Water Quality Improvements in Onondaga Lake Following Advanced Wastewater Treatment

OCDWEP
Lunch and Learn Presentation
07/18/13

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WATER
ENVIRONMENT
PROTECTION

Save the Rain
www.savetherain.us

Presentation Overview

- Review of pollution timeline
- Metrics of Water Quality
- Onondaga Lake - Historic Water Quality Conditions
- Regulatory Framework
- Onondaga County Infrastructure Projects & Initiatives
- Onondaga Lake Response to Upgrades
- Comparisons to Other Lake Rehabilitation Programs

Pollution History Timeline

- 1654 Explorers discover salt springs on the shores of Onondaga Lake
- 1793 Commercial salt production begins on the lakes shore
- 1880 Onondaga Lake is a popular resort area. West shore has many hotels, parks and bathing beaches
- 1884 and 1918 Solvay Process Company begins soda ash production and production of organic chemicals
- 1940 Swimming is banned
- 1946 Allied beings chlorine production (mercury wastes directly to lake - 165,000 lbs)
- 1970 Fishing is banned
- 1977 Allied closes chlorinated benzene plant and Willis Avenue chlor-alkali plant
- 1979 Metro upgraded to secondary and tertiary treatment

Trophic State and Eutrophication

Oligotrophic	Mesotrophic	Eutrophic
• nutrient poor • low productivity • clear water	• moderate level of productivity	• nutrient rich • high productivity • cloudy water • algal blooms

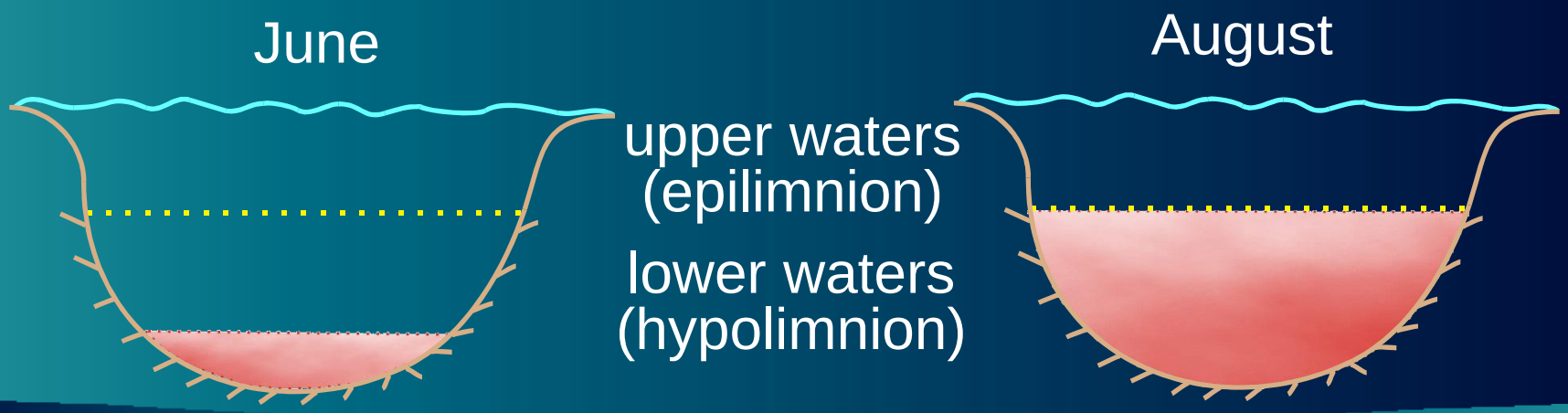
Phosphorus (P) and nitrogen (N) are the primary nutrients that in excessive amounts pollute our lakes, streams, and wetlands.

