Phosphorus Task Force Phase 2 Meeting
January 9, 2013
Riffe Tower, Rm. 1960

Attendance

Task Force
Larry Antosch, Dave Baker, Doug Busdeker, Dan Button, Steve Davis, Libby Dayton, Kevin Elder, Karl Gebhardt, Gail Hesse, Kevin King, Amy Klei, Greg LaBarge, Joe Logan, Terry McClure, Trinka Mount (for Rick Wilson), Jeffrey Reutter, Peter Richards, Mark Scarpitti, Mike Shelton (for Chris Wible), Julie Weatherington-Rice, Rick Wilson, Ron Wyss

Observers
Mike Bailey, Tom Fontana, Chris Henney, Jack Irvin, Jack Kramer, Linda Merchant-Masonbrink, Anthony Sasson, John Schlichter

Handouts

Agenda
Minutes from November 7 Task Force meeting
Restoring America's Wetlands: A private lands conservation success story (NRCS)

Announcements

- March calendar adjustment- Meeting scheduled for March 7 instead of March 6 because of conflicts. More conflicts for March 7. So now we need a doodle poll to select a new date.
- February meeting will be in Riffe, but on 31st floor.
- Nov. 14 Nutrient Forum. Well attended with couple hundred people. Information is on web at http://www.tetratech-ffx.com/ohio_nutrient/index.html
- Draft Nutrient Strategy expected to be revised by March or April.
- On January 8, State agency directors (ODNR, OEPA, ODA) met with Terry Cosby (NRCS) to discuss a certification program like in Minnesota or Michigan (if a farmer has a plan and goes through certification review, then they are held harmless by U.S. EPA). The directors are setting up a working group with several organizations to move this idea forward. There is also a certification program for commercial fertilizer dealers in western Lake Erie basin being developed; there is an offer from that working group to present their proposed programn to this group in March.
- Be mindful of the June deadline set by Nally to finish up P2 Task Force recommendations.

After hearing from Joe DePinto, our goal today is to agree on at least a framework for targets. We will be reviewing some papers that address water quality, drainage management, point sources and information about fertilizers in the coming months.

Presentation: Models Can Support Establishment of Phosphorus Loading Targets for Lake Erie – Dr. Joe DePinto, LimnoTech

First worked on 1970s targets. About five years ago, worked on IJC (International Joint Commission) workgroup that decided that the old models used to establish Annex 3 targets need to be updated due to lack of spatial and process resolution to represent the recent "re-eutrophication" and nearshore ecosystem changes. A new generation of models is needed; work started and continues. Current models are not totally there yet, but getting there.

Basics:

Some "unavailable phosphorus" entering system can become available through various physical-chemical and biological processes. How does loading P translate to biomass of algae? Need to consider loading of both immediately algal-available P as well as immediately unavailable P that may potentially be converted to algal-available P.

Internal loading today is about the same as 20-40 years ago since sediments respond so much slower than water column. Therefore with respect to sediment loading of P, sediments are still responding to high loads in the 1970s and 1980s.

What do we set targets for – benthic algae, blue-green algal blooms, hypoxia? May not be able to fully eliminate hypoxia in Central Basin; therefore, should probably aim at addressing HABs problem in Western Basin, which will definitely improve, but probably not eliminate hypoxia in Central Basin.

Models include cycling in water column. P gets reused several times in one growing season.

The P into the lakes from tributaries includes both algal available P (DRP) and particulate P which has a certain fraction than can be converted to SRP.

In 1980s, DePinto developed a dual culture diffusion apparatus to measure via a bioassay how much algal available P from particulate phosphorus is taken up by algae. Quick chemical measures were also made to evaluate a way to replace the lengthy bioassay process. Found good relationship between bioassay measure bioavailable P and NaOH-extractable phosphorus in particulate samples. Slope close to 1 and an intercept close to 0 so almost a direct measure of algal available P. There is a difference in rate of release in algal available P and the cycling of dead algae in the lake. The rate of release of tributary suspended sediment was a lot faster than the release from dead algae in the water column. So he developed a different way of doing the modeling to address this. Tributary loads are treated differently than the internal cycling.

