Developing the Statewide TMDL for Mercury Impairments Based on Concentration in Fish Tissue Caused Mainly by Air Deposition

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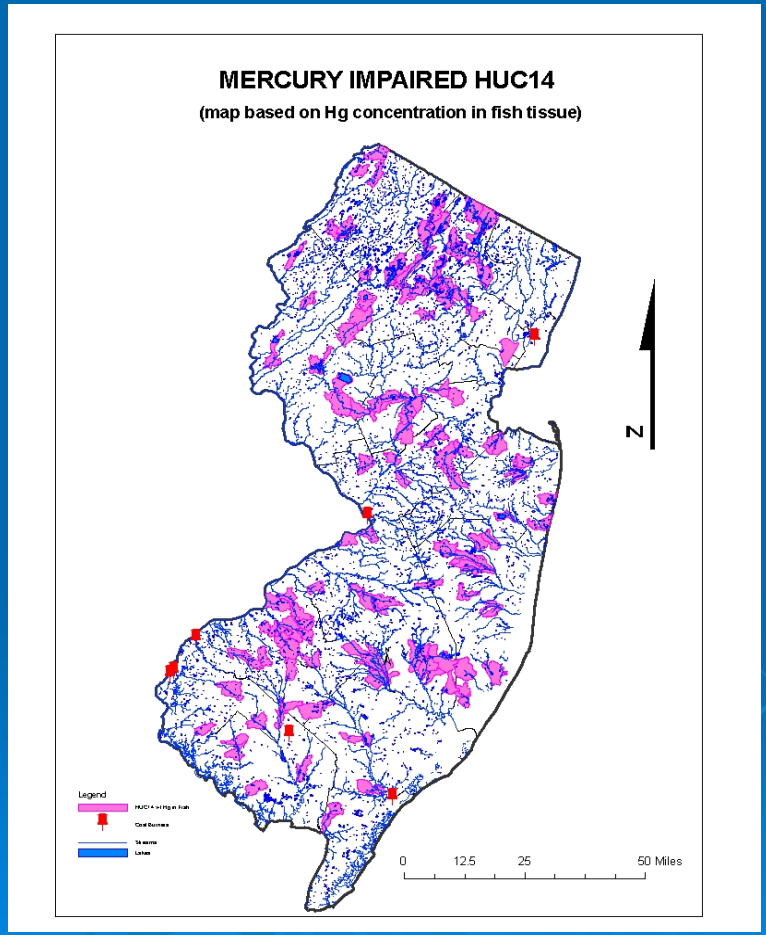
Fish-Mercury Impairment in NJ

- Mercury concentration in fish tissue exceeds 0.18 mg/kg
  - One meal per week 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)
- Mercury contamination by air deposition is a global problem
  - 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

- 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

The TMDL calculation is based on the 90th percentile concentration for a fish of standard length of the top trophic level fish, the large-mouth bass, *Micropterus salmoides;* assuming 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

- Air deposition is the primary source
- Watersheds excluded if:
  - ✓ Hg in surface water above SWQS (>0.050 µg/l)
  - ✓ Tidal Watersheds
  - ✓ Watersheds with known anthropogenic contamination other than from air
  - ✓ TMDLs in shared waters to be handled by the NY/NJ Harbor Estuary program or DRBC

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*

Meeting the SWQS of 0.050µg/L?

- $C_{water} = C_{fish}/BAF$
- 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 ug/L to 0.040 ug/L, i.e., < 0.050 ug/L

Data Analysis

- Data set:
  - n = 1,368
  - 26 different species
- Analysis of covariance used to estimate the length-adjusted concentrations of mercury in fish
  - 90th percentile concentration for largemouth bass = 1.15 ppm
- Most recent data used: collected from 2000 - 2007
  - Better represents the current condition
  - Samples collected from 1990-1999 higher in Hg

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 primarily estimated using REMSAD
    - 2001 emissions data
  - CMAQ
    - Enhance analysis of the effects of global background on mercury deposition
    - Applied with PPTM to provide a basis for assessing the uncertainty of the REMSAD PPTM results
  - Outputs from three global models were used to specify the boundary conditions for both REMSAD and CMAQ
    - Represent a plausible range of global background
- Load from dischargers
  - Representative concentration (19.75 ng/L) x sum of permitted flow = 6.8 kg/yr