- TP in the epilimnion - TP_{epi}
- Chlorophyll a in the epilimnion
- Secchi disk transparency - SDT
- Minimum DO at fall turnover - DO_{min}

The Eutrophication Process

high nutrient loading → excessive algal growth → oxygen depletion → diminished fish habitat

Oxygen Depletion



Onondaga Lake Facts

- Morphometry:
  - area = 12 km^2
  - mean depth = 10.9 m
  - maximum depth = 20 m
- Stratification: dimictic
- Chemistry: hardwater, alkaline
- Flushing rate: ~ 4 times/year
- Watershed: 738 km^2; population ~ 450,000
- Location: metropolitan Syracuse, NY

Class B: Best usage – primary and secondary contact recreation; suitable for fish propagation and survival

Class C: Best usage – fishing; suitable for fish propagation and survival; suitable for primary and secondary contact recreation, although other factors limit the use for these purposes

South Deep

METRO

Historically Degraded Water Quality Conditions in Onondaga Lake

- High concentrations of phytoplankton; algal blooms common
- Poor water clarity
- Rapid loss of dissolved oxygen (DO) from the lower waters
- Severe depletion of DO in upper waters during fall turnover and ..
- PCB's, dioxins, mercury

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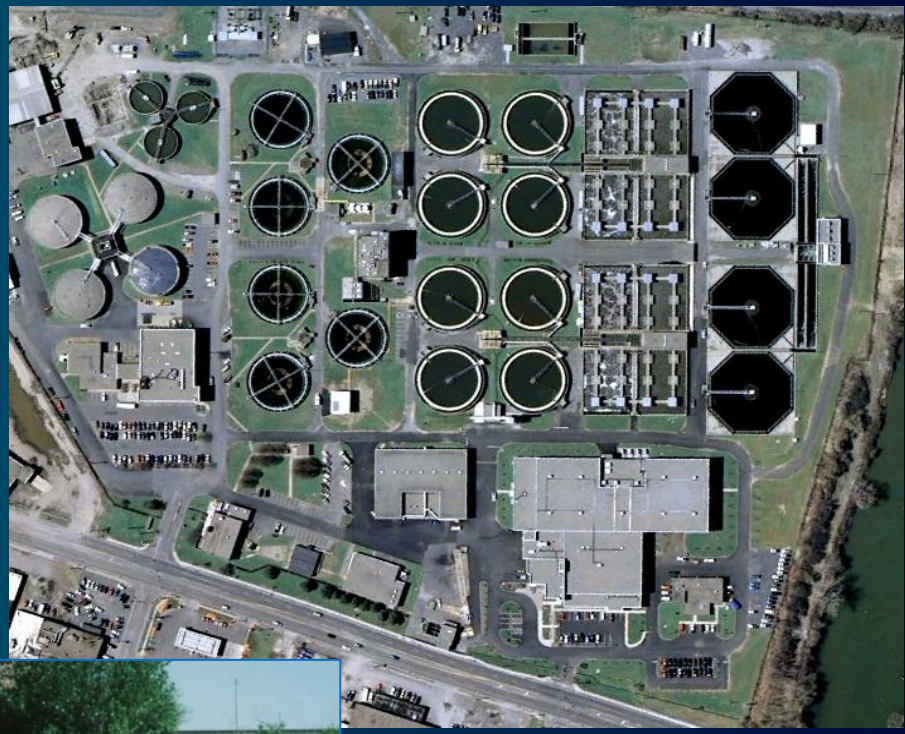
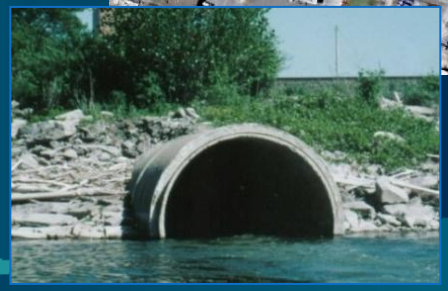
Infrastructure Projects
&
Initiatives

Metropolitan Syracuse Wastewater Treatment Plant (Metro)

- Services 245,000 residents and many industrial & commercial customers
- Treats 62 MGD (average); full secondary & tertiary treatment up to 126 MGD; hydraulic capacity of 240 MGD
- Discharges to surface of Onondaga Lake; 17% of annual inflow
- Effluent contributed ~ 90% of ammonia load; ~ 60% of phosphorus load to lake





