ADMC
Agricultural Drainage Management Coalition

Best Management Practices (BMPs) & Technologies for Addressing Nutrient Management

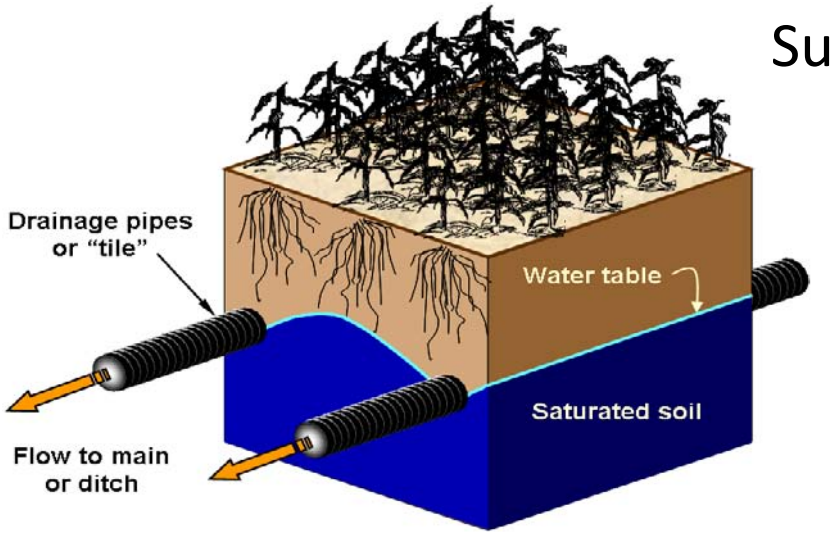
Ag Drainage Management Practices and Results

Dr. Harold F. Reetz, Jr.

