Statewide TMDL
for
Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition to Address 122 HUC 14s

Division of Watershed Management
NJDEP

July 15, 2009

Today's Meeting

- What are TMDLs?
- How was the TMDL developed?
- What are the next steps?
- Provide an opportunity for comments (now or in writing before August 14, 2009).

What are TMDLs?

Total Maximum Daily Loads (TMDLs) represent the assimilative or load capacity of the receiving water to be in compliance with SWQS, taking into consideration:

- point sources of pollutants (wasteload)
- nonpoint sources of pollutants (load)
- natural background

When Are TMDLs Required?

TMDLs are required, under Section 303(d) of the federal Clean Water Act, to be developed for waterbodies that cannot meet surface water quality standards after the implementation of technology-based effluent limitations

2008 Integrated List

305(b) Report

SUBLIST 1 & 2: FULL ATTAINMENT; LIMITED ATTAINMENT DATA

SUBLIST 3: INSUFFICIENT DATA TO ASSESS

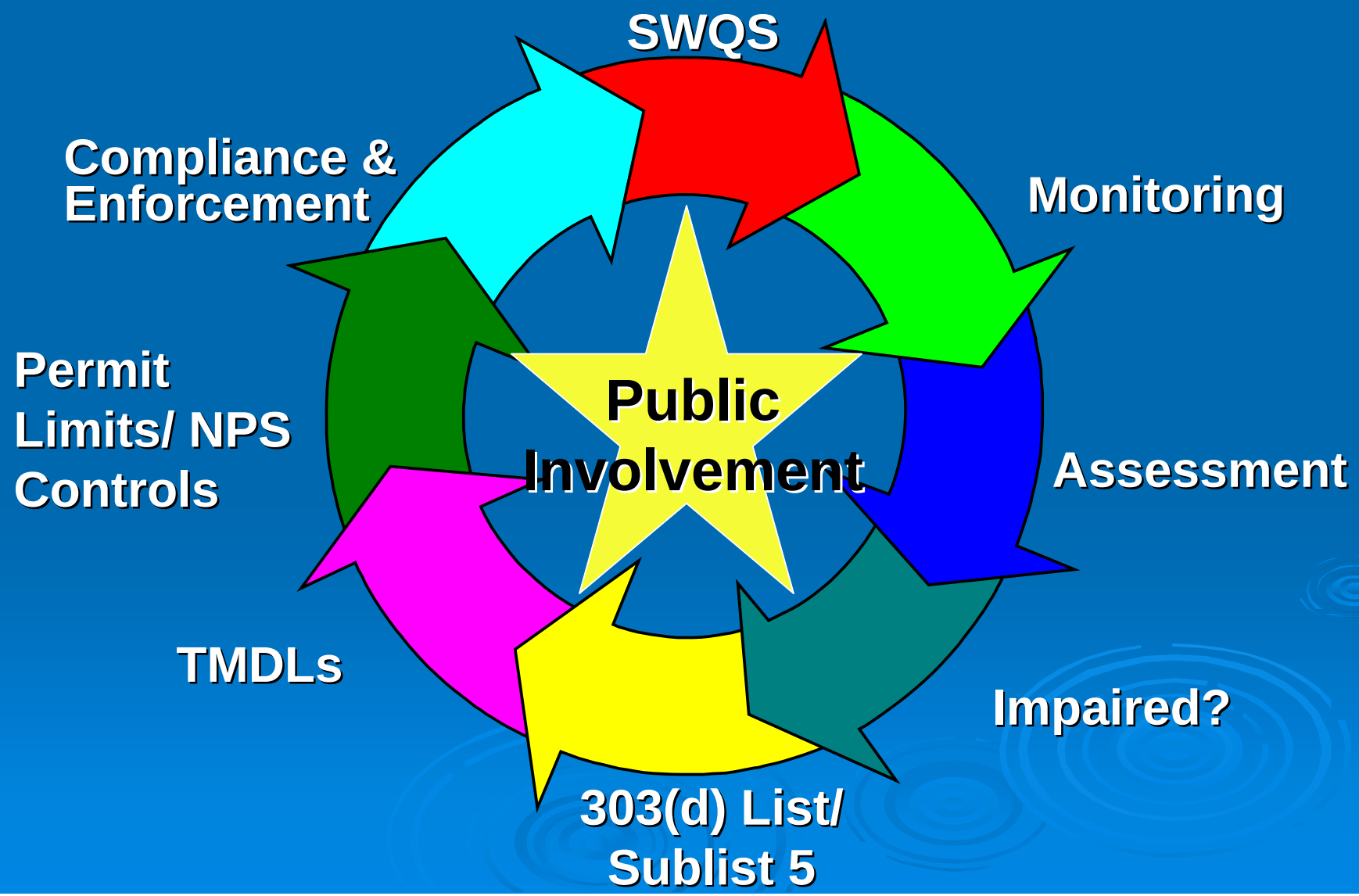
SUBLIST 4: IMPAIRED BUT:

- TMDL DONE
- IMPAIRMENT BY POLLUTION NOT POLLUTANT
- OTHER ENFORCEABLE MEASURE WILL ADDRESS

SUBLIST 5: NON-ATTAINMENT

303(d) List

Watershed Management Approach to TMDLs



Components of a TMDL

Source assessment

- characterization and quantification as necessary
- identify point, nonpoint and background sources

Water quality analysis

- link pollutant sources & water quality: model
- consider seasonal variation / critical conditions

TMDL calculations

- loading capacity
- margin of safety
- load and wasteload allocations

Follow-up Monitoring

Implementation

Public participation

How are TMDLs expressed?

Amount of pollutants that a waterbody can assimilate without violating surface water quality standards or other target

$$TMDL = \sum WLA + \sum LA + MOS$$

Where:

WLA is the wasteload allocation (point sources)

LA is the load allocation (non-point sources)

MOS is the margin of safety

Margin of Safety (MOS)

A required component of the TMDL that accounts for uncertainty concerning the relationship between effluent limitations and water quality (40 CFR 130.79(c))

The MOS shall be expressed either as:

- ✓ An internal modeling factor (an implicit MOS)
- ✓ Or as an explicit, separate factor (N.J.A.C. 7:15-7.7(a))

Fish-Mercury Impairment in NJ

Mercury concentration in fish tissue exceeds 0.07 mg/kg (NJ fish consumption advisory for sensitive population)

256 HUC14s listed in 2008 as fish-mercury impaired

The Approach

Modeled on the Northeast Regional Mercury TMDL established by New England Interstate Water Pollution Control Commission (NEIWPCC) and approved by EPA (2007).

Because Mercury contamination by air deposition is a global problem that cannot be remedied by the actions of a single state, NJ developed a statewide TMDL that would complement the regional efforts in the northeast.

The Approach (cont'd)

A linear response between deposition, ambient concentrations in water, sediments and fish tissue Hg levels.