Regulatory Framework

Consent Decree - 1988

ASLF, AG, DEC file compliant against OCDDS alleging violations of its state discharge permit

Amended Consent Judgment (ACJ) - 1998

Federal Judge signs ACJ ordering interim wastewater treatment plant improvements agreed upon by DEC, ASLF and OC

15-year $380 million Phased Compliance program to achieve Lake and Tributary compliance with CWA by December 2012 (ACJ Projects costs >$600M)

- Upgrades to Metro
- CSO Abatement Projects
- Implement AMP to assess the effectiveness of control actions

Metro Upgrades

Biological Aerated Filter (BAF)

- On-line January 2004 – 98% reduction in ammonia loading
- Polystyrene bead filter media
- Year-round nitrification
- BAF system achieved Metro Stage III SPDES

  (effective date Dec 2012; met Feb 2004)

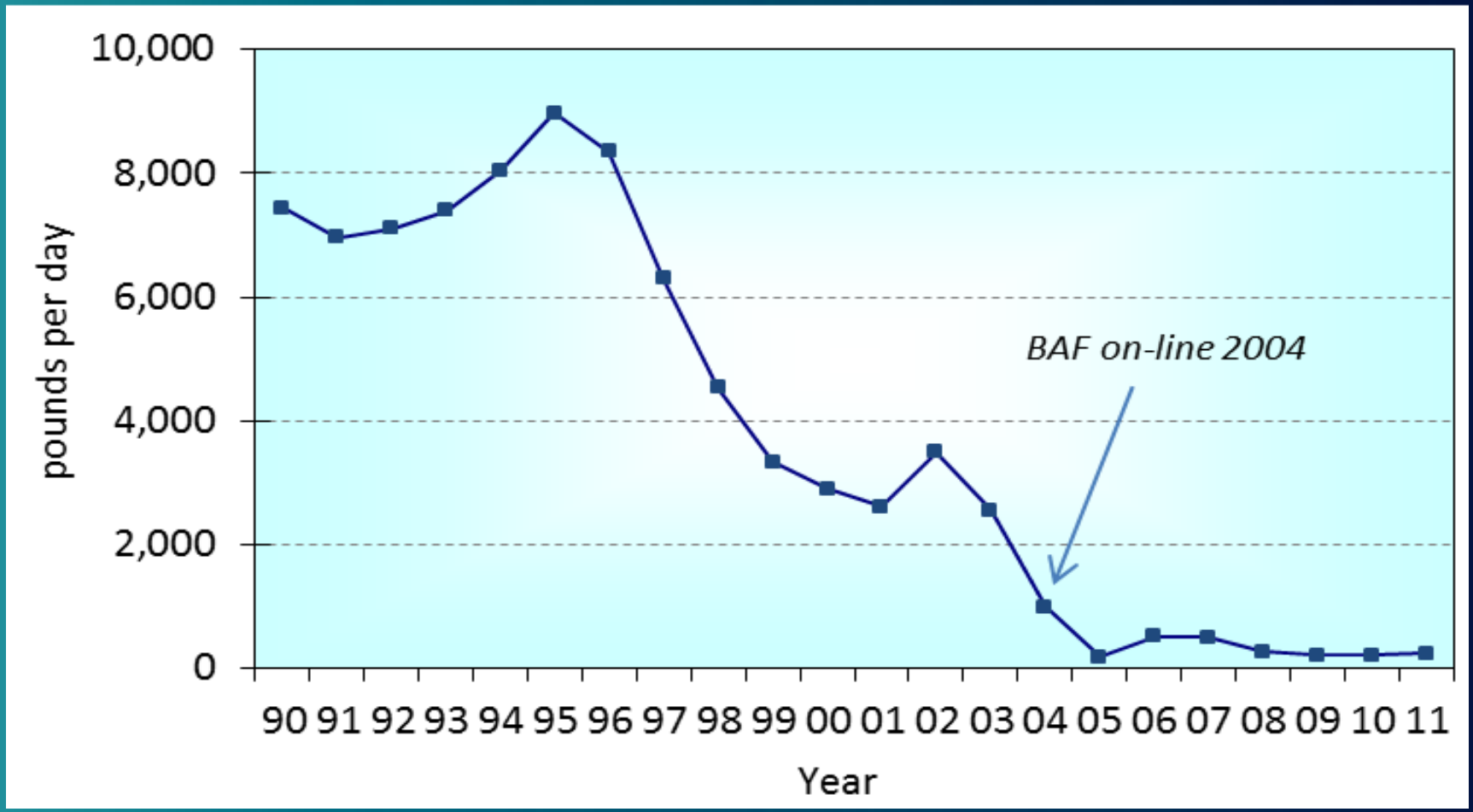
  - Onondaga Lake compliant with NYS ammonia standards, removed from 303(d) List (2008)

