NUTRIENTS: A High-profile Water Quality Issue

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June 2010

CLEAN WATER ACT COMPONENTS

- Beneficial Uses – aquatic life, drinking water, swimming
- Water Quality Standards – protect against adverse effects of pollutants
- Monitoring and Assessment – biological, chemical, physical – health of waterbody
- Permits – limit pollution from point sources – water quality-based and technology-based limits

CLEAN WATER ACT COMPONENTS (CONT'D)

- Total Maximum Daily Load (TMDL) – "Clean up plan" for impaired waters
- Inspection/Enforcement – compliance with permits and laws/regulations
- Watershed-based planning (regulatory and non-regulatory) to restore or protect water quality

CLEAN WATER ACT COMPONENTS (CONT'D)

Point Source – pollutants discharged to water out of pipe, e.g., municipal wastewater treatment plant, industrial wastewater, some urban stormwater, some livestock operations

- Regulated by permits

Non-Point Source – pollutants carried to waterbody by rain – urban stormwater in small municipalities, agricultural runoff, air deposition

- Managed through Best Management Practices (BMP)

CLEAN WATER ACT FRAMEWORK

1. Establish water quality standards to protect uses
2. Standards also used as basis for NPDES permit limits
3. Monitor and assess attainment
4. List waters not attaining uses
5. Develop TMDL to limit pollution

IMPACT OF NUTRIENTS ON LAKES, RIVERS AND STREAMS

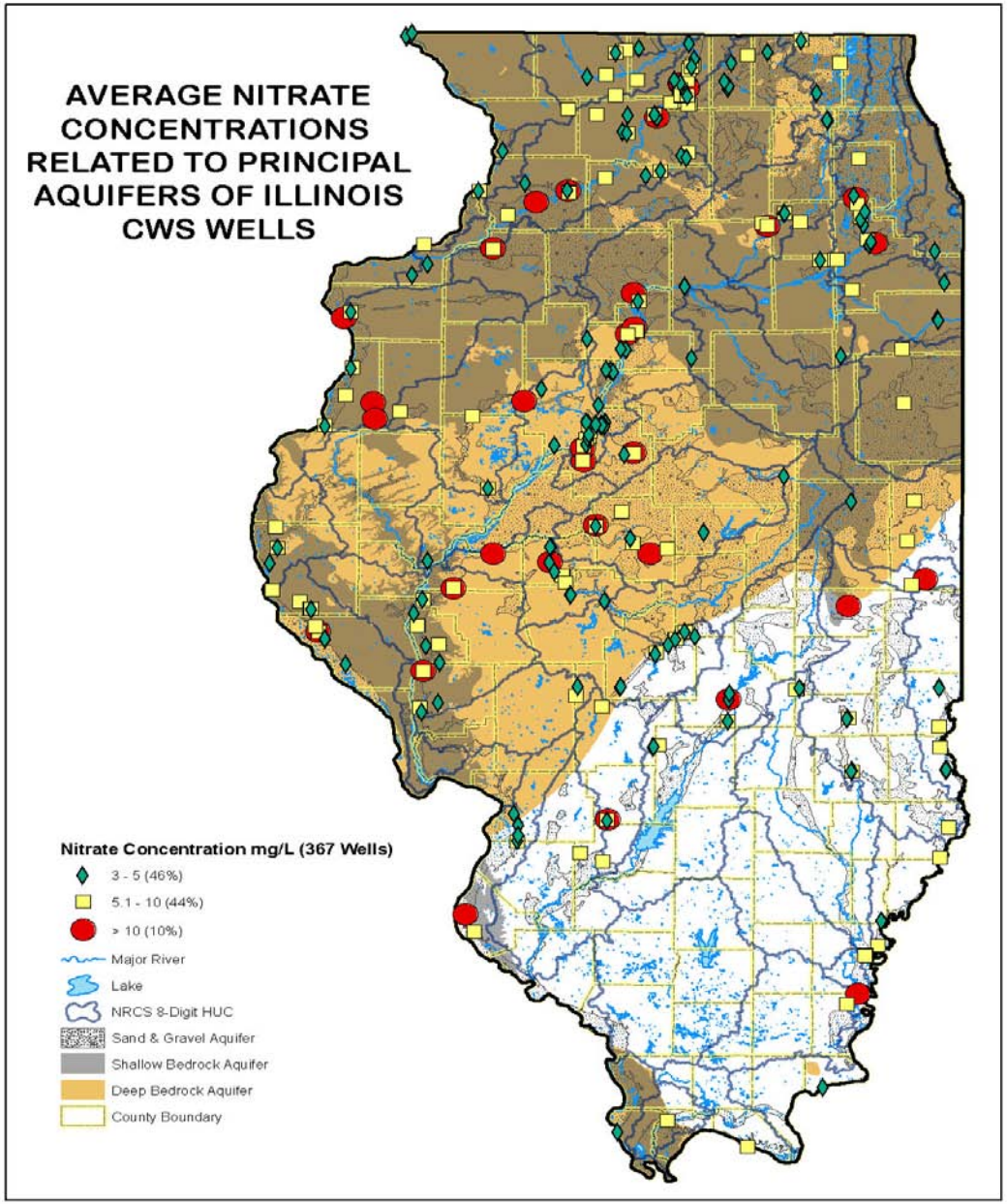
- Algal blooms deplete oxygen, block sunlight, may produce toxins, taste/odor problems in drinking water
- Hypoxic zone in Gulf of Mexico – 5,000 sq. mi. – decomposing algae
- Nitrogen →nitrates in drinking water →dangerous for infants

