to air deposition reductions.

Because these relationships are based on steady states, we do not expect that a proportional relationship between atmospheric deposition reductions and fish tissue reductions will be observed immediately. However, it is expected this response will be seen over the long term, once systems have reached steady state. While it is acknowledged that there is a time lag between mercury being deposited on land and that mercury reaching waterbodies, it is assumed that the terrestrial system will eventually reach a new steady state with atmospheric deposition, and total loading of mercury to surface water will be proportional to atmospheric deposition.

6.1 Northeast States Emissions Inventory

Comment:

- The Mercury TMDL properly relies on the studies prepared by NESCAUM to inventory mercury emissions in the northeastern states[3].

6.2 Atmospheric Deposition Modeling

Comment:

- The Mercury TMDL correctly analyzes the approximate relative contributions from in-state sources and upwind out-of-region sources to atmospheric mercury deposition in the States, relying on modeling by NESCAUM[3].

Comment:

- In Section 6.2, considering adding a graph similar to Figure 6-1 that incorporates data from Table 1 of the Mercury Matters report[9].

Response:

A graph showing the contributions of different sources to national mercury emissions will be added to the revised TMDL.

6.3 Point Sources to Water

Comments:

- Pollutant Sources – Point Sources: We recommend that the TMDL identify the specific NPDES-permitted point sources covered by the TMDL, including NPDES-permitted stormwater sources. The TMDL generally mentions categories of sources: POTWs, pulp and paper mills, lighting manufacturing, chemical and metal industries as the sources within the region and provides a list of categories of mercury sources in the New England Region. In particular, the regional approach would be better supported by showing the geographic distribution of sources within the region, and whether there are any state or local differences in sources that should be given special consideration or treated separately from other areas of the region. For example, Table 6-3 shows much higher mean and median concentrations for facilities in Rhode Island than in other states. We recommend that the TMDL explain the higher loadings from these facilities, and if appropriate, take such higher loadings into account in calculating the total source load, or consider treating these facilities separately[8].

- We also note that using a median concentration in wastewater treatment plants doesn't seem to fully account for other types of sources that may have much higher mercury concentrations in their discharges. If available, we recommend using facility-specific data, or estimates for source categories other than wastewater treatment plants, to better characterize the total loadings from point sources[8].

- Baseline total source load: The TMDL establishes a 1998 total source load based on loadings from wastewater treatment facilities. It would strengthen the TMDL if it were further explained why 1998 is an appropriate baseline. We also suggest that the states consider other types of facilities (e.g., pulp and paper mills, chloralkali facilities, MS4s) that may have a different mercury concentration in their effluent from POTWs. If appropriate, the TMDL should indicate how loadings from sources other than wastewater treatment plants are accounted for in the baseline loading estimate[8].

- The average concentration of mercury in point sources has an enormous variance among states. An explanation of the sources of this variance would be helpful and would bolster the credibility of the analysis. An explanation of how non-detects were handled in the calculation of average concentration would also be helpful[7].

Response:

The median wastewater concentration used in the development of the point source load was based on data from both wastewater treatment facilities and various types of industrial dischargers. This may not be clearly discussed in the draft TMDL, so it will be better described in the revised TMDL. It has been determined that data from Rhode Island were collected using EPA Method 245.1 and many samples were actually below the detection limit, but reported as the detection limit. The detection limit for this method is much higher than the newer EPA Method 1631. The states decided that it was not appropriate to use data collected with the older method and therefore these data will be excluded and the point source load revised. Rhode Island has a small amount of data that was collected under the older method, but the facilities were able to achieve a method detection limit much lower than the typical limit for this method. These data will be included in the calculation of the point source load. It was also determined that Connecticut's data were collected using EPA Method 245.1, so these data will be excluded and the point source load revised.

7.5 Wasteload Allocation

Comments:

- MWRA agrees that "implementation of mercury minimization plans will help assure that discharges have no reasonable potential to cause or contribute to an exceedance of water quality standards[7]."

- MWRA believes that aerial deposition is the largest remaining source of its mercury loadings, both within its collection system, and in its receiving waters. MWRA is therefore strongly in favor of the goals of the proposed TMDL[7].

- We agree that an MMP is an appropriate mechanism for addressing point source mercury discharges, and we support use of that regulatory tool in the TMDL instead of source-specific allocations or numeric permit limits[12].

- We agree with the conclusions in the draft regional TMDL that classify in-state point source contributions to waterways as *de minimis*, and the necessity of controlling sources of atmospheric deposition of mercury to waterbodies of the States[3].

Comment:

- <u>Definition of de minimis</u>: The TMDL establishes the WLA at 1.2% and indicates this is "de minimis." Using "de minimis" in this context may imply incorrectly that the point sources are not subject to any reductions. Thus, we recommend that the term "de minimis" not be used to describe the WLA. Alternatively, the TMDL should explain that the term does not imply that point sources are not subject to reductions under the wasteload allocation. It would also be helpful if the TMDL further explained why 1.2% was selected as the WLA, especially as this is higher than the WLA in other approved mercury TMDLs[8].

Response:

Upon re-evaluation of the point source load and wasteload allocation, a units error was discovered, resulting in the point source load increasing from 1.2 percent to 2.1 percent of the total load. However, the states still feel that 2.1 percent is insignificant, and therefore can be considered de minimis. As such, we feel that if the point source load is to remain de minimis in the final TMDL, it is appropriate to keep it as the same percentage of the TMDL as the percentage of the baseline loadings.

Comment:

- <u>Implementation of WLA in permits</u>: The TMDL indicates that the WLA will not be allocated among sources, but rather through mercury minimization plans and region-wide mercury reduction efforts. We recommend that the TMDL clarify how individual permits will be written on the basis of a single regional WLA, and how will the allocations be made among the states? We also recommend that the TMDL further describe how will it be determined that the WLA will not be exceeded, and how it will be determined that there will not be localized exceedance of the water quality standards (e.g., the TMDL could indicate that reasonable potential determinations would be made at the time of permit issuance)[8]

Response:

This TMDL places much emphasis on the fact that the States have agreed to a goal of virtual elimination of mercury. As is stated in Section 2.5 of the TMDL, as of 2006, all of the Northeast states have passed legislation to address mercury in products and require installation of dental amalgam separators. Individual laws and requirements vary by state, but legislation addresses bans on disposal of mercury-added products, bans on sale or distribution of mercury-added novelties and *measuring devices, requirements for labeling of mercury-added products, prohibition of primary and secondary schools purchasing or using mercury, removal of mercury switches from automobiles, and requirements on recycling of mercury-added products. Connecticut, Massachusetts, Maine, New Hampshire, and New York have all passed legislation to reduce mercury emissions limits from coal-fired utilities. The end result of all these mercury minimization efforts is that a smaller quantity of mercury makes its way into the waste stream and less mercury is discharged from wastewater treatment facilities. These efforts undoubtedly increase the likelihood of successfully implementing the wasteload allocation. Because these reduction efforts are on-going the states feel there is little else that could be done through the NPDES program that could further ensure that the WLA will not be exceeded. Evaluation of progress at the Phase II milestone will determine if mercury minimization plans and additional monitoring at point sources should be prescribed for dischargers that do not already have those programs in place.*

Comment:

- Stormwater: Because NPDES-regulated stormwater discharges are point sources that must be included in the WLA, the TMDL should indicate that any NPDES-regulated stormwater sources are subject to the wasteload allocation, regardless of whether the mercury in stormwater originally came from atmospheric deposition. In addition, if the WLA is determined by using the same percentage as the percentage of point source discharges in the TSL, this approach could result in inaccurate computations of the WLA. Thus, we recommend that mercury loadings from NPDES-regulated stormwater discharges be included in the estimates of point source mercury loadings in the point source portion of the TSL, and that these sources be added to the point source list[8].

Response:

The Northeast Regional TMDL for Mercury has been calculated and prepared based on the understanding of the states that the primary source of mercury to the waters covered by this TMDL is atmospheric deposition. Although the contribution of stormwater to mercury loading is unknown, the vast majority of mercury from stormwater that contributes to the impairment of these waters originates from air sources and should be controlled accordingly. Regulated stormwater is considered to be part of the de minimis WLA, but will be addressed through the controls on atmospheric deposition sources that are required to meet the load allocation. The states anticipate that once atmospheric deposition reductions are met, the only remaining regulated stormwater contributions would be solely attributed to natural sources and run-off from localized non-atmospheric sources. This residual stormwater contribution is considered to be a minute part of the WLA.

The states are already engaged in controlling stormwater pollution using best management practices (BMPs) in accordance with Clean Water Act §402(p) and 40 CFR 122.44(k) and any residual mercury in stormwater that originates from non-atmospheric sources can be addressed by these programs. The six minimum measures associated with permits for municipal separate storm sewer systems (MS4s) will contribute toward reducing mercury loading by reducing stormwater volume and sediment loading.

Comment:

- Future Growth: The TMDL does not identify an allocation for future growth. The TMDL should clarify whether all new or increased discharges would need to stay below the regional WLA[8].

Response:

All new or increased discharges will be required to stay below the regional WLA. This statement will be added to the revised TMDL.

7.6 Load Allocation

Comment:

- We recommend that the TMDL describe whether there are any geographic differences in sources or other factors that may affect fish mercury levels. In particular, the TMDL should provide a rationale for using a single estimate of deposition for the entire region, and whether there are any geographic differences in deposition within the region, e.g., near urban areas or specific sources. If appropriate, the TMDL should identify any areas of high local deposition that should be treated separately from the rest of the region, in addition to the area in Massachusetts[8].

Response:

Because the entire region is impacted by local, regional, and global mercury deposition sources, the Northeast states and NEIWPCC feel that it is appropriate to keep the TMDL at the scale of the entire region. Any regional differences in deposition are the result of local deposition sources that have already been addressed or are in the process of being addressed. Therefore, the entire region is in the same position of being primarily impacted by out-of-region sources and therefore feels it is appropriate to do the TMDL on a regional basis.

Kamman, et al. (2005) provides that although there are differences in fish tissue concentrations across states, differences in fish tissue concentrations are more strongly influenced by individual fish length than they are by jurisdiction. In the case of smallmouth bass, once the effect of length is accounted for, there is very little variation in fish concentrations among the states. This relationship can be seen in a graph that has been added to the revised TMDL.

7.7 Margin of Safety

Comments:

- In general, we recommend that the margin of safety be more fully justified. The TMDL uses an implicit MOS based on two conservative assumptions: use of the fish species with the highest mercury concentrations; and use of a midpoint (25%) estimate for contributions from natural sources (estimated to range from 15-35%). The description of how sediment cores from rural sites makes the natural source estimate conservative should be further explained. For example, use of the midpoint would be conservative for the lower end of the range, but not be conservative if the true contribution were at the higher end. In addition, use of a top fish species with higher mercury levels would typically be more conservative than using data from a lower trophic level fish such as smallmouth bass[8].

- We also suggest you look into whether there are other conservative assumptions in the TMDL that may provide an MOS. For example, if the TMDL does not account for reductions in the transformation of mercury to methylmercury due to reduced sulfur deposition, this may contribute to the MOS[8].

Response:

Smallmouth bass is not a lower trophic level fish – it is a high trophic level predator, and therefore an appropriate target fish. Additional information will be added to the margin of safety in the revised TMDL. The states agree that reduced sulfur deposition (which is occurring through federal and state actions) will lead to reduced mercury methylation. This reduction in methylation could potentially allow for the necessary reductions in mercury load to be less than proposed in the TMDL, meaning that the proposed loads allow for additional protection.

The states feel that it is more likely that the contribution from natural sources of mercury has been overestimated and therefore is more likely to be less than 25 percent instead of greater. The sediment cores were taken from rural locations where contributions from natural sources may be greater than the region as a whole, which has many urbanized areas.

An additional piece to add to the margin of safety is that EPA's fish tissue criterion is for methylmercury and the states are actually measuring total mercury in fish. It is estimated that about 90 percent of total mercury in fish is methylmercury. As states monitor for meeting TMDL goals, when fish have met the target of 0.3, 0.2, or 0.1 ppm total mercury, the methylmercury concentration will actually be lower, and therefore more protective.

7.8 Seasonal Variation and Critical Conditions

Comment:

- Although the TMDL mentions water chemistry and water level fluctuations as affecting mercury accumulation over the long term, the TMDL should describe how the critical conditions are being addressed or accounted for in the TMDL[8].

Response:

Because some areas are more sensitive to mercury pollution due to factors such as water chemistry, presence of wetlands, and water level fluctuations, these areas may also be more sensitive to reductions in mercury emissions and deposition. Therefore, these areas may actually respond more quickly to decreases in mercury deposition. However, the exact response of these areas is not known. Therefore, these areas are targeted to be more closely monitored during the TMDL implementation period. If monitoring results indicate that more specific reduction strategies are necessary for these areas, they will be implemented at that time. The adaptive implementation approach will allow for changes in the approach to addressing sensitive areas if necessary.

7.9 Daily Load

Comments:

- We believe that daily loading levels of mercury are essentially irrelevant to the goal of the TMDL, which should be to prevent mercury from building up in fish tissue over long periods of time. In addressing a mercury impairment based on protecting the fish consumption designated use, a daily load is not "technically defensible." Therefore, such a loading calculation should not be included in the TMDL[12].

- The daily load should not be calculated by simply dividing the annual load by 365. A daily load equal to 1/365th of the annual load has no relevance whatsoever to a daily impact on fish bioaccumulation of mercury. A more technically reasonable way to develop a meaningful daily load, as EPA has recommended in its recently-developed draft "daily load" guidance, is to apply recognized statistical techniques to the annual load numbers[12].

- The TMDL should state clearly that the daily load calculation has been done only to implement the recommendation in EPA's recent guidance, and is not intended to be implemented in permits[12].

- A daily wasteload allocation for mercury is inappropriate; even if it were appropriate, the proposed allocation is technically infirm[11].

Response:

In a memorandum issued on November 15, 2006 by Ben Grumbles, Assistant Administrator, Water, US EPA, provided guidance related to a court decision in the U.S. Court of Appeals, for the D.C. Circuit in the Friends of the Earth, Inc. v. EPA, et al., (D.C. Cir. 2006). The purpose of that memorandum was to relay EPA's recommendation that all future TMDLs and associated load allocations and wasteload allocations be expressed in terms of daily time increments. The memorandum goes on to explain that TMDL submissions can also include alternate non-daily expressions for the purposes of implementation of applicable water quality standards. The Northeast Regional TMDL does provide an alternate non-daily expression for the mercury load, as well as the daily load in order to comply with the EPA recommendation. The approach used in the Northeast Regional Mercury TMDL is consistent with the approach used in the Statewide Minnesota Mercury TMDL that was approved by EPA in March, 2007.

9 Implementation

Comments:

- It may be useful to at least mention that mercury levels in fish may have effects on aquatic biota as well as fish-eating wildlife such as loons, eagles, otters, and minks. At the Phase III review stage, the states may want to discuss whether or not whole fish mercury levels are sufficient to also protect fish and wildlife[9].

- Mercury reductions should aim to address the threat not only to human health but also to the health of natural ecosystems and to wildlife, especially the State's Species of Greatest Conservation Need. We also recommend that, as the TMDL is implemented, the states support research to determine whether the steps taken to reduce mercury in fish tissue to consistently safe levels also reduce mercury levels sufficiently to achieve ecosystem health and recovery, including among the most vulnerable species and ecosystems, and adjust the plan accordingly to achieve both goals[10].

Response:

Text will be added to the TMDL to briefly describe the concerns associated with mercury and wildlife. While the states agree that protection of wildlife is also important, the main goal of the TMDL is to protect human health. As resources are limited, the states cannot commit at this time to monitoring of mercury levels in wildlife, but some fish monitoring that is carried out for the purposes of fish consumption advisories can be used to assess the risk to wildlife.

Comments:

- Is there enough being done to make everyone aware of methods to safely dispose of compact fluorescent bulbs? What if it ends up in garbage, like most things we use does, and gets into our drinking water supply? Are manufacturers putting safeguards in place to "take back" used bulbs and dispose of them properly? Is legislation being enacted in New York State and surrounding states to this effect? Are stores asked to run such take-back programs? I would like your good offices to spearhead this effort. As a state government body that has the interest of safe drinking water for its citizens in mind, your office is best positioned to carry out this effort, in collaboration with other state governmental agencies[4].

- NYIPL recommends that NYSDEC come up with a recycling process for CFLs that works. We recommend that NYS provide the funding necessary for the towns within the state to recycle these mercury wastes as part of their normal recycling programs[13].

Response:

Effective public education and recycling programs for compact fluorescent lights are issues that all of the states are working on addressing at this time. The states acknowledge that more work needs to be done in this area and will continue to address this issue.

Comments:

- Angler survey data from New Hampshire indicate that smallmouth (and largemouth) bass have a high catch-and-release rate and are likely not the most-consumed freshwater fish. It is likely that perch (yellow and white) and trout are consumed at higher rates than bass. We believe that perch populations should continue to be sampled for mercury in addition to the smallmouth bass[6].

- The TMDL should not rely solely on mercury concentration in smallmouth bass as indicators of water quality. While seemingly ubiquitous, smallmouth bass are invasive species in many traditional coldwater fisheries. While brook trout do not bioaccumulate mercury at the same rate as smallmouth bass, length-standardized mercury concentrations corresponding to concentrations in smallmouth bass should also be calculated for brook trout to allow for monitoring in waterways where smallmouth bass are not present[5].

Response:

While smallmouth bass is the target species for the TMDL, it is not the only species that states will be monitoring. States will continue monitoring other species of fish, such as perch and trout, as they have done in the past. Smallmouth bass will be used as indicator for judging if TMDL goals are being met, but other species of fish will be monitored as part of normal monitoring program, provided that funding is available. Moreover, the calculation method and baseline results for length-adjusted brook trout and yellow perch are given in Kamman, et al. (2005).

Comments:

- The number of impaired waterbodies varies dramatically among states because of different listing policies. Does this affect how the TMDL would be implemented in different states[7]?

- Does the list of waterbodies in Appendix A impaired primarily by atmospheric deposition of mercury mean that the TMDL will in any way be implemented toward restoring those listed waterbodies vs. all water bodies[9]?

Response:

The Northeast Regional Mercury TMDL covers all of the waterbodies that are listed in Appendix A, which for some states includes all of their freshwaters. However, all waterbodies in the Northeast, whether they are listed or not, will benefit from the mercury reductions. Implementation of the TMDL will result in mercury reductions across the Northeast and not target specific locations within the region.

Comment:

- We support the "staged implementation" approach as proposed, provided the proposed loading reductions for upwind out-of-region sources are applied as described further below[3].

Comment:

- Given the difficulty of meeting these goals through the actions of the Northeast states, we encourage NEIWPCC to coordinate with other regions to undertake similarly stringent goals for the reduction of mercury through the TMDL process. In addition, the states and NEIWPCC should encourage action at the federal level to ensure that there is a uniform approach to mercury reductions to protect public and environmental health[10].

Response:

The New England States and New York were able to come together on this TMDL because the seven states are similarly impacted by mercury pollution. Further the states have shared data sets as they relate to fish tissue and atmospheric deposition and to extrapolate this information to other regions of the country would jeopardize the integrity of the data. However, should this approach prove to be successful, the states encourage other states and regions to use this TMDL as a model.

As the comment relates to encouraging action on the federal level, the Northeast states have argued in the Opening Brief of Government Petitioners dated January 11, 2006 in the matter of State of New Jersey, et al. vs. United States Environmental Protection Agency, the implementation of a strict plant-specific MACT for mercury under section 112(d) of the CAA would result in at least 90 percent control of mercury emissions by cost-effective and available technologies. Further, enacting a MACT standard under section 112(d) would require compliance within three years of the effective date of the standard. This TMDL adds a second dimension to the legal arguments presented by the Northeast states in the lawsuit mentioned above by calculating for the first time the extent of reductions needed to meet water quality standards in the region's listed waters and remove fish consumption advisories and certainly illustrates the need for federal action.

Comment:

- The draft TMDL should take into consideration the adequacy of monitoring practices used by municipal waste combustors[5].

Response:

The mercury emissions inventory is based on use of emissions factors and/or emissions monitoring data for each of the sectors for which emissions are reported. Emissions factors are revised periodically, which results in revision to the emissions inventory. The inventory values for MSWC are based on considerable stack test data and are viewed as being good quality. Emissions monitoring data is collected on an ongoing basis and results will be updated as appropriate.

Comment:

- The Clean Water Act does not confer additional authority on EPA or states to regulate air emissions sources[11].

Response:

The intent of the Northeast Regional Mercury TMDL is consistent with the requirements of the Clean Water Act in that it sets to establish a pollutant load for mercury – a level at which water quality impairments and fish consumption advisories could be eliminated. The calculations provided in the TMDL illustrate how much mercury, which is identified as coming primarily from atmospheric deposition, must be reduced in order for water quality goals to be achieved. Achieving the loading goals set forth in the TMDL can only happen if more stringent controls on air emissions are put into place.

The Northeast Regional Mercury TMDL does not infer that additional statutory authority to regulate air emissions is provided by the Clean Water Act. However, that statutory authority already exists under the Clean Air Act and can be implemented through state and federal regulatory programs. The TMDL simply identifies loading goals and the existing tools states and EPA have to achieve them. 40 CFR 130.7(b)(1)(iii) specifically states that "Each State shall identify those water quality-limited segments still requiring TMDLs within its boundaries for which…Other pollution control *requirements (e.g. best management practices) required by local, State, or Federal authority are not stringent enough to implement any water quality standards (WQS)applicable to such waters."*

9.1 State and Regional Implementation

Comment:

- The states should commit to a more detailed step-wise adaptive implementation method[11].

Response:

The states feel that the Northeast Regional TMDL already includes a detailed adaptive implementation plan. However, there are more details available in state mercury reduction plans and status reports. Web addresses for these reports will be provided in the appendices of the revised TMDL.

Comments:

- Very supportive of Northeast states' decisions to not participate in interstate trading allowed under CAMR[9].

- The Mercury TMDL states that none of the Northeast states will participate in the interstate trading of mercury emission credits as allowed under CAMR. The Northeast Environmental Organizations fully support this commitment by the States[3].

Comment:

- Recommend that states and EPA commit to repeating the Connecticut River Fish Tissue Contaminant Study in 2010[9].

Response:

The states agree that it may be beneficial to repeat the Connecticut River Fish Tissue Contaminant Study in 2010, but due to limited resources, cannot commit to it at this time.

9.1.2 Adaptive Implementation of Load Allocation

Comment:

- If fish tissue concentrations decline to levels that meet the 0.3 ppm water quality standards before the recommended 86.6 to 98.2 percent reduction in anthropogenic loadings is achieved, the target readjustment should be deferred until after the fish tissue concentrations meet the stricter (0.1 ppm) water quality standards utilized by Connecticut[5].

Response:

The TMDL will continue to be implemented until Connecticut's 0.1 ppm standard is met. This will be more clearly articulated in the revised TMDL.

9.2 Adaptive National Implementation

Comment:

- EPA should include not selling U.S. stockpiles of mercury as part of the strategy to reach Phase II goals by 2010[9].

Response:

The Northeast states agree that not selling U.S. stockpiles of mercury is one strategy that should be used to work toward meeting out-of-region reduction goals. This may help to reduce mercury emissions from global sources.

Comments:

- We further concur with the draft TMDL that the current federal CAMR is insufficient to meet the requirements of the TMDL[1].

- We strongly support New York and the other states that are suing the EPA for not implementing a strict MACT standard for power plant mercury emissions[1].

- It is important that EPA approves the Northeast Regional Mercury TMDL which calls for at least 90 percent control on out-of-region coal-fired power plants in addition to in-region controls to achieve its goals of reducing mercury contamination in Northeast waterbodies[14].

- The Northeast Regional TMDL would help prevent serious human health impacts as well as benefiting wildlife and sensitive ecosystems such as the Adirondacks and Catskills. Mercury's health and environmental effects are too devastating to leave to market dynamics. Furthermore, cuts must be made deeper and quicker than those proposed in the federal CAMR. We feel this plan is a step in the right direction for clean water for the future of not only New York but the entire Northeast region[14].

