

## Agricultural Drainage Management Systems Task Force

Minneapolis, MN

Oct 13-14, 2009

### Opening comments

Gary Sands welcomed everyone to Minneapolis, and all participants introduced themselves. William Hunt, NRCS State Conservationist, presented opening remarks regarding the Mississippi River Basin Initiative and opportunities for drainage.

*Note: The meeting was organized by goal, from the ADMS Task Force Action Plan. The four goals are noted with a grey background, as below.*

*ADMS Task Force Goal 1: RESEARCH. "Provide additional scientific and technical information on the development of environmental and societal goals and objectives, and performance measures for improved drainage water management practices and systems."*

### 5-state Conservation Innovation Grant

Preliminary results were presented from the 5-state Conservation Innovation Grant managed by the Agricultural Drainage Management Coalition. Researchers from each of the states (Ohio, Indiana, Illinois, Iowa, and Minnesota) presented results to date, for each of the following topics: **Drain flow:** Preliminary analysis showed that flow reductions from drainage water management were mostly between 20% and 60%, although they ranged from 1% to 97%. Some states conducted paired statistical analysis, while others compared total flow by year.

**Nitrate concentration and load:** Most states found that concentrations were more or less the same under free and controlled drainage, so that reduction in load is equal to reduction in flow. Interesting questions were raised about analysis of the nitrogen cycle, which would be helpful but has not been done in the project. The question of where the nitrate not lost through tile drains ultimately goes is still unanswered.

**Crop yield:** Differences in yield range from slightly negative to positive. In Indiana, results showed that the greatest benefit occurs at higher locations in the field, perhaps because that is where dry stress is more of a problem.

The project will be completed by March 2010.

*Outreach:* Karen Scanlon and Steve Werblow of the Conservation Technology Information Center (CTIC), presented outreach strategies developed for specific audiences. They also discussed key messages they are using. For example, in Year 3, messages include DWM is delivering, Yield data are now available, Outstanding benefits to the environment, Important hedge against the weather, Control is not difficult, Return on investment, aided by crop benefits and program money. Communication methods include the ADMC web site, farm forums, and print media (placements in major publications),

### Minnesota 2-stage ditch

Joel Peterson presented a talk developed by Bruce Wilson and others on a new project designed with the following goals: Self-sustaining ditch, bank stability, nitrogen removal. Self-sustaining means that Sediment in = sediment out. Bank stability means using a "bank sloughing reduction design" that included a toe drain for bank stability. Nitrogen is removed by a linear wetland, parallel to main channel. They are implementing a 1-mile section of ditch with these new practices.

## Bioreactors

Richard Cooke presented his “3<sup>rd</sup> generation” bioreactors, which use only one control structure, and a return pipe within the trench. The bioreactor can be located within the field, with 1 foot of soil over woodchips, or have woodchips to the surface if in a buffer. The newest system used paper-grade woodchips of very high quality which didn’t work as well, perhaps because they did not break down. Richard has developed a curve which will lead to design parameters for future bioreactors. He has recently received Illinois CIG funding to put in 5 more systems, which will lead to more points on the curve, that can be used to develop engineering design criteria for bioreactors.

Andry Ranaivoson of the University of Minnesota presented results from two bioreactors in Minnesota (Claremont and Dundas). Nitrate reductions were generally 10% to 100%, averaging about 50%. He also discussed options for determining life expectancy, through measuring C:N ratio.

Dan Jaynes mentioned that it seems most effective to put the bioreactor where there is a constant supply of water, so that the wood chips don’t dry out. Aerobic decomposition can greatly shorten the life of a bioreactor. Another option is to use a plastic liner to keep woodchips from drying out, but then there is a possibility of methyl-mercury. (In an early bioreactors design, they found methyl-mercury when standing water for too long. As long as there is flow, methyl-mercury stays at background level.)

Nitrous oxide has been a concern. Minnesota study suggested 0.5% of nitrogen removed becomes N<sub>2</sub>O rather than N<sub>2</sub>. In lab conditions, only 0.01%. But this needs to be compared to the N<sub>2</sub>O that would result from the nitrate going directly into the stream, which may be higher.

What is needed to develop design criteria and standards?