Ph.D, CPAg, CCA

Executive Director, ADMC

Artificial Drainage for Agriculture

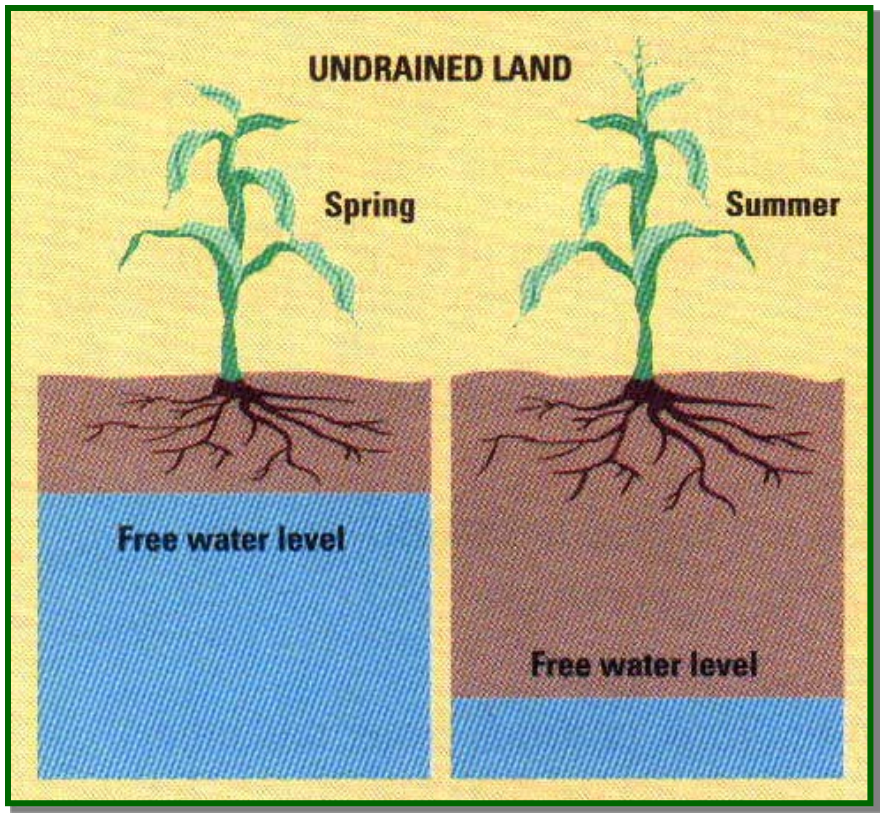


Subsurface ("Tile") Drainage

Surface Drainage

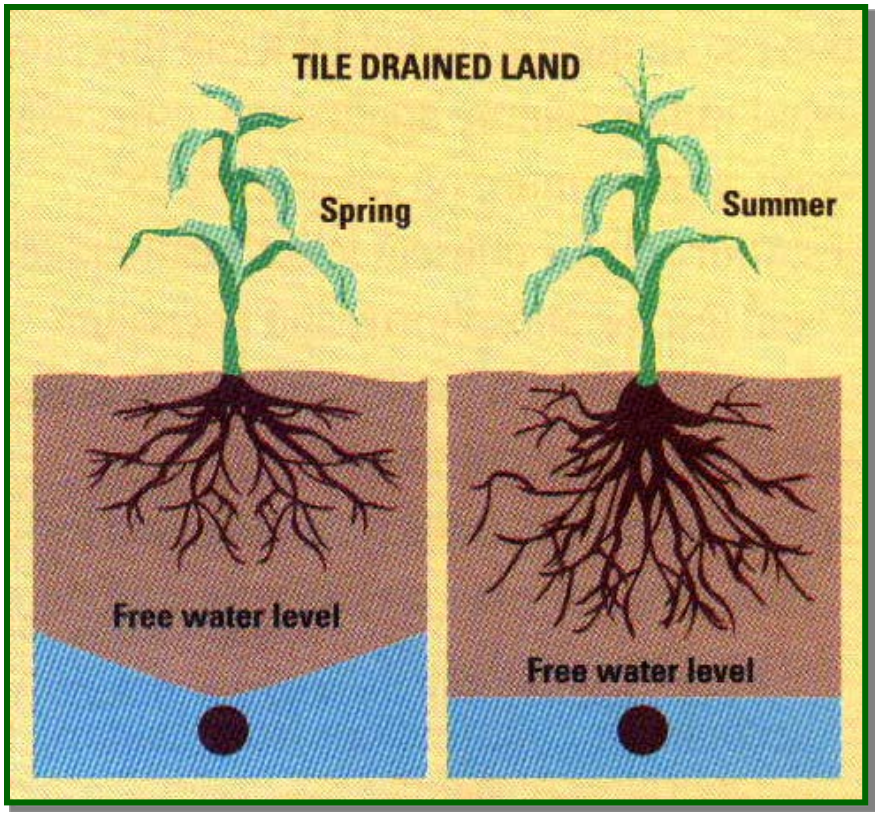
ADMC
Agricultural Drainage Management
Coalition

Benefits of *Subsurface* Drainage



"Wet feet" limits early root development

Better root system development



ADMC Agricultural Drainage Management Coalition

Benefits of Drainage Systems

- To remove excess water as quickly as possible.
  - *Facilitate field work*
  - *To reduce compaction*
  - *To warm soils earlier*
  - *Reduce seed rot/population losses*
  - *Encourage early deep root development*
  - *Maintain proper environment for crop production*
  - *Help reduce runoff and surface erosion*
  - *To reduce year-to-year fluctuations in production*

ADMC Agricultural Drainage Management Coalition

Potential Negative Impacts of Tile Drainage

- Increased nitrate-nitrogen losses
- Fewer temporary wetlands
- Occasionally over-drained soils during dry part of growing season

ADMC Agricultural Drainage Management Coalition

Existing and Emerging Water Management Practices to Improve Water Quality

- N treatment wetlands
- Bio-reactors
- Saturated buffers
- Blind inlets
- Improved waterways
- Tile outlet terraces
- Dry dams and diversions
- Drainage water management