PUBLIC WATER SUPPLIES

- 7 stream/river segments (83 miles) “not supporting” due to nitrate
  North Fork, Vermilion River,
  Salt Fork, Vermilion River,
  Vermilion River (Illinois Basin)
- 3 lakes “not supporting” due to nitrate
  Lake Bloomington
  Lake Decatur
  Lake Vermilion

PUBLIC WATER SUPPLIES CONT'D

- 8% of community water supplies (CWS) wells have nitrate ≥ background but ≥ 10 mg/L
- 2% of CWS wells have nitrate ≥ 10 mg/L
- 10.5% of rural private wells have nitrate ≥ 10 mg/L


AVERAGE NITRATE CONCENTRATIONS RELATED TO PRINCIPAL AQUIFERS OF ILLINOIS CWS WELLS
Nitrate Concentration mg/L (367 Wells)
3 - 5 (46%)
5.1 - 10 (44%)
> 10 (10%)
Major River
Lake
NRCS 8-Digit HUC
Sand & Gravel Aquifer
Shallow Bedrock Aquifer
Deep Bedrock Aquifer
County Boundary

AQUATIC LIFE USE/AESTHETICS

- Phosphorus is listed as a contributing cause in 35% of impaired stream miles

- Of lake acres deemed impaired for aesthetic use:
  - 82% were impaired in part by total phosphorus
  - 81% were impaired in part by aquatic algae