- Estimates of longevity (10 to 20 years?), needed for estimates of cost per kg NO<sub>3</sub>-N removed
- Criteria for sizing the bioreactor (% of flow, residence time needed)
- Unintended consequences (methyl mercury, nitrous oxide)

There is an interim NRCS standard, developed in Iowa, that can be used in any state if requested.

## Water balance for drained and subirrigated corn

Xinhua Jia of the Agricultural and Biosystems Engineering Department, North Dakota State University ([Xinhua.jia@ndsu.edu](mailto:Xinhua.jia@ndsu.edu)) presented her research on water balances for three treatments: undrained, drained, subirrigated/drained.

- The evapotranspiration (ET) was measured by the eddy covariance method. The ET for the drained field was 9.4% higher than the undrained field from June 1 to September 2, 2009. The highest ET difference occurred in July and August. The reference ET (ET<sub>o</sub>) by atmometers showed that the  
$$ET_{o\_subirrigated} > ET_{o\_drained} > ET_{o\_undrained}.$$
- Subirrigation was applied through the sump pump structure, and controlled by the water level measurements at the sump and in the field. The outflow was automatically measured by a current sensor and recorded by a Hobo datalogger.

- Soil moisture was measured by Hydra Probe II soil moisture, salinity and temperature sensors for the three fields, with two replicates and at six depths. The soil moisture was higher near the tile for the subirrigated field. The highest soil moisture change occurred at 60-90 cm, where the highest water uptake takes place.
- Surface runoff, seepage, and infiltration have not been measured, but will be measured later on or estimated based on other field measurement, such as topography map, soil physical parameters, and water level measurement throughout the field.

*ADMS Goal 4: RESEARCH GAPS: “Identify key technology gaps in drainage water management systems and related agricultural management systems and propose coordinated research, inventory, data collection, modeling, and technical assistance information programs to address the gaps.”*

#### **Priority research and tech transfer needs**

Jane Frankenberger and Katie Flahive led a discussion of priorities, both to update our Action Plan and to help EPA prioritize spending of a small sum they have allocated for drainage management. The group reviewed research needs from previous meetings, briefly discussed what it would take to address them, and added a few more. The full list of needs, discussion comments, and voting results, is in the Appendix of these notes (page 9).

A “vote” was taken, in which all participants had the opportunity to select one issue, and the winner in a landslide was (2) **addressing where the water and nitrate go** (when drainage water management reduces drain flow). Other issues that received a number of votes were (1) Nutrient reduction (economic and environmental) benefits at the watershed scale from drainage water management, and (6) How to monitor practices, especially a methodology for farmers.

Task Force members will follow up to come up with practical ideas for addressing this vital issue.

*ADMS Goal 3: OUTREACH and TECH TRANSFER: “Provide coordination of the technical, educational, and extension materials on the design, implementation, and operation of drainage water management systems that supports its success and sustainability.”*

#### **EPA Update**

Katie Flahive provided an overview from EPA, including the recent meeting of the Hypoxia Task Force in Iowa. She is looking into possible drainage management opportunities in the following grant programs:

- EPA State Innovation Grants Program (Environmental Results Program)
- EPA National Center for Environmental Research Programs
  - o Science to Achieve Results (STAR) Program
  - o Environmental Technology Verification Program
  - o Small Business Innovative Research Program
  - o Sustainability Program

#### **NC State DWM website:**

Muhammad Youssef provided an update on the NC State drainage advisory, developed with a CIG grant to help farmers manage drainage. An evaluation showed that producers appreciated the advisory information, and the interaction with NCSU researchers. It is free, supported

currently by a grant. Future funding is unknown. The group asked many questions about the possibility of updating model runs continually, like irrigation scheduling software, and even possibly sending out alerts on Twitter. NCSU researchers would be interested in populating another state, but would need funding.

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## WEDNESDAY

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### Next meeting

Norm Fausey led a discussion about the next meeting. It was decided to hold it around the March 9 “Water Showcase” organized by ARS in St. Louis. Norm Fausey will schedule and reserve a room.

### ARS Activities and Updates

Jim Fouss sent a statement shared by Norm Fausey. He wanted Task Force members to know that he plans for his future involvement with the ADMS Task Force to be primarily in an Advisory Role. He emphasized that the last 7 years with the TF have been a pleasure and very rewarding, and is confident we will keep up the good work in the research that “feeds” the TF and the “technology transfer” with our NRCS, Extension, and Industry partners taking the lead.