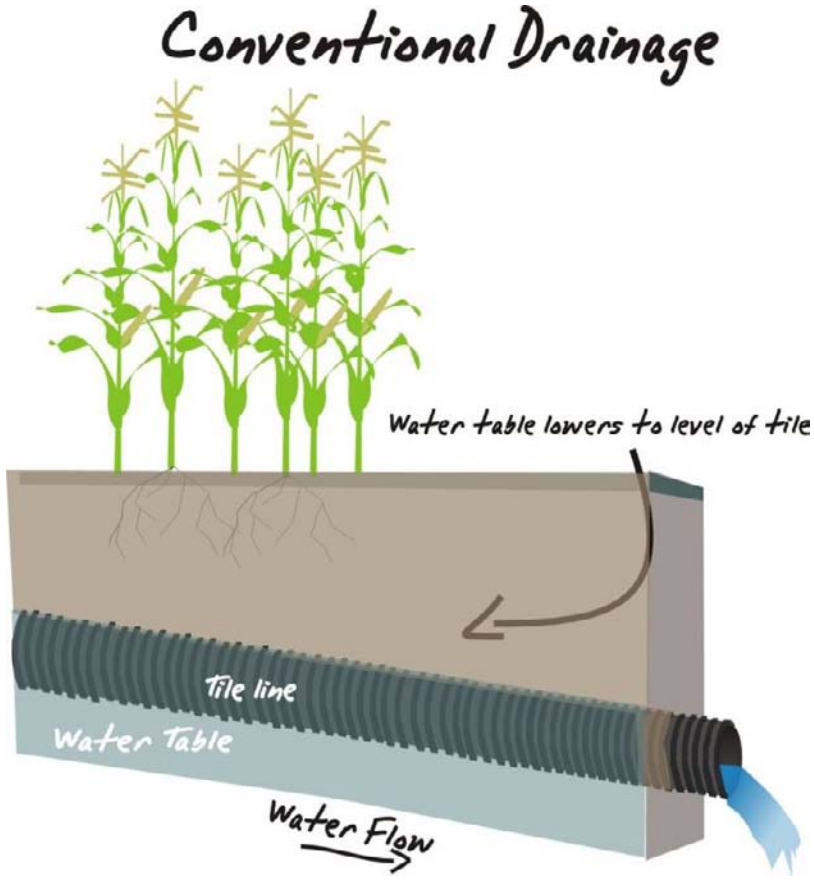
ADMC Agricultural Drainage Management Coalition