$$C_{fish} = BAF * C_{water}$$

$$C_{fish\ t1}/C_{fish\ t2} = C_{water\ t1}/C_{water\ t2}$$

$$C_{fish\ t1}/C_{fish\ t2} = L_{\ t1}/L_{\ t2}$$

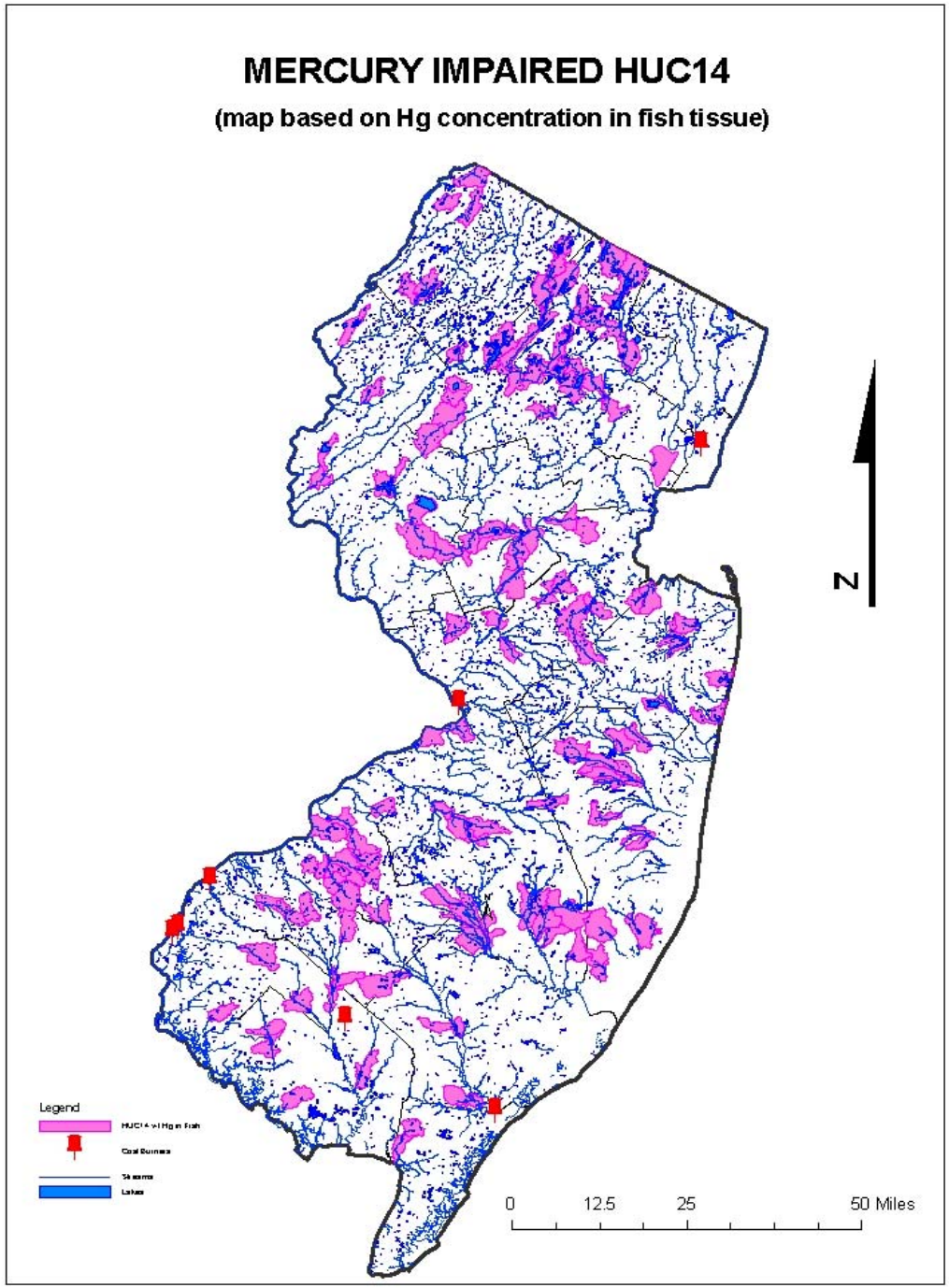
A decrease in Hg emissions will result in a proportional decrease in Hg concentrations in fish.

The Approach (cont'd)

Mercury is bioaccumulative so it is assumed that if the top trophic level fish has acceptable levels of mercury, the lower trophic levels will be acceptable as well.

Current Approach Focuses on Assessment Unit (HUC14) Impairments Where:

- Air deposition is the primary source;
- Watersheds were excluded if:
  - ✓ Hg in surface water above SWQS (>0.050 µg/L);
  - ✓ Tidal Watersheds;
  - ✓ Watersheds with known anthropogenic contamination other than from air.
  - ✓ TMDLs to be handled by the NY/NJ Harbor Estuary progam or DRBC
- A total of 122 HUC14s are addressed in this study


MERCURY IMPAIRED HUC14
(map based on Hg concentration in fish tissue)
N
Legend
0
12.5
25
50 Miles