Previous Lake Erie Model (modification of 1970s DiToro model – There is not much difference until June when loads are no longer driving the system and internal cycling is driving primary production.

Think about availability, cycling, and how it is operated on in the lake.

SRP has gone up quite a bit today.

There are two pathways of internal sediment loading, neither of which will change quickly:

1) Sediment re-suspension of particulate P. Wind/wave re-suspension is most pronounced in the western basin.

2) Pore diffusive flux of dissolved P (more important in central basin in hypoxic zone). Rate is dependent on dissolved P in pores and overlying water column dissolved oxygen gradient. Not impacted by wind. Redox in sediment is crucial. Sediment-aerobic layer thickness governs the rate at which water in anaerobic layer can release pore water with phosphorus. When iron is reduced from Fe^3 to Fe^2 there is less P binding.

Rate of release of P from sediments is based on water column equilibrium capacity to take P from the sediment. But if an algae bloom assimilates P in water column, then more P is released from the sediment.

Re-suspension seen on satellite is from top millimeter of the sediment near the shore.

Sediment coming to Lake Erie has decreased since 1970s.

Dayton – Sediment could act as a sink when equilibrium changes.

When the overlying water has a dissolved oxygen concentration of <2mg/l, there is significant pore diffusion P release from the sediments. pH at high oxygen governs release of P; requires pH > 10 to induce aerobic release of SRP from iron oxides in sediments.

Anaerobic environment releases P more than aerobic environment. Oxidized iron and sulfate in surface sediments act as a barrier to release P from aerobic sediments.

Internal load is 10-15% of external load in central basin.

DRP is a small fraction of total P, but the algal availability is the important concept here.

There is no long-term equilibrium –there is a source in the watershed that impacts the equilibrium. We need to look at tile drained systems and whether this is the source.

Reutter – See little more Total P in central basin sediments than in western basin sediment. Also increasing pockets of hypoxia in western basin.

Western basin has more sand and may explain why there is less P in western basin sediments.

Hypoxia in western basin in pretty transient. So there is not that much P contribution from the sediment. Deepening of hypoxia in central basin since 1995.

With more oxygen, aerobic sediment layer gets thicker and blocks P release.

Shoreline sediments have sand and its re-suspension is not a big deal in impacting P release because it is oxygenated. It is re-suspension from deeper anaerobic water that we should focus on for P release.

EcoFore Hypoxia Modeling-NOAA funded project to access causes and remedies of central basin hypoxia.

Drivers of Hypoxia in Central Basin (driven by P from western basin and generating algal growth)

- Thickness of Central Basin bottom layer
- Organic matter flux to the bottom
- Sediment Oxygen demand-decomposition of algae contributes 60% of hypolimnetic oxygen demand

Eutrophication Model – to model oxygen

Can calculate the number of hypoxic days vs. annual TP load, e.g.,

11,000 MT ≈ 40 hypoxic days, covering 5,000 km^2

6,000 MT ≈ 25 days, covering 2,000 km^2

How big an area is covered by hypoxic zone? Could calculate areas as percent of Central Basin area using bathymetry data and depth profile of dissolved oxygen.

Microcystis bloom in Western Basin in 2011 began in July in Monroe MI area; grew into Central Basin in September; by October, had waned in WB but strong in CB.

Maumee P load fueled 2011 bloom: big load in May, not washed through by more storms. 120 billion ft^3 difference between 2011 and 2012; 2000 MT (approximately 30% of TP load in typical year)

Maumee FWMC = 93 ug/l (~4% of flow to WB)

Detroit FWMC = 10 to 15 ug/l (~95% of flow to WB)

Can we set load targets for microcystis? (See Stumpf et al. 2012 PloSONE graph)

Western Lake Erie Ecosystem Model (WLEEM): USACE Buffalo, National Science Foundation (sub to University of Michigan), Great Lakes Protection Fund (sub to The Nature Conservancy). Objective: model ecological response to Western basin Lake Erie to external (e.g., Maumee) and internal (e.g., wind-driven re-suspension) sources. Sediment, nutrients, also includes benthic algae and dresseinids. If we want to eliminate microcystin, model showed would need to reduce Maumee total P load by 40%.