- ADK supports the strategy set forth in the Northeast Regional TMDL demonstrating that New York and other Northeastern states have taken all possible actions to reduce mercury emissions and discharges, providing a basis for EPA to abandon its cap and trade approach to controlling mercury emissions and instead include a strict mercury emission standard in Clean Air Act Title V permits for Midwestern coal-fired power plants and other industrial facilities[14].

- CCE supports the plan's assertion that more stringent, comprehensive national and international mercury control programs are necessary to make fish safe to eat in our region. In order to make fish safer to eat in New York, the U.S. EPA should develop a more protective mercury pollution reduction program[2].

- The Northeast Environmental Organizations support and commend the States' efforts to work cooperatively to target the primary sources—out-of-region power plants—of the mercury threat to the Northeast region by calling for immediate implementation of existing economically and technically feasible reduction control technologies on these sources[3].

- Very supportive of Northeast states in matter of State of *New Jersey et al. vs. United States Environmental Protection Agency*. EPA should start enforcing higher stands at municipal waste incinerators, coal plants, and other point sources of mercury throughout the country, using a timeframe that will lead to more immediate results[9].

10 Reasonable Assurances

Comment:

- Enhanced pollution controls at municipal waste combustors are the best way to ensure TMDL goals are met[9].

Response:

The states are currently addressing further reductions of mercury emissions from municipal waste combustors through pollution prevention efforts, including legislation regarding management and disposal of mercury-containing products. At this time, the states feel that this is the most cost effective strategy for reducing emissions from this sector. However, based on developments in technology, the states will consider further pollution controls on municipal waste combustors as appropriate.

Comment:

- Mercury emissions from residential heating increased between 1998 and 2002. What is this category increasing and what can be done about it? The Northeast states should address this issue as a significant contributor to in-region emissions[9].

Response:

Within the Northeast Mercury Emissions inventory, estimates of emissions from residential heating are considered to be the most uncertain. The Northeast States for Coordinated Air Use Management is currently conducting a study to improve the confidence in the emissions factor used for this sector. The results of this study may show that mercury emissions from this sector were previously overestimated. The Northeast states will determine how to address emissions from this sector once this study is complete. In addition, NESCAUM is part of an initiative to look at the feasibility of using low-sulfur and/or low sulfur biodiesel blend home heating oil that would have co-benefits of reduced mercury.

Comment:

- The Mercury TMDL clearly establishes that the mandated reductions in mercury loading to the waters of the States cannot be met by in-state reductions alone. The Reasonable Assurances section must therefore: (i) state that CAMR will be insufficient to achieve the necessary reductions, (ii) require that significant reductions be made by upwind out-of-region sources, primarily coal-fired power plants, (iii) require that the MACT provisions of section 112(d) of the CAA be adopted as the mechanism for implementing these reductions, (iv) state that EPA is obligated under both section 112 of the CAA and the loading reduction requirements of the TMDL provisions in section 303(d) of the Clean Water Act to act to immediately to reduce the emission of mercury from these sources, and (v) specify that the timeframe for implementation shall be as set forth in section 9 of the Mercury TMDL[3].

Response:

The implementation section of the draft TMDL currently addresses the recommended language regarding CAMR and section 112(d) of the CAA. The states go on to recommend adaptive implementation of this TMDL and that a strict 90 percent MACT standard be enacted under section 112(d) to meet the national implementation requirements of the TMDL for Phase II (2003-2010). Upon consideration and review of the above comment, the States have modified the TMDL to include this discussion in Section 10: Reasonable Assurances. In addition, in order to better explain goals associated with both the load and waste load allocations, the TMDL has been modified to include clarifying language in those and other appropriate sections of the TMDL.

Authors of Comments Provided Above:

1. The Adirondack Council, 342 Hamilton Street, Albany, NY 12210

2. Citizens Campaign for the Environment, 735 Delaware Road, Box 140, Buffalo, NY 14223

3. Conservation Law Foundation on behalf of Clean Water Fund, National Wildlife Federation, Mercury Policy Project, Vermont PIRG, New York PIRG, Environmental Advocates of New York, Lake Champlain Waterkeeper, Hudson Riverkeeper, Casco Baykeeper, Saranac Waterkeeper, Upper St. Lawrence Riverkeeper, Soundkeeper, Inc., Environment New Hampshire
   27 North Main Street, Concord, New Hampshire 03301

4. Sridhar Venkatesan, 1 Anton Court, Stony Point, NY 10980

5. Joseph J. Heath, Attorney at Law on behalf of the Onondaga Nation, 716 East Washington Street, Suite 104, Syracuse, NY 13210

6. New Hampshire Fish and Game Department, 11 Hazen Drive, Concord, NH 03301

7. Massachusetts Water Resources Authority, Charlestown Navy Yard, 100 First Avenue, Building 39, Boston, MA 02129

8. U.S. Environmental Protection Agency, Office of Water

9. Connecticut River Watershed Council, 15 Bank Row, Greenfield, MA 01301

10. Nature Conservancy, 195 New Karner Rd, Suite 200, Albany, NY 12205

11. Hunton & Williams LLP on behalf of The Utility Water Act Group, Riverfront Plaza, East Tower, 951 East Byrd Street, Richmond, VA 23219

12. Barnes & Thornburg LLP on behalf of the Federal Water Quality Coalition, One North Wacker Drive, Suite 4400, Chicago, IL 60606

13. New York Interfaith Power & Light, 401 Parsons Drive, Syracuse, NY 13219

14. Adirondack Mountain Club, 301 Hamilton Street, Albany, NY 12210

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

December 20, 2007

Gina McCarthy, Commissioner
Connecticut Department of Environmental Protection
79 Elm Street
Hartford, CT 06106-5127

SUBJECT: **Notification of Approval of Northeast Mercury TMDL**

Dear Commissioner McCarthy:

Thank you for your submittal, together with the other northeast states, of the Northeast Regional Mercury Total Maximum Daily Load (TMDL). The TMDL addresses all freshwater segments in the State of Connecticut, except for 11 segments listed in the TMDL as excluded due to the presence of local sources. The statewide application of the TMDL is based on the inclusion on Connecticut's 2006 303(d) list of waters subject to the statewide fish advisory for mercury.

The U.S. Environmental Protection Agency (EPA) hereby approves the Northeast Mercury TMDL submitted with your cover letter dated October 24, 2007. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

We appreciate the work of your staff and the New England Interstate Water Pollution Control Commission (NEIWPCC) in preparing a comprehensive and informative TMDL report and incorporating public comment. We also appreciate that Connecticut and the other northeast states have been in the forefront of state efforts to develop mercury reduction programs. My staff and I look forward to continued cooperation with the CTDEP in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions regarding this approval, please contact Steve Silva at (617) 918-1561 or have your staff contact Eric Perkins at (617) 918-1602.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystem Protection

Enclosure

cc: Paul Stacey, CTDEP
Ron Poltak, NEIWPCC
Beth Card, NEIWPCC
Stephen Silva, EPA Region 1
John Goodin, EPA HQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

December 20, 2007

David Littell, Commissioner
Maine Department of Environmental Protection
17 State House Station
Augusta, ME 04333-0017

SUBJECT: **Notification of Approval of Northeast Mercury TMDL**

Dear Commissioner Littell:

Thank you for your submittal, together with the other northeast states, of the Northeast Regional Mercury Total Maximum Daily Load (TMDL). The TMDL addresses all freshwater segments in the State of Maine, based on the inclusion on Maine's 2006 303(d) list of waters subject to the statewide fish advisory for mercury.

The U.S. Environmental Protection Agency (EPA) hereby approves the Northeast Mercury TMDL submitted with your cover letter dated October 24, 2007. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

We appreciate the work of your staff and the New England Interstate Water Pollution Control Commission (NEIWPCC) in preparing a comprehensive and informative TMDL report and incorporating public comment. We also appreciate that Maine and the other northeast states have been in the forefront of state efforts to develop mercury reduction programs. My staff and I look forward to continued cooperation with the MEDEP in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions regarding this approval, please contact Steve Silva at (617) 918-1561 or have your staff contact Eric Perkins at (617) 918-1602.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystem Protection

Enclosure

cc: Andrew Fisk, MEDEP
Ron Poltak, NEIWPCC
Beth Card, NEIWPCC
Stephen Silva, EPA Region 1
John Goodin, EPA HQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

December 20, 2007

Laurie Burt, Commissioner
Massachusetts Department of Environmental Protection
1 Winter Street
Boston, MA 02108

SUBJECT: **Notification of Approval of Northeast Mercury TMDL**

Dear Commissioner Burt:

Thank you for your submittal, together with the other northeast states, of the Northeast Regional Mercury Total Maximum Daily Load (TMDL). The TMDL addresses 79 waters in the Commonwealth of Massachusetts that are listed as impaired for mercury on the Massachusetts 2006 303(d) list.

The U.S. Environmental Protection Agency (EPA) hereby approves the Northeast Mercury TMDL submitted with your cover letter dated October 24, 2007. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

We appreciate the work of your staff and the New England Interstate Water Pollution Control Commission (NEIWPCC) in preparing a comprehensive and informative TMDL report and incorporating public comment. We also appreciate that Massachusetts and the other northeast states have been in the forefront of state efforts to develop mercury reduction programs. My staff and I look forward to continued cooperation with the MassDEP in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions regarding this approval, please contact Steve Silva at (617) 918-1561 or have your staff contact Eric Perkins at (617) 918-1602.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystem Protection

Enclosure

cc: Glenn Haas, MassDEP
Dennis Dunn, MassDEP
Ron Poltak, NEIWPCC
✓Beth Card, NEIWPCC
Stephen Silva, EPA Region 1
John Goodin, EPA HQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

December 20, 2007

Thomas Burack, Commissioner
New Hampshire Department of Environmental Services
PO Box 95 – 29 Hazen Drive
Concord NH, 03302-0095

SUBJECT: **Notification of Approval of Northeast Mercury TMDL**

Dear Commissioner Burack:

Thank you for your submittal, together with the other northeast states, of the Northeast Regional Mercury Total Maximum Daily Load (TMDL). The TMDL addresses 5,124 water segments in the State of New Hampshire that are listed as impaired for mercury on the New Hampshire 2006 303(d) list.

The U.S. Environmental Protection Agency (EPA) hereby approves the Northeast Mercury TMDL submitted with your cover letter dated October 24, 2007. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

We appreciate the work of your staff and the New England Interstate Water Pollution Control Commission (NEIWPCC) in preparing a comprehensive and informative TMDL report and incorporating public comment. We also appreciate that New Hampshire and the other northeast states have been in the forefront of state efforts to develop mercury reduction programs. My staff and I look forward to continued cooperation with the NHDES in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions regarding this approval, please contact Steve Silva at (617) 918-1561 or have your staff contact Eric Perkins at (617) 918-1602.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystem Protection

Enclosure

cc: Harry Stewart, NHDES
Paul Currier, NHDES
Ron Poltak, NEIWPCC
Beth Card, NEIWPCC
Stephen Silva, EPA Region 1
John Goodin, EPA HQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

December 20, 2007

W. Michael Sullivan, Director
Rhode Island Department of Environmental Management
235 Promenade Street, Suite 425
Providence, RI 02908

SUBJECT: **Notification of Approval of Northeast Mercury TMDL**

Dear Director Sullivan:

Thank you for your submittal, together with the other northeast states, of the Northeast Regional Mercury Total Maximum Daily Load (TMDL). The TMDL addresses 19 waters in the State of Rhode Island that are listed as impaired for mercury on the Rhode Island 2006 303(d) list.

The U.S. Environmental Protection Agency (EPA) hereby approves the Northeast Mercury TMDL submitted with your cover letter dated October 24, 2007. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

We appreciate the work of your staff and the New England Interstate Water Pollution Control Commission (NEIWPCC) in preparing a comprehensive and informative TMDL report and incorporating public comment. We also appreciate that Rhode Island and the other northeast states have been in the forefront of state efforts to develop mercury reduction programs. My staff and I look forward to continued cooperation with the RIDEM in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions regarding this approval, please contact Steve Silva at (617) 918-1561 or have your staff contact Eric Perkins at (617) 918-1602.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystem Protection

Enclosure

cc: Alicia Good, RIDEM
Ron Poltak, NEIWPCC
Beth Card, NEIWPCC
Stephen Silva, EPA Region 1
John Goodin, EPA HQ

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
1 CONGRESS STREET, SUITE 1100
BOSTON, MASSACHUSETTS 02114-2023

December 20, 2007

Laura Pelosi, Commissioner
Vermont Department of Environmental Conservation
103 South Main Street
Waterbury, VT 05671-0401

SUBJECT: **Notification of Approval of Northeast Mercury TMDL**

Dear Commissioner Pelosi:

Thank you for your submittal, together with the other northeast states, of the Northeast Regional Mercury Total Maximum Daily Load (TMDL). The TMDL addresses 31 water segments in the State of Vermont that are listed as impaired for mercury on the Vermont 2006 303(d) list.

The U.S. Environmental Protection Agency (EPA) hereby approves the Northeast Mercury TMDL submitted with your cover letter dated October 24, 2007. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA), and of EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

We appreciate the work of your staff and the New England Interstate Water Pollution Control Commission (NEIWPCC) in preparing a comprehensive and informative TMDL report and incorporating public comment. We also appreciate that Vermont and the other northeast states have been in the forefront of state efforts to develop mercury reduction programs. My staff and I look forward to continued cooperation with the VTDEC in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

If you have any questions regarding this approval, please contact Steve Silva at (617) 918-1561 or have your staff contact Eric Perkins at (617) 918-1602.

Sincerely,

Stephen S. Perkins, Director
Office of Ecosystem Protection

Enclosure

cc: Pete Laflamme, VTDEC
Ron Poltak, NEIWPCC
✓Beth Card, NEIWPCC
Stephen Silva, EPA Region 1
John Goodin, EPA HQ

BC

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

DEC 2 1 2007

Ms. Sandra Allen, Director
Division of Water, 4th Floor
New York State Department of Environmental Conservation
625 Broadway
Albany, New York 12233-3500

Dear ~~Ms.~~ Sandi Allen:

Thank you for your submittal, together with the other northeast states, of the Northeast Regional Mercury Total Maximum Daily Load (TMDL). The TMDL addresses eighty-two (82) waters in New York State that are listed as impaired for mercury on New York's 2006 303(d) list.

The U.S. Environmental Protection Agency (EPA) hereby approves the Northeast Mercury TMDL submitted with your cover letter dated October 24, 2007. EPA has determined that this TMDL meets the requirements of §303(d) of the Clean Water Act (CWA) and EPA's implementing regulations (40 CFR Part 130). A copy of our approval documentation is enclosed.

We appreciate the work of your staff and the New England Interstate Water Pollution Control Commission (NEIWPCC) in preparing a comprehensive and informative TMDL report and incorporating public comment. We also appreciate that New York and the other northeast states have been in the forefront of state efforts to develop mercury reduction programs. My staff and I look forward to continued cooperation with New York in exercising our shared responsibility of implementing the requirements under Section 303(d) of the CWA.

Upon EPA's approval, this TMDL will be incorporated in the New York State Water Quality Management Plan.

Sincerely,

Walter E. Mugdan
Director
Division of Environmental Planning and Protection

Enclosure

cc: Richard E. Draper, Director, Bureau of Water Assessment and Management, New York State Department of Environmental Conservation (w/enclosure)
Bethany A. Card, Director of Water Quality Programs, New England Interstate Water Pollution Control Commission (w/enclosure)

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 paeleolimnological 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.

Critical Conditions

The TMDL report notes in sections 4.2 and 7.8 that there are some factors, such as water chemistry and water level fluctuations in combination with enhanced deposition of acid forming precursors and enhanced mercury deposition, that make conditions more favorable for mercury accumulation in fish. However, the report explains that these are not short-term critical conditions, but rather factors that contribute to greater accumulation of mercury in fish over long periods of time. Therefore, there are no critical times or hydrologic conditions of concern, but rather critical areas (referred to as sensitive areas in the TMDL report) where these factors have produced elevated fish tissue concentrations in comparison to background regional levels. Specific geographic areas that may be more sensitive are identified in the TMDL report. The degree to which these areas will respond to mercury reductions is unknown. Because these areas are more sensitive, it is possible that they may experience a more rapid decrease in fish tissue concentrations than surrounding areas. The TMDL report indicates that these areas will be closely monitored during the implementation period. Depending on whether or not these sensitive areas respond sufficiently to reductions in mercury loadings, the states will determine whether additional reductions are needed.

Table A-1 in Appendix A identifies waters (noted with an asterisk) that are excluded from this regional TMDL. Twenty of these waters are located in northeastern Massachusetts and have elevated fish tissue concentrations as a result of high levels of localized atmospheric deposition. Appendix A also lists a few waters in Connecticut and New Hampshire that are excluded from the TMDL due to the presence of local sources.

Assessment: EPA finds that the Mercury TMDL submitted by the states adequately identifies the loading capacity and accounts for critical conditions. The states' overall methodology of calculating the loading capacity by applying a reduction factor to the total source load is acceptable. The assumptions regarding use of a reduction factor are explained further in Section 1. The use of 1998 as the baseline for determining needed reductions is also reasonable given the clustering of fish tissue data around this year and given that the effects of the mercury reduction requirements initiated by the states after 1998 may not yet be fully realized.

The approaches for determining the total point source loads, total nonpoint source loads, and total source loads are acceptable. The use of median effluent concentrations and design flows is appropriate for determining the total point source load. EPA believes that it is reasonable to use the regional median and mean effluent concentrations to calculate loadings from the sources in NH and CT for which facility-specific data are not available, as the median can reasonably be expected to reflect the range of effluent concentrations in these states. Based on the consideration that the nonpoint source load is from atmospheric deposition, combining the contributions from anthropogenic and natural sources of deposition is appropriate for determining the total nonpoint source load. REMSAD and GEOSCHEM models are peer-reviewed models that are reasonable for use in estimating atmospheric deposition from anthropogenic sources, while use of published paleolimnological studies to estimate deposition from natural sources is also acceptable. [a]

The states' choice of smallmouth bass as the target species is reasonable based on its high mercury concentration and the presence of the species throughout the region. Use of a standard length fish is an appropriate approach for taking into account variations in mercury due to fish age and length, and the use of the 90th percentile standard length fish ensures that 96% of all fish will meet the target. EPA believes that using the 90th percentile smallmouth bass, or 96% of all fish, is adequately protective given the expected variability of fish tissue response to mercury reductions (i.e., some fish will likely show greater improvements than expected and others may show lesser improvements), the analytical uncertainties, and the fact that most fish data may not yet reflect the results of significant mercury reductions in the region.

EPA also concludes that the TMDL has considered critical conditions. A small number of waters in Massachusetts, Connecticut, and Southeastern New Hampshire that have high levels of fish tissue concentrations as a result of local sources have been excluded from the TMDL. EPA believes that it is appropriate to address such waters separately from the regional TMDL, as they may not achieve water quality standards based on the regional TMDL calculation. Other potentially sensitive areas included in the TMDL have been identified and will be monitored and evaluated. EPA believes that including these sensitive waters in the TMDL is appropriate, as these waters are expected to achieve water quality standards under this TMDL given their greater sensitivity to changes in mercury loadings. However, the states indicate that they may modify their approach to these waters depending on how these waters respond to mercury reductions.

4. Load Allocations (LAs)

Based on the 0.3 ppm target concentration for the 90th percentile standard length fish, the load allocation for the northeast region is 4.69 kg/day. For the Maine target of 0.2 ppm and the Connecticut target of 0.1 ppm, the load allocations are 3.13 kg/day, and 1.56 kg/day, respectively. The load allocations are gross allotments for all of the nonpoint sources collectively (predominantly atmospheric deposition) and apply on a region-wide basis.

To determine the load allocations, the states first determined the loading capacity for each target concentration by applying the appropriate reduction factor to the total source load. As described in Section 7.3 of the TMDL, the reduction factors are 0.74, 0.82, and 0.91 for the targets 0.3 ppm, 0.2 ppm, and 0.1 ppm respectively. The WLA was set at 2.1% of the loading capacity, as described further below. The LA was determined by subtracting the WLA of 2.1% from the loading capacity for each target concentration, based on the TMDL equation: Loading Capacity = WLA + LA + MOS. Because this TMDL uses an implicit MOS rather than an explicit MOS (as described in Section 7.7 below) the value for MOS in this equation is zero,

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[a] EPA notes that other approaches and models, such as the Community Multi-Scale CMAQ, are available for estimating atmospheric deposition. EPA guidance does not specify that a particular model or models should be used in TMDLs.

The final allocations being approved are the daily loads for the 90th percentile standard length smallmouth bass, as shown in Section 8 of the TMDL document. For the states with a target of 0.3 ppm, the LA is 4.69 kg/day.[b] For Maine the LA is 3.13 kg/day, and for Connecticut the LA is 1.56 kg/day.

Consistent with the definition of load allocation at 40 CFR 130.2(g), the TMDL document separates out the contributions from natural sources to the load allocation. Natural sources are estimated to contribute as much as 25% of the load allocations, and anthropogenic sources are assumed to contribute the remaining 75% of the load allocations. The TMDL document indicates that reduction efforts will focus on the anthropogenic portion of the load allocations.

Assessment: EPA finds that the load allocations are adequately specified at levels that, when combined with the wasteload allocations, establish TMDLs at the levels necessary to attain and maintain water quality standards. As described above, a TMDL is established to meet the target of 0.3 ppm in each state except for ME and CT, where TMDLs are established at levels necessary to meet 0.2 ppm and 0.1 ppm respectively. As defined at 40 CFR 130.2(d), the load allocation may be a gross allocation depending on the available data and approach for determining the loading. The predominant nonpoint source of mercury to the waters included in the TMDL is atmospheric deposition. Given that, and that the relative contribution from atmospheric sources is considered to be similar across the waterbodies included in the TMDL, a gross allocation is reasonable.

Section 7.6.2 of the TMDL document describes the in-region and out-of-region contributions to the anthropogenic deposition loads, identifies reductions from the in-region vs. out-of-region sources that could meet the load allocations, and suggests the level of reductions that should be achieved in each of three phases of implementation. The information on in-region vs. out-of-region contributions and phases of reductions, although reviewed by EPA, is not considered part of the approved load allocations. EPA considers the specifics regarding where or how necessary reductions will be achieved, while important information, to be part of implementation, and therefore these provisions are not being approved or disapproved in this decision.

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[b] The daily WLA and LA can be derived from equations in the TMDL as follows: For the group of states other than ME and CT, the loading capacity is [WLA (38 kg/yr) + LA (1,712 kg/yr)]/365 = 4.8 kg/day. For ME and CT, the loading capacities are, respectively: (25 kg/yr + 1,141 kg/yr)/365 = 3.2 kg/day; and (13 kg/yr + 571 kg/yr)/365 = 1.6 kg/day. Based on these equations, it follows that the LA for the group of states other than ME and CT is 4.8 kg/day – (38 kg/yr/365) = 4.69 kg/day, and the LAs for ME and CT are respectively: 3.2 kg/day – (25 kg/yr/365) = 3.13 kg/day; and 1.6 kg/day – (13 kg/yr/365) = 1.56 kg/day. Although EPA is approving the daily loads, the TMDL report also includes an annual expression of the WLA and LA. In addition, the TMDL report includes both a daily load and annual load expression for the 80th percentile and the 90th percentile standard length fish.

5. Wasteload Allocations (WLAs)

The wasteload allocations are described in Section 8 of the TMDL document, and work out to 0.104 kg/day for the states with a fish tissue target of 0.3 ppm, 0.07 kg/day for Maine (which has a fish tissue target of 0.2 ppm) and 0.04 kg/day for Connecticut (which has a fish tissue target of 0.1 ppm). The states did not assign wasteload allocations to individual point sources; rather, the states established a gross wasteload allocation for each of the three reduction targets. This aggregate approach was taken due to the specific circumstances of this TMDL, including that the total wasteload allocation represents a very small fraction (only 2.1%) of the total allocation to the northeast states, the overwhelming majority (97.9%) of the mercury load is from widespread atmospheric sources, and waters significantly impacted by point sources have been excluded from the TMDL (and will be addressed through other means).