Summary of Emissions Inventory of New Jersey (tpy) (ICF,2008)

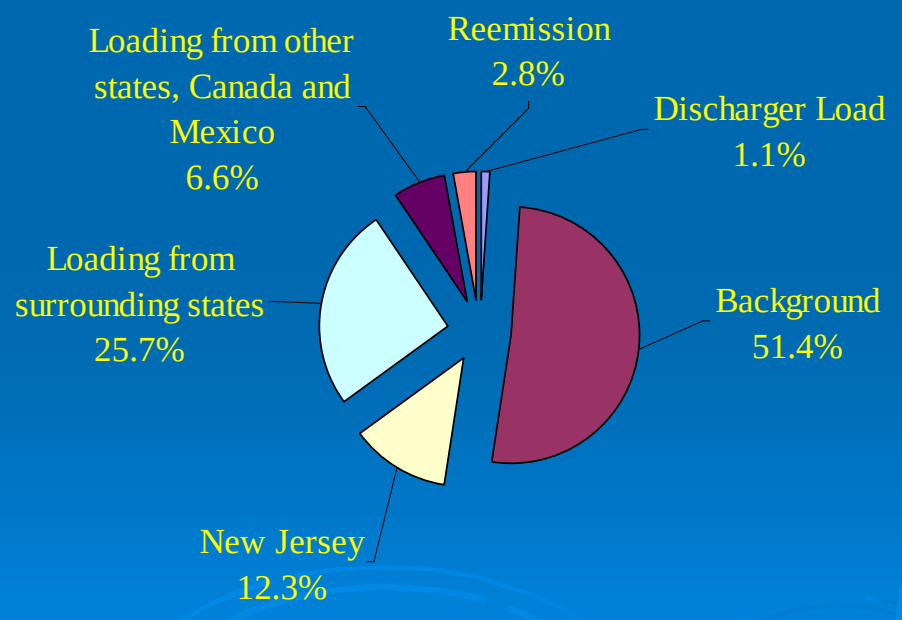
Facilities	Hg0 (tpy)	Hg2* (tpy)	HgP* (tpy)	Total (tpy)
Coal-fired Power Plants	0.148	0.069	0.022	0.241
Iron and Steel Industry	0.320	0.048	0.037	0.405
RRFs and UAs	0.111	0.195	0.078	0.384
Point Source Total	0.579	0.312	0.137	1.03
Non-point Sources	0.464	0.096	0.055	0.613
Total	1.043	0.408	0.192	1.643

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 states (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%

Distribution of Current Mercury Load

Current Load = 601 kg/yr



TMDL Calculations

- Reduction doesn't apply to
  - Load from dischargers
  - Air deposition load due to natural background.
- 25% of the background load and reemission is assumed to be due to natural sources and therefore non-reducible.