Actiflo® System (HRFS)

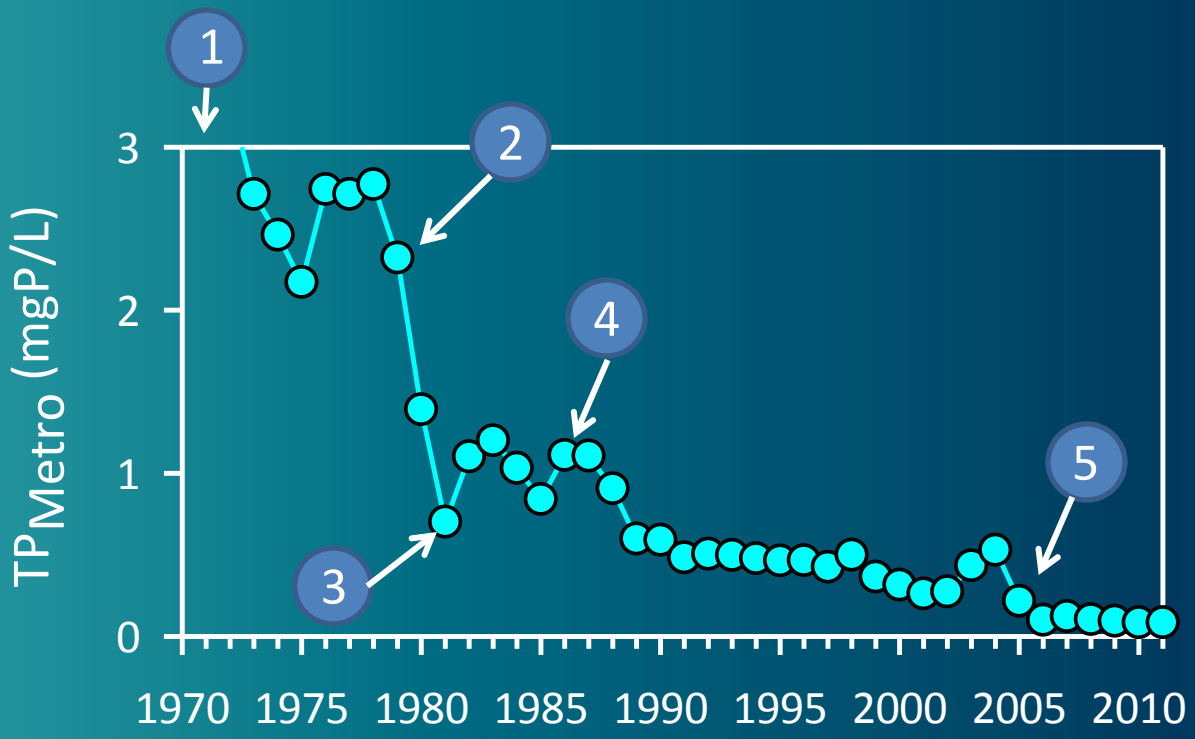
- On-line February 2005 – 86% reduction in TP loading
- High rate flocculation/settling of TP
- Actiflo® system met Metro Stage II SPDES Interim Phosphorus limit of 0.12 mg/L on schedule (4/1/06)
  - Metro Stage II SPDES Interim P limit amended - 0.10mg/L (November 2009 ACJ 4th Stip)