The wasteload allocations were set at 2.1%, which is the percentage of the baseline total source load estimated to be from point sources. The TMDL document explains that this was done because substantial reductions have already been achieved at these point sources, and the remaining loads spread among the approximately 3000 facilities are extremely small. Given that almost all of the total source load is coming from nonpoint source atmospheric deposition, the states chose to focus reduction efforts on the nonpoint source portion of the source load and to ensure that point sources remain small. In addition, the TMDL document states that the ongoing implementation of mercury minimization plans together with other region-wide mercury reduction efforts will help ensure that these discharges will continue to decrease and will have no reasonable potential to cause or contribute to an exceedence of water quality standards. The TMDL document also states that each permit will be analyzed, as appropriate, to prevent any localized exceedences of the wasteload allocation, and that all new or increased discharges will be required to stay below the regional wasteload allocation.

The 2.1% WLAs also apply to mercury contributions from regulated stormwater. The regulated stormwater portion of the WLAs include both mercury from atmospheric sources and mercury from any local sources within the watershed. The TMDL document notes that implementation of the atmospheric portion will be accomplished using the same strategy and approach as is outlined for implementation of the load allocation. The local watershed sources (which are extremely small, when present), will be addressed through stormwater management practices and ongoing local source reduction efforts. Because the magnitude of the non-atmospheric component is so small, both the atmospheric and non-atmospheric components are combined into the aggregate WLAs.

The TMDL does not set aside an allocation for future growth. This is because the Northeast states have agreed to a goal of virtual elimination of mercury and have passed a variety of laws to phase out in-region mercury sources. Mercury amounts generated by the northeast states have steadily declined since 1998. To the extent that new or increased discharges might occur, the states have indicated that these discharges will be required to stay below the regional wasteload allocation, as indicated above. Accordingly, no reserve capacity is believed to be needed.

Assessment: In most circumstances, EPA would expect TMDLs to include individual wasteload allocations for each facility with an NPDES-permitted discharge per 40 C.F.R. § 130.2(h) and EPA guidance. However, the use of aggregate WLAs is acceptable in this case because the total discharge from these facilities makes up such a small percentage of the overall source load (2.1%), is spread among an unusually large number of sources (approximately 3000), and the TMDL document indicates that all regulated point source discharges will be analyzed to prevent any localized exceedences of water quality standards and to ensure that the aggregate WLAs are met. By including these statements, the TMDL document indicates how the aggregate WLA would be implemented at the individual point source level, consistent with 40 C.F.R. § 130.2(h).

Regulated stormwater (i.e., stormwater discharges subject to NPDES permit programs such as the Phase I and II stormwater programs and the construction permit program) is appropriately included in the WLAs. The small size of the WLAs is reasonable given that nearly all of the mercury in stormwater originates from atmospheric sources and will be addressed at its source via the implementation strategies developed for the load allocations, and that any stormwater mercury not from atmospheric sources (typically minute amounts) will be addressed through local source reduction efforts and stormwater management practices. It is also reasonable to combine the atmospheric and local mercury contributions to stormwater into aggregate WLAs, because of the insignificance of the local components.

Given that mercury levels in the northeast states have been declining over the last 10 years and are expected to continue to decline, it is reasonable that no allocations are set aside for future growth.

EPA concludes that the wasteload allocations are adequately specified in the TMDL at levels sufficient (when combined with the load allocation) to attain and maintain water quality standards, and that future growth is adequately addressed. EPA finds that the use of a gross WLA is acceptable in this circumstance because, 1) the point source discharges are a very small percentage of the total source load, 2) this small portion of the load is spread among an unusually large number of sources (approximately 3000), and the TMDL document includes statements indicating that all discharges will be managed consistent with the aggregate WLA.

6. Margin of Safety (MOS)

The TMDL Report identifies several conservative assumptions that provide an implicit MOS for the TMDL. These factors include:

- The assumption that 25% of atmospheric sources of mercury are natural. According to the TMDL Report, this load can be as low as 15%. The data is based on sediment cores taken from rural locations where the contributions from natural sources are likely to be higher. The Northeast Regional Mercury TMDL includes more urbanized areas and would therefore have a lower range of contribution from natural sources;
- The percent reduction for the TMDL does not account for additional reductions in methylmercury that may occur as a result of the implementation of ongoing state and

federal programs to reduce sulfur emissions. Reductions in sulfur deposition and sulfate-reducing bacterial activity will decrease the rate of mercury methylation.

Assessment: EPA concludes that the Northeast Regional Mercury TMDL includes an adequate MOS.

7. Seasonal Variation

Seasonal variation is discussed in Section 7.8 of the TMDL Report which notes that while "mercury deposition and concentrations in water may vary due to seasonal differences in wind patterns" this does not result in seasonal differences in concentrations in fish because mercury bioaccumulates in fish over their life spans.

Assessment: EPA concludes that the TMDL has accounted for seasonal variation. Although there may be seasonal variation in mercury methylation, this variation does not have a significant impact on fish tissue concentrations over the life span of a fish. The TMDL fish tissue target is based on the protection of human health. TMDLs developed using human health criteria are generally based on long-term exposures.

8. Monitoring Plan

The TMDL report discusses monitoring in several sections of the document, including Sections 4.1, 4.2 and 9 and the Response to Comments. The report indicates that existing state programs for the monitoring of mercury concentrations in fish tissue will continue as the TMDL is implemented, to monitor progress towards attainment of the TMDL targets. While smallmouth bass concentrations will be used as the primary indicator to judge whether TMDL goals are being met, mercury concentrations will continue to be measured in a wide variety of other fish species, including perch and trout, providing funding continues to be available. The TMDL report also notes that sensitive areas with elevated mercury concentrations will be monitored especially closely to determine whether they are responding adequately to implementation measures.

Assessment: EPA concludes that the TMDL report adequately describes plans for future monitoring to track effectiveness of the TMDL, although EPA is not approving these recommendations for monitoring through this decision.

9. Implementation Plans

Section 9 of the TMDL document includes a detailed implementation plan and a state-by-state compilation of mercury control programs. The TMDL uses an adaptive implementation approach which includes three phases. Phase I (1998-2003) and II (2003-2010) goals rely on the reductions from agreements made through the regional Mercury Action Plan (MAP) agreed to by the Conference of the New England Governors and Eastern Canadian Premiers (NEG-ECP). The MAP goals include: 50% reduction of regional mercury emissions by 2003; 75% reduction by 2010. The regional Mercury Task Force (MTF) includes representatives from the New England states and Eastern Canadian provinces and reports on the progress towards meeting the goals of the MAP. Phase III (beyond 2010) of the implementation plan does not include a specific goal but does include a re-evaluation of emission reductions, deposition and fish tissue concentrations in order to establish additional mercury reductions programs to achieve standards.

The TMDL document describes the legislation in each of the states requiring stringent reductions in mercury from coal-fired utilities (Table 9-1), and that the states have chosen not to participate in the cap-and-trade approach allowed under the Clean Air Mercury Rule (CAMR). The TMDL document also describes efforts in each of the states to reduce mercury in other air sources and products containing mercury, as well as regional efforts. The next phase of the MAP will be to focus on reductions from four other categories: sewage sludge incinerators (SSIs); municipal waste combustors (MWCs); area sources; and residential heating/commercial and industrial oil combustion. Through the NEG-ECP MTF process, the New England states have committed to the virtual elimination of mercury.

New York is not a member of NEG-ECP, but has been participating in the regional mercury study and in the development of the MAP. The State has established its own Mercury Task Force and participates in several regional efforts. Similar to the New England states, New York has enacted legislation to control use of mercury in products, require installation of amalgam separators and has set emissions limits for MWCs.

Although point sources are considered insignificant, further reductions in wastewater concentrations are anticipated based on legislation in all states which requires the installation of amalgam separators, household products legislation, and several other pollutant minimization efforts that vary by state.

The TMDL document indicates that the Northeast states are already addressing all mercury sources within their control and that greater reductions are needed from out-of-region sources. The adaptive implementation approach will monitor the implementation of regional and national controls and the response in fish tissue concentrations and if needed, the reduction goals will be modified.

Assessment: While, the TMDL document includes a detailed discussion of implementation activities and outlines the mercury reduction efforts in each state, EPA is taking no action on the implementation plan. The TMDL includes statements summarizing the states' position regarding the adequacy of CAMR and the recommendation for a Maximum Achievable Control Technology (MACT) standard. As conveyed in our comments on the draft TMDL, EPA considers these statements to be part of implementation rather than part of the TMDL calculation and therefore is not commenting or taking action on them. EPA notes, however, that the Agency does not believe anything in the TMDL document provides new or additional authority to regulate the sources of atmospheric deposition.

10. Reasonable Assurances

Section 10 of the TMDL document provides discussion of reasonable assurances based on activities at the state, regional, national, and international levels. In considering reasonable assurance, EPA took into account both the discussion in Section 10, as well as the discussion in Sections 7 and 9 of the TMDL document regarding activities to achieve the wasteload allocation.

The New England states have demonstrated a commitment to the reduction of mercury through regional and state-specific efforts. Under the New England Governors-Eastern Canadian Premiers Mercury Task Force (NEG-ECP), the New England states have adopted a regional Mercury Action Plan with a goal of virtual elimination. Although not a member of the NEG-ECP, New York State also has programs demonstrating a commitment to mercury reduction. The states have adopted strict emission limits on MWCs and municipal waste incinerators, resulting in respective reductions in emissions of 87% and 96.6% for these two sectors. Emission reductions have been achieved in other sectors as well, as shown in Table 10-1. To date, there has been a 70% reduction in regional mercury emissions between 1998 and 2002, and a 74% reduction in deposition. The five states with coal-fired utilities have adopted legislation requiring reductions in emissions from coal-fired utilities, and additional efforts are planned to reduce emissions from other sectors. Given the existing requirements and the states' progress in significantly reducing mercury emissions, EPA believes that the states will continue to implement mercury reduction programs at the state and regional levels. Such programs will in turn enable progress toward achieving the load allocation.

As described in Sections 2.5 and 7.5 of the TMDL document, point sources are considered to be insignificant. Point sources contribute 2.1% of the total source load, and therefore the WLA is set at 2.1% of the TMDL. As each of the states has requirements to install dental amalgam separators as well as mercury products legislation, the point sources are expected to decline even further. State-specific programs include efforts to address use, recycling, and disposal of mercury-containing products. Mercury minimization plans will also be implemented to reduce mercury discharges. The states will conduct analyses on a permit by permit basis to prevent exceedances of the WLA on a site-specific basis. EPA believes that the states' efforts to reduce mercury entering the waste stream, together with analyses at the permit stage as appropriate, will ensure that the WLA is not exceeded.

The states point out that reductions needed to achieve the TMDL must come not only from sources within the northeast region but also from sources outside the region. The states identify national and international programs focused on reducing mercury. Such efforts will also contribute toward achieving the load allocation. National programs include the Clean Air Mercury Rule (CAMR) and the National Vehicle Switch Recovery Program, while international efforts include programs under the Commission on Environmental Cooperation and United Nations Environment Program. As described in Section 9, the TMDL document includes statements summarizing the states' position regarding the adequacy of CAMR and the recommendation for a Maximum Achievable Control Technology (MACT) standard.

Assessment: EPA believes that the TMDL adequately quantifies the water quality problem due to mercury in the waters covered by the TMDL and identifies the load reductions needed in order for those waters to achieve water quality standards. The TMDL describes comprehensive ongoing and planned state, national and international activities designed to achieve substantial reductions from sources described in the load allocation. In addition, and most importantly, existing point source contributions are an insignificant part of the total source load. In light of these factors, EPA concludes that the TMDL's wasteload allocation is reasonable. As noted above and in the previous section, EPA views the statements regarding the adequacy of CAMR and the recommendation for a MACT standard to be part of implementation and therefore is not commenting or taking action on these statements.

11. Public Participation

Section 11 of the TMDL document describes the public participation process. Each of the seven states conducted public participation in accordance with its own procedures. The New England Interstate Water Pollution Control Commission (NEIWPCC) and each of the states posted the TMDL on their websites. Six of the seven states published notice of the TMDL in local newspapers, and a total of eight public meetings were conducted during April and May 2007. Several states also issued press releases, and a few notified groups likely to have an interest in the TMDL. Specific activities conducted by each state are summarized in Table 11-1.

The draft TMDL was released for public comment April 11, 2007 for a 59-day comment period. Comments on the draft TMDL were provided to NEIWPCC and the states from 14 different groups. Where appropriate, the TMDL document was revised in response to public comments. The responses to comments are included in Appendix E of the TMDL.

Assessment: In reviewing the TMDL document, EPA reviewed the public comments and the states' responses. EPA finds that the states' public participation actions satisfy the requirement in 40 CFR 130.7(c)(1)(ii) that TMDLs be subject to public review in accordance with state procedures. In addition, EPA concludes that the states adequately responded to public comments.

12. Submittal Letter

Assessment: A letter to EPA dated October 24, 2007 and signed by the Commissioners of the environmental departments of CT, MA, ME, NH, NY and RI, and the Secretary of the Vermont Agency of Natural Resources, indicates that the TMDL document is being submitted under Section 303(d) of the Clean Water Act for review and approval.

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Sources of Mercury Deposition in the Northeast United States

Prepared by
NESCAUM

March 2008

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SOURCES OF MERCURY DEPOSITION IN THE NORTHEAST UNITED STATES

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Executive Summary

In December 2007, the U.S. EPA approved a regional total maximum daily load (TMDL) for mercury that was submitted by NEIWPCC and its member states. For the NEIWPCC states to meet this regional TMDL, atmospheric mercury deposition in the region must be reduced by at least 98 percent relative to 1998 levels.

In order to help achieve the regional mercury TMDL, there is a need to identify and summarize available information on the sources of anthropogenic mercury being deposited in the NEIWPCC states and the NEIWPCC region. In this report, NESCAUM draws upon modeling studies using the Regional Modeling System for Aerosols and Deposition (REMSAD) to help identify sources and source regions in the U.S. contributing to atmospheric mercury deposition in the Northeast.

With respect to mercury deposition attributable to emissions from continental U.S. sources, the REMSAD modeling information indicates that nearly half of the mercury deposited across the NEIWPCC region comes from sources within the seven NEIWPCC states. Another forty percent of the deposition in the region attributable to U.S. sources derives from sources in states immediately upwind, including Pennsylvania, New Jersey, Ohio, West Virginia and Maryland. Contributions from other states and individual sources are also important, as tabulated in this report.

1. INTRODUCTION

On October 24, 2007, the six New England states along with New York submitted a request to the United States Environmental Protection Agency (U.S. EPA) to establish a regional total maximum daily load (TMDL) for mercury under the Clean Water Act (NEIWPCC, 2007). The U.S. EPA approved the TMDL request on December 20, 2007 (US EPA, 2007).

In developing their TMDL request, the states considered sources of mercury to regional waters that included atmospheric deposition, municipal wastewater treatment plants, non-municipal wastewater discharges, and stormwater. Among these sources, the states identified 97.9 percent of the total mercury load as coming from atmospheric deposition. The states also determined that achieving target fish mercury concentrations ranging from 0.1 to 0.3 ppm will require an at least 98 percent reduction in atmospheric mercury deposition arising from anthropogenic sources relative to 1998 levels.

In order to help achieve the states' TMDL goals, there is a need to identify and summarize available information on the sources of anthropogenic mercury being deposited in the NEIWPCC states and the NEIWPCC region. In this report, NESCAUM draws upon modeling studies using the Regional Modeling System for Aerosols and Deposition (REMSAD) to help identify sources and source regions in the U.S. contributing to atmospheric mercury deposition in the Northeast. The REMSAD information comes from a report prepared by ICF International for the U.S. EPA Office of Water (ICF, 2006) as well as REMSAD studies previously performed by NESCAUM.

With respect to mercury deposition attributable to emissions from continental U.S. sources, the REMSAD modeling information indicates that nearly half of the mercury deposited across the NEIWPCC region comes from sources within the seven NEIWPCC states. Only New York State receives less than half of its mercury deposition from within the region. Another forty percent of the deposition in the region attributable to U.S. sources derives from sources in states immediately upwind, including Pennsylvania, New Jersey, Ohio, West Virginia and Maryland. Those same five states account for over half of the modeled deposition to New York State. Contributions from other states and individual sources are also important, as tabulated in this report.

2. MERCURY IN THE ENVIRONMENT

Mercury (elemental symbol Hg) exists naturally in the earth's crust at trace levels. This metal can enter the environment through natural (e.g., volcanic eruptions, diffusion from water and land) and man-made processes (e.g., combustion of mercury-containing fuels), after which it may cycle through land, air, and water while undergoing chemical and physical transformations. From the perspective of public health, the concern rests primarily with a toxic organic form, methylmercury, which bioaccumulates in fish, thus exposing people who eat the fish to mercury's toxic effects.

An early step to address mercury in the environment was taken in 1998 by the northeast states (through air, water, and waste interstate agencies), along with U.S. federal and Canadian partners, by documenting the state of knowledge of mercury in the environment (NESCAUM et al., 1998). The report covered a wide range of topics, including: background information on mercury; how it cycles in the environment; what were the primary emission sources in the Northeast in 1996 and in what quantity; and how local, regional and global sources affected the Northeast. Following this publication, the New England Governors and Eastern Canadian Premiers (NEG-ECP) released their Mercury Action Plan. This plan, and revisions thereof, outlined the region's goal for virtual elimination of regional mercury emissions, with interim emission reduction goals of 50 percent by 2003 and 75 percent by 2010 (Conference of New England Governors-Eastern Canadian Premiers, 1998; 2001). As a result of this and efforts in other Northeast states, the region has achieved significant reductions in mercury releases to the environment through a combination of pollution controls and waste management practices (NEIWPCC et al., 2007). These measures appear to have their intended effect. A recent study has found that a statistically significant decline in mercury wet deposition occurred in the Northeast between 1998 and 2005, based on wet deposition monitoring data from the Mercury Deposition Network (Butler et al., 2008). The authors of this study hypothesized that the downward trends are a result of changes in local and regional mercury emissions, rather than global.

Although this report focuses on anthropogenic emissions and their eventual deposition, this section provides a brief overview of the mercury cycle. The context here provides a basis for understanding the importance of tracking the human impact in the global cycling of this pollutant.

2.1. Mercury exposure and health effects

As a persistent, bioaccumulative, and neurotoxic pollutant, mercury is an important environmental concern in the northeastern United States. When released into the environment and deposited or carried into water bodies, mercury can be converted to methylmercury, a particularly toxic form of mercury. A number of factors influence the rate of methylation in the water, including the acidity of the surrounding water, dissolved sulfate, and dissolved organic carbon (DOC) levels (Wiener et al., 2006). Acidity and DOC appear to be particularly important parameters, with more acidified conditions and higher levels of DOC frequently associated with higher levels of methylmercury (Kamman, 1998). Methylated mercury in the aquatic food chain can bioaccumulate in fish tissue to concentrations markedly higher than in the surrounding water. Birds, such as common loons, and mammals, such as otters, that eat the fish will also have high levels of mercury in their bodies.

A major route of exposure to mercury in humans is also through the eating of fish. Women of child bearing age are of special concern as methylmercury ingested by a mother can transport across the placenta into the brain of a developing fetus. In young children and fetuses, methylmercury inhibits the normal development of the nervous system, an effect that may occur even at low exposure levels. This damage frequently is not apparent until later in the developmental process, when motor and verbal skills are found to be delayed or abnormal. Developmental effects have been found in children exposed *in utero*, even though their mothers did not experience any symptoms of adult toxicity.

Given recent measurements showing elevated mercury levels in freshwater fish in the Northeast, eight northeast states (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) have issued health advisories that recommended limiting the consumption of fish from state water bodies. This is the best immediate approach for limiting exposure to mercury that is already present in the environment. Over the longer term, because most mercury in the Northeast is believed to reach watersheds through atmospheric deposition, decreasing its introduction into the environment by limiting mercury emissions to the atmosphere should permit an eventual lifting of the fish consumption warnings.

2.2. Chemical properties

Mercury is present in several forms in the environment. In the gas phase, two forms dominate: elemental mercury (Hg^0) and its oxidized divalent form (Hg^{2+}). Divalent mercury often binds with other elements (sulfur, oxygen, halogens) as mercuric salts, and may exist in different phases (e.g., gas, particle, or aqueous). Atmospheric particulate mercury is a third species of mercury that is operationally defined as mercury collected in particulate measurement devices (e.g., filters) (Cohen et al., 2004).

Elemental mercury does not readily dissolve in water and has a relatively high volatility. As a result of these characteristics, it exists primarily in the gas phase as only small amounts will dissolve in atmospheric droplets or remain adsorbed onto the surfaces of aerosol particles. Therefore, elemental mercury is removed relatively slowly from the atmosphere, and has an atmospheric lifetime on the order of a year (Cohen et al., 2004, Seigneur et al., 2003; Poissant et al., 2005).

The divalent form of mercury (Hg^{2+}) in the gas phase is often termed reactive gaseous mercury (RGM). RGM is highly soluble, less volatile than Hg^0, and adheres readily to surfaces. The divalent form of mercury as well as other oxidized states can also exist in the atmosphere as particulate-bound mercury (Hg(p)). Particulate-bound mercury is relatively insoluble and less volatile than elemental mercury. Oxidized mercury in either of these two phases is prone to removal from the atmosphere by wet and dry deposition, and has a considerably shorter atmospheric lifetime (days to weeks) than the elemental form (Cohen et al., 2004).

2.3. Atmospheric processes

Each of the mercury forms described above has a different fate in the atmosphere. Although mercury cycles between its elemental (reduced) and oxidized forms, most of the mercury in the atmosphere (the "global pool") exists in the elemental state (generally >95 percent). This is a direct result of the limited solubility and high volatility of Hg^0, such that it remains in the atmosphere with a lifetime on the order of one year, free from deposition processes associated with aqueous or particle bound states.

With its relatively long lifetime, gaseous elemental mercury can be transported over very long distances, even globally. Thus, emissions in any continent can contribute to deposition in other continents (UNEP, 2002). As noted above, the global pool of mercury is almost entirely elemental mercury. By contrast, reactive gaseous mercury and particle-bound mercury are more readily deposited, thus they have shorter lifetimes of days to weeks and typically deposit within 50 to 500 miles of their source. These forms of mercury tend to have a more local and regional impact.

3. REMSAD

3.1. General description

The Regional Modeling System for Aerosols and Deposition (REMSAD) is a three-dimensional Eulerian grid model developed by Systems Applications International, Inc. The U.S. EPA and others have used the model to simulate the physical and chemical atmospheric processes relevant to atmospheric pollutants, including fine particles and air toxics. The model relies on the continuity equation, which represents the mass balance of each species by mathematically tracking emissions, advection, diffusion, chemical reactions, and removal processes.

Model users specify grid spacing and dimensions. Input requirements for the model include meteorological parameters, emission fields, and boundary conditions. Using these inputs, the model solves the continuity equation in a stepwise fashion. For each time step, fresh emissions are added, followed by horizontal and then vertical transport by advection, diffusion and deposition. Chemical reactions are performed, and then transport processes are again performed.

