Preparing a Mercury Reduction Plan for use as an Implementation Plan for a Mercury TMDL

2009 Mercury Science and Policy Conference
November 18, 2009

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Evolution of a Mercury Reduction Plan

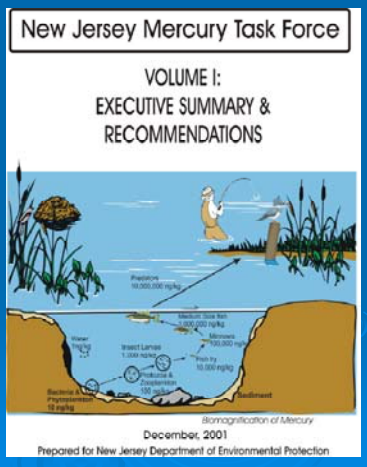
Part I - History

New Jersey Mercury Task Force

- Convened in 1998
- Reps from Government, Emission Sources, Public Interest Groups, Academia, and Fishing Organizations
- **Charge**
  - Review current science on Hg **impacts** on human health and ecosystems
  - Inventory & assess Hg **sources**
  - Develop comprehensive Hg **reduction plan** for NJ

Mercury Task Force Recommendations

- December 2001 Report
- **Goal** - Virtual elimination of anthropogenic uses & releases of Hg
- **2-step Milestone**:
  - 75% reduction in air emissions from 1990 levels by 2006
  - 85% reduction below 1990 levels by 2011



Mercury Task Force Recommendations (cont.)

- 17 Recommendations including:
  - Air emissions
  - Urging federal action
  - Products
  - Water, Fish Tissue, and Wildlife
  - Monitoring environmental progress & reductions

NJDEP Mercury Workgroup

- Facilitates communication between DEP programs and EPA on mercury reduction efforts and outcomes
- Consists of representatives from programs with mercury issues
  - Air, Solid Waste, Water, Watershed Management, Water Monitoring, Site Remediation, Pollution Prevention, Science & Research, and EPA Region II

NJ Mercury Reduction Action Plan

- Began in 2006 as report on status of implementing Task Force recommendations
  - First milestones were approaching…where were we?
- Realized additional reductions and a plan for achieving reductions was necessary
- Mercury TMDL being developed and an implementation plan would be needed

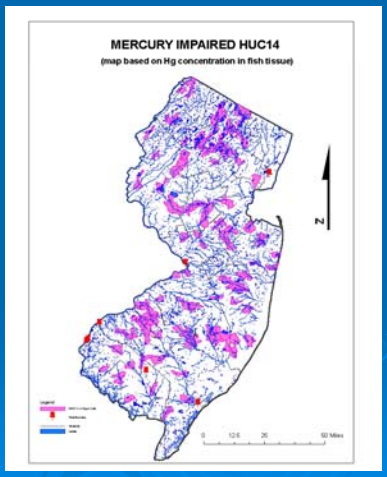
Evolution of a Mercury Reduction Plan

Part II

Developing the Statewide TMDL for Mercury Impairments

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)
  - 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.
- $C_{fish} = BAF \times C_{water}$
- $C_{fish\ t1} / C_{fish\ t2} = C_{water\ t1} / C_{water\ t2}$
- $C_{fish\ t1} / C_{fish\ t2} = L_{t1} / L_{t2}$
- A decrease in Hg emissions will result in a proportional decrease in Hg concentrations in fish.

The Approach

TMDL Calculation

- Standard length fish
- 90th percentile concentration
- Top trophic level
  - Large-mouth bass, *Micropterus salmoides*
- Top trophic level fish has acceptable levels of mercury, lower trophic levels will be acceptable as well.

Current Approach Focuses on Assessment Unit (HUC14) Impairments

- Air deposition is the primary source
- Watersheds excluded:
  - Hg in surface water above SWQS (>0.050 µg/l)
  - Tidal Watersheds
  - Known anthropogenic contamination other than from air
  - Shared waters to be handled by the NY/NJ Harbor Estuary progam 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 surface water dischargers
  - Discharger load= median concentration x sum of permitted flow
  - Median concentration= 19.75 ng/l; discharger load = 6.8 kg/yr