Ammonia Loading from Metro

1990-2011



Total Phosphorus Concentration of Metro Effluent



~ 100 fold decrease in TP_{Metro} from 1970 to 2011

1. 1971: ban on P detergents
2. 1979: secondary treatment
3. 1981: tertiary treatment; Ca-rich industrial waste
4. 1986: tertiary treatment; ferrous sulfate
5. 2005: ACTIFLO®

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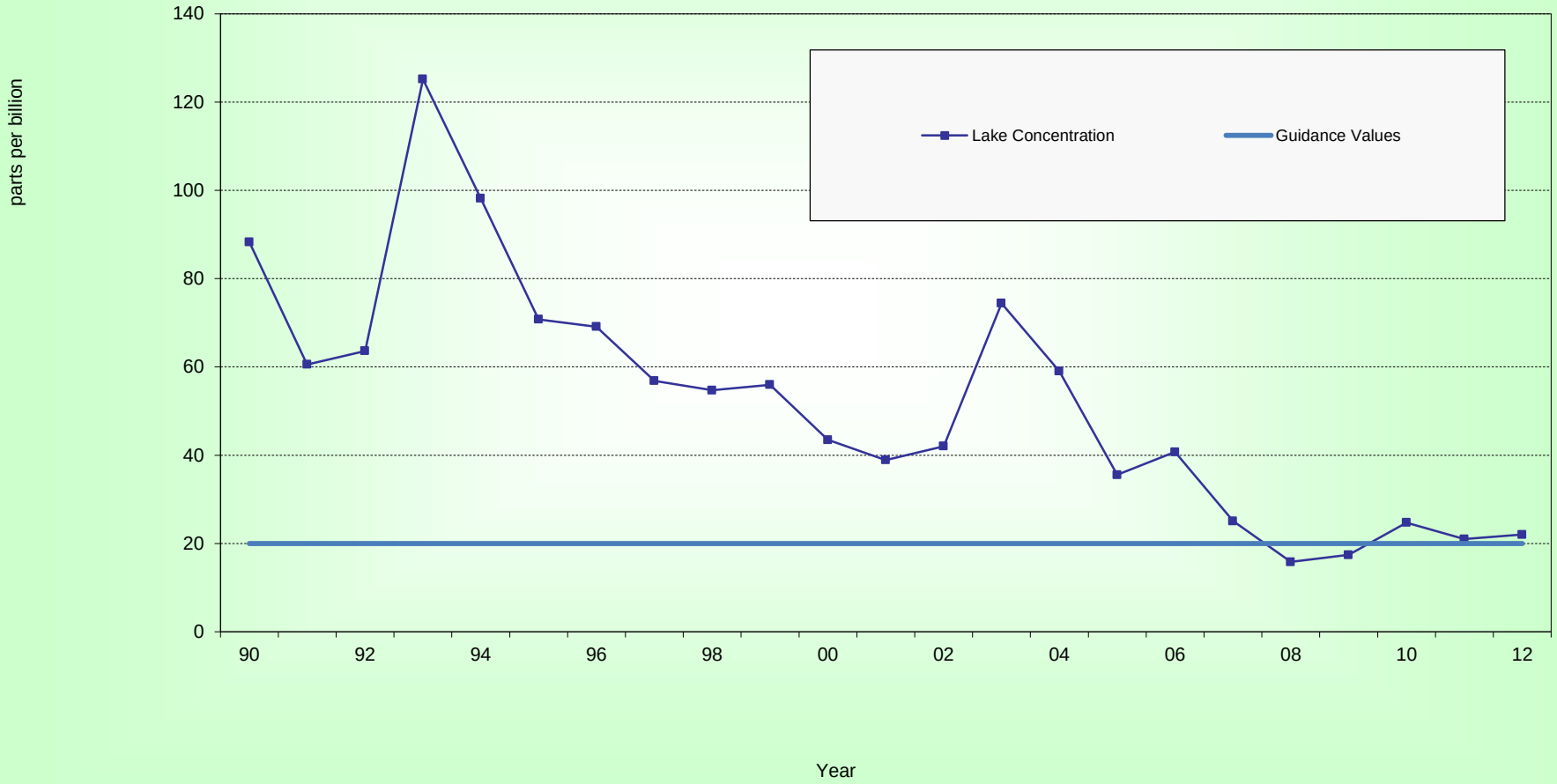
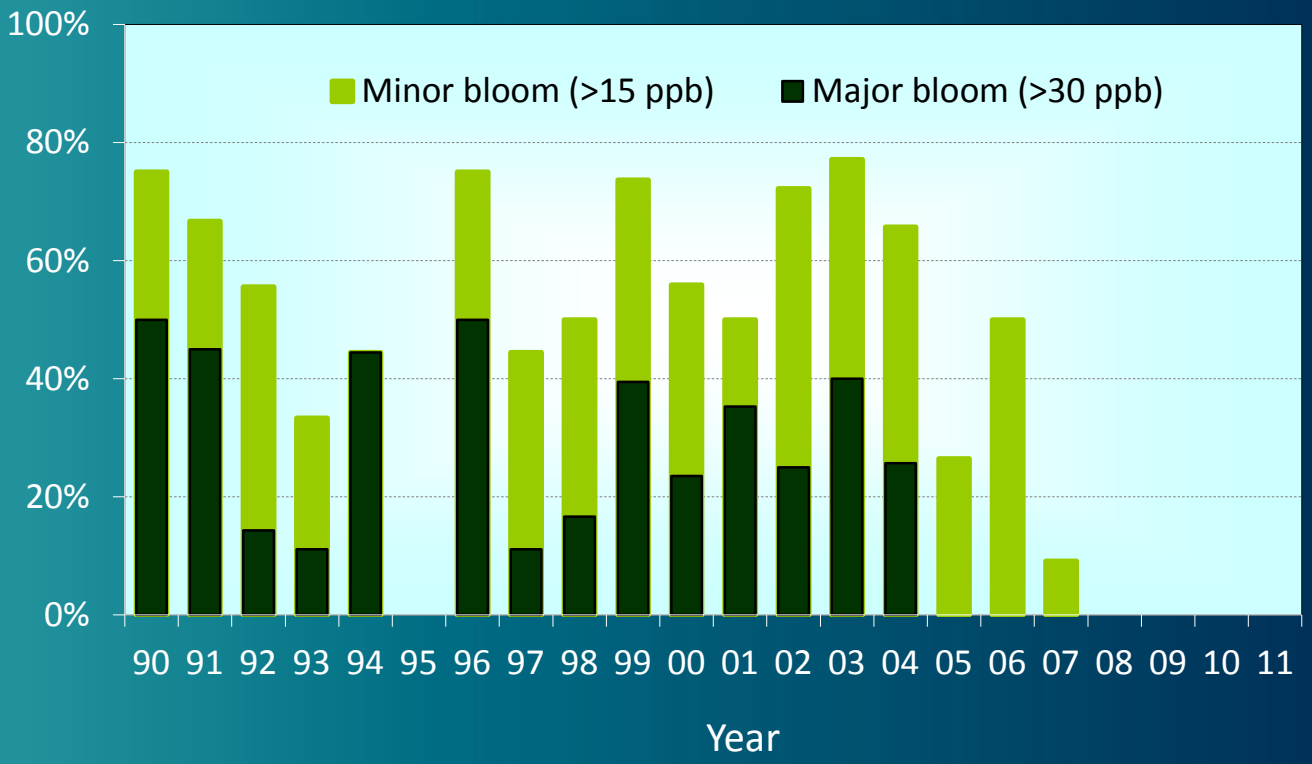
Response to Upgrades