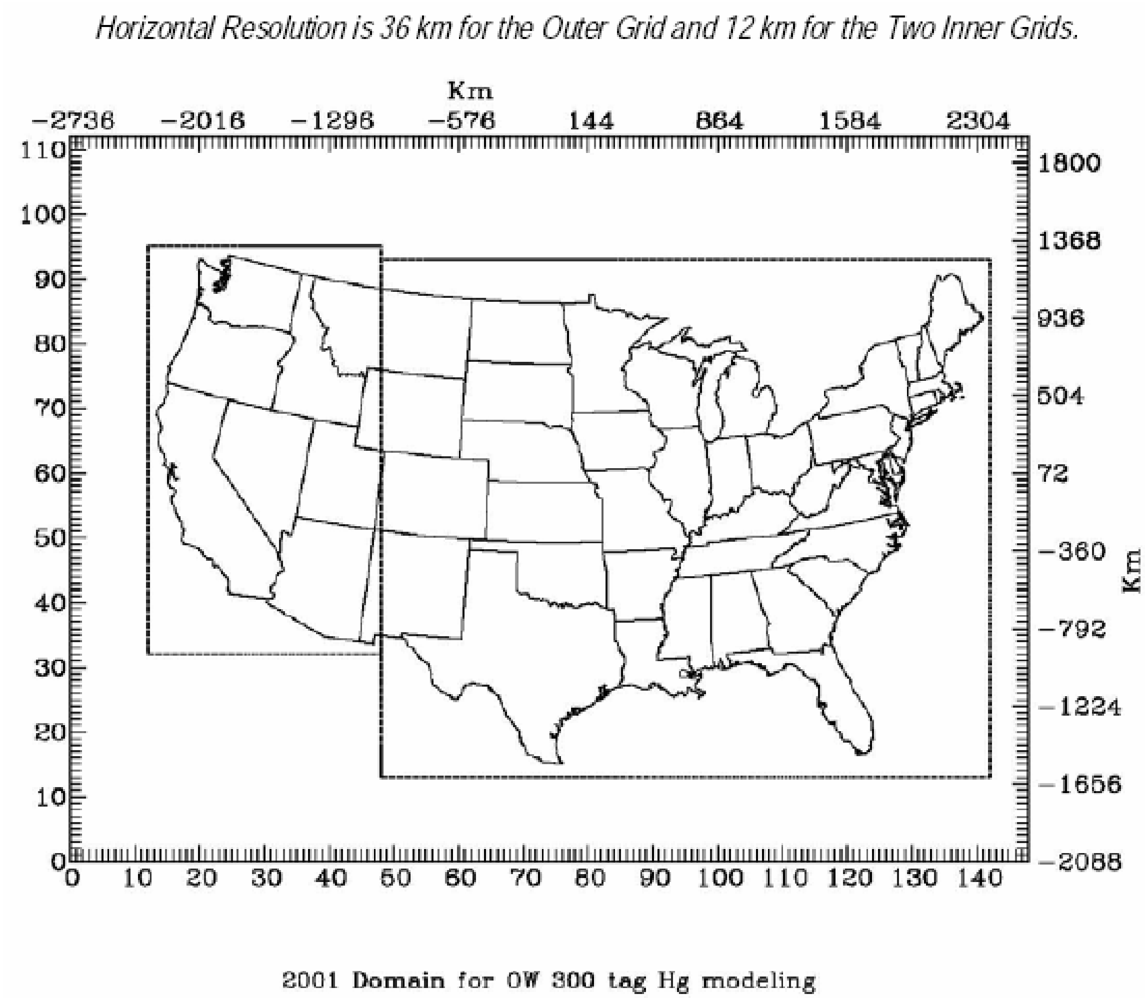
After the model has been run, gridded output is available for analysis. The output is user-specified and generally includes concentration fields for the surface layer and deposition results. Post-processing programs are used to reformat the output for comparison to monitored results in assessing model performance, often summarizing results by relevant time intervals, such as daily or annual average values.

In this report, we summarize previous REMSAD results that have used a "tagging" feature in the model. In these modeling applications, mercury emissions from specific sources or regions have been "tagged" by REMSAD so that it can track mercury species (i.e., gaseous elemental mercury, reactive gaseous mercury, and particulate mercury) in space and time from the point of emission to the point of deposition (or exit out of the modeling domain) without disturbing the physical or chemical processes affecting that species. The REMSAD tagging feature provides the ability to compare the tagged contributions to mercury deposition in specific downwind locations from a range of local and upwind individual sources, source categories, and regions. In this summary report, we draw mainly from the reported results by ICF International in a REMSAD study done for the U.S. EPA Office of Water (ICF, 2006), and compare the ICF tagged results with previous REMSAD work done by NESCAUM for the Massachusetts Department of Environmental Protection (NESCAUM, 2007).

3.2. ICF model description

ICF has previously described its modeling framework and inputs in its report to the U.S. EPA Office of Water (ICF, 2006). Here, we only briefly present the model details before presenting the tagged contribution results relative to the NEIWPCC region and individual NEIWPCC states. A more complete description is in the ICF report. Figure 3-1 displays the map of the model domain used in the ICF REMSAD (version 8) work. ICF used a 36-km outer grid modeling domain that covered the continental United States and adjacent portions of Canada and Mexico. Two higher resolution 12-km grids covered the entire continental United States, with one nested grid covering approximately the western quarter of the U.S. and the other nested grid covering the eastern three-quarters of the U.S. ICF modeled annual mercury deposition for the year 2001, with a total of 16 simulations performed for this deposition period.

Figure 3-1 Representation of continental 36-km gridded modeling domain with two nested 12-km inner grids



For mercury emissions used as inputs into the REMSAD simulations, ICF adapted a 2001 mercury emissions inventory for Canada and the U.S. developed by the U.S. EPA for the Clean Air Mercury Rule. ICF revised this inventory based on changes it received from U.S. EPA regional offices and states, which ICF documents in its report (ICF, 2006). For Mexico, ICF used a 1999 point source mercury inventory developed by the Commission for Environmental Cooperation (CEC, 2001). For criteria pollutants, ICF used an emissions inventory the U.S. EPA prepared for the Clean Air Interstate Rule.

ICF used a 2001 36-km scale resolution meteorological input from the NCAR/Penn State Mesoscale Model (MM5) prepared by the U.S. EPA for the Clean Air Interstate Rule and the Clean Air Mercury Rule. The REMSAD simulations used the carbon-bond V (five) photochemical mechanism (CB-V) (Gery et al., 1989) to represent chemical processing of mercury and other atmospheric pollutants. Additional parameters are included to account for re-emission to the atmosphere of previously deposited mercury, as well as other physical processes, such as dry and wet deposition.

3.3. ICF model performance

ICF performed a variety of graphical analyses and statistical measures of its REMSAD results, which are described in its report to the U.S. EPA (ICF, 2006). For mercury, ICF found the simulated spatial distribution of deposition to be consistent with the information on emissions, annual transport, and rainfall patterns. ICF found that wet deposition accounted for much of the deposition within the modeling domain, and compared the simulated wet deposition results to available monitoring data in 2001 from 53 sites in the Mercury Deposition Network (MDN), a network of the National Atmospheric Deposition Program (NADP, 2007). Overall, ICF noted that its modeled results tended to overestimate mercury wet deposition when compared to the MDN monitoring data. ICF noted that emerging research suggests that the MDN monitoring data may underestimate mercury wet deposition by 16 percent (Miller et al., 2005). ICF could not compare the simulated dry deposition results because an adequate dry deposition monitoring network does not exist.

4. MODELED CONTRIBUTIONS TO MERCURY DEPOSITION IN NEIWPCC STATES AND REGION

4.1. ICF REMSAD results

The U.S. EPA provided the ICF REMSAD results to NESCAUM with total (wet plus dry) annual deposition results for the Northeast covering the seven NEIWPCC states. Data tables in MS Access contained the deposition total and percent contribution from each tagged source. Using ArcGIS, NESCAUM assigned grid cells to states with an algorithm comparing the cell center location with state boundaries. Using these assignments, NESCAUM then calculated both overall total and tag-specific mercury deposition across each of the seven NEIWPCC states and the region as a whole. These calculations provide the basis for data tabulated in this report.

The tables display the ICF deposition results from continental U.S. sources to receptors in the NEIWPCC region in kilograms and their corresponding percent contributions. Deposition attributable to mercury sources outside the continental U.S. are not included in the tables, as well as contributions from sources in the U.S. whose emissions transport outside the country (and modeling domain) to become part of the "global" contribution that may later recirculate into the U.S. and deposit. In the ICF modeling results, the "global" mercury contribution is about 70 percent of total deposition in the NEIWPCC region as a whole, and varies by individual state (see Table 4–3).

As shown in Table 4-1a and b, nearly half of deposition within the NEIWPCC region attributable to U.S. sources comes from sources within the seven states. For most states (except Rhode Island and Vermont), internal sources represent the greatest contribution among U.S. sources to anthropogenic deposition within the state.

Table 4-1a Deposition from Anthropogenic Sources within the NEIWPCC Region (kg) (from U.S. sources only).

		Receiving Region							
		CT	MA	ME	NH	NY	RI	VT	NEIWPCC
Source Region	CT	48.8	9.7	3.0	2.8	10.1	4.8	1.7	**80.8**
	MA	12.1	80.1	10.9	11.1	15.2	3.8	11.9	**145.2**
	ME	0.1	0.6	34.7	1.3	0.3	0.1	0.3	**37.4**
	NH	0.5	3.3	6.6	22.8	1.5	0.2	4.9	**39.8**
	NY	17.4	10.0	8.3	5.9	212.3	1.6	13.5	**269.0**
	RI	1.4	17.1	1.6	0.8	1.0	3.8	0.4	**26.1**
	VT	<0.05	0.2	0.2	0.4	0.3	<0.05	2.2	**3.3**
	NEIWPCC	**80.5**	**120.8**	**65.1**	**45.1**	**240.7**	**14.3**	**35.0**	**601.6**

Table 4-1b Percent Anthropogenic Contribution to Deposition within the NEIWPCC Region (from U.S. sources only).

		Receiving Region							
		CT	*MA*	*ME*	*NH*	*NY*	*RI*	*VT*	*NEIWPCC*
Source Region	*CT*	42.0	6.2	2.6	4.0	1.4	25.1	2.4	**6.5**
	MA	10.5	51.1	9.6	16.1	2.2	19.7	17.3	**11.6**
	ME	0.1	0.4	30.3	1.8	<0.05	0.4	0.5	**3.0**
	NH	0.5	2.1	5.8	32.9	0.2	1.3	7.1	**3.2**
	NY	15.0	6.4	7.2	8.5	30.2	8.5	19.6	**21.6**
	RI	1.2	10.9	1.4	1.2	0.1	19.9	0.6	**2.1**
	VT	<0.05	0.1	0.2	0.6	<0.05	0.1	3.2	**0.3**
	NEIWPCC	**69.3**	**77.1**	**57.0**	**65.1**	**34.2**	**75.1**	**50.8**	**48.2**

Appendix A provides summary tables (Table 6–1) for each NEIWPCC state and the region that show the contribution to deposition from states in the continental U.S. relative to the total contribution attributable to continental U.S. sources. These results expand upon those in Table 4-1a and b. In addition to the contributions of NEIWPCC states to deposition in the Northeast, five other states rank in the top ten contributing states throughout the Northeast (Pennsylvania, New Jersey, Ohio, Maryland, and West Virginia). Virginia, Michigan, and Indiana also ranked in the top ten contributing states for some jurisdictions.

Additional tables in Appendix A (Table 6-2) show the contribution of individual source tags to deposition. In most cases the tags represent emissions from a specific source, although some tags include emissions from a discrete region or limited group of sources (e.g., StateName_Other_Utilities).

4.2. Comparison with NESCAUM REMSAD results

In preparing its regional mercury TMDL, NEIWPCC used NESCAUM's REMSAD deposition results from two modeling scenarios, a 1998 base-case and a 2002 control-case (NESCAUM, 2007). Although the NESCAUM results identified major source categories and source regions contributing to deposition in the Northeast, they did not track emissions from individual states. ICF, however, did follow a state-specific approach in its REMSAD modeling for the U.S. EPA. We compare the output from both models here to demonstrate reasonable consistency in the results, despite the number of differences that exist between the two modeling scenarios. Differences include meteorology, grid size, boundary conditions, emissions totals, and emissions speciation.

In this section, we compare the NESCAUM 2002 control-case REMSAD results with the ICF results, which used a 2001 year mercury emissions inventory. Differences in emissions totals and speciation of those emissions likely dominate the observed differences in deposition attribution, with differences in boundary conditions also likely having an important influence.

Table 4–2 summarizes the modeled emissions totals by source region (New England, New York/New Jersey, Rest of the US), model run (ICF and NESCAUM) and mercury speciation (Hg^0, Hg^{2+}, Hg(P)). Although similar total emissions (8 percent difference) were modeled in the NESCAUM region, emissions in the rest of the U.S. were substantially greater (25 percent) in NESCAUM's modeling. The overall speciation of the modeled emissions also differed, with ICF modeling a higher percentage of Hg^{2+} (21 percent) and Hg(P) (28 percent) in the NESCAUM region, but a lower percentage (by 35 and 38 percent, respectively) of these species in the rest of the U.S., relative to the NESCAUM emissions.

Although less important for this analysis, ICF and NESCAUM relied on different boundary conditions for their simulations. ICF used averaged model results based on three separate global models while the NESCAUM modeling used one global model to establish boundary conditions. ICF's global boundary conditions on average had somewhat higher Hg levels, which led to higher deposition attributable to the boundary.

Beyond emissions and boundary conditions, the modeled meteorological year was different, with ICF using 2001 and NESCAUM 1996. The major difference between these two years shows substantially increased rainfall in 1996 along the Eastern Seaboard and parts of the Midwest. This could lead to increased wet deposition in the Northeast. Unfortunately, ICF's results are available only for total deposition, so the influence of meteorology cannot be confirmed. The differences in total deposition due to meteorology when integrated over the entire NEIWPCC region may not be large, as increases in wet deposition may be offset by corresponding decreases in dry. Likewise, grid-size differences should not appreciably affect results when integrated over a wide region. Small states or areas with strong gradients in surface characteristics could see some differences.

Table 4-2 Emissions Summary for ICF and NESCAUM Modeling.

Comparison of Modeled Emission Data					
New England	ICF (kg/yr)	NESC (kg/yr)	ICF %	NESC %	% DIFFERENCE*
Hg^0	853	1,116	42.1	54.2	-23%
Hg^{2+}	862	680	42.5	33.0	27%
Hg(P)	318	263	15.4	12.8	19%
Hg Total	2,033	2,059			-1%
NY/NJ	ICF (kg/yr)	NESC (kg/yr)	ICF %	NESC %	% DIFFERENCE
Hg^0	2,087	2,830	55.0	66.8	-26%
Hg^{2+}	1,207	1,034	31.8	24.4	16%
Hg(P)	499	372	13.2	8.8	35%
Hg Total	3,793	4,236			-11%
Rest of US	ICF (kg/yr)	NESC (kg/yr)	ICF %	NESC %	% DIFFERENCE
Hg^0	50,340	59,239	59.3	52.5	-15%
Hg^{2+}	27,197	41,731	32.1	37.0	-35%
Hg(P)	7,285	11,884	8.6	10.5	-39%
Hg Total	84,822	112,854			-25%
US Total	ICF (kg/yr)	NESC (kg/yr)	ICF %	NESC %	% DIFFERENCE
Hg^0	53,279	63,140	58.8	53.0	-16%
Hg^{2+}	29,266	43,454	32.3	36.5	-33%
Hg(P)	8,101	12,519	8.9	10.5	-35%
Hg Total	90,646	119,113			-24%

* % DIFFERENCE calculated from (ICF – NESC)/NESC.

The NESCAUM modeling did not explicitly separate New Jersey's mercury emissions from New York's when tracking tagged emissions, so a direct comparison between the NESCAUM and ICF results of U.S. source contributions from inside and outside the NEIWPCC region is not possible. Therefore, the following comparison of modeling results refers to contributions from sources in the NESCAUM region (New England states plus New Jersey and New York) to deposition in the NEWIPCC region (New England states plus only New York). Contributions from sources in the rest of the U.S. refer to sources outside the NESCAUM region.

Despite the modeling differences, a comparison of the two results as shown in Table 4-3 reveals reasonable consistency, especially when focused on deposition to the NEIWPCC region as a whole (final table of Table 4–3). Overall, ICF modeled 71.6 percent of mercury deposition in the NEIWPCC region as coming from global sources (which would also include a portion of U.S. mercury emissions that form part of the global pool), while NESCAUM modeled a 61.2 percent contribution from global sources. ICF modeled NESCAUM sources contributing 15.3 percent to deposition in the NEIWPCC region with NESCAUM modeling a 16.7 percent contribution. ICF estimated that U.S. sources outside the NESCAUM region contributed 13.1 percent to deposition in the NEIWPCC region with NESCAUM estimating a 22.1 percent contribution. As discussed previously, differences between the emissions inventories used by each model, differences in emitted mercury species profiles, different meteorological years, and different boundary conditions all contribute to differences in this comparison.

Differences in mercury speciation in the different inventories used by ICF and NESCAUM deserve special mention. The relative trends in deposition follow the relative contributions of reactive emissions, with the ICF results predicting 14-21 percent higher deposition in the NEIWPCC region due to NESCAUM sources as compared to NESCAUM results. ICF modeled 16-27 percent higher reactive emissions (RGM/Hg(P)) than did NESCAUM for NESCAUM source states. The opposite trend is observed for sources from the rest of the U.S. ICF predicted 76 percent of the deposition to the NEIWPCC region that NESCAUM modeling predicted. ICF's speciation in the rest of the U.S. had only two-thirds of the reactive emissions as NESCAUM modeling.

Generally speaking, the predicted contribution of New England states to deposition agrees well. In some instances, ICF results are greater, which is likely due to the higher levels of RGM emitted in the region relative to the NESCAUM emissions. Also, some variation in state-specific emissions totals explain differences (e.g., for Maine, ICF total emissions were more than twice those of the NESCAUM emissions for that state, which likely explains the much larger predicted deposition to Maine from ICF modeling).

In summary, based on this comparison, the results of the two model simulations are in reasonable agreement. ICF model inventories for states outside of the NESCAUM region better reflect current emissions for those states as they represent 2001 emissions. The NESCAUM emissions inventory for that region represents late 1990s emissions—the baseline period for the TMDL. This implies the ICF model apportionment results characterize near-current state-specific contributions to deposition in the Northeast. This apportionment provides a reasonable estimate of the relative importance of mercury emissions sources to deposition within the NEIWPCC region.

Table 4-3 Comparison of Hg Deposition from ICF and NESCAUM Modeling.

Total Modeled Deposition					
Connecticut	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	63.0	62.7	22.3	25.2	0.5%
NYNJ	25.9	33.1	9.1	13.3	-22%
ROUS	27.2	42.4	9.6	17.0	-36%
Global	166.7	110.4	59.0	44.4	51%
Total	282.8	248.6			14%
US Total	116.1	138.2			-16%

Maine	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	56.9	34.7	6.9	5.7	64%
NYNJ	11.6	10.1	1.4	1.7	15%
ROUS	45.8	58.0	5.5	9.5	-21%
Global	711.0	506.3	86.1	83.1	40%
Total	825.3	609.0			36%
US Total	114.3	102.7			11%

Massachusetts	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	110.9	92.4	28.1	27.4	20%
NYNJ	15.4	15.9	3.9	4.7	-3%
ROUS	30.4	50.1	7.7	14.8	-39%
Global	237.9	179.5	60.3	53.1	33%
Total	394.6	337.9			17%
US Total	156.7	158.4			-1%

New Hampshire	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	39.2	36.6	13.9	15.4	7%
NYNJ	8.4	8.6	3.0	3.6	-2%
ROUS	21.6	36.4	7.7	15.3	-41%
Global	212.3	156.6	75.4	65.7	36%
Total	281.5	238.1			18%
US Total	69.3	81.6			-15%

New York	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	28.4	27.1	1.3	1.5	5%
NYNJ	258.3	216.9	11.5	12.4	19%
ROUS	416.9	527.8	18.5	30.1	-21%
Global	1547.3	983.6	68.7	56.0	57%
Total	2250.9	1755.4			28%
US Total	703.6	771.8			-9%

Total Modeled Deposition

Rhode Island	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	12.7	9.6	23.5	22.9	32%
NYNJ	2.6	1.9	4.8	4.6	37%
ROUS	3.8	6.5	7.1	15.5	-42%
Global	34.7	23.9	64.6	57.0	45%
Total	53.8	41.9			28%
US Total	19.0	18.0			6%

Vermont	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	21.5	11.7	7.0	5.6	84%
NYNJ	16.8	11.8	5.4	5.6	42%
ROUS	30.7	39.7	10.0	19.0	-23%
Global	239.0	145.5	77.6	69.7	64%
Total	308.0	208.7			48%
US Total	68.9	63.2			9%

NEIWPCC Region	ICF kg	NESC kg	ICF %	NESC %	% DIFFERENCE*
New England	332.5	274.7	7.6	8.0	21%
NYNJ	339.0	298.2	7.7	8.7	14%
ROUS	576.3	760.9	13.1	22.1	-24%
Global	3148.9	2105.8	71.6	61.2	50%
Total	4396.8	3439.6			28%
US Total	1247.9	1333.8			-6%

* % DIFFERENCE calculated from (ICF – NESC)/NESC.

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6. APPENDIX A: TABLES OF MERCURY CONTRIBUTIONS TO THE NEIWPCC REGION AND STATES

Data in this appendix summarize modeling results based on ICF's MS Access database from the U.S. EPA. Values are rounded to the nearest tenth of a kg and nearest tenth of a percent. Sources whose contribution would round to zero are listed with "<0.05." Listings of zero imply virtually no contribution (roughly below 10^{-7} percent contribution) was attributed to that source or source region.

The mass deposition and percent contributions in the tables are those attributable solely to continental U.S. mercury emission sources. Contributions from sources outside the U.S. (as well as from sources in the U.S. whose emissions transport out of the country and recirculate back in as part of the "global" background) are not included in the tables. In the ICF modeling results, the "global" mercury contribution is about 70 percent of total deposition in the NEIWPCC region as a whole, and varies by individual state (see Table 4–3).

Table 6-1. State Contributions to NEIWPCC Region and Individual States.