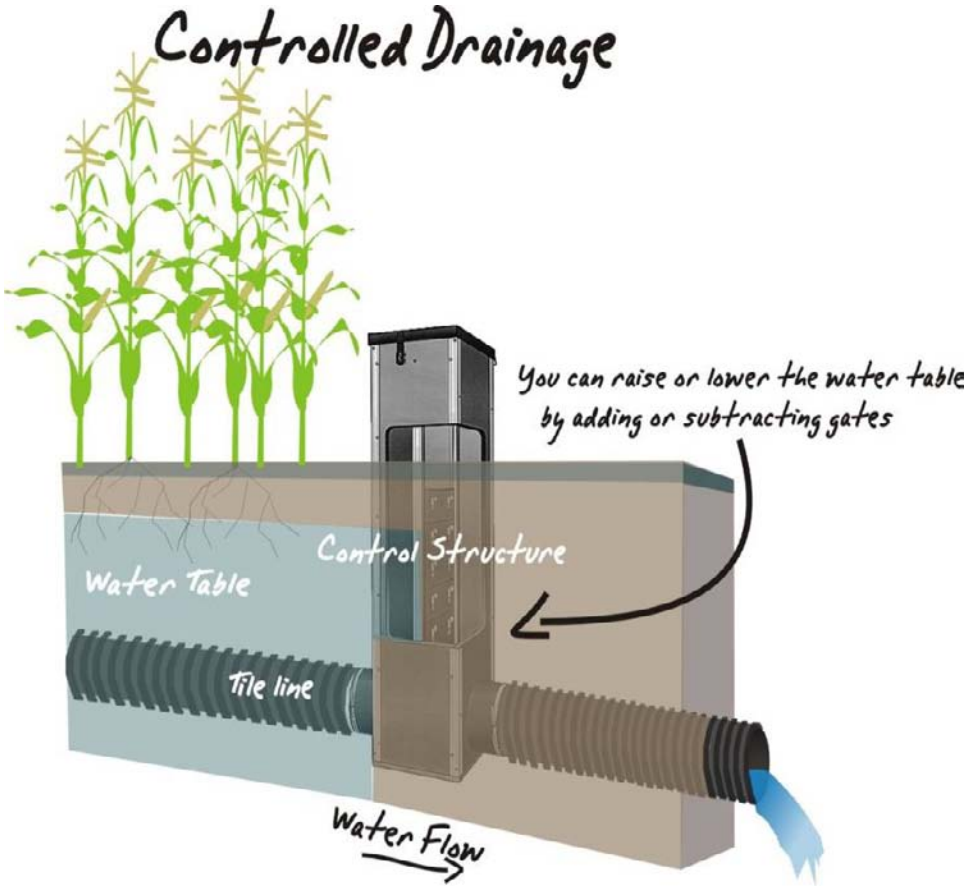
The Golden Rule of Drainage

Agricultural Drainage Management Systems (ADMS) Task Force

ADMC Agricultural Drainage Management Coalition

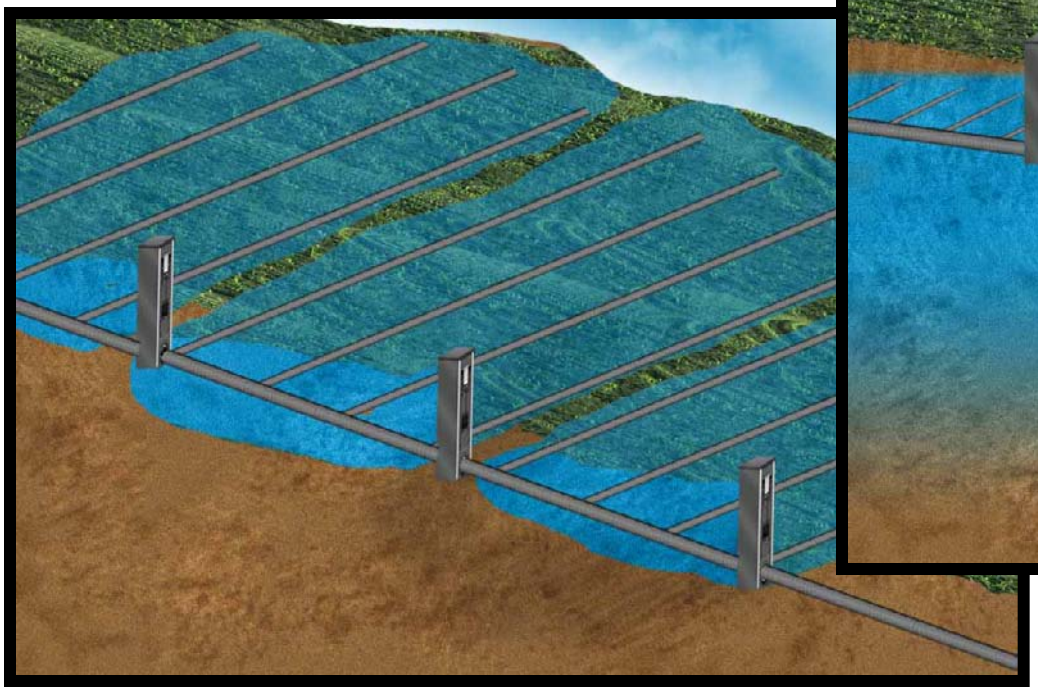
Drainage Water Management



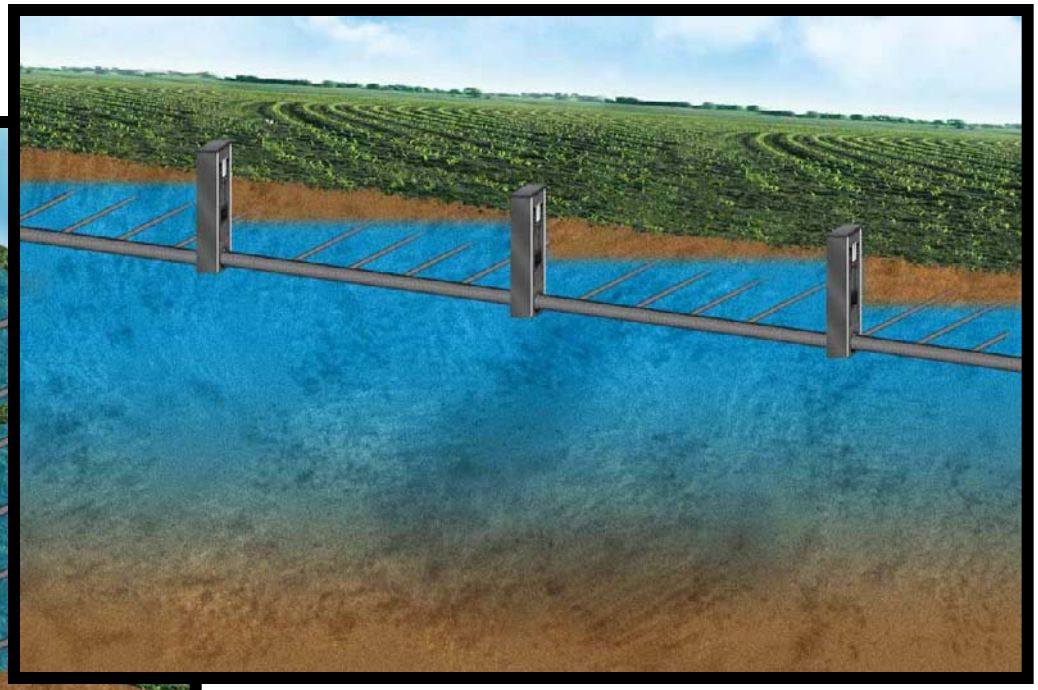