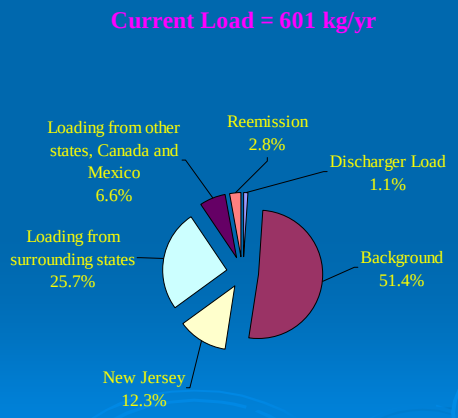
Summary of Emissions Inventory of New Jersey (tpy) (ICF,2008)

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



TMDL Calculations

- Reduction doesn't apply to
  - Point source surface water dischargers
  - Air deposition from 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

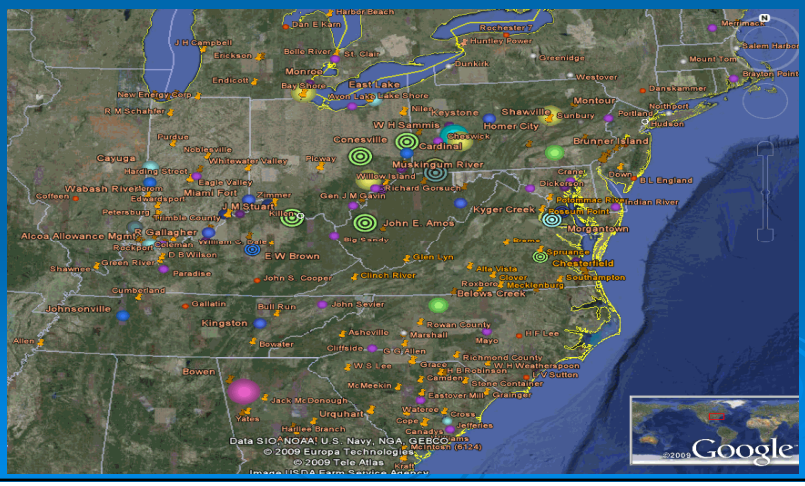
Category	Existing Load (kg/yr)	TMDL Load		Percent Reduction
		kg/yr	kg/day	
Total Annual Load	**601.0**	**94.1**	**0.26**	**84.3%**
Discharger Load (WLA)	6.8	6.8	0.02	-
Air Deposition Load (LA/WLA)	594.2	87.3 (65.0/22.3)	0.24 (0.18/0.06)	85.3%
Background due to natural source	77.3	77.3	0.21	-
Background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



Evolution of a Mercury Reduction Plan

Part III

Developing the Mercury Reduction Plan

Updating Emission Data

➢2006 Goal from Task Force Report was 75% reduction in mercury emissions

➢Based on following categories:

- Iron & Steel Manufacturing
- Coal Combustion
- Products
- MSW Combustion
- Sludge Incineration
- Crematoria
- Laboratories
- Cultural Uses
- Fuel Combustion

Source Inventory Reductions

- Where possible actual emissions data was used (either from stack tests or sludge concentration)
- Data showed a reduction of 67% was achieved
- However, top 4 source categories remained the same
  - Iron and Steel Manufacturing, Coal Combustion, Products, MSW combustion

Reviewed All Recommendations

- Reviewed Task Force recommendations and determined which were fully implemented and which needed work
  - Air emission recommendations implemented
  - Dental amalgam recommendation implemented
- Also decided which of remaining recommendations were still viable

EPA Guidelines

Used EPA's guidance on "Recommended Elements of a Comprehensive State Mercury Reduction Program"

(Attachment B of "Listing Waters Impaired by Atmospheric Mercury Under Clean Water Act Section 303(d): Voluntary Subcategory 5m for States with Comprehensive Mercury Reduction Programs")

Let the Debate Begin….

- Many discussions were held concerning which recommendations were the highest priority
- Having a Workgroup that met monthly expedited these discussions
- Science vs Policy debates
- Interests of Programs may conflict at times

Contents of Reduction Plan

- "Success stories" of areas where mercury reductions have occurred (air emissions, dental amalgams, auto switches, etc)
- Action Items to be addressed by the Department in the future
  - Focuses on Products and Air and Fish Monitoring, Wildlife Criteria

Wait, Wait, Wait….

- Received approval from Commissioner to prepare Reduction Plan in October 2007
- Completed Plan in July 2009
- Obtained Approval (from different Commissioner) for Plan in November 2009

New Jersey Mercury Reduction Action Plan

- Available on-line at: http://www.nj.gov/dep/dsr/mercury_task_force.htm
- New Jersey State-wide Mercury TMDL available on-line at: http://www.state.nj.us/dep/watershedmgt/tmdl.htm

For Additional Information

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