Jim asked Norm to present his views on three more things: (1) To encourage Task Force and Coalition members to continue putting effort into “retrofitting” existing drainage systems so that the current problems realized with excessive N-loss from subdrained cropland will be improved over the long term – otherwise, we may not gain on the current problems; (2) to keep in mind something that Dale Bucks and Jim have recommended from time-to-time and that is to explore potential methods and evaluate benefits, if any, for the management (control) of surface drainage systems; and (3) for some of the Task Force members to evaluate the benefits of open-ditch drainage systems on farmland where subsurface drainage is not used (i.e., where tile drains are not installed in the cropland and outlet into an open-ditch where the water level is controlled for drainage management). Finally, Jim asked that we plan on holding a future Task Force meeting somewhere in the Lower Mississippi River Basin, and he will make every effort to attend.

Dan Jaynes and Norm Fausey will co-lead the ARS participation in the ADMS TF.

The National Soil Tilth Lab in Ames has become the National Laboratory for Agriculture and the Environment.

### NRCS Activities and Updates

Doug Toews will be NRCS lead for the ADMS TF, as Mike Sullivan is fully engaged by the Mississippi River Basin Healthy Watersheds Initiative (MRBI).

Doug gave a presentation on the MRBI. NRCS will dedicate at least \$80 million per year through the life of the 2008 Farm Bill. Information is at [http://www.nrcs.usda.gov/programs/pdf\\_files/mrbi\\_factsheet.pdf](http://www.nrcs.usda.gov/programs/pdf_files/mrbi_factsheet.pdf).

Questions were asked regarding how the CCPI in particular would work, since technical assistance and outreach will be needed but not funded by the MRBI.

Sheryl Kunickis is currently at the Resources Inventory and Assessment Division, where she works on the NRI. She congratulated the group on the numerous accomplishments.

She mentioned the CEAP Geospatial Vulnerability Assessment tool, which will be piloted in Wisconsin. She recently talked with ARS leadership about re-establishing the functions of the Partnership Management Team, although not with that name. She asked the group to consider what remote sensing tools might be part of a CIG. For example, are there opportunities to identify tile lines through remote sensing?

### **Industry Update**

Charlie Schafer discussed many ways the drainage industry is participating in current initiatives. He showed a new surface inlet that would reduce sediment into tile lines. He was asked about the “water gate” subsurface water control structure, which is now going into manufacturing. It may present a cost-effective way to implement DWM in steeper topography. He was asked about sizes, and responded that manufacture so far has been 8 inch and 10 inch, but can be necked down to 4 or 6 inch for retrofit of smaller submains.

They are working on requests to NRCS for practice standards, are interested in the Chesapeake Bay, and interested in nutrient trading.

Leonard Binstock updated the group on the ADMC. The 5-state Demonstration project is finishing up. They are preparing templates for the final reports.

*Educational opportunities:* More and more producers are contacting ADMC for help with drainage questions. Many producers are more up to date with GPS and geospatial technologies than contractors. They are helping contractors adopt new technology.

They feel ADMC has a great opportunity to help with education. Budget cuts in agencies for applying practices. Need to ramp up training. Gary Sands, Matt Helmers, Jeff Strock worked with ADMC to put on a training in July in Des Moines. 38 contractors paid \$250 to learn to apply DWM. Issued a certificate and put names on web site of people that have been trained. Need to go to bioreactors and other practices.

### **Other updates**

- Joseph Britt of the **Sand County Foundation** stated that the MRBI is a creative use by NRCS of using programs created for one purpose for another purpose, and that it is very important that this initiative succeed.
- Dave DeGeus, Upper Mississippi River Watershed Coordinator for **The Nature Conservancy**, discussed his role and the organization’s focus on partnerships. A major challenge is achieving implementation at a scale big enough to make a difference. He is interested in agricultural drainage and how we can work together.

### **Education**

Extension agricultural engineers in Indiana, Illinois, Iowa, Missouri and Minnesota met in June to prioritize educational needs. The group decided to develop extension publications on the following topics. A timeline is not yet available.

1. How do design DWM systems-retrofits
2. How to design DWM systems-new systems
3. Drainage depth and spacing for economic and environmental objectives
4. Bioreactors

In addition, they planned to prioritize a Midwest conservation drainage guide, with many of the tools from the Illinois Drainage Guide.