NEIWPCC Region		
State	**kg**	**%**
PA	270.8	21.7
NY	269.0	21.6
MA	145.2	11.6
CT	80.8	6.5
NJ	70.0	5.6
OH	68.8	5.5
WV	48.6	3.9
MD	46.2	3.7
NH	39.8	3.2
ME	37.4	3.0
RI	26.1	2.1
MI	25.1	2.0
VA	18.7	1.5
IN	16.4	1.3
KY	14.6	1.2
NC	14.2	1.1
IL	11.1	0.9
TN	6.8	0.5
AL	6.3	0.5
GA	5.7	0.5
DE	5.3	0.4
WI	3.4	0.3
VT	3.3	0.3
SC	2.5	0.2
TX	2.5	0.2
MO	2.5	0.2
FL	1.1	0.1
IA	1.0	0.1
AR	1.0	0.1
LA	0.7	0.1
MS	0.6	0.1
MN	0.6	<0.05
CA	0.5	<0.05
KS	0.5	<0.05
OK	0.3	<0.05
OR	0.1	<0.05
ND	0.1	<0.05
MT	<0.05	<0.05
ID	<0.05	<0.05
NM	<0.05	<0.05
UT	<0.05	<0.05
NE	<0.05	<0.05
SD	<0.05	<0.05
WY	<0.05	<0.05
CO	<0.05	<0.05
DC	<0.05	<0.05

Connecticut		
State	**kg**	**%**
CT	48.8	42.0
NY	17.4	15.0
PA	13.2	11.4
MA	12.1	10.5
NJ	8.4	7.3
MD	3.6	3.1
WV	1.9	1.6
OH	1.9	1.6
VA	1.7	1.5
RI	1.4	1.2
NC	1.0	0.8
DE	0.7	0.6
MI	0.6	0.5
NH	0.5	0.5
IN	0.4	0.4
KY	0.4	0.4
IL	0.3	0.3
GA	0.2	0.2
SC	0.2	0.2
AL	0.2	0.2
TN	0.2	0.2
ME	0.1	0.1
WI	0.1	0.1
FL	0.1	0.1
TX	0.1	0.1
MO	0.1	0.1
VT	<0.05	<0.05
IA	<0.05	<0.05
CA	<0.05	<0.05
LA	<0.05	<0.05
MN	<0.05	<0.05
AR	<0.05	<0.05
MS	<0.05	<0.05
KS	<0.05	<0.05
OK	<0.05	<0.05
OR	<0.05	<0.05
ID	<0.05	<0.05
MT	<0.05	<0.05
UT	<0.05	<0.05
SD	<0.05	<0.05
ND	<0.05	<0.05
CO	0.0	0.0
DC	0.0	0.0
NE	0.0	0.0
NM	0.0	0.0
WY	0.0	0.0

Maine		
State	**kg**	**%**
ME	34.7	30.3
PA	17.7	15.5
MA	10.9	9.6
NY	8.3	7.2
NH	6.6	5.8
OH	4.9	4.3
MD	3.8	3.3
WV	3.6	3.2
NJ	3.4	3.0
CT	3.0	2.6
MI	2.3	2.0
IN	1.8	1.6
VA	1.7	1.5
NC	1.7	1.5
KY	1.6	1.4
RI	1.6	1.4
IL	1.5	1.3
GA	0.9	0.8
TN	0.8	0.7
AL	0.8	0.7
DE	0.5	0.4
WI	0.4	0.4
TX	0.4	0.4
SC	0.4	0.3
MO	0.3	0.2
VT	0.2	0.2
AR	0.1	0.1
FL	0.1	0.1
CA	0.1	0.1
IA	0.1	0.1
MS	0.1	0.1
LA	0.1	<0.05
OK	<0.05	<0.05
MN	<0.05	<0.05
KS	<0.05	<0.05
OR	<0.05	<0.05
SD	<0.05	<0.05
MT	<0.05	<0.05
ID	<0.05	<0.05
CO	0.0	0.0
DC	0.0	0.0
ND	0.0	0.0
NE	0.0	0.0
NM	0.0	0.0
UT	0.0	0.0
WY	0.0	0.0

Massachusetts		
State	**kg**	**%**
MA	80.1	51.1
RI	17.1	10.9
PA	13.0	8.3
NY	10.0	6.4
CT	9.7	6.2
NJ	5.4	3.5
MD	4.3	2.8
NH	3.3	2.1
WV	2.4	1.5
OH	2.4	1.5
VA	1.9	1.2
NC	1.2	0.8
MI	0.9	0.6
IN	0.7	0.4
KY	0.7	0.4
DE	0.6	0.4
ME	0.6	0.4
IL	0.5	0.3
TN	0.3	0.2
GA	0.3	0.2
AL	0.3	0.2
SC	0.2	0.1
TX	0.2	0.1
VT	0.2	0.1
WI	0.1	0.1
MO	0.1	0.1
FL	0.1	<0.05
AR	<0.05	<0.05
CA	<0.05	<0.05
IA	<0.05	<0.05
MS	<0.05	<0.05
LA	<0.05	<0.05
MN	<0.05	<0.05
KS	<0.05	<0.05
OK	<0.05	<0.05
OR	<0.05	<0.05
SD	<0.05	<0.05
NM	<0.05	<0.05
UT	<0.05	<0.05
ID	<0.05	<0.05
MT	<0.05	<0.05
CO	<0.05	<0.05
ND	<0.05	<0.05
DC	0.0	0.0
NE	0.0	0.0
WY	0.0	0.0

New Hampshire		
State	**kg**	**%**
NH	22.8	32.9
MA	11.1	16.1
PA	8.9	12.9
NY	5.9	8.5
CT	2.8	4.0
NJ	2.5	3.7
MD	2.5	3.6
OH	2.1	3.0
WV	1.8	2.6
ME	1.3	1.8
VA	1.0	1.5
NC	0.9	1.3
RI	0.8	1.2
MI	0.8	1.2
IN	0.7	1.0
KY	0.6	0.9
IL	0.4	0.6
VT	0.4	0.6
DE	0.3	0.5
TN	0.3	0.4
GA	0.3	0.4
AL	0.2	0.3
SC	0.2	0.2
TX	0.1	0.2
WI	0.1	0.2
MO	0.1	0.1
AR	0.1	0.1
FL	<0.05	0.1
CA	<0.05	<0.05
IA	<0.05	<0.05
MS	<0.05	<0.05
MN	<0.05	<0.05
LA	<0.05	<0.05
OK	<0.05	<0.05
KS	<0.05	<0.05
OR	<0.05	<0.05
SD	<0.05	<0.05
CO	0.0	0.0
DC	0.0	0.0
ID	0.0	0.0
MT	0.0	0.0
ND	0.0	0.0
NE	0.0	0.0
NM	0.0	0.0
UT	0.0	0.0
WY	0.0	0.0

New York		
State	**kg**	**%**
NY	212.3	30.2
PA	203.2	28.9
OH	53.7	7.6
NJ	46.0	6.5
WV	36.2	5.1
MD	28.5	4.0
MI	19.1	2.7
MA	15.2	2.2
IN	11.7	1.7
VA	11.1	1.6
KY	10.3	1.5
CT	10.1	1.4
NC	8.3	1.2
IL	7.6	1.1
TN	4.7	0.7
AL	4.3	0.6
GA	3.5	0.5
DE	2.8	0.4
WI	2.4	0.3
MO	1.8	0.2
TX	1.5	0.2
NH	1.5	0.2
SC	1.3	0.2
RI	1.0	0.1
IA	0.8	0.1
FL	0.8	0.1
AR	0.7	0.1
LA	0.5	0.1
MS	0.5	0.1
MN	0.4	0.1
KS	0.4	0.1
ME	0.3	<0.05
CA	0.3	<0.05
VT	0.3	<0.05
OK	0.2	<0.05
ND	0.1	<0.05
OR	0.1	<0.05
MT	<0.05	<0.05
ID	<0.05	<0.05
NM	<0.05	<0.05
UT	<0.05	<0.05
NE	<0.05	<0.05
WY	<0.05	<0.05
SD	<0.05	<0.05
CO	<0.05	<0.05
DC	<0.05	<0.05

Rhode Island		
State	**kg**	**%**
CT	4.8	25.1
RI	3.8	19.9
MA	3.8	19.7
PA	1.7	9.0
NY	1.6	8.5
NJ	0.9	4.9
MD	0.5	2.8
OH	0.3	1.6
VA	0.3	1.4
WV	0.3	1.3
NH	0.2	1.3
NC	0.1	0.7
MI	0.1	0.7
DE	0.1	0.5
IN	0.1	0.5
ME	0.1	0.4
KY	0.1	0.4
IL	0.1	0.3
TN	<0.05	0.2
AL	<0.05	0.1
SC	<0.05	0.1
GA	<0.05	0.1
WI	<0.05	0.1
MO	<0.05	0.1
TX	<0.05	0.1
VT	<0.05	0.1
FL	<0.05	<0.05
IA	<0.05	<0.05
CA	<0.05	<0.05
MN	<0.05	<0.05
MS	<0.05	<0.05
AR	<0.05	<0.05
KS	<0.05	<0.05
LA	<0.05	<0.05
OR	<0.05	<0.05
OK	<0.05	<0.05
SD	<0.05	<0.05
CO	0.0	0.0
DC	0.0	0.0
ID	0.0	0.0
MT	0.0	0.0
ND	0.0	0.0
NE	0.0	0.0
NM	0.0	0.0
UT	0.0	0.0
WY	0.0	0.0

Vermont		
State	**kg**	**%**
NY	13.5	19.6
PA	13.0	18.9
MA	11.9	17.3
NH	4.9	7.1
OH	3.5	5.1
NJ	3.3	4.7
MD	3.1	4.5
WV	2.4	3.5
VT	2.2	3.2
CT	1.7	2.4
MI	1.3	1.9
NC	1.1	1.6
VA	1.0	1.5
IN	1.0	1.5
KY	0.9	1.3
IL	0.6	0.9
RI	0.4	0.6
TN	0.4	0.6
GA	0.4	0.5
AL	0.4	0.5
ME	0.3	0.5
DE	0.3	0.5
WI	0.2	0.3
TX	0.2	0.3
SC	0.2	0.3
MO	0.1	0.2
AR	0.1	0.1
FL	0.1	0.1
IA	<0.05	0.1
CA	<0.05	0.1
MN	<0.05	0.1
MS	<0.05	<0.05
LA	<0.05	<0.05
OK	<0.05	<0.05
KS	<0.05	<0.05
ND	<0.05	<0.05
OR	<0.05	<0.05
SD	<0.05	<0.05
UT	<0.05	<0.05
MT	<0.05	<0.05
ID	<0.05	<0.05
NM	<0.05	<0.05
WY	<0.05	<0.05
CO	0.0	0.0
DC	0.0	0.0
NE	0.0	0.0

Table 6-2 Source Contributions to NEIWPCC Region and Individual States.

Tagged Sources to NEIWPCC Region	kg	%	Tagged Sources to NEIWPCC Region	kg	%
PA_Other_utilities	56.9	4.6	OH_Cardinal	8.5	0.7
MA_Pittsfield_RRF	50.0	4.0	MI_Sources_in_Detroit_ Metro	8.2	0.7
PA_Montour	43.7	3.5	OH_W._H._Sammis	8.2	0.7
PA_Keystone	37.7	3.0	PA_Bruce_Mansfield	8.0	0.6
PA_Homer_City	36.0	2.9	PA_General_Electric_Co.	7.9	0.6
NJ_Essex_Co._RRF	28.4	2.3	MD_Brandon_Shores	7.5	0.6
MA_Springfield_RRF	27.2	2.2	CT_Naugatuck_ Treatment_Company	7.4	0.6
PA_Shawville	25.4	2.0	KY_Ghent	7.1	0.6
NY_American_Ref-Fuel_Co_Niagara	24.2	1.9	OH_Conesville	7.1	0.6
NY_Counties_bordering _Lake_Ontario	21.5	1.7	WV_John_E_Amos	7.0	0.6
OH_Other_utilities	21.4	1.7	MI_Monroe_Power_Plant	6.6	0.5
NY_Counties_bordering _NY/NJ_Harbor	21.4	1.7	MD_Other_utilities	6.6	0.5
NY_Niagara_Falls	21.1	1.7	WV_Fort_Martin	6.2	0.5
NY_Wheelabrator _Westchester	20.7	1.7	RI_Rhode_Island_ Hospital	5.9	0.5
NY_Niagara_Mohawk _Pwr_Corp	20.7	1.7	WV_Mitchell_(WV)	5.9	0.5
NH_SES_Claremont_ RRF_(Wheelerbrator_ Claremont)	16.9	1.4	RI_Zambarano_Memorial _Hospital	5.6	0.5
NJ_Counties_bordering _NY/NJ_Harbor	16.6	1.3	MD_Chalk_Point	5.6	0.4
CT_Bridgeport_RES_CO _(Wheelabrator)	15.3	1.2	NJ_Co_Steel_Sayreville	5.2	0.4
ME_Mid_Maine_Waste _Action_Corp.	14.9	1.2	NJ_Hudson	5.1	0.4
MA_Brayton_Point	14.7	1.2	MD_Morgantown	4.9	0.4
PA_Harrisburg_WTE	14.0	1.1	IN_Other_Utilities_outside _Gary,_IN_MSA	4.5	0.4
CT_Mid-Connecticut _Project_(CRRA)	13.2	1.1	WV_Philip_Sporn	4.3	0.3
WV_Other_utilities	11.5	0.9	MD_Baltimore_Res_Co	4.0	0.3
WV_Mt._Storm_Power _Station	11.0	0.9	NC_Roxboro	3.9	0.3
MA_SE_Mass_RRF	10.0	0.8	RI_Narragansett_Bay _Commission_Fields_Pt.	3.9	0.3
NH_Merrimack	9.7	0.8	OH_Kyger_Creek	3.9	0.3
CT_Mattabassett_ Regional_Sewage_ Authority	9.1	0.7	KY_Big_Sandy	3.3	0.3
CT_Southeastern_ Connecticut_RRF_ (American)	8.6	0.7	RI_Woonsocket _WWTF/NET_Co	3.2	0.3
OH_Eastlake	8.5	0.7	VA_Chesterfield_Power _Station	2.8	0.2
			OH_ASHTA_Chemicals_ Inc.	2.7	0.2
			VT_Residential_Fuel _Combustion	2.6	0.2
			MI_Central_Wayne _Co._Sanitation_Authority	2.5	0.2

Tagged Sources to NEIWPCC Region	kg	%
IN_Rockport	2.5	0.2
NC_Belews_Creek	2.5	0.2
IL_Other_utilities_outside _Chicago_MSA	2.3	0.2
IL_Other_non-utility_ source_inside_Chicago_ MSA	2.3	0.2
NJ_Camden_RRF	2.2	0.2
MD_Phoenix_Services_ Inc._(Formerly_Medical_ Waste_Associates)	2.0	0.2
ME_Greater_Portland _Region_RRF	1.9	0.2
DE_Indian_River	1.8	0.1
TN_Kingston_Fossil_ Plant	1.7	0.1
MI_J._H._Campbell	1.6	0.1
KY_Paradise_Fossil_ Plant	1.6	0.1
DE_Occidental_Chemical _Corp.	1.6	0.1
NC_Marshall	1.6	0.1
GA_Bowen	1.5	0.1
NH_Wheelabrator_ Concord	1.5	0.1
WV_PPG_Industries_- _Inc.	1.4	0.1
IN_Clifty_Creek	1.4	0.1
MI_St_Clair_Power_Plant	1.4	0.1
VA_NASA_Refuse- fired_Steam_Generator	1.3	0.1
AL_Gorgas	1.3	0.1
IL_Other_utilities_inside _Chicago_MSA	1.3	0.1
IL_Powerton	1.3	0.1
DE_Edge_Moor	1.3	0.1
AL_Gaston	1.2	0.1
GA_Scherer	1.2	0.1
MO_Labadie	1.2	0.1
IN_Gibson_Generating _Station	1.1	0.1
IN_Tanners_Creek	1.1	0.1
VA_Norfolk_Navy_Yard	1.1	0.1
KY_H._L._Spurlock	1.0	0.1
AL_Miller	1.0	0.1
WI_Pleasant_Prairie	1.0	0.1
VA_Chesapeake_Energy	0.9	0.1

Tagged Sources to NEIWPCC Region	kg	%
_Center		
IL_Joliet_29	0.8	0.1
ME_Penobscot_Energy _Recovery	0.8	0.1
GA_Wansley	0.7	0.1
IL_Waukegan	0.7	0.1
TN_Gallatin_Fossil_Plant	0.7	0.1
TN_Johnsonville_Fossil_ Plant	0.7	0.1
NC_BMW_NC	0.6	0.1
TX_Monticello	0.6	0.1

Tagged Sources to Connecticut	kg	%
CT_Mid-Connecticut _Project_(CRRA)	8.8	7.6
CT_Bridgeport_RES_CO _(Wheelabrator)	8.5	7.3
CT_Mattabassett_Region al_Sewage_Authority	6.3	5.4
CT_Naugatuck_ Treatment_Co.	5.3	4.6
MA_Springfield_RRF	5.3	4.6
NY_Wheelabrator Westchester	4.3	3.7
MA_Pittsfield_RRF	3.6	3.1
NJ_Essex_Co._RRF	3.4	2.9
PA_Other_utilities	3.0	2.6
CT_Southeastern_CT_ RRF	2.7	2.4
PA_Montour	2.1	1.8
NJ Counties at NY/NJ Harbor	1.9	1.6
NY Counties at NY/NJ Harbor	1.8	1.5
PA_Keystone	1.6	1.4
PA_Homer_City	1.5	1.3
PA_Shawville	1.0	0.8
MA_Brayton_Point	0.8	0.7
PA_Harrisburg_WTE	0.7	0.6
NJ_Co_Steel_Sayreville	0.6	0.6
NJ_Hudson	0.6	0.5
MD_Brandon_Shores	0.6	0.5
OH_Other_utilities	0.6	0.5
WV_Mt._Storm_Power_ Stn.	0.6	0.5
MA_SE_Mass_RRF	0.5	0.4
MD_Chalk_Point	0.5	0.4
MD_Other_utilities	0.4	0.4
WV_Other_utilities	0.4	0.4
MD_Morgantown	0.4	0.3
RI_Zambarano_Mem._ Hpl.	0.3	0.3
MD_Baltimore_Res_Co	0.3	0.3
VA_Chesterfield_Power_ Stn.	0.3	0.3
PA_General_Electric_Co.	0.3	0.2
NC_Roxboro	0.3	0.2
OH_Cardinal	0.3	0.2
NJ_Camden_RRF	0.3	0.2

Tagged Sources to Connecticut	kg	%
DE_Indian_River	0.3	0.2
WV_John_E_Amos	0.3	0.2
OH_W._H._Sammis	0.2	0.2
PA_Bruce_Mansfield	0.2	0.2
NH_SES_Claremont_RR F_(Wheelerbrator_ Claremont)	0.2	0.2
WV_Fort_Martin	0.2	0.2
RI_Rhode_Island_ Hospital	0.2	0.2
OH_Conesville	0.2	0.2
WV_Mitchell_(WV)	0.2	0.2
NY_Counties at Lake Ontario	0.2	0.2
KY_Ghent	0.2	0.2
RI_Narragansett_Bay _Commission_Fields_Pt.	0.2	0.2
VA_NASA_Refuse-fired_Steam_Generator	0.2	0.2
MI_Monroe_Power_Plant	0.2	0.2
MI_Sources_in_Detroit_ Metro	0.2	0.2
DE_Occidental_Chemical _Co	0.2	0.1
VA_Norfolk_Navy_Yard	0.2	0.1
OH_Eastlake	0.2	0.1
NY_American_Ref-Fuel_Co_Niagara	0.2	0.1
NH_Merrimack	0.2	0.1
NY_Niagara_Falls	0.2	0.1
NY_Niagara_Mohawk_ Pwr_Co	0.2	0.1
MD_Phoenix_Services_ Inc._(Formerly_Medical_ Waste_Assn.)	0.1	0.1
DE_Edge_Moor	0.1	0.1
VA_Chesapeake_Energy _Ctr.	0.1	0.1
RI_Woonsocket_WWTF/ NET	0.1	0.1
WV_Philip_Sporn	0.1	0.1
NC_Belews_Creek	0.1	0.1
IN_Other_Utilities_outside _Gary,_IN_MSA	0.1	0.1
OH_Kyger_Creek	0.1	0.1
KY_Big_Sandy	0.1	0.1
NC Sources by Waccama Lake	0.1	0.1

Tagged Sources to Connecticut	kg	%
NC_Marshall	0.1	0.1
IL_Other_utilities_outside_Chicago_MSA	0.1	0.1
WV_PPG_Industries_-_Inc.	0.1	0.1
OH_ASHTA_Chemicals_Inc.	0.1	0.1
IN_Rockport	0.1	0.1
IL_Other_non-utility_sources_inside_Chicago_MSA	0.1	0.1
DE_Motiva_Enterprises_(formerly_Star)	0.1	0.1

Tagged Sources to Maine	kg	%
ME_Mid_Maine_Waste_ Action_Corp.	13.9	12.2
PA_Other_utilities	3.8	3.3
PA_Keystone	2.7	2.4
PA_Homer_City	2.7	2.3
PA_Montour	2.5	2.2
NH_Merrimack	2.5	2.1
MA_Pittsfield_RRF	2.0	1.8
ME_Greater_Portland_ Region_RRF	1.7	1.5
OH_Other_utilities	1.6	1.4
MA_Brayton_Point	1.6	1.4
MA_SE_Mass_RRF	1.5	1.3
PA_Shawville	1.5	1.3
MA_Springfield_RRF	1.3	1.2
NH_SES_Claremont_ RRF_(Wheelerbrator_ Claremont)	1.3	1.1
NJ_Essex_Co._RRF	1.1	1.0
PA_Harrisburg_WTE	0.9	0.8
WV_Other_utilities	0.8	0.7
KY_Ghent	0.8	0.7
WV_Mt._Storm_Power_ Station	0.8	0.7
ME_Penobscot_Energy_ Recovery	0.8	0.7
NJ_Counties_bordering_ NY/NJ_Harbor	0.7	0.6
NY_Wheelabrator_Westc hester	0.7	0.6
NY_American_Ref- Fuel_Co_Niagara	0.7	0.6
MI_Sources_in_Detroit_ Metro	0.7	0.6
CT_Bridgeport_RES_CO _(Wheelabrator)	0.6	0.6
MD_Brandon_Shores	0.6	0.6
NY_Niagara_Falls	0.6	0.5
NY_Niagara Mohawk Pwr Corp	0.6	0.5
WV_John_E_Amos	0.6	0.5
NY_Counties at Lake Ontario	0.6	0.5
OH_Cardinal	0.5	0.5
OH_W._H._Sammis	0.5	0.5
NY_Counties at NY/NJ Harbor	0.5	0.5

Tagged Sources to Maine	kg	%
IN_Other_Utilities_outside _Gary,_IN_MSA	0.5	0.5
PA_Bruce_Mansfield	0.5	0.5
CT_Southeastern_ Connecticut_RRF_ (American)	0.5	0.4
ME_Dragon_Products_Co	0.5	0.4
MD_Chalk_Point	0.5	0.4
OH_Eastlake	0.5	0.4
MD_Other_utilities	0.5	0.4
OH_Conesville	0.5	0.4
MI_Monroe_Power_Plant	0.5	0.4
PA_General_Electric_ Company	0.5	0.4
NC_Roxboro	0.5	0.4
MD_Morgantown	0.5	0.4
WV_Fort_Martin	0.4	0.4
CT_Mid- Connecticut_Project_ (CRRA)	0.4	0.3
WV_Mitchell_(WV)	0.4	0.3
NH_Schiller_	0.3	0.3
IL_Other_non- utility_sources_inside_Chi cago_MSA	0.3	0.3
WV_Philip_Sporn	0.3	0.3
OH_Kyger_Creek	0.3	0.3
RI_Rhode_Island_ Hospital	0.3	0.3
CT_Mattabassett_ Regional_Sewage_ Authority	0.3	0.3
GA_Other_Sources	0.3	0.3
RI_Zambarano_Memorial _Hpt.	0.3	0.3
MD_Baltimore_Res_Co	0.3	0.3
NH_Wheelabrator_ Concord	0.3	0.3
IL_Other_utilities_outside _Chicago_MSA	0.3	0.3
NJ_Co_Steel_Sayreville	0.3	0.3
KY_Big_Sandy	0.3	0.3
VA_Chesterfield_Power_ Station	0.3	0.3
IN_Rockport	0.3	0.2
RI_Narragansett_Bay_ Commission_Fields_Pt.	0.3	0.2

Tagged Sources to Maine	kg	%
NC_Belews_Creek	0.3	0.2
RI_Woonsocket WWTF/NET Co	0.3	0.2
GA_Scherer	0.2	0.2
OH_ASHTA_Chemicals_Inc.	0.2	0.2
CT_Naugatuck_Treatment_Co.	0.2	0.2
NJ_Hudson	0.2	0.2
MI_J._H._Campbell	0.2	0.2
MI_Central_Wayne_Co._Sanitation_Authority	0.2	0.2
GA_Bowen	0.2	0.2
TN_Kingston_Fossil_Plant	0.2	0.2
IL_Other_utilities_inside_Chicago_MSA	0.2	0.2
DE_Occidental_Chemical_Corp	0.2	0.2
NJ_Camden_RRF	0.2	0.1
DE_Indian_River	0.2	0.1
NC_Marshall	0.2	0.1
MO_Labadie	0.2	0.1
AL_Gaston	0.2	0.1
AL_Gorgas	0.2	0.1
IL_Powerton	0.2	0.1
KY_Paradise_Fossil_Plant	0.2	0.1
IN_Clifty_Creek	0.2	0.1
MD_Phoenix_Services_Inc._(Formerly_Medical_Waste_Associates)	0.2	0.1
AL_Miller	0.1	0.1
IN_Gibson_Generating_Station	0.1	0.1
WI_Pleasant_Prairie	0.1	0.1
KY_H._L._Spurlock	0.1	0.1
VA_NASA_Refuse-fired_Steam_Generator	0.1	0.1
WV_PPG_INDUSTRIES_-_INC.	0.1	0.1
IL_Joliet_29	0.1	0.1
TX_Monticello	0.1	0.1
VT_Residential_Fuel_Combust.	0.1	0.1
MI_St_Clair_Power_Plant	0.1	0.1
GA_Wansley	0.1	0.1