Target for TMDL

Advisories for the high risk population	
Mercury (TR) Concentration in Fish Tissue	Advisory
Greater than 0.54 µg/g (ppm)	Do not eat
Between 0.19 and 0.54 µg/g (ppm)	One meal per month
Between 0.08 and 0.18 µg/g (ppm)	*One meal per week*
0.07 µg/g (ppm) or less	Unlimited consumption
Advisories for the general population	
Mercury (TR) Concentration in Fish Tissue	Advisory
Greater than 2.81 µg/g (ppm)	Do not eat
Between 0.94 and 2.81 µg/g (ppm)	One meal per month
Between 0.35 and 0.93 µg/g (ppm)	One meal per week
0.34 µg/g (ppm) or less	*Unlimited consumption*

Surface Water Criteria

Surface Water Criteria - N.J.A.C. 7:9B-1.5(a) 4

Toxic substance	Fresh Water (FW2) Criteria (µg/L)		
	Aquatic		Human Health
	Acute	Chronic	
Mercury	1.4(d) (s)	0.77(d) (s)	0.050(h)(T)

d = criterion expressed as a function of the water effects ratio
T = total
h = noncarcinogenic effect-based human health criteria
s = dissolved

Meeting the SWQS?

- $C_{water} = C_{fish}/BAF$
- BAF of Methlymercury = 1,690,000 L/kg (trophic level 3 and trophic level 4 fish of 2,700,000 and 680,000 L/kg)
- Ratio of dissolved methyl mercury to total mercury: 0.059 to 0.005
- If C_{fish} = 0.34 mg/kg, C_{water} = 0.0034 **µg**/L to 0.04 **µg/L** < 0.050 **µg/L**

Data Analysis

- The initial data set included 2,474 samples analyzed for mercury in fish tissue;
- Samples were excluded for the following reasons:
  - outside the study area of this TMDL
  - analyzed before 1990 when lab contamination would have been an issue
  - sources other than air deposition present
  - whole fish samples were analyzed
- The final data set used for this TMDL analysis included 1,368 samples from 26 different species

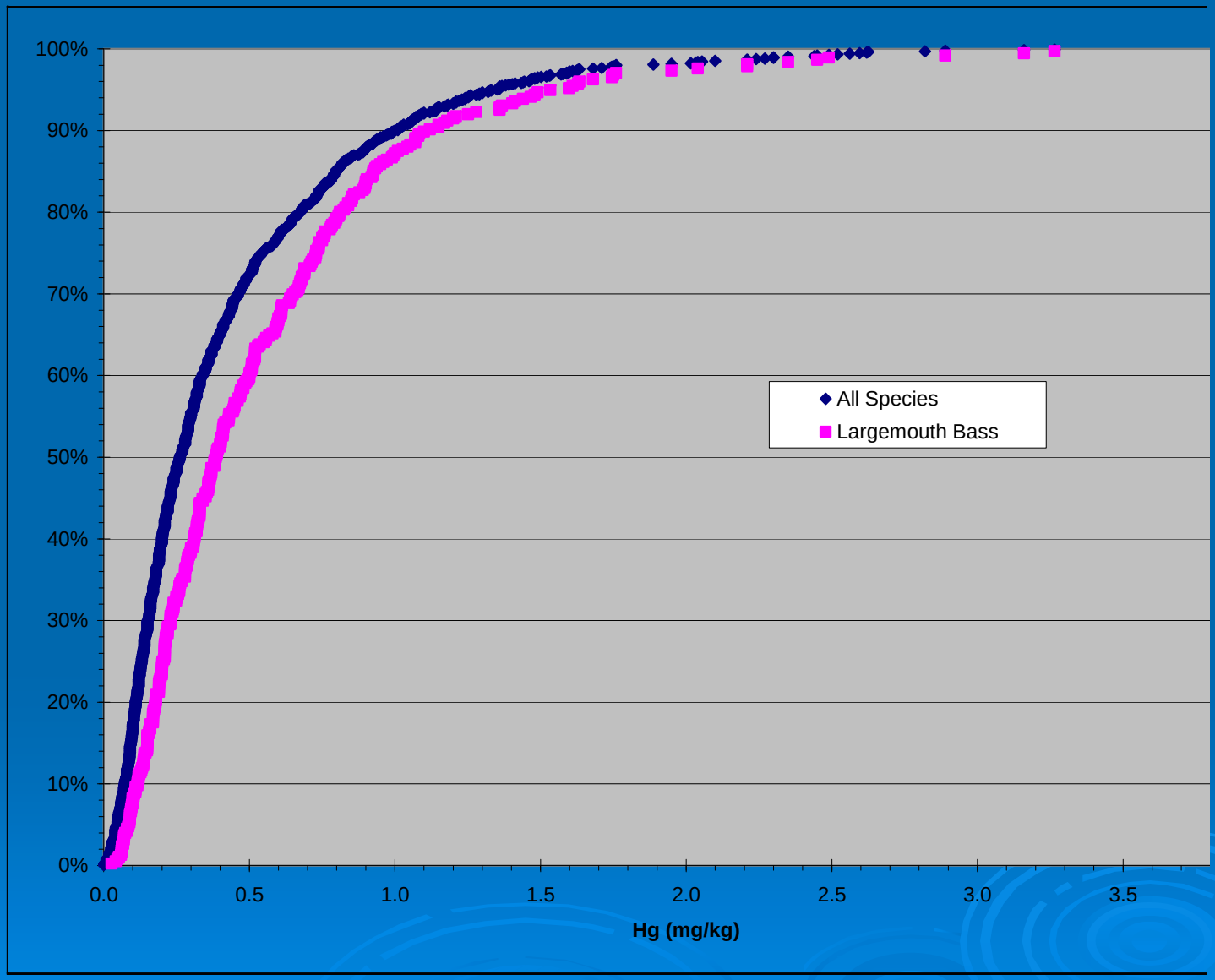
Data Analysis (cont'd)