ADMC
Agricultural Drainage Management Coalition

Drainage Water Management



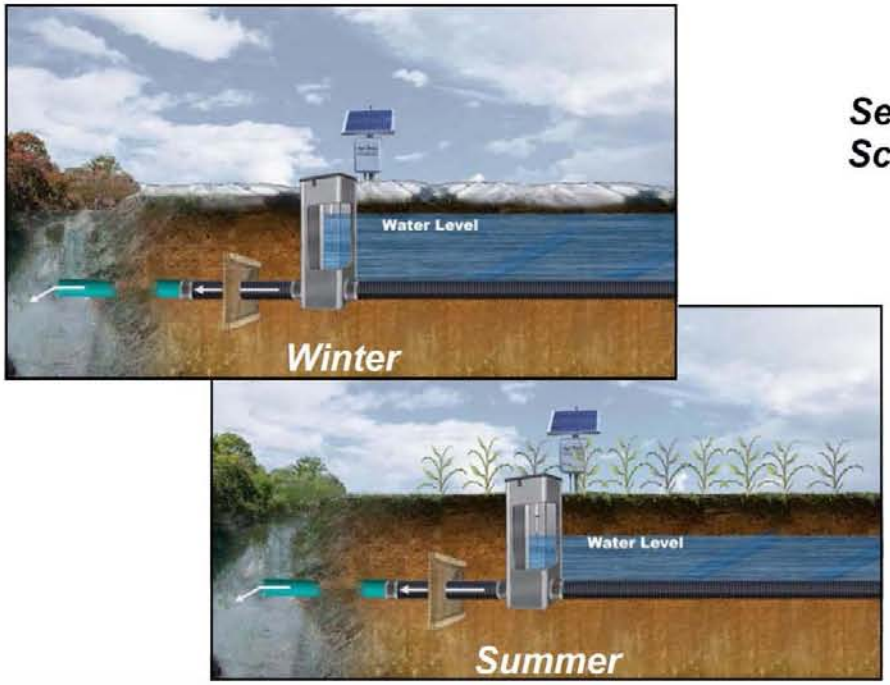
Areas of influence that each structure manages.



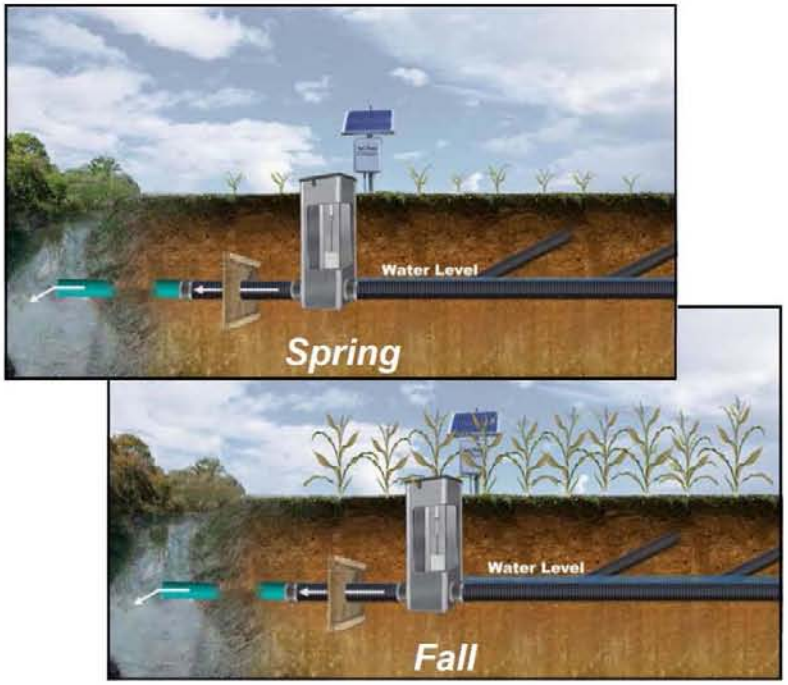
Water Level Control Structures "stair-step" the water up through the field.