Tagged Sources to Maine	kg	%
DE_Edge_Moor	0.1	0.1
IN_Tanners_Creek	0.1	0.1
VA_Norfolk_Navy_Yard	0.1	0.1
IL_Waukegan	0.1	0.1
NC_BMW_NC	0.1	0.1
TN_Olin_Corp.	0.1	0.1
VA_Chesapeake_Energy_Ctr.	0.1	0.1
TN_Gallatin_Fossil_Plant	0.1	0.1
TN_Johnsonville_Fossil_Plant	0.1	0.1
IA_Other_utilities	0.1	0.1
MO_Rush_Island	0.1	0.1
AL_Sources_in_the_Mobile_Bay_area	0.1	0.1

Tagged Sources to Massachusetts	kg	%
MA_Pittsfield_RRF	22.2	14.1
MA_Springfield_RRF	14.6	9.3
MA_Brayton_Point	9.4	6.0
MA_SE_Mass_RRF	6.3	4.0
RI_Rhode_Island_ Hospital	4.6	3.0
RI_Zambarano_Memorial _Hpt.	3.3	2.1
PA_Other_utilities	3.1	2.0
RI_Narragansett_Bay_Co mmission_Fields_Pt.	2.8	1.8
RI_Woonsocket WWTF/NET Co	2.3	1.5
CT_Mid-CT_Project_(CRRA)	2.2	1.4
NJ_Essex_Co._RRF	2.0	1.3
PA_Montour	1.9	1.2
CT_Southeastern_CT_ RRF	1.6	1.0
CT_Bridgeport_RES_CO _(Wheelabrator)	1.5	1.0
PA_Keystone	1.5	0.9
PA_Homer_City	1.4	0.9
NY_Wheelabrator_ Westchester	1.4	0.9
NJ_Counties at NY/NJ Harbor	1.1	0.7
CT_Mattabassett_ Regional_Sewage_ Authority	1.1	0.7
NH_SES_Claremont_ RRF	1.0	0.6
PA_Shawville	0.9	0.6
NY_Counties at NY/NJ Harbor	0.9	0.6
PA_Harrisburg_WTE	0.8	0.5
NH_Merrimack	0.8	0.5
MD_Brandon_Shores	0.8	0.5
OH_Other_utilities	0.7	0.5
WV_Mt._Storm_Power_ Station	0.7	0.5
CT_Naugatuck_ Treatment_Co.	0.6	0.4
MD_Chalk_Point	0.6	0.4
MD_Other_utilities	0.6	0.4
WV_Other_utilities	0.5	0.3
MD_Morgantown	0.5	0.3

Tagged Sources to Massachusetts	kg	%
NJ_Co_Steel_Sayreville	0.5	0.3
WV_John_E_Amos	0.4	0.2
MD_Baltimore_Res_Co	0.4	0.2
NJ_Hudson	0.4	0.2
NC_Roxboro	0.3	0.2
KY_Ghent	0.3	0.2
OH_Cardinal	0.3	0.2
VA_Chesterfield_Power_ Station	0.3	0.2
PA_Bruce_Mansfield	0.3	0.2
OH_W._H._Sammis	0.3	0.2
PA_General_Electric_ Company	0.3	0.2
NY_Counties at Lake Ontario	0.3	0.2
NY American Ref-Fuel Co Niag.	0.3	0.2
MI_Sources_in_Detroit_ Metro	0.3	0.2
WV_Fort_Martin	0.3	0.2
OH_Conesville	0.3	0.2
DE_Indian_River	0.2	0.2
NJ_Camden_RRF	0.2	0.2
NY_Niagara_Falls	0.2	0.2
MI_Monroe_Power_Plant	0.2	0.1
WV_Mitchell_(WV)	0.2	0.1
OH_Eastlake	0.2	0.1
NY_Niagara_Mohawk_ Pwr_Co.	0.2	0.1
ME_Mid_Maine_Waste_ Action	0.2	0.1
WV_Philip_Sporn	0.2	0.1
IN_Other Util. outside Gary, IN	0.2	0.1
OH_Kyger_Creek	0.2	0.1
NC_Belews_Creek	0.2	0.1
VA NASA Refuse-fired_Steam_Generator	0.2	0.1
MD_Phoenix_Services_ Inc._(Formerly Medical Waste Asc.)	0.2	0.1
DE_Occidental_Chemical _Corp.	0.2	0.1
KY_Big_Sandy	0.2	0.1
VA_Norfolk_Navy_Yard	0.2	0.1
DE_Edge_Moor	0.1	0.1

Tagged Sources to Massachusetts	kg	%
VT_Residential FuelCombustion	0.1	0.1
VA_Chesapeake_Energy_Ctr.	0.1	0.1
NC_Marshall	0.1	0.1
IN_Rockport	0.1	0.1
IL_Other util.outside Chicago	0.1	0.1
OH_ASHTA_Chemicals_Inc.	0.1	0.1
NH_Wheelabrator_Concord	0.1	0.1
IL_Other non-utility sources inside Chicago MSA	0.1	0.1
TN_Kingston_Fossil_Plant	0.1	0.1
MI_Central_Wayne_Co._Sanitation_Authority	0.1	0.1
GA_Bowen	0.1	0.1

Tagged Sources to New Hampshire)	kg	%
NH_SES_Claremont_RRF _(Wheelerbrator _Claremont)	10.0	14.5
NH_Merrimack	5.3	7.6
MA_Pittsfield_RRF	3.4	4.9
MA_Springfield_RRF	2.0	2.9
PA_Other_utilities	2.0	2.9
PA_Montour	1.4	2.0
PA_Keystone	1.1	1.7
PA_Homer_City	1.1	1.7
NH_Wheelabrator_ Concord	1.0	1.4
NJ_Essex_Co._RRF	0.9	1.3
PA_Shawville	0.7	1.0
OH_Other_utilities	0.7	1.0
CT_Bridgeport_RES_CO_ (Wheelabrator)	0.6	0.9
MA_Brayton_Point	0.6	0.9
NY_Wheelabrator_ Westchester	0.6	0.8
NJ_Counties_bordering_ NY/NJ_Harbor	0.5	0.8
CT_Mid-Connecticut_Project_ (CRRA)	0.5	0.7
MA_SE_Mass_RRF	0.5	0.7
PA_Harrisburg_WTE	0.5	0.7
ME_Mid_Maine_Waste_ Action_Corp.	0.5	0.7
WV_Other_utilities	0.4	0.6
MD_Brandon_Shores	0.4	0.6
NY_Counties_bordering_ NY/NJ_Harbor	0.4	0.6
WV_Mt._Storm_Power_St ation	0.4	0.6
KY_Ghent	0.3	0.5
CT_Southeastern _Connecticut_RRF _(American)	0.3	0.5
MD_Chalk_Point	0.3	0.5
MD_Other_utilities	0.3	0.5
CT_Mattabassett _Regional_Sewage _Authority	0.3	0.4
VT_Residential_Fuel_ Combustion	0.3	0.4
MD_Morgantown	0.3	0.4
OH_Cardinal	0.3	0.4
OH_W._H._Sammis	0.3	0.4
WV_John_E_Amos	0.3	0.4
NC_Roxboro	0.3	0.4
MI_Sources_in_Detroit_ Metro	0.3	0.4
PA_Bruce_Mansfield	0.3	0.4
NY_American_Ref-Fuel_Co_Niagara	0.2	0.4
PA_General_Electric_ Company	0.2	0.3
NY_Counties_bordering_ Lake_Ontario	0.2	0.3
OH_Conesville	0.2	0.3
RI_Zambarano_Memorial_ Hospital	0.2	0.3
NY_Niagara_Mohawk_ Pwr_Corp	0.2	0.3
NY_Niagara_Falls	0.2	0.3
CT_Naugatuck_Treatment _Company	0.2	0.3
WV_Fort_Martin	0.2	0.3
NJ_Co_Steel_Sayreville	0.2	0.3
MD_Baltimore_Res_Co	0.2	0.3
WV_Mitchell_(WV)	0.2	0.3
MI_Monroe_Power_Plant	0.2	0.3
IN_Other_Utilities_outside _Gary,_IN_MSA	0.2	0.3
OH_Eastlake	0.2	0.3
VA_Chesterfield_Power_ Station	0.2	0.3
NJ_Hudson	0.2	0.2
WV_Philip_Sporn	0.2	0.2
OH_Kyger_Creek	0.1	0.2
RI_Woonsocket_WWTF/ NET_Co	0.1	0.2
NC_Belews_Creek	0.1	0.2
IN_Rockport	0.1	0.2
RI_Rhode_Island_Hospital	0.1	0.2
KY_Big_Sandy	0.1	0.2
ME_Greater_Portland_ Region_RRF	0.1	0.2
NJ_Camden_RRF	0.1	0.2
RI_Narragansett_Bay _Commission_Fields_Pt.	0.1	0.2
DE_Indian_River	0.1	0.2

Tagged Sources to New Hampshire)	kg	%
MD_Phoenix_Services_ Inc._(Formerly_Medical_ Waste_Associates)	0.1	0.2
IL_Other_utilities_outside_ Chicago_MSA	0.1	0.1
DE_Occidental_Chemical _Corporation	0.1	0.1
NH_Schiller_	0.1	0.1
NC_Marshall	0.1	0.1
VA_NASA_Refuse-fired_Steam_Generator	0.1	0.1
MI_Central_Wayne_Co._ Sanitation_Authority	0.1	0.1
IL_Other_non-utility_sources_inside_Chicago_MSA	0.1	0.1
OH_ASHTA_Chemicals_ Inc.	0.1	0.1
DE_Edge_Moor	0.1	0.1
TN_Kingston_Fossil_Plant	0.1	0.1
KY_Paradise_Fossil_Plant	0.1	0.1
GA_Scherer	0.1	0.1
GA_Bowen	0.1	0.1
VA_Norfolk_Navy_Yard	0.1	0.1
MO_Labadie	0.1	0.1
IN_Clifty_Creek	0.1	0.1
MI_J._H._Campbell	0.1	0.1
WV_PPG_INDUSTRIES_-_INC.	0.1	0.1
VA_Chesapeake_Energy_ Center	0.1	0.1
IL_Powerton	0.1	0.1
KY_H._L._Spurlock	0.1	0.1

Tagged Sources to New York	kg	%
PA_Other_utilities	41.6	5.9
PA_Montour	33.7	4.8
PA_Keystone	28.8	4.1
PA_Homer_City	27.4	3.9
NY_American_Ref-Fuel_Co_Niagara	22.4	3.2
PA_Shawville	20.1	2.9
NY_Counties_bordering_Lake_Ontario	19.8	2.8
NJ_Essex_Co._RRF	19.5	2.8
NY_Niagara_Falls	19.4	2.8
NY_Niagara_Mohawk_Pwr_Corp	19.1	2.7
NY_Counties_bordering_NY/NJ_Harbor	17.0	2.4
OH_Other_utilities	16.5	2.3
NY_Wheelabrator_Westchester	12.6	1.8
NJ_Counties_bordering_NY/NJ_Harbor	11.5	1.6
PA_Harrisburg_WTE	10.4	1.5
MA_Pittsfield_RRF	9.2	1.3
WV_Other_utilities	8.7	1.2
WV_Mt._Storm_Power_Station	8.0	1.1
OH_Eastlake	7.0	1.0
OH_Cardinal	6.7	0.9
MI_Sources_in_Detroit_Metro	6.4	0.9
OH_W._H._Sammis	6.4	0.9
PA_Bruce_Mansfield	6.2	0.9
PA_General_Electric_Company	6.1	0.9
OH_Conesville	5.5	0.8
WV_John_E_Amos	5.2	0.7
MI_Monroe_Power_Plant	5.1	0.7
KY_Ghent	4.9	0.7
WV_Fort_Martin	4.7	0.7
WV_Mitchell_(WV)	4.5	0.6
MD_Brandon_Shores	4.4	0.6
MD_Other_utilities	4.3	0.6
NJ_Hudson	3.5	0.5
CT_Bridgeport_RES_CO_(Wheelabrator)	3.4	0.5
NJ_Co_Steel_Sayreville	3.3	0.5
WV_Philip_Sporn	3.2	0.5

Tagged Sources to New York	kg	%
MD_Chalk_Point	3.2	0.5
IN_Other_Utilities_outside_Gary,_IN_MSA	3.2	0.5
OH_Kyger_Creek	2.9	0.4
MD_Morgantown	2.9	0.4
MD_Baltimore_Res_Co	2.5	0.4
KY_Big_Sandy	2.4	0.3
MA_Springfield_RRF	2.3	0.3
NC_Roxboro	2.2	0.3
OH_ASHTA_Chemicals_Inc	2.1	0.3
MI_Central_Wayne_Co._Sanitation_Authority	2.0	0.3
IN_Rockport	1.7	0.2
IL_Other_utilities_outside_Chicago_MSA	1.6	0.2
IL_Other_non-utility_sources_inside_Chicago_MSA	1.6	0.2
NC_Belews_Creek	1.5	0.2
VA_Chesterfield_Power_Station	1.5	0.2
MD_Phoenix_Services_Inc._(Formerly_Medical_Waste_Associates)	1.3	0.2
TN_Kingston_Fossil_Plant	1.2	0.2
MI_J._H._Campbell	1.2	0.2
KY_Paradise_Fossil_Plant	1.2	0.2
NJ_Camden_RRF	1.2	0.2
MI_St_Clair_Power_Plant	1.1	0.2
GA_Bowen	1.1	0.1
WV_PPG_INDUSTRIES_-_INC.	1.0	0.1
IN_Clifty_Creek	1.0	0.1
NC_Marshall	1.0	0.1
AL_Gorgas	0.9	0.1
MA_Brayton_Point	0.9	0.1
IL_Powerton	0.9	0.1
IL_Other_utilities_inside_Chicago_MSA	0.9	0.1
DE_Indian_River	0.9	0.1
AL_Gaston	0.8	0.1
DE_Occidental_Chemical_Corporation	0.8	0.1
CT_Mid-Connecticut_Project_(CRRA)	0.8	0.1

Tagged Sources to New York	kg	%
IN_Tanners_Creek	0.8	0.1
CT_Naugatuck_Treatment_Company	0.8	0.1
MO_Labadie	0.8	0.1
IN_Gibson_Generating_Station	0.8	0.1
CT_Mattabassett_Regional_Sewage_Authority	0.7	0.1
DE_Edge_Moor	0.7	0.1
GA_Scherer	0.7	0.1
KY_H._L._Spurlock	0.7	0.1
WI_Pleasant_Prairie	0.7	0.1
AL_Miller	0.7	0.1
NH_SES_Claremont_RRF_(Wheelerbrator_Claremont)	0.7	0.1
VA_NASA_Refuse-fired_Steam_Generator	0.6	0.1
CT_Southeastern_Connecticut_RRF_(American)	0.6	0.1
IL_Joliet_29	0.6	0.1
MA_SE_Mass_RRF	0.5	0.1
VA_Norfolk_Navy_Yard	0.5	0.1
IL_Waukegan	0.5	0.1
TN_Gallatin_Fossil_Plant	0.5	0.1
GA_Wansley	0.5	0.1
NH_Merrimack	0.4	0.1
TN_Johnsonville_Fossil_Plant	0.4	0.1
VA_Chesapeake_Energy_Center	0.4	0.1
AL_Sources_in_the_Mobile_Bay_area	0.4	0.1
IA_Other_utilities	0.4	0.1
VA_Jewel_Coke_Company_LLP	0.4	0.1
TX_Monticello	0.4	0.1
NC_BMW_NC	0.4	0.1

Tagged Sources to Rhode Island	kg	%
CT_Southeastern_Connecticut_RRF_(American)	2.7	14.4
RI_Zambarano_Memorial_Hpt.	1.1	5.9
MA_Brayton_Point	0.9	4.8
MA_Springfield_RRF	0.8	4.4
MA_Pittsfield_RRF	0.5	2.7
PA_Other_utilities	0.4	2.0
MA_SE_Mass_RRF	0.3	1.8
NJ_Essex_Co._RRF	0.3	1.8
RI_Rhode_Island_Hospital	0.3	1.8
CT_Mid-Connecticut_Project_(CRRA)	0.3	1.5
CT_Mattabassett_Regional_Sewage_Authority	0.3	1.5
RI_Narragansett_Bay_Commission_Fields_Pt.	0.3	1.5
PA_Montour	0.3	1.4
CT_Bridgeport_RES_CO_(Wheelabrator)	0.2	1.3
NJ_Counties_bordering_NY/NJ_Harbor	0.2	1.0
NY_Wheelabrator_Westchester	0.2	1.0
PA_Keystone	0.2	1.0
PA_Homer_City	0.2	0.9
RI_Woonsocket_WWTF/NET_Co	0.2	0.9
NY_Counties_bordering_NY/NJ_Harbor	0.1	0.8
PA_Shawville	0.1	0.7
CT_Naugatuck_Treatment_Company	0.1	0.6
OH_Other_utilities	0.1	0.5
MD_Brandon_Shores	0.1	0.5
PA_Harrisburg_WTE	0.1	0.5
WV_Mt._Storm_Power_Station	0.1	0.4
NH_SES_Claremont_RRF_(Wheelerbrator_Claremont)	0.1	0.4
NJ_Co_Steel_Sayreville	0.1	0.4
NH_Merrimack	0.1	0.4
MD_Chalk_Point	0.1	0.4
MD_Morgantown	0.1	0.3
MD_Other_utilities	0.1	0.3
NJ_Hudson	0.1	0.3
WV_Other_utilities	0.1	0.3

Tagged Sources to Vermont	kg	%
MA_Pittsfield_RRF	9.1	13.2
NH_SES_Claremont_RRF _(Wheelerbrator _Claremont)	3.6	5.2
PA_Other_utilities	3.0	4.3
PA_Montour	2.0	2.9
VT_Residential_Fuel _Combustion	1.8	2.6
PA_Keystone	1.8	2.5
PA_Homer_City	1.7	2.4
NJ_Essex_Co._RRF	1.2	1.7
OH_Other_utilities	1.2	1.7
PA_Shawville	1.0	1.5
NY_Wheelabrator _Westchester	0.9	1.3
MA_Springfield_RRF	0.8	1.2
NJ_Counties_bordering _NY/NJ_Harbor	0.7	1.0
PA_Harrisburg_WTE	0.7	1.0
WV_Other_utilities	0.6	0.9
NY_Counties_bordering _NY/NJ_Harbor	0.6	0.8
MD_Brandon_Shores	0.6	0.8
NH_Merrimack	0.5	0.8
WV_Mt._Storm_Power _Station	0.5	0.7
CT_Bridgeport_RES_CO _(Wheelabrator)	0.5	0.7
KY_Ghent	0.5	0.7
NY_Counties_bordering _Lake_Ontario	0.4	0.7
OH_Cardinal	0.4	0.6
NY_American_Ref-Fuel_Co_Niagara	0.4	0.6
NY_Niagara_Falls	0.4	0.6
MI_Sources_in_Detroit _Metro	0.4	0.6
NY_Niagara_Mohawk_Pwr _Corp	0.4	0.6
OH_W._H._Sammis	0.4	0.6
MA_Brayton_Point	0.4	0.6
PA_General_Electric _Company	0.4	0.6
MD_Chalk_Point	0.4	0.6
MD_Other_utilities	0.4	0.6
OH_Eastlake	0.4	0.6

Tagged Sources to Vermont	kg	%
PA_Bruce_Mansfield	0.4	0.6
OH_Conesville	0.4	0.6
MD_Morgantown	0.4	0.5
MI_Monroe_Power_Plant	0.3	0.5
WV_John_E_Amos	0.3	0.5
WV_Fort_Martin	0.3	0.5
NC_Roxboro	0.3	0.5
WV_Mitchell_(WV)	0.3	0.4
IN_Other_Utilities_outside _Gary,_IN_MSA	0.3	0.4
MA_SE_Mass_RRF	0.3	0.4
NJ_Co_Steel_Sayreville	0.3	0.4
MD_Baltimore_Res_Co	0.3	0.4
WV_Philip_Sporn	0.2	0.3
NJ_Hudson	0.2	0.3
CT_Mid-Connecticut_Project_ (CRRA)	0.2	0.3
OH_Kyger_Creek	0.2	0.3
NC_Belews_Creek	0.2	0.3
IN_Rockport	0.2	0.3
VA_Chesterfield_Power _Station	0.2	0.3
CT_Southeastern _Connecticut_RRF _(American)	0.2	0.3
KY_Big_Sandy	0.2	0.2
NJ_Camden_RRF	0.2	0.2
CT_Mattabassett _Regional_Sewage _Authority	0.1	0.2
OH_ASHTA_Chemicals_Inc	0.1	0.2
IL_Other_utilities_outside _Chicago_MSA	0.1	0.2
NC_Marshall	0.1	0.2
MI_Central_Wayne_Co. _Sanitation_Authority	0.1	0.2
MD_Phoenix_Services_Inc. _(Formerly_Medical_Waste _Associates)	0.1	0.2
ME_Mid_Maine_Waste_ Action _Corp.	0.1	0.2
CT_Naugatuck_Treatment _Company	0.1	0.2

Tagged Sources to Vermont	kg	%
IL_Other_non-utility_sources_inside_Chicago_MSA	0.1	0.2
DE_Occidental_Chemical_Corporation	0.1	0.2
KY_Paradise_Fossil_Plant	0.1	0.2
RI_Zambarano_Memorial_Hospital	0.1	0.1
GA_Bowen	0.1	0.1
DE_Edge_Moor	0.1	0.1
MI_J._H._Campbell	0.1	0.1
DE_Indian_River	0.1	0.1
IN_Clifty_Creek	0.1	0.1
TN_Kingston_Fossil_Plant	0.1	0.1
RI_Rhode_Island_Hospital	0.1	0.1
WV_PPG_INDUSTRIES_-_INC.	0.1	0.1
GA_Scherer	0.1	0.1
NH_Wheelabrator_Concord	0.1	0.1
KY_H._L._Spurlock	0.1	0.1
IL_Powerton	0.1	0.1
MO_Labadie	0.1	0.1
AL_Gaston	0.1	0.1
RI_Narragansett_Bay_Commission_Fields_Pt.	0.1	0.1
AL_Gorgas	0.1	0.1
IN_Gibson_Generating_Station	0.1	0.1
IL_Other_utilities_inside_Chicago_MSA	0.1	0.1
RI_Woonsocket_WWTF/NET_Co	0.1	0.1
IN_Tanners_Creek	0.1	0.1
MI_St_Clair_Power_Plant	0.1	0.1
VA_NASA_Refuse-fired_Steam_Generator	0.1	0.1
AL_Miller	0.1	0.1
WI_Pleasant_Prairie	0.1	0.1
GA_Wansley	0.1	0.1
NC_BMW_NC	0.1	0.1
TN_Johnsonville_Fossil_Plant	0.1	0.1

7. APPENDIX B: QUALITY ASSURANCE PROJECT PLAN

1.1 Title and Approval Page

Quality Assurance Project Plan for the NEIWPCC Mercury Project

January 23, 2008

New England Interstate Water Pollution Control Commission (NEIWPCC)
116 John Street
Boott Mills South
Lowell, MA 01852-1124
978.323.7929

Northeast States for Coordinated Air Use Management (NESCAUM)
101 Merrimac Street
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APPROVAL SIGNATURES

Arthur Marin, Executive Director, NESCAUM	Date
Michael Jennings, Quality Assurance Manager, NEIWPCC	Date
Charla Rudisill, Quality Assurance Manager, NESCAUM	Date
Susannah L. King, Project Manager, NEIWPCC	Date
Paul J. Miller, Project Manager, NESCAUM	Date
John Graham, QA Reviewer, NESCAUM	Date
Jeri Weiss, Project Officer, U.S. EPA Region 1	Date
Quality Assurance Officer, U.S. EPA Region 1	Date

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1.2 QAPP Distribution List

Arthur Main, NESCAUM, Executive Director
Paul Miller, NESCAUM, Deputy Director & Project Manager*
Susannah L. King, NEIWPCC, Project Manager*
Michael Jennings, NEIWPCC, Quality Assurance Manager
Gary Kleiman, NESCAUM, Science and Technology Team Leader
Charla Rudisill, NESCAUM, Quality Assurance Manager
John Graham, NESCAUM**,** QA Reviewer
Jeri Weiss, U.S. EPA Region 1, Project Officer
U.S. EPA Region 1, Quality Assurance Officer

*Primary Contacts

1.3 Purpose and Background

Purpose

The purpose of this project is to compile existing REMSAD modeling information on mercury deposition in the NEIWPCC region and apportion it by source region and major source category. This will be useful in regulatory and policy decisions, for example relating to TMDLs for mercury-impaired water bodies. Specifically, the NEIWPCC states will use the REMSAD information to identify and rank (in a relative sense) source regions and individual sources that the model identifies as making a contribution to atmospheric mercury deposition in a NEIWPCC state and in the NEIWPCC region. These source regions and individual sources, therefore, can have an impact on exceedances of a regional Northeast mercury TMDL.