- Since mercury concentration in fish tissue increases with length, an analysis of covariance model was used to estimate the length-adjusted concentrations of mercury in fish;
- Samples collected from 1990-1999 were significantly different from samples collected from 2000- 2007. So, the samples from 2000-2007 were used in the analysis to better represent the current condition.

Data Analysis (cont'd)

Largemouth Bass is chosen as the indicator species of this TMDL

- Top trophic level fish
- 2nd high average concentration among all species
- Largest sample size
- Best distribution throughout the state



Cumulative Distribution of Mercury Concentrations in Fish Tissues

Mercury Concentration Related to Fish-length for 2000 to 2007 data

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
Largemouth bass	35.11	0.531	0.64	**1.15**

Required Reduction

- Required reduction for high risk population to have one meal per week

  1-(0.18/1.15) = 84.3%

- Required reduction for general population to have unlimited consumption

  1-(0.34/1.15) = 70.4%

Source Assessment

- **Air Deposition Load**
  - Model-Based Analysis and Tracking of Airborne Mercury Emissions to Assist in Watershed Planning, ICF, 2008
  - Deposition of Mercury was primarily estimated using the REMSAD model based on 2001 emissions data.
  - Multiscale Air Quality (CMAQ) modeling system was used to enhance the analysis of the effects of global background on mercury deposition and CMAQ was applied with Particle and Precursor Tagging Methodology (PPTM) to provide a basis for assessing the uncertainty of the REMSAD PPTM results.
  - The outputs from three global models were used to specify the boundary conditions for both REMSAD and CMAQ and thus represent a plausible range of global background.
- **Load from Wastewater discharges**

Summary of Emissions Inventory of New Jersey in Tons per Year (tpy) (ICF,2008)