Summer Phosphorus Levels in Upper Waters of Onondaga Lake

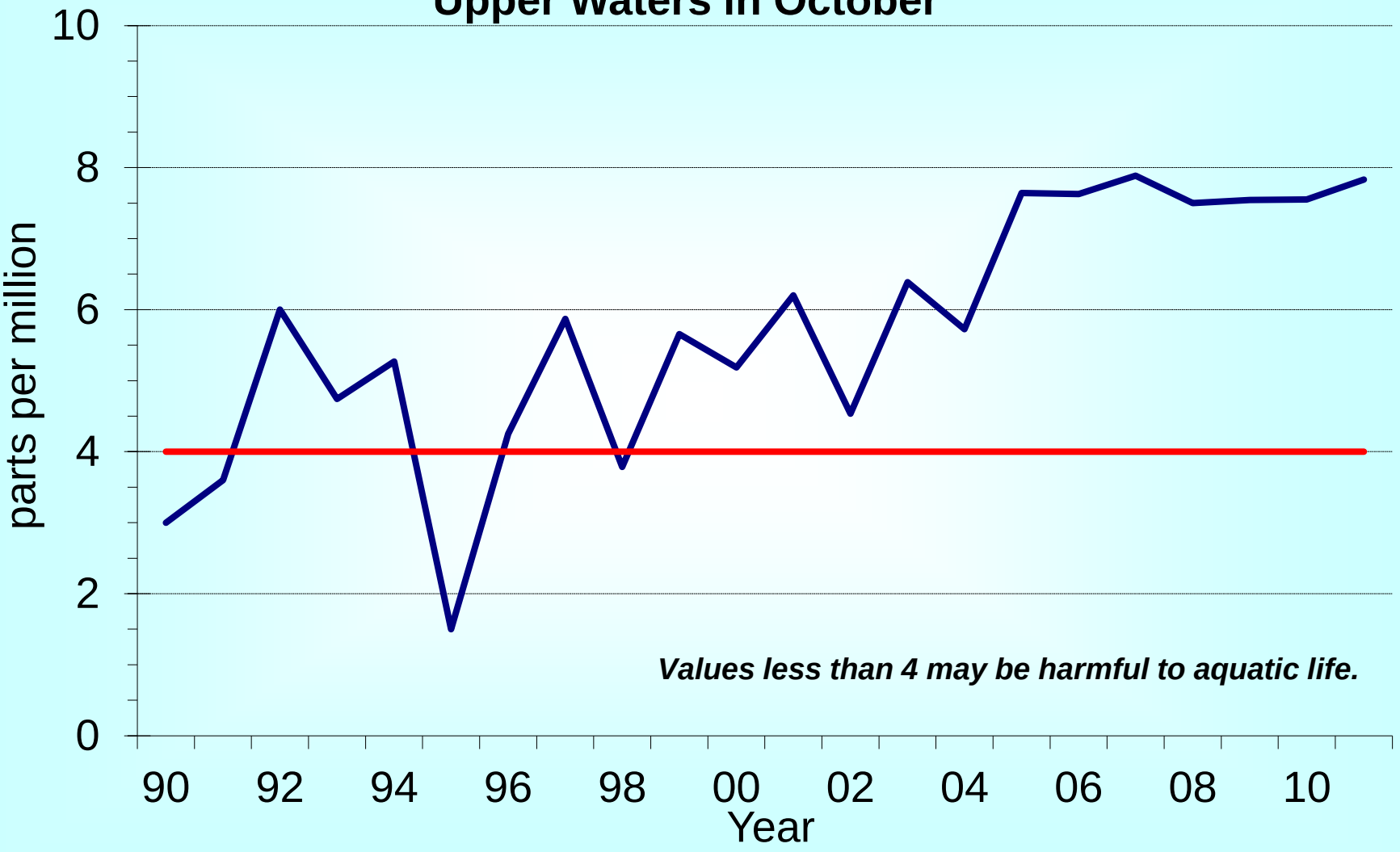


Algal Bloom Frequency During Summer



- No major algal blooms since 2004
- No minor algal blooms since 2007
- Cyanobacteria (large bluegreen algae) are no longer an important component of the algal community