ADMC Agricultural Drainage Management Coalition

Drainage Water Management



Seasonal Schedule



ADMC Agricultural Drainage Management Coalition

Benefits of Drainage Water Management

- Potential to regulate rate of water loss from field
  - *Maintain adequate water supply for the crop to increase yields*
  - *Keep nutrient in the root zone for the crop*
  - *Increase denitrification (N_2 ⇧)*
  - *Increase groundwater recharge*
  - *Create/improve wildlife habitat*
  - *Reduce potential downstream contamination from nutrients (e.g., hypoxia)*
  - *Potentially help reduce flooding downstream*

ADMC Agricultural Drainage Management Coalition

ADMC/NRCS CIG Demo Project

ADMC Awarded Largest Conservation Innovation Grant (CIG) Nationally ---2006 through 2009

Total Funding

USDA/NRCS…….. $971,790

Matching Funds…….. $974,019

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

ADMC
Agricultural Drainage Management Coalition

ADMC/NRCS CIG Demo Project

- The 20 field evaluations in
  - *Nutrient reductions,*
  - *Crop yields,*
  - *Profitability,*
  - *Timing of drainage water management,*
  - *Precipitation,*
  - *Drainage outflows.*

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

ADMC
Agricultural Drainage Management Coalition

ADMC/NRCS CIG Demo Project

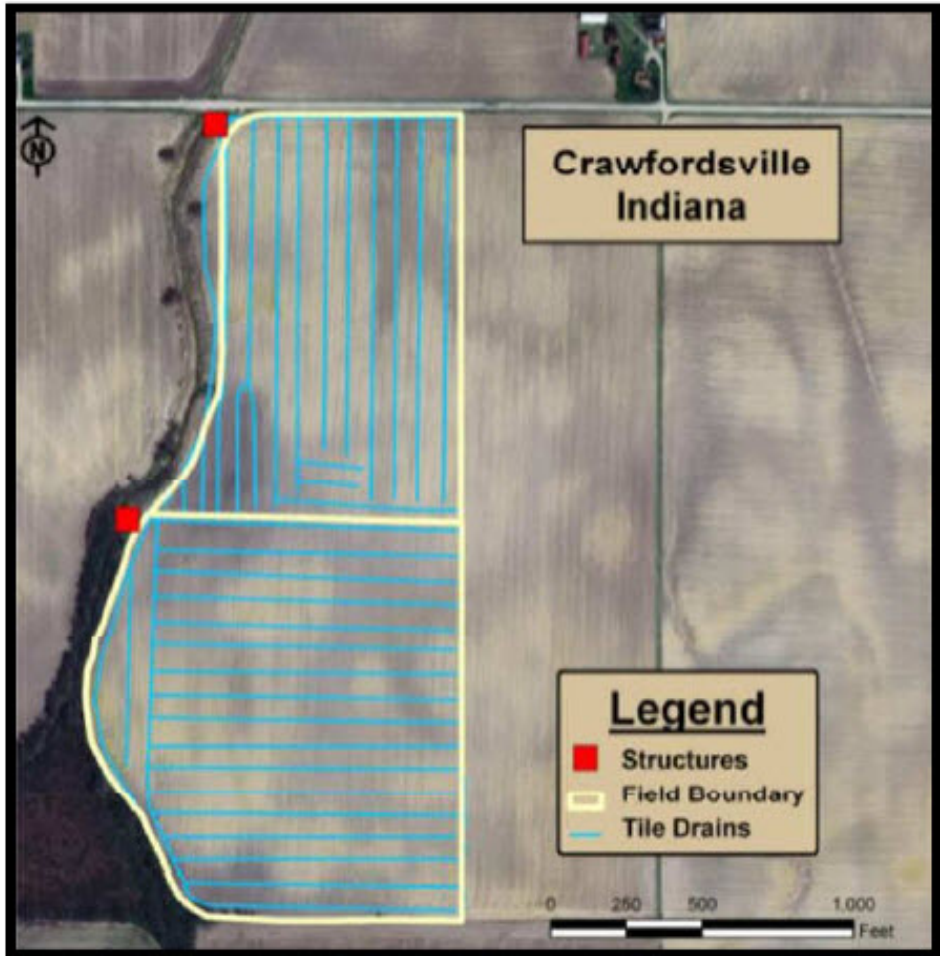
Partners/Collaborators

- Agricultural Drainage Management Coalition (ADMC)
- USDA Natural Resources Conservation Service (NRCS)
- Agricultural Research Service, Columbus, Ohio (ARS)
- Land Improvement Contractors Association (LICA)
- National Corn Growers Association
- Minnesota Department of Agriculture
- National Laboratory for Agriculture and the Environment, Ames, Iowa
- Iowa State University
- Purdue University
- The Ohio State University
- University of Illinois
- University of Minnesota
- Farmer cooperators

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

ADMC
Agricultural Drainage Management Coalition

Paired Systems for Studies



An example of a paired drainage system used in the study. This one near Crawfordsville, Indiana, shows the tile drain pattern and the location of the DWM control structures.