We are working on linked models of watershed BMPs and lake response. The watershed model is SWAT at HUC12 scale. BMPs were cover crops and 3-m filter strips, assuming 100% BMP implementation on 50% of land. Based on 2004 (a relatively light year for microcystin), a 50% total P reduction would result in 23% reduction in algal biomass. y= 0.45x The model doesn't include 2011 data. Agricultural Research

Service is working on a much finer scale model; could develop farm-level HRU model, but this would be a significant amount of work. We are at least a year away from a targeted model.

Member comments:

Scarpitti: This shows a need to focus on BMPs that increase infiltration.

Reutter: Setting a target to eliminate anoxia is probably not practical. Anything we do to lessen microcystin will help anoxia.

Development of dissolved phosphorus targets for Lake Erie Group discussion

This after-lunch discussion began with members asking questions about Joe DePinto's morning presentation and transitioned to discussion of a framework for targets.

Question – How much shown as Total P can be modeled as DRP?

In the lake we can do either. In the watershed it is more problematic. Still trying to figure out what is going on in the watershed to find major DRP source. Don't know how to answer whether to focus targets on total or dissolved P. Should focus on both.

Question – Has there been any discussion of building new BMPs in the models aimed at SRP to see if they make a difference in additional reduction of P to the system? What more do you need?

There is difficulty in getting that data on a farm-specific basis. The new CEAP model for Maumee and Sandusky will have more recent information. However, only aggregate data about farming practices are available because of non-disclosure agreements.

Question – What happened to the DRP component of SWAT?

ARS has been working on the DRP runoff portion in the SWAT model and now is also looking into updating the model relative to what is coming out of tiles. The one DePinto is using is the 2009 version that does not include this.

SWAT does not model ephemeral gullies, which form readily throughout the Maumee and Sandusky watersheds. There is a project on the Tiffin watershed that will incorporate the ephemeral routines from AGNPS into SWAT. This will model formation and delivery of sediment through ephemeral gullies. This new feature will then be turned over to ARS to incorporate it into a new official version of SWAT, maybe about a year from now.

Question – DO and 2 mg/l for diffusion-rate. Is 2 a critical number?

P release is proportional to the lower water column DO as it declines from 2 mg/l (a critical level).

Question –Reoccurring algal blooms have been depositing in the central basin. Is there more P available because of this?

The real concern is that cyanobacteria don't make a positive contribution to food chain. They become detrital material instead of giving energy to fish, because the fish don't eat them. The western basin blooms contribute to the reservoir of decomposable material in the central basin, contributing to oxygen demand and loading. To reduce the dead zone in the central basin, we need to reduce carbon from cyanobacteria deposition and decomposition. Re-suspension in the central basin is less likely.

Question – Should we focus on spring or fall loading of P?

Focus on spring loads when thinking about cyanobacteria. When thinking of overall lake health, we should consider both spring and fall loading. Consider impact on diatoms that walleye utilize. In 2011, high P loading in fall did not create spring 2012 bloom.

Question - How shall we frame the targets we will set? Can Task Force agree we want to talk about seasonal targets? Are annual targets also needed?

2011 and 2012 showed us that seasons made a difference.

Seasonal targets make a lot of sense. Fall load in 2011 created huge blooms in winter of 2012. There was no ice cover so could see the blooms in the winter. And then in the summer, there was a bloom by Fairport. Winter loading may have contributed to this.

For hypoxia, it doesn't matter whether loading comes in spring or fall. So we should look at annual loading over a period of time with seasonal targets embedded. Reducing total loads by BMPs is best.

Now the load is skewing towards dissolved P. Watershed models currently used should reflect this. They are still trying to work this out. SWAT coefficient is adjusted to allow the model to predict dissolved P. Libby Dayton's and other's work will help refine SWAT. The lake models do consider DRP now.

Fertilizer application is going to happen in both spring and fall. We can't enforce when it is applied. So we need to focus on best practices for whenever farmers apply fertilizer. If we say farmers can apply fertilizer in the fall, it sends the unintended message that they can apply without BMPs. They may end up applying fertilizer to frozen ground.