Leonard BInstock suggested an internet training guide for design of some practices, and the possibility of offering workshops in conjunction with other meetings. However at least one day is needed for drainage water management. Internet training may be a method for increasing the audience and number of opportunities.

Upcoming events related to drainage management:

- Iowa-Minnesota Drainage Research Forum: Nov 10, 2009 in Ames
- Minnesota-North Dakota Drainage Workshop: Feb 2-3, 2010 in Fargo
- 9<sup>th</sup> Intl Drainage Symposium, June 13-16, 2010 in Quebec City. Program Chair Gary Sands offered to include additional presentations if requested.
- Overholt Drainage School: March 22-26 in Sidney, OH
- Two drainage workshops in Illinois in February 2010
- Science to Solutions Dec 9-11, 2009 in Des Moines
- ADMC has an “Events” page on their web site (<http://www.admcoalition.com/events.html>)

*ADMS Goal 2: DRAINAGE DATABASES: “Make sure that the completed and ongoing data sets for improved drainage water management systems are catalogued, cross referenced, and integrated into a national agricultural database.”*

#### **Drainage questions in 2012 Ag Census**

Dan Jaynes reminded the group that there is no modern, up-to-date census of drainage – the latest is from the 1980s. Task Force members (led by Dan) asked for two questions related to drainage in the 2012 census of agriculture. It would be helpful if more people sent letters to the NASS group planning. He will send information to the email list.

#### **Update Action Plan**

Norm Fausey led a discussion of the ADMS TF Action Plan, last updated in 2006. Some of the changes are listed below. Norm volunteered to send out a revision of the current Action Plan to be used as a working document.

#### **General:**

Some felt that the group was originally created for drainage water management. Do we need to go through a process to expand the mission? *A motion was made to expand the scope of the ADMS Task Force (if not already done) to encompass water quality and quantity issues related to agricultural drainage. This could include all aspects of land drainage related to agriculture: wetland treatment, bioreactors, blind inlets, etc.) The motion passed.*

It would be very helpful to have a short annual report, which could be emailed to specific people (such as Under Secretaries) to inform them of accomplishments. (MSEA project created 1-page, 2-sided “waving papers”, which were successful.) Larry Brown agreed to do this the first year.

Discussion on specific goals or action items:

#### **Goal 1:**

Look at performance measures. Ohio has a multi-agency group for performance measures. They are adding DWM to EPA’s tools for TMDLs. For spring meeting, we will ask each state to speak about their state’s approach to performance measures. Include design criteria for bioreactors (Richard Cooke)

**Goal 3:**

- List all presentations anyone has done. Put on web site, and also in annual report.
- Web site needs bibliography.
- 3.3 is done. We could compile results over time.

**Goal 4:**

We listed 12 research gaps and prioritized on Tuesday. Are there others?

1. Look at effect of drainage on reducing phosphorus runoff. Discuss at next meeting. Norm Fausey will report on the Ohio Task Force addressing this.
2. Sediment and hydrology information is needed.
3. Need to look at practices with respect to climate change. Doug Toews will lead a discussion at the next meeting, so that we can be ready to answer questions. (Note: One paper has been submitted to the Intl Drainage Symposium addressing this; also Iowa is addressing.)
4. Denitrification and conversion to nitrous oxide.

Discussion will continue at the next meeting. Norm Fausey will lead.

The meeting ended at noon.