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

ADMC
Agricultural Drainage Management Coalition

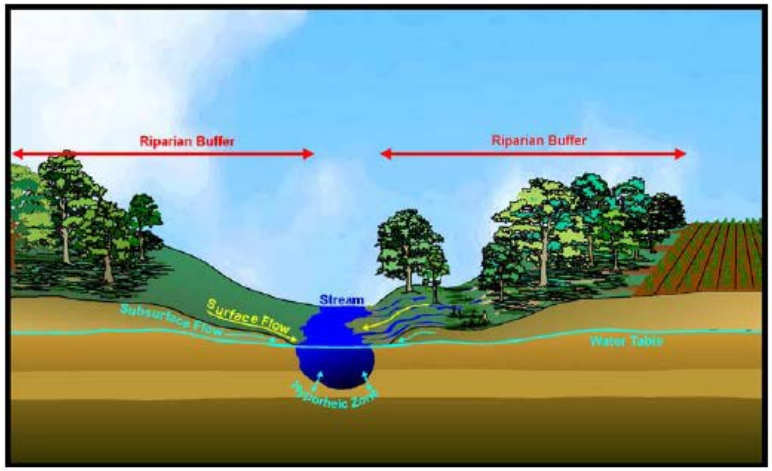
Effects of DWM on Water Flow and Nitrate Losses---Lessons Learned

- Moderation of water flow
  - *Lower peak flows*
  - *More sustained low flows*
  - *Reduced downstream flooding???*
- Maintain water supply in dry season
- Up to 90% reductions in nitrate outflow
- Up to 20% crop yield increase
- Considerable variation among locations
  - *Soil differences*
  - *Weather differences*

EPA United States Environmental Protection Agency

Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness:

A Review of Current Science and Regulations





EPA/600/R-05/118
October 2005

Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness:
A Review of Current Science and Regulations

Paul M. Mayer
Steven K. Reynolds, Jr.
Timothy J. Canfield
U.S. Environmental Protection Agency
Office of Research and Development
National Risk Management Research Laboratory
Ada, Oklahoma 74820

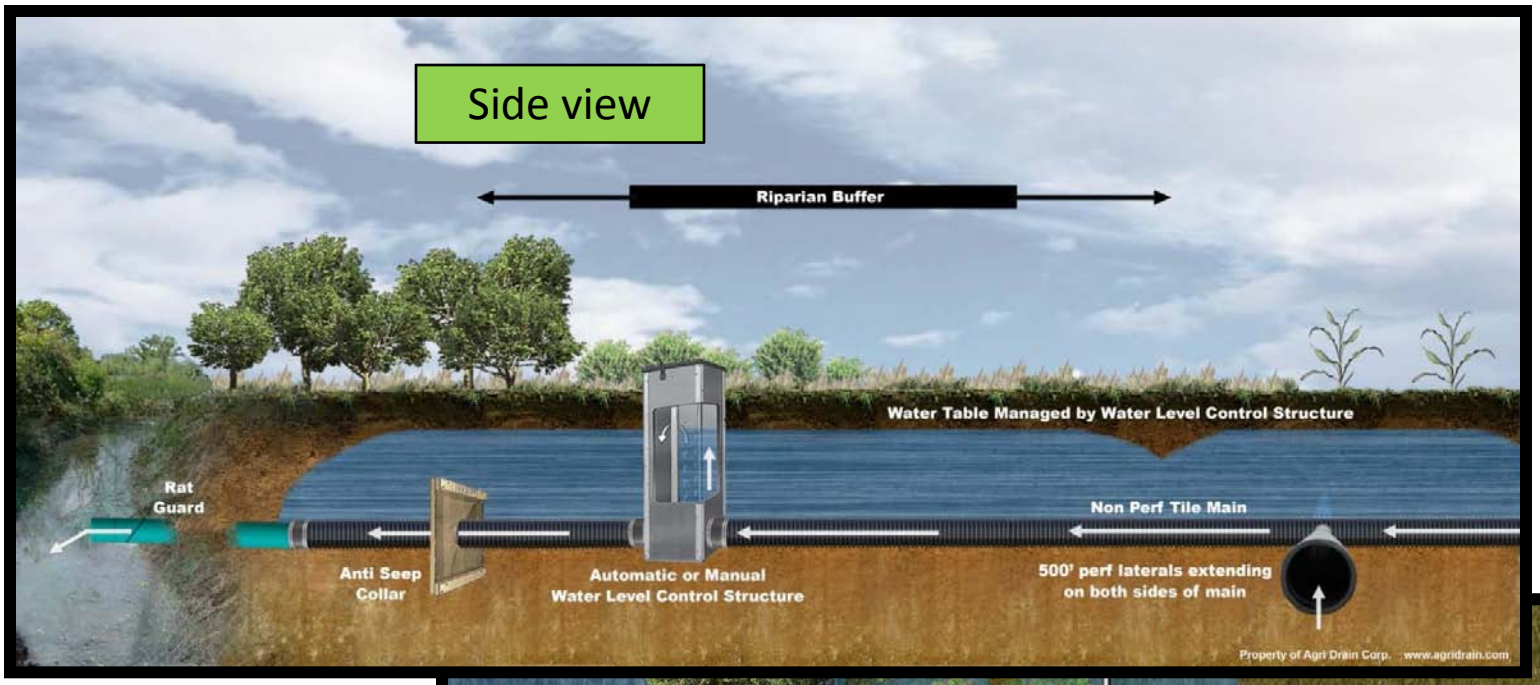
Marshall D. McCutchen
East Central University
Ada, Oklahoma 74820