Facility Name	HG0* (tpy)	HG2* (tpy)	HGP* (tpy)	Total (tpy)
B.L. England	0.094	0.016	0.004	0.114
Hudson*	0.011	0.028	0.003	0.041
Mercer	0.030	0.015	0.011	0.057
Deepwater	0.002	0.004	0.000	0.006
Logan Generating Company - L.P.	0.001	0.000	0.000	0.002
Chambers Cogeneration - L.P.	0.010	0.006	0.004	0.021
Co Steel Raritan	0.090	0.011	0.011	0.112
Atlantics States Cast Iron Pipe	0.033	0.004	0.004	0.041
U.S. Pipe & Fndy. Co	0.019	0.011	0.000	0.030
Co Steel Sayreville*	0.178	0.022	0.022	0.222
Essex County RRF*	0.047	0.123	0.042	0.212
Camden RRF*	0.011	0.029	0.010	0.050
Union County RRF	0.003	0.008	0.003	0.014
Gloucester County	0.002	0.005	0.002	0.009
Warren Energy RF	0.001	0.001	0.001	0.003
Howarddown	0.002	0.001	0.001	0.004
Hoeganese	0.005	0.003	0.002	0.010
Camden County Muassi	0.005	0.003	0.002	0.010
Stony Brook Regional Sewerage Authority	0.011	0.007	0.005	0.023
Bayshore Regional Sewerage Authority	0.004	0.002	0.002	0.008
Somerset Raritan Valley Sewerage Authority	0.007	0.004	0.003	0.014
Northwest Bergen County Utilities Authority	0.005	0.003	0.002	0.010
Parsippany – Troy Hills Township WWTP	0.004	0.003	0.002	0.009
Atlantic County Utilities Authority	0.003	0.002	0.001	0.006
Gloucester County Utilities Authority	0.001	0.001	0.000	0.002
Point Source Total	0.579	0.312	0.137	1.030
Non-point Source	0.464	0.096	0.055	0.613
Total	1.043	0.408	0.192	1.643

Mercury Air Deposition Load for NJ (ICF, 2008)

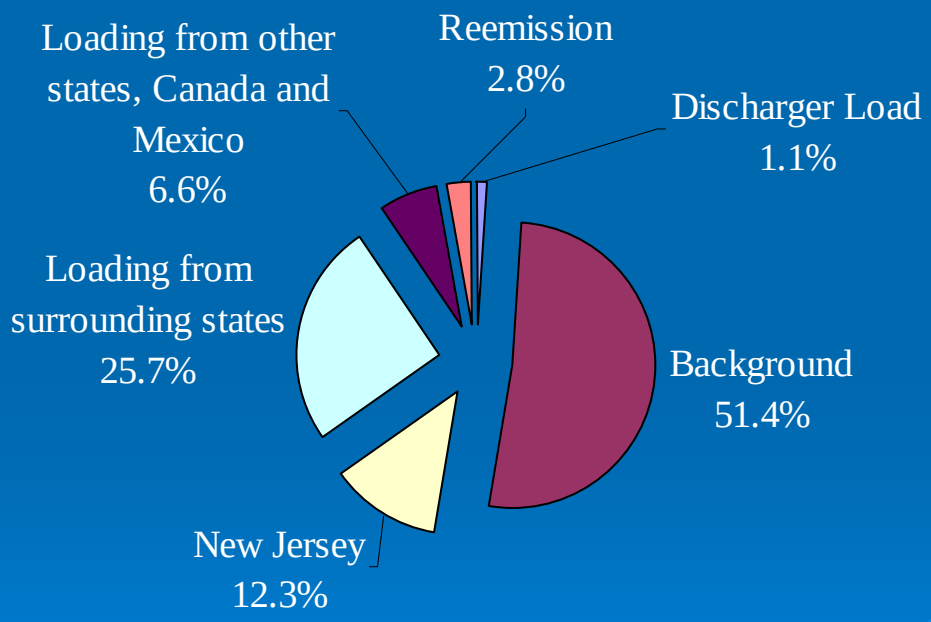
Category	Load (kg/yr)	Percent of Total Load
Background	309.0	52.0%
Background-reemission	16.9	2.8%
New Jersey	74.1	12.5%
Loading from the surrounding state (Total)	154.6	26.0%
Pennsylvania	102.8	17.3%
Maryland	25.1	4.2%
New York	13.7	2.3%
Delaware	11.1	1.9%
Connecticut	1.8	0.3%
Loading from other states, Canada and Mexico	39.6	6.7%
Total	594.2	100%

Load from Dischargers

- Major and minor municipal dischargers and industrial dischargers with mercury limit in their permits.
- Exclude the dischargers that discharge to the tidal and coastal area
- Median concentration (19.75 ng/L) of samples collected at POTWs through NY-NJ Harbor TMDL sampling effort as the representative concentration
- **Current load from dischargers = representative concentration x sum of permitted flow = 6.8 kg/yr**

Distribution of Current Mercury Load

Current Load = 601 kg/yr



TMDL Calculations

- Load capacity = current load * (1- required reduction).
- Reduction doesn't apply to the load from dischargers and the air deposition load due to the natural background.
- 25% of the background load and reemission is assumed to be due to natural sources and therefore non-reducible.