ALGAL TOXIN MONITORING PROJECT 2005-2008

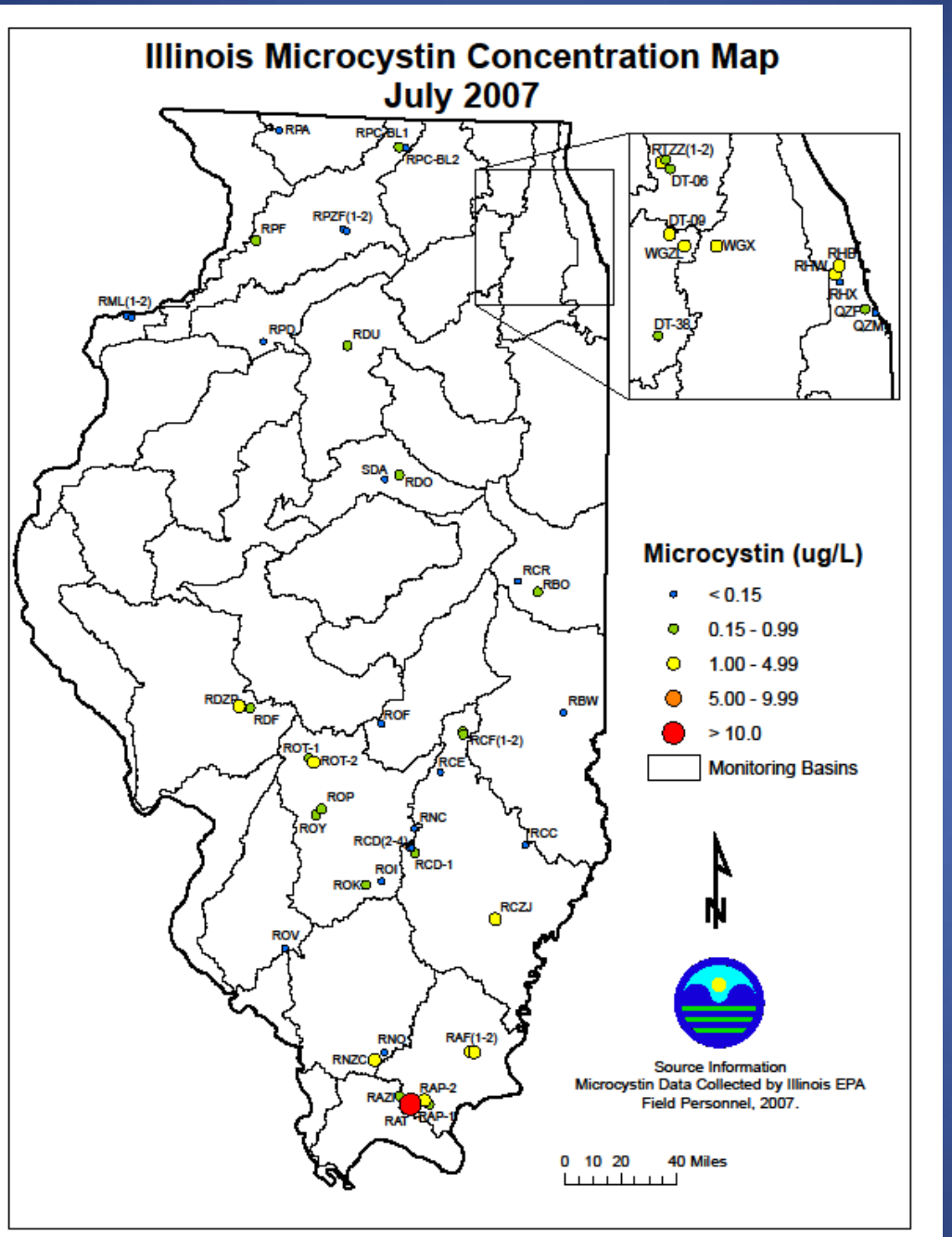
- 366 samples – Public water supply lakes (2005-06)
  - Public recreational access points on lakes (2007-08)
- 50% of samples had detectable levels of microcystin – all in low risk category
- Algal species capable of producing microcystins present, under right conditions algal blooms could produce much higher concentrations than those detected

MICROCYSTIN LEVELS IN ILLINOIS LAKES

(WHO guidelines:
drinking water ≥ 1 ug/L

Recreation
mild = 2-4 ug/L
moderate = 20 ug/L
High = 200 ug/L

	2005	2006	2007	2008
N	12	10	165	179
Minimum	0.09 ug/L	0.15 ug/L	0.12 ug/L	0.15 ug/L
Maximum	8.00 ug/L	8.20 ug/L	10.77 ug/L	17.47 ug/L
Median	.015 ug/L	0.7 ug/L	0.20 ug/L	0.15 ug/L
Average	1.78 ug/L	2.35 ug/L	0.75 ug/L	0.64 ug/L