Some years there are ideal conditions in spring and some in fall. This year (2012) fertilization is already done in the fall because we had dry conditions. There were high yields and high prices in Ohio last year because of a dry fall, and farmers made a lot of money. Some farmers applied lots of fertilizer because they had lots of money. Certification programs need to target dissolved-phosphorus-reducing BMPs.

Addressing only seasonal loads is risky because it implies other seasons aren't important. It also concentrates risk rather than spreading it throughout the year. A lot of this comes down to education and messaging. We should focus on cover crops, incorporation, promoting infiltration, etc. We don't need more than 20 ppm in soils.

Question - What are we managing for? Lack of HABs? Goal of reducing delivery in the spring through BMPs? What form should a target take?

Was there an allocation of a certain percent to the Maumee? No, it was the whole lake. The western basin met the 11,000 metric tons target by limiting point sources to 1 mg/l and 30% reduction of NPS which occurred from no-till. Allocations were made by county (1983). We used practices to reduce the upward trend of Total P; now we need to do the same with dissolved P.

Maybe we should have a target for DRP and total. No backsliding on total P and improve DRP.
TP = 15 in western basin was the target –was not met in western basin. Central basin targets were met and for a few years the hypoxia targets were met. Things have changed so can't use those old models for a permanent solution.

If we focus our target on western basin, this should benefit the central basin.

Larger fall and winter DRP contributions than in spring have been observed.

We need to get a handle on the DRP trend, even if we don't have a number. If we stay with total P only, we may not have the result we want.

We haven't talked about concentrations (just loads).

Need a total P goal and a DRP goal (as a possible % of total).

Consider bioavailable particulate P target. It may not be practical. It may be difficult to institute the methods to measure it to determine if we meet the target. And it is more expensive. It is the right way to go if we are strictly looking at the science.

Cyanobacteria have much higher demand for P than other organisms. The Maumee is hands down the culprit feeding the cyanobacteria with respect to concentrations (loads are about the same between Detroit and Maumee). Concentration is the key to cyanobacteria. Maybe consider event-mean concentration? Flow-weighted mean concentration?

BMPs help take the weather variations out of the picture.

We can directly measure total P, but it is difficult to measure the bioavailable P.

What about a narrative goal? It is easier to explain to public. Numbers are important for regulatory purposes but difficult to explain to the public. However, a numerical goal provides a measure of direction.

Consider an adaptive management approach. Have a goal and a target. Have things that move you in that direction.

Set a target at the mouth of the watershed.

GLOS March data management of HABs in the western basin. Bulletin may expand to a daily report and a seasonal projection.

Look at loads associated with different sizes of HABs. Then decide what size HAB bloom, if any we would accept. Perhaps a subset of Task Force could come up with this analysis based on available information.

We are not going to meet goal every year. But we can use an adaptive management approach.

Consider PWS, beaches, in-lake recreation protection. Pick a goal so society as a whole is benefited with respect to microcystin. Relate P concentration to beneficial uses is difficult to do except on a site specific basis. This is what USEPA wants us to do. Can't translate *Microcystis sp.* to microcystin and how that translates to phosphorus loads.

Let's consider the following approach:

- Develop an annual target for the western basin for TP and DRP
    - 4-6 weeks after a storm event….the temperature will determine what type of bloom.
    - What are agricultural logistics for seasonal targets?
- Have a smaller subset of Task Force to come up with some numbers based in what is in the lake to get to a tributary target. Based on available data, determine what loads have resulted in what size (or absence) of a HAB bloom in the past.
- Devise an adaptive management process -because of the watershed scale issue. Monitoring has to have a good sense of watershed management of nutrients if we are going to use adaptive management. We have to know what all of the farmers are doing.
- Possibly develop a biomass target

15 ug/l is achievable in the western basin. We need a hard target for the Maumee to minimize near-shore blooms.

Develop careful messaging around each part of these recommendations; explain 5 year running average in the narrative, etc.

THE PLAN FOR THE NEXT MEETING:

- Look at only the annual target options for the western basin for TP and DRP
- Then look collectively as a group what the smaller group comes up with for historic loads and resultant size of HABs.
- Then collectively discuss a seasonal target.