Background

The U.S. Environmental Protection Agency (EPA) has developed a mandatory Agency-wide Quality Assurance Program that requires all organization performing work for EPA to develop and operate management processes for assuring that data or information collected are of the needed and expected quality for their intended use. It also required that environmental technology used for pollution control is designed, constructed, and operated according to defined specification and protocols. These requirements apply to all organizations that conduct environmental data operations on behalf of EPA through contracts, financial assistance agreements, and interagency agreements.

This document states the Quality Assurance Project Plan (QAPP) by the New England Interstate Water Pollution Control Commission (NEIWPCC) and the Northeast States for Coordinated Air Use Management (NESCAUM) for compiling existing information from modeled mercury deposition in the Northeast. In all data collection activities, it is NESCAUM's intent to provide procedures that ensure the highest level of quality assurance that is appropriate for the intended use of the data.

1.4 Project Objectives and Use of Secondary Data

Objectives

NESCAUM will assist the NEIWPCC states in clarifying various upwind contributions to mercury deposition in the northeastern United States to improve the understanding of mercury deposition in the NEIWPCC region.

Mercury emissions have become of increasing concern in recent years due to mercury's role as a persistent, bioaccumulative, neurotoxic pollutant. When released into the environment and deposited or carried into water bodies, mercury is easily converted to methylmercury, a particularly toxic form of mercury. Methylmercury readily passes up the food chain, accumulating in the tissues of fish and other animals. Ingestion of methylmercury can cause numerous adverse effects in plants, birds, and mammals, including humans.

Use of Secondary Data

NESCAUM and EPA have independently conducted modeling simulations using the REMSAD regional air quality model to better understand the impact of various emitting sources and regions on local ecosystems and populations. A unique aspect of the modeling work is the Particle and Precursor Tagging Methodology (PPTM) feature. The PPTM approach permits the user to track emissions from a specific source, source category, source region, or combination of these by assigning a "tag" to the emissions. The tagging scheme is an accounting system that follows species through space and time in the model without disturbing the physical or chemical processes affecting that species. With careful consideration, the user can establish a model run to assess the impact and influence of several specific modeled sources, source categories, or control measures. This work has supported efforts by the Northeast States under the New England Governors/Eastern Canadian Premieres' Mercury Action Plan (MAP) and other state and federal initiatives to control mercury emissions.

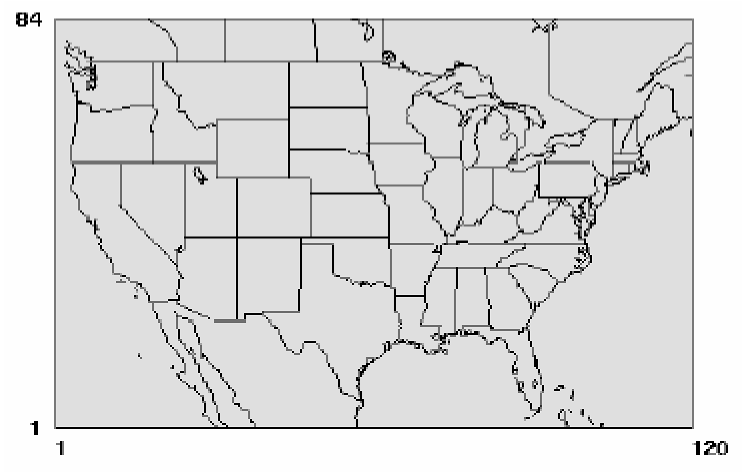
The secondary data used in this project consist of the modeled mercury deposition outputs from the two previous tagged mercury REMSAD modeling investigations. The previous modeling efforts incorporate mercury emission inventory data developed by EPA, the NESCAUM states (CT, ME, MA, NH, NJ, NY, RI, VT), and others. Total mercury deposition outputs from these modeling efforts will be summarized according to upwind contribution from sources or source regions to specific downwind receptors (e.g., defined by state borders or watershed topography). We will use standard Microsoft® Access database management software to summarize the modeled outputs. The Access software is an aid for summarizing the existing modeled data according to various criteria we choose to aggregate the information by, and does not change the values of the modeled data.

1.5 Secondary Data Needed

The secondary data in this project come from two sources:

1. <u>REMSAD modeling by NESCAUM.</u> NESCAUM previously modeled the impact of various mercury source categories on receptors (grid cells) downwind by analyzing the mercury concentrations located in the surface layer and deposited via wet and dry deposition. A QAPP was separately done for this modeling effort in November 2004 and approved by EPA (EPA Region 1 Project Manager Alison Simcox – see Appendix A). NESCAUM completed the modeling in January 2006 with a final report in October 2007.

The NESCAUM work employed the Regional Modeling System for Aerosols and Deposition (REMSAD version 7.13), which is a three-dimensional Eulerian grid model developed by Systems Applications International, Inc. EPA and others have used the model to simulate the physical and chemical atmospheric processes relevant to atmospheric pollutants, including fine particles and air toxics. The model relies on the continuity equation, which represents the mass balance of each species by mathematically tracking emissions, advection, diffusion, chemical reactions, and removal processes. The requirements and parameters of the modeling exercise are listed below.



<u>Modeling Specifications</u>

REMSAD v7.13
National Domain (lat/long)

<u>Modeling Domain</u>

120 (E-W) by 84 (N-S) grid cells
Cell size (~36 km)
1/2 degree longitude (0.5)
1/3 degree latitude (0.3333)
E-W range: 66º W - 126º W
N-S range: 24º N - 52º N
Vertical extent: Ground to 16,200 meters (100mb) with 12 layers

<u>Datasets</u>

<u>Emissions Inventories</u> – The emission inventories developed or obtained by NESCAUM were the subject of a previous QAPP (separate from the modeling QAPP referenced above) in November 2004, and approved by EPA (EPA Region 1 Project Manager Alison Simcox – see Appendix B).

<u>Mercury emissions:</u>

- For emissions <u>outside</u> Northeast:
  - EPA's 1996 Hg inventory for the Clear Skies Act
  - 2000 Canadian Hg Emissions (inventory provided by EPA)
- For emissions <u>within</u> Northeast
  - NESCAUM's Hg updated inventory for 2002/03

Criteria pollutants emissions:

- 2001 “proxy” surface and point emission files for criteria pollutants provided by EPA via Clear Skies Act of 2003.

Meteorology

- 1996 36 km 12 layer meteorology (provided by EPA)

2. REMSAD modeling by ICF International under contract to the EPA Office of Water. This effort for EPA applied REMSAD to support an analysis of the sources of airborne mercury and their contribution to water quality impairment and fish contamination throughout the continental U.S. The objective of the study was to use atmospheric deposition modeling to quantify contributions of specific sources and source categories to mercury deposition within each of the lower 48 states. The results of the study were expected to provide state and local air and water quality agencies with 1) an improved understanding of the sources and mechanisms contributing to mercury deposition and 2) supporting information for future analyses of Total Maximum Daily Loads (TMDLs) and identification of effective control measures for achieving water quality standards. The final report to EPA on this work is dated November 30, 2006.

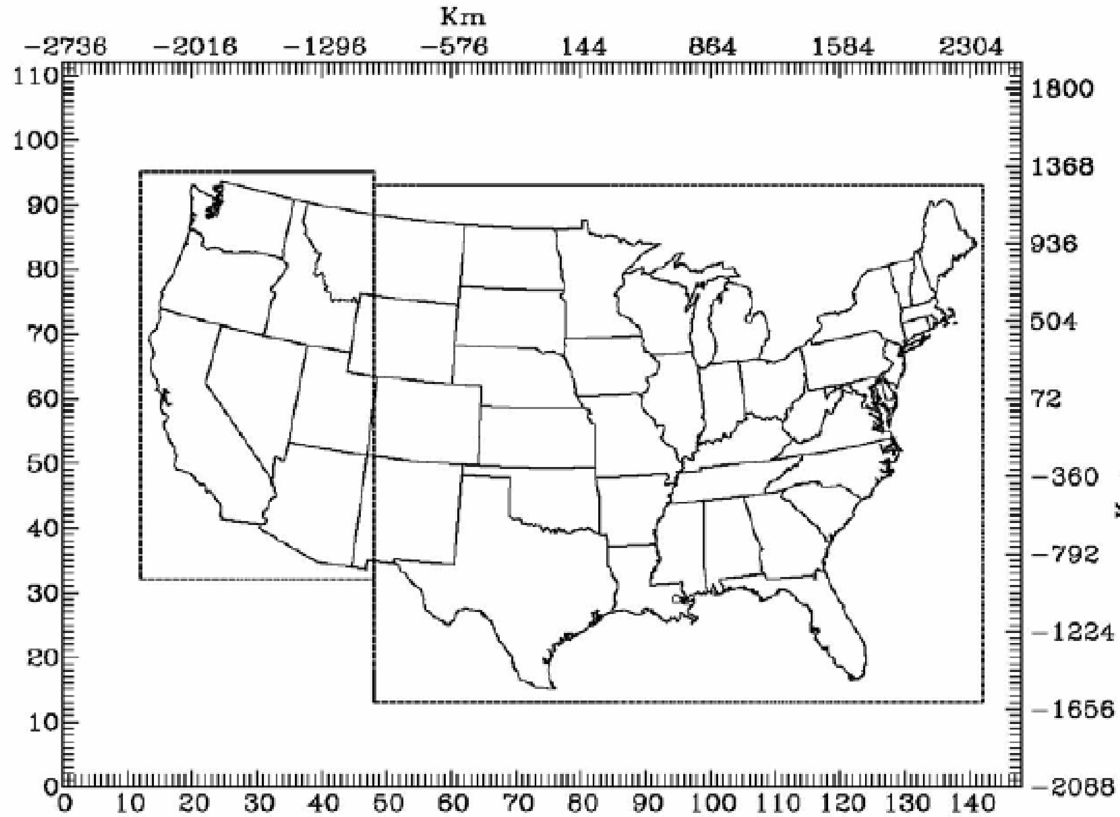
Modeling Specifications

REMSAD v8
National Domain (lat/long)

Modeling Domain (see figure below)

36 km outer grid
Two 12 km nested inner grids over eastern three quarters and western quarter of U.S., encompassing entire U.S. at 12 km scale grid resolution

Horizontal Resolution is 36 km for the Outer Grid and 12 km for the Two Inner Grids.



2001 Domain for OW 300 tag Hg modeling

Datasets

Emissions Inventories

Mercury emissions:

- U.S. and Canada - 2001 Clean Air Mercury Rule inventory from EPA with documented state-specific changes from EPA regional offices and their member states where necessary (described in ICF report).
- Mexico – 1999 point source mercury emissions from the Commission for Environmental Cooperation, *Preliminary Atmospheric Emissions Inventory of Mercury in Mexico, Report No. 3.2.1.04*, 2001 (www.cec.org).

Criteria pollutants emissions:

- 2001 emission inventory for criteria pollutants prepared by EPA for the Clean Air Interstate Rule.

Meteorology

- 2001 36 km meteorology from MM5 prepared by EPA for the Clean Air Interstate Rule and Clean Air Mercury Rule

1.6 Data Analysis

NESCAUM will take the extensive individual source-tagging already conducted by the EPA Water Program and use Microsoft® Access database management software to provide a state-by-state source apportionment of contributing upwind states to downwind mercury deposition in selected areas. Summarizing the REMSAD data with Access will not create new or alter existing data from the modeling studies (hence it does not introduce additional uncertainty sources to the modeled data). It will summarize and display the existing REMSAD mercury deposition outputs according to regions of interest selected by NESCAUM.

1.7 Responsibilities

Commitment to and direct responsibility for the quality objectives and operations detailed in this QAPP begins with the NESCAUM Executive Director and continues through to the Project Managers. The authority and responsibility for directing QA activities within NESCAUM and NEIWPCC have been delegated to the designated QAMs. The QAMs will not be directly involved in compiling and evaluating data and data sources.

Paul Miller, NESCAUM, and Susannah King, NEIWPCC, the Project Managers, will oversee the compilation and reporting of data taken from existing sources (i.e., secondary data). QA review will be conducted by John Graham, NESCAUM QA Reviewer. Jeri Weiss is the EPA Region 1 Project Manager.

Name	**Title**	**Mailing Address**	**Phone number**	**Email address**
Arthur Marin	NESCAUM, Executive Director	NESCAUM 101 Merrimac St. 10 floor Boston, MA 02114	617-259-2017	amarin@nescaum.org
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Susannah King	NEIWPCC, Project Manager	NEIWPCC 116 John Street Boott Mills South Lowell, MA 01852	978-323-7929	sking@neiwpcc.org
Michael Jennings	NEIWPCC, Quality Assurance Manager	NEIWPCC 116 John Street Boott Mills South Lowell, MA 01852	978-323-7929	mjennings@neiwpcc.org
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	Quality Assurance Manager	101 Merrimac St. 10 floor Boston, MA 02114		
John Graham	NESCAUM, QA Reviewer	NESCAUM 101 Merrimac St. 10 floor Boston, MA 02114	617-259-2023	jgraham@nescaum.org
Jeri Weiss	EPA Region 1, Project Officer	EPA Region 1 1 Congress Street Suite 1100 Boston, MA 02114	617-918-1568	weiss.jeri@epa.gov
	EPA Region 1, Quality Assurance Officer	EPA New England Regional Laboratory 11 Technology Drive North Chelmsford, MA 01863		

1.8 Project Schedule and Deliverables

NESCAUM will compile and summarize the modeling data sources in a draft report for delivery on or before February 15, 2008. NESCAUM will consider and revise the draft summary report on or before March 15, 2008.

2.1 Sources of Secondary Data

The two REMSAD modeling information sources are:

1. Northeast States for Coordinated Air Use Management (NESCAUM), *Modeling Mercury in the Northeast United States*, (Boston, MA) October 2007. Submitted to the Massachusetts Department of Environmental Protection and U.S. EPA Region 1.

2. ICF International, *Model-based Analysis and Tracking of Airborne Mercury Emissions to Assist in Watershed Planning*, Final Report (San Rafael, CA) November 30, 2006. Prepared for EPA Office of Water, Washington, DC.

2.2 Data Generators

The secondary data used in this project were generated by the organizations listed in Section 2.1 above. Inventory information used as inputs into the modeling studies largely come from EPA inventories, with specific corrections provided by EPA regional offices, states, and internal quality checks by each organization. The modeling information was generated over the 2005-2006 time period.

2.3 Source Hierarchy

There is no data source hierarchy in this project.

2.4 Data Source Selection Rationale

The data sources are the only two modeling efforts that generated tagged mercury deposition data specific to the region of interest in the Northeast. Both efforts used emission inventory inputs developed and reviewed by EPA and the states.

2.5 Identification of Data Sources

The sources of secondary data gathered in this project will be identified in the project deliverable.

3.1 Data Quality Requirements

The REMSAD modeling performed by NESCAUM, along with the mercury inventory inputs, were subject to prior QAPPs approved by EPA Region 1 (Alison Simcox, Region 1 Project Officer). The generated data are specifically intended for their use in this project – modeling the contribution of mercury emissions from upwind regions or sources to downwind total mercury deposition. Likewise, the REMSAD modeling performed by ICF International generated data that is specifically intended for the same use as this project. The ICF modeling data were prepared for the EPA using EPA emission inventory inputs.

3.2 Determining Data Quality

Given that EPA has used the REMSAD model for mercury, we assume that a certain amount of model validation has been performed already. In this project, we will assess data quality in both the NESCAUM and ICF studies by relying on each study's reported model performance evaluations. In each study, modeled deposition results were compared to studies using different models (e.g., RELMAP, CMAQ), as well as available monitored data, although this is known to be both sparse and of variable quality.

The sources of uncertainty in REMSAD outputs, similar to other Eulerian-based air quality models, include incomplete knowledge of atmospheric mercury chemistry, wet and dry deposition, initial and boundary conditions, emission inventories, and domain grid resolution. ICF noted in its report to EPA on its REMSAD modeling results that, "all model simulation results include some uncertainty, and that uncertainty is often difficult to quantify. Therefore, although [ICF] may report contribution values to tenths of a percent, this is done to cover values that range widely in magnitude, not because of actual precision to that level. The contribution results should be viewed in a relative sense more than an absolute sense." This is the manner in which this project is using REMSAD modeling data.

3.3 Special Training/Certifications

The data in this project are provided by EPA and require no certification to use. While there is no special training specific to this project, Dr. John Graham and Dr. Paul Miller are Ph.D.-trained scientists familiar with the handling of large datasets and have many years experience in evaluating and interpreting air quality modeling results. Dr. Graham has relevant direct experience in applying REMSAD and its tagging feature for assessing mercury deposition contributions in the Northeast. Dr. Miller has relevant direct experience in developing mercury emission inventories for modeling applications.

3.4 Documents and Records

Document and record storage at NESCAUM is the responsibility of individuals charged with performing the tasks associated with this function. NESCAUM has established a controlled-access central file system. All NESCAUM employees have access to these files during normal business hours.

So that NESCAUM may assure availability of requested information, members of the public are required to schedule an appointment to review NESCAUM files. All files will remain in the possession of NESCAUM.

Confidential documents are stored in secure areas. Procedures for chain of custody and confidentiality for evidentiary documents and records are documented in all QAPPs and other quality assurance plans.

File maintenance is the responsibility of all NESCAUM employees. Employees are required to file their own documents or have this task done by support staff according to NESCAUM policy. Files are kept on-site.

NESCAUM is providing the following information under this project:

1. Summary tables of mercury deposition values generated by REMSAD, in Microsoft® Access.
2. One draft and one final report (with copies) in Microsoft® Word and hardcopy to be submitted to NEIWPCC describing the summary of the REMSAD results contained from item 1 above. Elements in report are described in Section 4.3 below.

Version control, updates, distribution, and disposition are maintained or performed by the NESCAUM Project Manager Paul Miller and the NESCAUM QA Manager Charla Rudisill.

NESCAUM stores both financial and programmatic files for the appropriate length of time as determined in NESCAUM's Federal Assistance Agreements.

NEIWPCC may implement, at its discretion, various audits or reviews of this project to assess conformance and compliance to the quality assurance project plan in accordance with the NEIWPCC Quality Management Plan.

4.1 Data Reduction Procedures

There are no data reduction procedures *per se* in this project. Initially, NESCAUM planned to use a software data management tool developed by the consultant ESRI under a contract from EPA called AggreGATOR to manage and visualize the REMSAD deposition data according to various attributes. AggreGATOR is a GIS database tool (an enhanced version of ARC-Hydro) that allows users to extract the REMSAD deposition results for any grid cell or combination of grid cells and calculate the simulated contribution from each tagged source or source category to any location, area, or hydrologic zone in the modeling domain. EPA provided a beta version of this tool to NESCAUM.[1]

After initial trials, NESCAUM has decided it is more efficient to use standard Microsoft® Access database management software to manage the REMSAD output data rather than using the AggreGATOR tool. While it is different software, the intended uses are identical. NESCAUM will use Microsoft® Access to extract the REMSAD deposition results for any grid cell or combination of grid cells and sum the simulated contribution from each tagged source or source category to the grid or collection of grid cells (the cells can correspond to any location, area, or hydrologic zone in the modeling domain). NESCAUM is using the Access software for database management, and will not alter the REMSAD data. Therefore, use of Access introduces no additional uncertainty to the modeled data beyond that already associated with the REMSAD model.

4.2 Data Validation Procedures

No new data are being created by this project. Secondary data drawn from previous NESCAUM modeling of mercury deposition using REMSAD were created under previous QAPPs (modeling and emissions inventory) approved by EPA Region 1. Data from the ICF REMSAD modeling effort supported by EPA will be used as provided. While the two modeling outputs are not directly comparable due to differences in year modeled (i.e., meteorology) and emission inventory inputs, NESCAUM will qualitatively cross compare the results and document any major differences.

4.3 Project Product

The project product will be a report to NEIWPCC summarizing the REMSAD mercury deposition modeling relevant to the NEIWPCC states with source attributions. This is expected to help support future consultations among the NEIWPCC states and with out-of-region contributors to mercury deposition in the region as the NEIWPCC region seeks to achieve its regional mercury TMDL targets.

[1] Personal communication from Dwight Atkinson, EPA Office of Water, Washington, DC, Atkinson.Dwight@epa.gov, 202-566-1226 (2007). Additional details drawn from a Powerpoint presentation by Atkinson, in June 2007.

The report will include the following elements:

1. Description of ICF REMSAD modeling effort that identifies model inputs (e.g., emissions inventory, meteorology) and summarizes its comparison of modeled deposition outputs to monitored wet deposition data from the Mercury Deposition Network. The description will also include the applicability of the REMSAD data for the intended purpose of this project and identify sources of uncertainties in the REMSAD model outputs.
2. Summary tables of mercury deposition contributions to receptor areas generated by the ICF REMSAD results. The criteria used for the summary tables will include:
   - Contribution of each contributing state to entire NEIWPCC region (New England + New York)
   - Contribution of each contributing state to each of NEIWPCC states
   - Contribution of each major source (individual sources tagged by ICF) in contributing states to entire NEIWPCC region
   - Contribution of each major source in contributing states to each of NEIWPCC states
   - Contribution of entire NEIWPCC region to entire NEIWPCC region
   - Contribution of each NEIWPCC state to each of the other NEIWPCC states

   To the extent any data are excluded, it will be based on a *de minimis* contribution level, i.e., considered an insignificant contributor to total deposition in a receptor region. If a *de minimis* level is used, the level and reasoning for choosing such a level will be given in the report.
3. Qualitative comparison of NESCAUM REMSAD results with the ICF REMSAD results.

Appendix A: Quality Assurance Project Plan for the Mercury Modeling Project

November 30, 2004

Northeast States for Coordinated Air Use Management (NESCAUM)
101 Merrimac Street
10th Floor
Boston, MA 02114
617.259.2000

APPROVAL SIGNATURES

Executive Director, NESCAUM

________________________________ ______________
Kenneth A. Colburn Date

Quality Assurance Manager, NESCAUM

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Charla Rudisill Date

Project Manager, NESCAUM

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Arthur Marin Date

Inventory Manager, NESCAUM

________________________________ ______________
Matthew Irvine Date

QA Reviewer, NESCAUM

________________________________ ______________
Jung-Hun Woo Date

Project Officer, USEPA Region I

________________________________ ______________
Alison Simcox Date

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1.0 Background and Project Definition

Background

The US Environmental Protection Agency (EPA) has developed a mandatory Agency-wide Quality Assurance Program that requires all organization performing work for EPA to develop and operate management processes for assuring that data or information collected are of the needed and expected quality for their intended use. It also required that environmental technology used for pollution control is designed, constructed, and operated according to defined specification and protocols. These requirements apply to all organizations that conduct environmental data operations on behalf of EPA through contracts, financial assistance agreements, and interagency agreements.