**Attendance**

1. Jeanne Hansen	ADMC	<a href="mailto:jhansen@admcoalition.com">jhansen@admcoalition.com</a>
2. Leonard Binstock	ADMC	<a href="mailto:lbinstock@admcoalition.com">lbinstock@admcoalition.com</a>
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7. Norm Fausey	ARS	<a href="mailto:Norm.fausey@ars.usda.gov">Norm.fausey@ars.usda.gov</a>
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10. Steve Werblow	CTIC	<a href="mailto:werblow@mind.net">werblow@mind.net</a>
11. Mike Schilling	Ellingson	
12. Katie Flahive	EPA	<a href="mailto:Flahive.katie@epa.gov">Flahive.katie@epa.gov</a>
13. John Torbert	Iowa DDA	<a href="mailto:JtorbertIDDA@mchsi.cm">JtorbertIDDA@mchsi.cm</a>
14. Matt Helmers	Iowa State U	<a href="mailto:mhelmers@iastate.edu">mhelmers@iastate.edu</a>
15. Warren Formo	Minn AWRC	<a href="mailto:warren@mawrc.org">warren@mawrc.org</a>
16. Joel Peterson	Minn BWSR	<a href="mailto:Joel.r.peterson@state.mn.us">Joel.r.peterson@state.mn.us</a>
17. Riley Maanum	Minn Corn Growers	<a href="mailto:maanum@mncorn.org">maanum@mncorn.org</a>
18. Richard Werzberger	Minn Corn Growers	
19. Steve Sodeman	Minn Corn Growers	<a href="mailto:ssodeman@federatedwildblue.com">ssodeman@federatedwildblue.com</a>
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24. Steve Commerford	MN Soybean Growers	
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#### **Appendix: Complete notes from discussion of *Research Gaps and Priorities***

*Suggestions, with comments and discussion of how they could be addressed below.*

1. Nutrient reduction (economic and environmental) benefits at the watershed scale from field scale practices.
 

*Comments/What would it take?*

  - This is very complicated. Requires at least 300-400K \$. Extension of water balance study at watershed scale.
  - WATERSHED CEAP programs are doing this. So limit this to DWM. This is appropriate for MRBI. (Should we be providing guidance to MRBI? )
2. Where does the water and nitrogen go?
 

*Comments/What would it take?*

  - On subset of CIG sites, monitor N loss out the bottom.
  - This is complex. I'm not sure we can make headway with a small amt of money. Can measure soil N above and below tile.
  - Ohio has measured at 3 depths with piezometers. Almost no nitrate goes down. USGS in Indiana has monitored at 10', found no nitrate.
  - Problem is that this method does not address the potential for lateral movement.
3. Manure fertilizer and drainage water
  - In WI manure is paramount. Developing a critical conditions index to warn farmers off the field.
  - Group in OH and MI already addressed manure preferential flow issues very well.
4. Interaction of multiple practices in conjunction with DWM
  - This will complicate things even more. We already have a lot of unanswered questions for single practices.
5. How to target locations within a watershed for the practices
  - Good future area. We've tried to estimate based on other soil and landscape features, but targeting based on elevation will be possible soon, especially once LIDAR is available. (But target upslope vs. lower down locations? We don't know this.)

- This is one of the most important questions for DWM. OM content, texture, depth of profile all affect DWM and are key to large scale application of the practice.
6. How to monitor practices. Develop methodology for farmers
    - There is an expectation in the MRBI for monitoring. We need farmer technology for water quality tests.
  7. Acquiring soil data needed for DRAINMOD (Illinois Drainage Guide), namely the water content near saturation.
    - Need 5 levels from 0-100cm (not available in soil survey)
    - Skaggs believes we need to test soils. Another possibility may be to get this relationship from Rosetta (but need to check).
      - Problem with Rosetta is that the results cover the entire range; we need near saturation for DRAINMOD.
    - Transfer functions work better for some soils than others. What is the effect on a model of running it with data from these functions compared to measured and calibrated data. What is the error?
    - Before asking for more measurements, see how model will respond without calibration. How many measurements do you need to take to get reliability? At different scales?
  8. Effect of DWM on soluble P
  9. Evaluate relationship between soil tilth and water holding properties
    - Evaluate non structural practices to manage water. e.g. increasing infiltration, cropping. ..
  10. Modify DRAINMOD to handle annual variations
    - Youssef: DRAINMOD models one year and takes the average for 50 years.
  11. Remote sensing of ET to help manage.

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**VOTES**

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	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>
1:	5	1	
2:	17	1	
3:	1		
4:	1	1	1
5:	1		1
6:	3		1
7:	1		
8:	1		
9:	1	2	
10:			1

**Additional comments or suggestions (on paper)**

- Remember when applying 4356 gal of manure that means 1 gallon on 10 square feet. Plus it is covered by disks. And an inch of rain is 27000 gallons or .16 inch of liquid in 43560/acre
- Establish a Center for Technology and Conservation Drainage
- Documenting DWM applied pursuant to MRBI and Great Lakes Restoration (GLR) Watershed projects.
- It is a combination between 7&8: looking for ways to obtain DRAINMOD model without extra measurement & assessing the performance of the model without calibration.