Mercury TMDL for One Meal per Week by High Risk Population

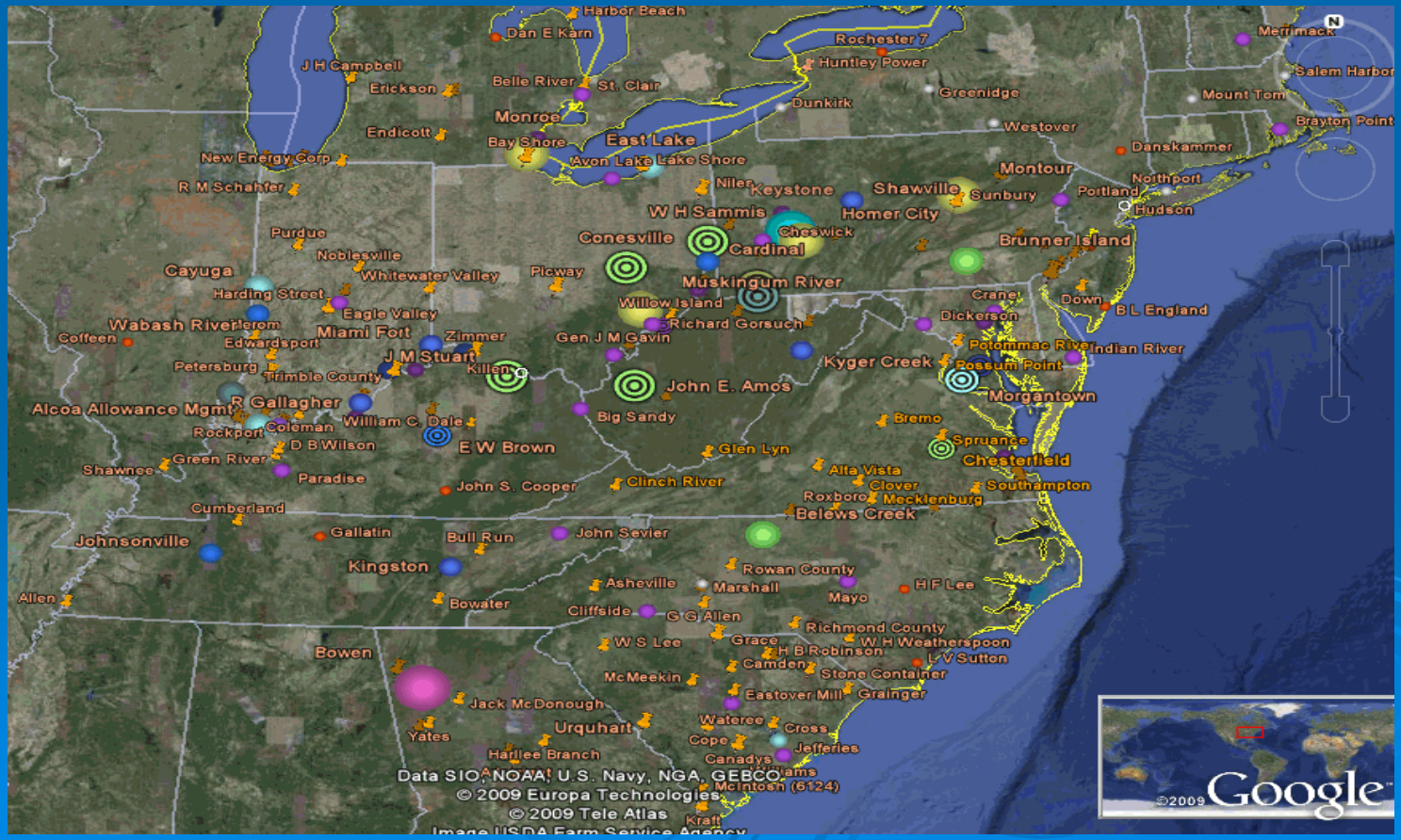
Category	Existing Load (kg/yr)	TMDL Load		Percent Reduction
		kg/yr	kg/day	
Total Annual Load	**601.0**	**94.1**	**0.26**	**84.3%**
Discharger Load (WLA)	6.8	6.8	0.02	-
Air Deposition Load (LA/WLA)	594.2	87.3 (65.0/22.3)	0.24 (0.18/0.06)	85.3%
Background due to natural source	77.3	77.3	0.21	-
Background 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 sources	4.2	4.2	0.01	-
Reemission due to anthropogenic sources	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 (LA/WLA)	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%

Implementation

New Jersey must work with other states and USEPA, New Jersey cannot solve this problem alone



Clean Water Act 319(g) Conference

- June 2010
- Convened by EPA at the request of the Northeast States
- Brought together 18 states to discuss reduction of air deposition of mercury

Draft Recommendations

- EPA should set mercury MACT standards at a level that will facilitate compliance with water quality standards.
- EPA should adopt national standards for mercury in both consumer and industrial products to establish a federal regulatory floor.

Draft Recommendations (continued)

- EPA should continue its efforts to seek an international agreement to reduce global mercury usage and releases.
- Research on both the environmental and health impacts of mercury should be broadened, in partnership with the states and academic institutions.

For more information:

- The TMDL document is available online at http://www.state.nj.us/dep/watershedmgt/tmdl.htm
- Contact me at Anne.Witt@DEP.STATE.NJ.US
- Or (609) 633-1166