This document states the Quality Assurance Project Plan (QAPP) for modeling the 2003 mercury point and area source inventory by the Northeast States for Coordinated Air Use Management (NESCAUM). In all data collection activities, it is NESCAUM's intent to provide procedures that ensure the highest level of quality assurance that is appropriate for the intended use of the data.

It is the policy of NESCAUM that all NESCAUM activities that generate environmental data will be part of a Quality Assurance Program (QAP) and will be documented within the framework of a Quality Assurance Management Plan (QAMP). This project is subject to the overall QAP for NESCAUM, which is attached in Appendix A. The environmental data generated in this project will also be subject to the following QA Project Plan (QAPP), which specifies the detailed procedures required to assure production of quality data. This QAPP has been prepared by the project manager, and reviewed and approved by the Quality Assurance Manager (QAM) prior to the start of any data collection.

Problem Definition

Fish consumption advisories are in effect in the northeast region due to the potentially hazardous levels of mercury that bioaccumulate in freshwater and marine fish. Mercury is a potent neurotoxin affecting children and the developing fetus. The principal source of mercury to the aquatic food chain is known to be atmospheric deposition from local and long-range emission sources. In 1998, the Northeast states worked with the U.S. EPA to model mercury deposition based on an updated emission inventory of stationary sources in the region. The study was designed to provide a better understanding of the dispersion and deposition of mercury emitted by sources within the region, outside the region, and the relative contribution of the global reservoir. Currently, the northeast states are in the process of updating the mercury inventory for the northeast region used in the 1998 report by including new sources and improving emission estimates for existing sources. This project will model the updated mercury inventory to provide deposition estimates in the region. The project will provide input to a broader effort that is developing an integrated approach for assessing the effects of mercury from the atmosphere and from point and non-point sources on watersheds and, ultimately, fish populations.

2.0 Project Objectives, Organization, and Responsibilities

Project Objectives

The purpose of this project is to conduct deposition modeling of mercury in the Northeast region of the U.S., based on an updated inventory.

Two specific goals are:

1. To determine mercury deposition in the NESCAUM region and apportion in by source region and major source category.

2. To provide input (i.e., loading) values to aquatic and ecological models that may prove useful in regulatory and policy decisions, for example relating to TMDL development for mercury impaired water bodies.

The data quality objective (DQO) is to provide first order estimates of mercury deposition by modeling the improved (2002-3) emission inventory for mercury in the northeast along with other air quality model inputs provided by EPA from its regulatory development for Clear Skies.

NESCAUM Organization

Commitment to and direct responsibility for the quality objectives and operations detailed in this QAPP begins with the Executive Director and continues through to the Project Manager, and Inventory Manager. The authority and responsibility for directing QA activities within NESCAUM have been delegated to the designated QAM. The QAM will not be directly involved in generating, compiling, and evaluating raw data.

Arthur Marin, the Project Manager, and Matthew Irvine, Inventory Manager, will oversee the technical review of the inventory. QA review will be conducted by Emily Savelli and Jung-Hun Woo, QA Reviewers. Alison Simcox is the EPA-NE Project Manager.

Distribution List

Kenneth A. Colburn, NESCAUM, Executive Director
Arthur Marin, NESCAUM, Project Manager
Matthew Irvine, NESCAUM, Inventory Manager
Charla Rudisill, NESCAUM, Quality Assurance Officer
Emily Savelli, NESCAUM, QA Reviewer
Jung-Hun Woo, NESCAUM**,** QA Reviewer*
Alison Simcox, EPA-NE, Project Manager

***Primary Contact**

Responsibilities

Name	Title	Mailing Address	Phone number	Email address
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Matthew Irvine	NESCAUM, Inventory Manager	NESCAUM 101 Merrimac St. 10 floor Boston, MA 02114	617-259-2000	mirvine@nescaum.org
Charla Rudisill	NESCAUM, Quality Assurance Officer	NESCAUM 101 Merrimac St. 10 floor Boston, MA 02114	617-259-2036	crudisell@nescaum.org
Emily Savelli	NESCAUM, QA Reviewer	NESCAUM 101 Merrimac St. 10 floor Boston, MA 02114	617-259-2034	esavelli@nescaum.org
Jung-Hun Woo	NESCAUM**,** QA Reviewer	NESCAUM 101 Merrimac St. 10 floor Boston, MA 02114	617-259-2087	jwoo@nescaum.org
Alison Simcox	USEPA-Region 1	1 Congress Street Suite 1100 Boston, MA 02114	617-918-1684	simcox.alison@epa.gov

3.0 Specific Tasks

The modeling team is conducting quality control and verification checks on the input to ensure accuracy and completeness. Quality assurance of inventory development/prepeartion, emissions modeling/processing, and air quality modeling results is very important. Since we will develop an updated Hg inventory for the Northeast US for 2002-2003, it is important to analyze differences 1) by years, 2) by regions, and 3) by source sectors to estimate their impacts on Hg emissions and deposition. Air quality modeling combines many complex procedures that include disparate datasets and numerous processing steps. Therefore, it is critical that quality assurance be performed on each step (e.g. inventory development/preparation, emissions modeling/processing, air quality modeling) prior to being used by the next step.

Task 1: Review/validate NESCAUM and other inventories

A separate QAPP has been developed for the Hg emissions inventory development/preparation component of this project. The review process includes the following:

- Margaret M. Round and Matthew Irvine, Inventory Manager will develop the NESCAUM emissions inventory by coordinating a review with the NESCAUM Hg Inventory Workgroup and appropriate EPA staff, investigating other emissions databases, and scientific research results. Any emission inconsistencies among years/regions/sectors without properly documented reasons will be investigated and corrected.

- Emily Savelli and Jung-Hun Woo, QA reviewers at NESCAUM, will prepare summary contents of data to help identify errors.

- Matthew Irvine of NESCAUM will provide a final inventory in SMOKE/IDA-friendly format to the QA Reviewers for QA and further processing.

- NESCAUM has the 1996 Clear Skies Act (CSA) Hg and 2001 CSA criteria emission inventory for point, area, and mobile sources in-house. They will be downloaded from EPA's ftp site [2]in SMOKE/IDA format.

- NESCAUM will obtain a copy of a recent Canadian Hg Emissions Inventory from the US EPA and process it for integration with US data.

[2] (ftp://ftp.epa.gov/pub/modelingcenter/Clear_skies/CSA2003/Emissions/1996/)

Task 2: QA Reviewers will conduct appropriate QA review for emissions processing

Emissions processing will be conducted using SMOKE emissions processor and some other processing software developed internally at NESCAUM. Emissions processing can be classified into three major components: a) SMOKE-ready inventory preparation, b) emissions tagging by regions and by source sectors, c) air quality model-ready emissions processing using SMOKE.

a. SMOKE-ready inventory preparation

QA tasks include (1) check consistency in SCC codes to ensure whether emissions inventories are classified in the correct classification system, and (2) check any unexpected source dropping or double counting during inventory processing.

b. Emissions tagging by regions and by source sectors

Tagging emissions is necessary to model/analyze concentration/deposition fields for pre-defined scenarios. Emissions tagging will be conducted using software developed in-house by NESCAUM. This software will tag emissions and then generate the corresponding SMOKE/IDA format input file. However, the SMOKE emissions processor has to be changed since the present SMOKE version cannot recognize tagged emissions. An emissions data consistency check for pre- and post- NESCAUM in-house processing as well as the updated-SMOKE emissions processing will be conducted to ensure no loss or gain of emissions occurs.

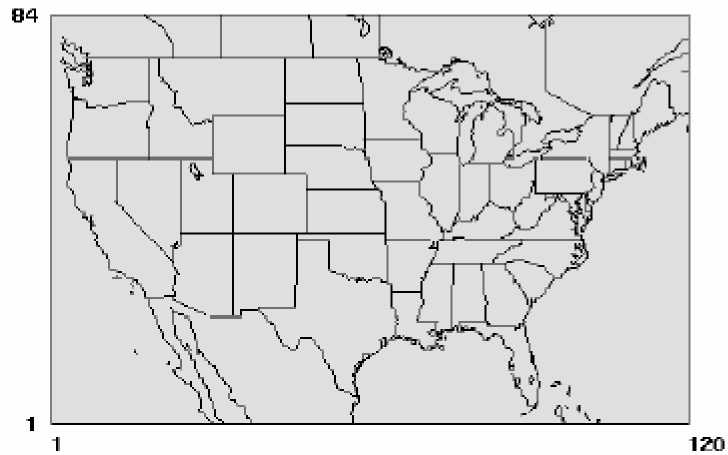
c. Air quality model-ready emissions processing using SMOKE

After preparing the SMOKE-ready tagged emissions inventory and modifying the SMOKE parameter files, standard emissions processing (e.g., spatial/temporal allocation and chemical speciation) will be conducted. We will import the desired inventories into SMOKE using the Smkinven program then apply the profile data using the necessary SMOKE programs (Grdmat (spatial), Spcmat (speciation) and Temporal). The scripts, configuration, and assigns files used will be checked to ensure that correct input data and environment variable settings are used. Any possible technical errors will be found and corrected by examination of log files in each of the processing programs. The pre- and post- data consistency check for each program will be conducted using Smkreport. The gridded inventory will be visualized using tools (e.g., PAVE) to create plots with the scale set to a very low value to determine whether there are areas omitted from the raw inventory or if emissions sources are erroneously located in water cells. We will visualize the gridded inventory using PAVE plots for each inventory pollutant to evaluate emissions distributions and look for erroneous state trends (groups of states or counties with excessively high, low or missing emissions).

Task 3: Atmospheric Modeling

Model

The objective of the modeling is to investigate the impact of various source categories on receptors (grid cells) downwind by analyzing the Hg concentrations located in the surface layer and deposited via wet and dry deposition.



Modeling Specifications

REMSAD v7.13
National Domain (lat/long)

Modeling Domain

120 (E-W) by 84 (N-S) grid cells
Cell size (~36 km)
1/2 degree longitude (0.5)
1/3 degree latitude (0.3333)
E-W range: 66º W - 126º W
N-S range: 24º N - 52º N
Vertical extent: Ground to 16,200 meters (100mb) with 12 layers

Datasets

Emissions Inventories

Hg emissions:

- For emissions outside Northeast:
  - US EPA's 1996 Hg inventory for CSA
  - 2000 Canadian Hg Emissions (inventory provided by US EPA)
- For emissions within Northeast
  - NESCAUM's Hg updated inventory for 2002/03

Criteria pollutants emissions:

- 2001 "proxy" surface and point emission files for criteria pollutants provided by US EPA via Clear Skies Act of 2003.

Meteorology

- 1996 36km 12 layer Meteorology (provided by US EPA)

Modeling Run

The model will be run to determine the impact of different source categories and regional emissions in the northeast.

Specifically:

- Assess deposition of source categories that are tagged in four regions: New England vs. Northeast (i.e., NY & NJ) vs. Rest of US vs. Canada.

Therefore, the runs are based on:

2001 proxy criteria pollutant inventory +1996 Hg inventory + Northeast Hg inventory with NESCAUM's 2002/03 Hg inventory +Canadian inventory

Modeling Tags

Mercury Region-Tags:

(1) New England
(2) NY + NJ (Northeast = Tag (1) + Tag (2))
(3) Outside the Northeast (i.e., rest of US)
(4) Canada*

Mercury Source-Tags:

(1) utility boilers
(2) municipal waste combustors (MWC) and medical waste incinerators (MWI)
(3) sewer sludge incinerators (SSI)
(4) rest of point sources (not tagged above)
(5) area sources (stationary area + non-road)
(6) on-road mobile

* Only limited source tag will be applied to Canadian emissions inventory

Task 4: Quality Assurance of other inputs for and results from the model

Given that EPA has used this model for mercury it is assumed that a certain amount of model validation has been performed already. The meteorology will be used as developed for EPA's previous REMSAD applications. Other input files (e.g., land cover) will also be used as provided. Boundary (BC) and Initial (IC) condition files will be developed using available information from literature and previous applications of the model. One approach that may be used to assess the impact of mercury flux through the boundaries will be to tag those inputs. This will provide a means to evaluate extra continental transport and other long range transport, given the atmospheric lifetime of elemental mercury. If the boundary conditions are deemed to be erroneous, a first order correction on the results could be achieved without re-running the model, providing a separate tag is available for the BCs.

Model results will be compared to available monitored data, although this is known to be both sparse and of variable quality. Since the combination of model inputs are a mixture of data from different years (1996 meteorology, various EI, BC/IC based on available information), a true model validation cannot be performed. Instead, the comparison seeks only to assess the various ranges and spatial characteristics of modeled deposition results versus monitored results.

Task 5: Documentation and Modeled Output

A final report will be prepared at the completion of the project. This report will summarize the motivation for the project and briefly review the development of the NESCAUM region emission inventory, referencing the detailed emission inventory development documentation. The model set up and inputs will be overviewed with appropriate caveats and limitations noted. Emission totals will be tabulated by region and by source sector (tag). Results of the modeling will be presented graphically, displaying deposition totals as annual and seasonal averages with regional and categorical divisions.

The annual and seasonal deposition and surface layer concentration results will be provided to EPA for use as input values for other ongoing efforts including deposition modeling (Dartmouth College), modeling of spatial distribution of mercury in fish (MERGANSER model by USGS). Long-term average results will be formatted as GIS (ArcInfo or Arcview) gridded files, in addition to the simple gridded ASCII model averaged output. Additional detailed output files will be saved and provided to EPA and will include results for all modeled species in addition to mercury. These data files will also contain all model vertical levels and hourly time resolution, along with deposition results.

4.0 Documents and Records

Document and record storage at NESCAUM is the responsibility of individuals charged with performing the tasks associated with this function. NESCAUM has established a controlled-access central file system. All NESCAUM employees have access to these files during normal business hours.

So that we may assure availability of the requested information, members of the public are required to schedule an appointment to review NESCAUM files. All files will remain in the possession of NESCAUM.

Confidential documents are stored in secure areas. Procedures for chain of custody and confidentiality for evidentiary documents and records are documented in all QAPPs and other quality assurance plans.

File maintenance is the responsibility of all NESCAUM employees. Employees are required to file their own documents or have this task done by support staff according to NESCAUM policy. Files are kept on-site.

- Appendix B: Quality Assurance Project Plan for the Mercury Emissions Inventory Project

November 30, 2004

Northeast States for Coordinated Air Use Management (NESCAUM)
101 Merrimac Street
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Boston, MA 02114
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APPROVAL SIGNATURES

Executive Director, NESCAUM

______________________________	______________
Kenneth A. Colburn	Date

Quality Assurance Manager, NESCAUM

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Charla Rudisill	Date

Project Manager, NESCAUM

______________________________	______________
Arthur Marin	Date

Inventory Manager, NESCAUM

______________________________	______________
Matthew Irvine	Date

Project Officer, USEPA Region I

______________________________	______________
Alison Simcox	Date

Table of Contents

1.0 Background and Project Definition

Background

The US Environmental Protection Agency (EPA) has developed a mandatory Agency-wide Quality Assurance Program that requires all organizations performing work for EPA to develop and operate management processes for assuring that data or information collected are of the needed and expected quality for their intended use. It also requires that environmental technology used for pollution control is designed, constructed, and operated according to defined specification and protocols. These requirements apply to all organizations that conduct environmental data operations on behalf of EPA through contracts, financial assistance agreements, and interagency agreements.

This document states the Quality Assurance Project Plan (QAPP) for updating the mercury point and area source inventory by the Northeast States for Coordinated Air Use Management (NESCAUM) for 2000-2003. In all data collection activities, it is NESCAUM's intent to provide procedures that ensure the highest level of quality assurance that is appropriate to the intended use of the data.

It is the policy of NESCAUM that all NESCAUM activities that generate environmental data will be part of a Quality Assurance Program (QAP) and will be documented within the framework of a Quality Assurance Management Plan (QAMP). This project is subject to the overall QMP for NESCAUM, which is attached in Appendix A. The environmental data generated in this project will also be subject to the following QA Project Plan (QAPP), which specifies the detailed procedures required to assure production of quality data. This QAPP has been prepared by the project manager, and reviewed and approved by the Quality Assurance Manager (QAM) prior to the start of any data collection.

Problem Definition

Fish consumption advisories are in effect in the northeast region due to the potentially hazardous levels of mercury that bioaccumulate in freshwater and marine fish. Mercury is a potent neurotoxin affecting children and the developing fetus. The principal source of mercury to the aquatic food chain is known to be atmospheric deposition from local and long-range emission sources. The inventories will be used to support state and federal activities related to the assessment and control of mercury emissions in the region. This includes the regional GIS-based models of Hg in fish tissue. These models, which integrate air deposition, watershed characteristics, and fish tissue data, are intended to be a tool for assessing mercury impaired water bodies through the region. In addition, the inventory will be used to support fulfillment of the NEG-ECP Mercury Action Plan milestones of 50% reduction in emissions from 1998-2003 and 75% reduction in 2010.

2.0 Project Objectives, Organization, and Responsibilities

Project Objectives

The purpose of this project is to prepare a comprehensive emissions inventory for point and area sources for the year 2003 for the Northeast region. The approach will use the U.S. Environmental Protection Agency (EPA) National Emissions Inventory for the year 1999 as a starting point. This 1999 inventory will be updated through a state review process for all states in the Northeast region, with states revising the 1999 inventory to levels reflective of 2003 emissions.

NESCAUM Organization

Commitment to and direct responsibility for the quality objectives and operations detailed in this QAPP begins with the Executive Director and continues through to the Project Manager, and Inventory Manager. The authority and responsibility for directing QA activities within NESCAUM have been delegated to the designated QAM. Charla Rudisill is the QAM at NESCAUM. The QAM will not be directly involved in generating, compiling, and evaluating raw data.

Arthur Marin, Project Manager and Matthew Irvine, the Inventory Manager, will oversee the technical review of the NESCAUM emissions inventory by coordinating a review with the NESCAUM Hg Inventory Workgroup and appropriate EPA staff, investigating other emissions databases, and scientific research results. Any emission inconsistencies among years/regions/sectors without properly documented reasons will be investigated and corrected.. Project managers are responsible for including appropriate QA requirements in all projects. Project managers are responsible for assuring all data generated for a monitoring project is sufficiently reviewed and/or validated to assure its usefulness for the project and that it meets the data quality objective stated in the QA project plan.

Distribution List

Kenneth A. Colburn, NESCAUM, Executive Director
Arthur Marin, NESCAUM, Project Manager*
Matthew Irvine, NESCAUM, Inventory Manager
Charla Rudisill, NESCAUM, Quality Assurance Officer
Alison Simcox, EPA-NE, Project Manager

***Primary Contact**

Responsibilities

The 1999 National Emissions Inventory (NEI) Input Format Version 3.0 (NIF 3.0) files will be distributed to the Mercury Inventory Workgroup[3]. EPA has extensively quality assured the 1999 NEI Version 3.0 based on input for Versions 1 and 2 from the Hg Inventory Workgroup. This inventory will be further reviewed by designated staff from each of the Northeast state air quality agencies that are participating in the Mercury Inventory Workgroup, revised, and returned to NESCAUM. NESCAUM will conduct quality assurance (QA) activities on the inventory submitted by each state to identify any format and/or data content problems. Resolution of any outstanding issues will be conducted through consultation with the Mercury Inventory Workgroup.

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Alison Simcox	USEPA-Region 1	1 Congress Street Suite 1100 Boston, MA 02114	617-918-1684	simcox.alison@epa.gov

[3] List of Mercury Inventory Workgroup

CT	Ellen Pierce	ellen.pierce@po.state.ct.us	617-574-6801
ME	Doug Saball	doug.saball@state.me.us	860-424-3412
MA	Azin Kavian	azin.kavian@state.ma.us	207-287-2437
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3.0 Data Quality Objectives

The main data quality objectives that NESCAUM will work to fulfill include:

- Accuracy and Representativeness– The accuracy and representativeness of the inventory will be determined by the Mercury Inventory Workgroup. Emission calculations will be spot-checked by NESCAUM once the revised inventories are submitted to the Inventory Manager;

- Completeness – As part of the quality control (QC) process, the NESCAUM inventory Manager will identify any significant missing data from the inventories submitted by the Workgroup. If data are missing, the Inventory Manager will contact the state designee directly to fill in any gaps.

It should be noted that the NEI has also undergone extensive QA/QC by U.S. EPA in two rounds of review by the state and local agencies. Specific information on these activities may be found at the following website: www.epa.gov/ttn/chief/eidocs/qa_training.pdf

4.0 Specific Tasks

Task 1: Acquisition of 1999 NEI mercury inventory

NESCAUM will obtain a copy of the 1999 NEI (Version 3) mercury inventory for point and area sources for each of the Northeast states from EPA's CHIEF website in Microsoft Access and covert each state file to a Microsoft Excel worksheet.

Task 2: Distribution of Mercury Inventory to Mercury Inventory Workgroup

The NESCAUM Project Manager will distribute the 1999 NEI mercury inventory to each designee on the Mercury Inventory Workgroup. Each designee will then review the 1999 information within the excel spreadsheet to look for any errors; recent changes, and make appropriate updates. Categories to be reviewed or updated include: plant names, stack information, plant locations, mercury emissions, source classification codes (SCC), source closures and new sources. Upon completion, the updated excel file with changes noted will be returned to NESCAUM.

Task 3: Coordinate states in the review of the mercury inventory

NESCAUM will host a series of conference calls with the Mercury Inventory Workgroup to discuss the review of the inventory, updating of the emission estimates and other information, and resolution of any outstanding issues. The review process will be focused on the accuracy, representativeness, and completeness of the inventory. Any significant changes to the inventory will be documented in the final report for this project.

Task 4: Each state will provide a revised version of the inventory to NESCAUM

Task 5: NESCAUM will undertake QA procedures to ensure the accuracy, representativeness, and completeness of the inventory

The Energy Information Administration (EIA) was used as a comparable database to ensure accurate state emission estimates for utility boilers. The 1999 National Emissions Inventory (NEI) was employed to ensure all sources operating were included in the inventory as well as completing missing portions of information for the inventory. These procedures along with those in Task 3 serve to ensure an accurate and complete inventory for the entire Northeast region. Any changes to the inventory resulting from this task will be documented in the final report for this project.

Task 6: The inventory will be prepared in SMOKE/IDA compatible NIF3.0 export format

Inventory Data Analyzer (IDA) format is a text format that is simpler than NIF3.0 and can be input directly into SMOKE. However, the spreadsheet (e.g. MS Excel) or database (e.g. MS Access) format is an easier format to correct and update during the initial QA process since the user is able to manipulate numbers by field and record. The flat spreadsheet formatted NIF3.0 export files, which include all necessary fields for SMOKE/IDA, are created in EXCEL for easier update and faster conversion into the IDA text format.

NESCAUM will pull annual mercury emissions from these NIF3.0 Emission tables for each source sector and state into one "base" table that will then be used to prepare summary charts and maps. This table will also be designed to include all the necessary fields for SMOKE/IDA format input files. NESCAUM will compare state by state totals as the files are processed. First, emission totals in the base table will be compared to the emission totals generated from the NIF 3.0 tables to ensure that all data are retrieved from the NIF 3.0 tables to support the summaries. The final check will compare emission summaries in the base table to the emission summaries generated from the in-house tagging software to ensure that all data are correctly converted into SMOKE IDA text format.

Task 7: Documentation

Throughout the project an on-going documentation of how the final inventory was generated will be undertaken. The initial documentation will be from EPA's documentation of the 1999 NEI for point and area sources. The comments in the NESCAUM report to EPA will include each emission category estimate documented in terms of the assumptions underlying the estimate, source of the data, degrees of uncertainties, and appropriate considerations governing its use. Emphasis will be focused on major categories such as municipal waste combustors, medical waste incinerators, sewage sludge incinerators, and electric utilities.

5.0 Documents and Records

Document and record storage at NESCAUM is the responsibility of individuals charged with performing the tasks associated with this function. NESCAUM has established a controlled-access central file system. All NESCAUM employees have access to these files during normal business hours.

So that we may assure availability of the requested information, members of the public are required to schedule an appointment to review NESCAUM files. All files will remain in the possession of NESCAUM.

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