Illinois Microcystin Concentration Map
July 2007
RPA
RPC-BL1
RPC-BL2
RPZF(1-2)
RPF
RML(1-2)
RPD
RDU
SDA
RDO
RCR
RBO
RDZR
RDF
ROF
RBW
RCF(1-2)
ROT-1
ROT-2
RCE
ROP
ROY
RNC
RCD(2-4)
RCD-1
RCC
ROI
ROK
RCZJ
ROV
RNQ
RAF(1-2)
RNZC
RAZ
RAP-2
RAT
RAP-1
RTZZ(1-2)
DT-06
DT-09
WGZ
WGX
RHB
RHM
RHX
QZF
QZM
DT-38
Microcystin (ug/L)
< 0.15
0.15 - 0.99
1.00 - 4.99
5.00 - 9.99
> 10.0
Monitoring Basins
N
Source Information
Microcystin Data Collected by Illinois EPA
Field Personnel, 2007.
0 10 20 40 Miles

NUMERICAL WATER QUALITY STANDARDS

- In 2000 USEPA established recommended numeric and nitrogen based on “reference conditions”
- Various numbers for different “eco-regions”
- States have 3 years to adopt federal standard or establish their own
- Illinois opted to establish its own
- Funded research through CFAR to establish cause-effect relationship
- Results indicated complex relationship between nitrogen/phosphorus → adverse effect
- No standards proposed yet – most states similar

PROPOSED STANDARDS VS. ILLINOIS NUTRIENT LEVELS

	P (mg/L)	N (mg/L)
USEPA National Criteria - Corn Belt Eco-region - Southeast Forested Eco-region	 0.076 0.037	 2.18 0.69
Other States	0.04 – 0.1	1-3
Concentrations in Illinois Streams (mean)	0.38	5.2

CURRENT MANAGEMENT APPROACHES - ISSUES

- NPDES permits and TMDL load limits address only municipal and industrial sources
- Management of non-point source pollution – voluntary, incentive-based – no guaranteed reductions
- State and federal cost-share programs for NPS – federal not well-targeted for nutrients
- Collective status of BMP implementation in Illinois not known

CURRENT MANAGEMENT APPROACHES – ISSUES

- Available data indicate over-application of fertilizer/manure not the issue
  - What are the effective BMPs?
  - Need economically viable 3rd crop?
  - Cost to get significant nutrient reduction from agriculture could be billions $$
- New/expanding WWTP have 1 mg/L phosphorus limit
  - Only 6.5% currently required to limit P – smaller # removing N

CURRENT MANAGEMENT APPROACHES – ISSUES

- Limit of technology =
  - P 0.1 – 0.5 mg/l
  - N 1 – 3 mg/L
- Collective cost to remove nutrients could be billions $$

WHAT OTHER STATES ARE DOING

Establishing numeric water quality standards:

- WI – P standard, varies for different waterbody types
- MN – P standard, lakes only
- FL – federal promulgation, P and N – lakes and flowing waters
- CO – outstanding resource lakes and streams
- MT – varies for different waterbody types
- OH – P and N – affect only waters that are susceptible
- MI – P standard for flowing waters

WHAT OTHER STATES ARE DOING CONT'D

Targets for reduction without numeric WQS for N & P:

- KS – used hypoxia goals to require point source nutrient removal; non-point source implementation through watershed plans
- CT – identified/required optimal nutrient "yield" per acre for urban, agricultural and forested lands assuming optimal BMP implementation
- NC – required nutrient reductions from point and non-point sources through state authorities to meet TMDL goals
- VA – for Chesapeake Bay goals; limit of technology nutrient removal from point sources, baseline agricultural BMPs and promotes voluntary implementation