Minimum Oxygen Concentration
Upper Waters in October



Resurgence of Recreational Interest

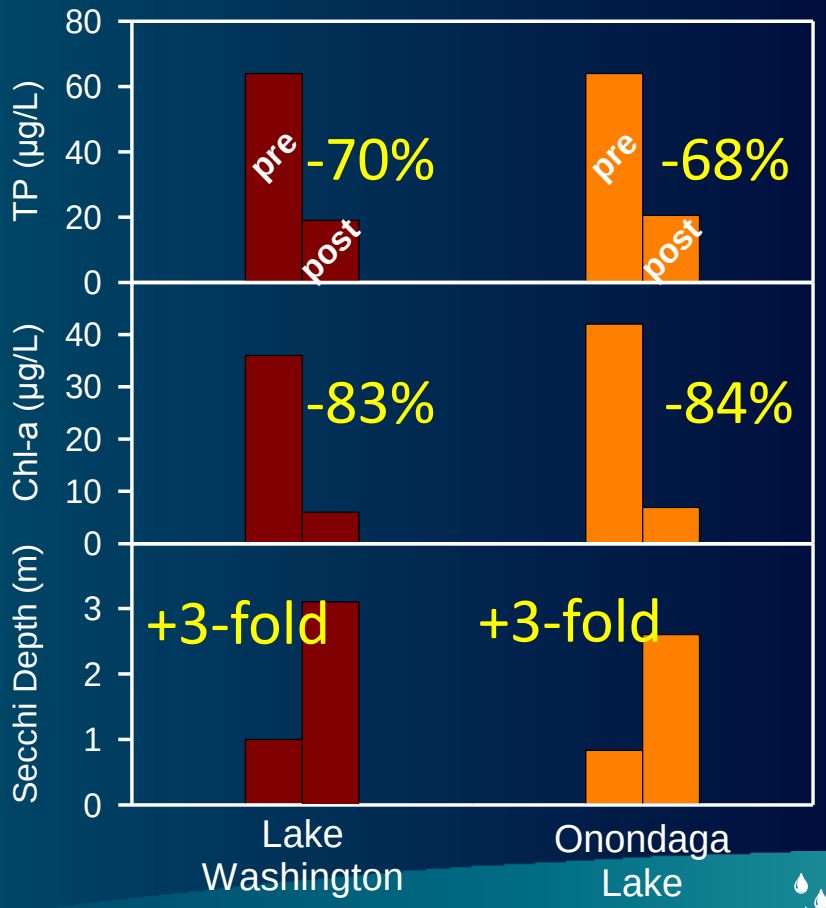
Macrophytes: 5 fold increase over the decade in lake shoreline

Fish Community: Expanded, supports varied recreational fishery; County's Program (2000-2012) captured 49 different fish species; since early 1990's - total of 64 species identified

- **Wild Carp Week Triathalon** [2006 - Present]
- **2007 USA Wakeboard Nationals** [July 2007]
- **2007 Bassmaster Memorial** [July 2007]
- **Fishing For Dollars Tournament** [2007 & 2008]

Response of Lakes to Diversion and Advanced Wastewater Treatment

- **Diversion**
  - Lake Washington, Washington
  - Lake Sammamish, Washington
  - Lake Norrviken, Sweden
  - Madison Lakes, Wisconsin
- **Advanced Wastewater Treatment**
  - Shagawa Lake, Minnesota
  - Lake Zürich, Switzerland
  - Lake Søbygaard, Denmark



ACJ 4th Stipulation (2009)

Incorporates County Executive's initiative on green infrastructure to *promote sustainability* & ensure *cost effectiveness* while providing multiple community & environmental benefits [ACJ through 2018]

Green: Save the Rain Program

[green roofs/permeable pavement/tree plantings/rain gardens/cisterns]

Gray: CSO Abatements Projects

[storage and treatment]

Goals

1. Capture & Treat 95% of Annual CSO Volume by reducing the amount of stormwater runoff/untreated sewage reaching the lake and its tributaries
2. Achieve compliance with AWQS in Tributaries and Onondaga Lake

Save the Rain Awards & Recognition

- US EPA green infrastructure partner community, 2011
- 2012 NYWEA Sustainability Award
- 2012 USGBC Global Community Leadership Award
- 2013 U.S. Water Prize from U.S. Water Alliance

U.S. GREEN BUILDING COUNCIL

UNITED STATES WATER PRIZE

…and if you are going to the NYS Fair, check out the new exhibit -

http://www.9wsyr.com/mediacenter/local.aspx?videoid=4135618