TMDL Calculation (cont'd)

- WLA portion of the air deposition load, which is technically a LA, is derived by applying the percentage of urban land within Tier A municipalities (25.6%) to the overall air deposition load based on the assumption that this load reaches the water bodies through regulated stormwater facilities.

Mercury TMDL for One Meal per Week by High Risk Population

Category	Existing Load (kg/yr)	TMDL Load		Percent Reduction
		kg/yr	kg/day	
Total Annual Load	**601.0**	**94.1**	**0.26**	**84.3%**
Discharger Load (WLA)	6.8	6.8	0.02	-
Air Deposition Load (WLA/LA)	594.2	87.3 (65.0/22.3)	0.24 (0.18/0.06)	85.3%
Background due to natural source	77.3	77.3	0.21	-
Background due to anthropogenic sources	231.8	2.6	0.01	98.9%
New Jersey	74.1	0.8	0.002	98.9%
Loading from surrounding states	154.6	1.8	0.005	98.9%
Loading from other states, Canada and Mexico	39.6	0.4	0.001	98.9%
reemission due to natural source	4.2	4.2	0.01	-
Reemission due to anthropogenic source	12.7	0.1	0.0004	98.9%

Mercury TMDL for Unlimited Consumption by General Population

Category	Existing Load (kg/yr)	TMDL		Percent Reduction
		kg/yr	kg/day	
Annual Load	601.0	177.7	0.49	70.4%
Discharger Load	6.8	6.8	0.02	-
Air Deposition Load (WLA/LA)	594.2	170.9 (127.2/43.7)	0.47 (0.35/0.12)	71.2%
Background due to natural source	77.3	77.3	0.21	-
Background due to anthropogenic sources	231.8	40.4	0.11	82.6%
New Jersey	74.1	12.9	0.04	82.6%
Loading from surrounding states	154.6	27.0	0.07	82.6%
Loading from other states, Canada and Mexico	39.6	6.9	0.02	82.6%
reemission due to natural source	4.2	4.2	0.01	-
Reemission due to anthropogenic source	12.7	2.2	0.01	82.6%

Margin of Safety

- The MOS included in this TMDL is implicit because of the following conservative assumptions:
  - The 90th percentile fish mercury concentration based on the largemouth bass, *Micropterus salmoides*. This species of fish has the highest concentration of the species that are ubiquitous throughout the state;
  - Reductions in sulfur deposition and sulfate-reducing bacterial activity will decrease the rate of mercury methylation. The percent reduction does not account for additional reductions in methyl mercury that may occur as a result of the implementation of ongoing state and federal programs to reduce sulfur emissions.

Implementation

- New Jersey must work with other states and USEPA, New Jersey cannot solve this problem alone
- The existing regulations concerning mercury will continue to be implemented, enforced, and evaluated for effectiveness:
  - the dental amalgam regulations
  - mercury emissions from air sources
  - the removal of automobile mercury switches

Implementation (cont'd)

- New Jersey plans to develop surface water criteria based upon a methyl mercury fish tissue concentration of 0.18 mg/kg which is based upon consumption of 1 meal per week by high risk individuals.
- Explore the development of legislation that addresses mercury-containing products and limits the sale of mercury for approved purposes.

Additional Information

- Anne Witt, Research Scientist II
  anne.witt@dep.state.nj.us
  (609) 633-1441

- Jay Springer, Supervising Environmental Specialist
  jay.springer@dep.state.nj.us
  (609) 633-1441

- Website: www.nj.gov/dep/watershedmgt/tmdl.htm

Public Comments

- The Public Comment period will continue for 30 days after this public hearing, ending on August 14, 2009.
- Interested persons should submit written comments on the proposed amendment to:

Barbara Hirst, Bureau Chief, BEAR
New Jersey Department of Environmental Protection
Division of Watershed Management
P. O. Box 418, 401 East State Street
Trenton, New Jersey 08625