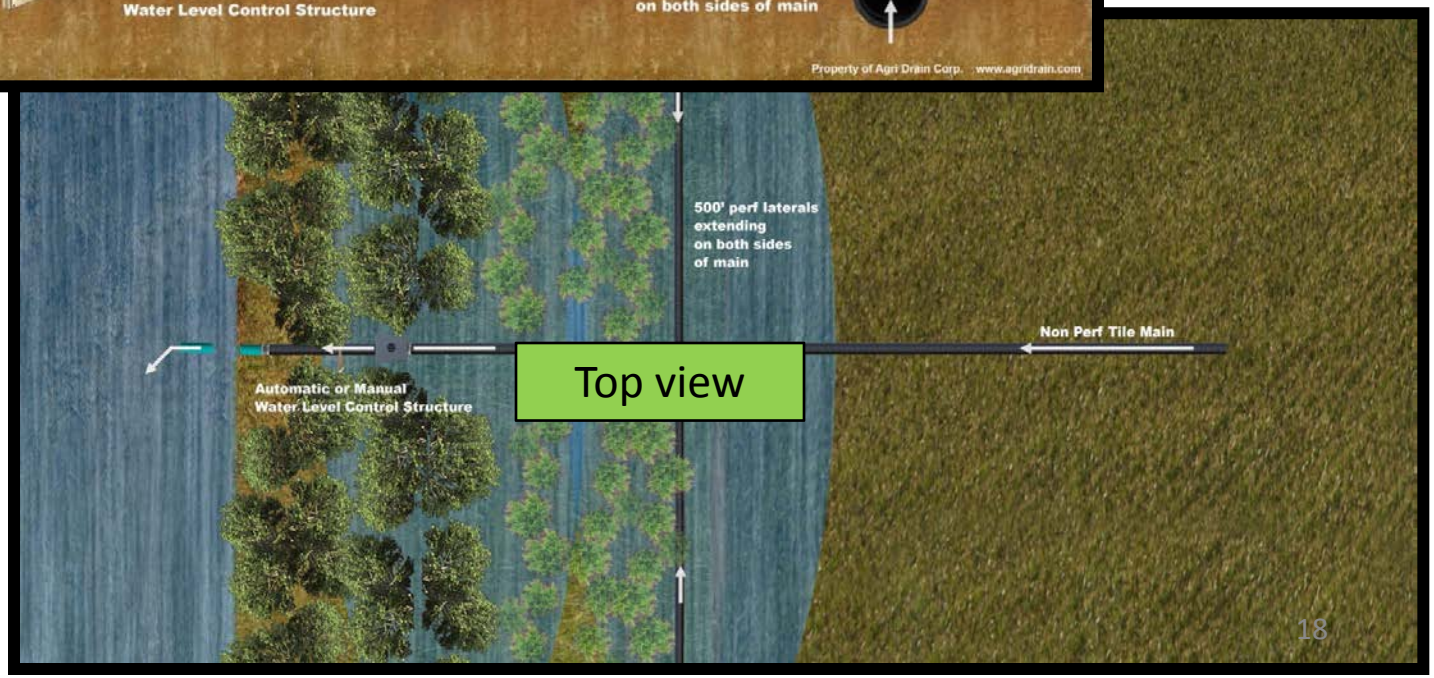
Project Officer
Paul M. Mayer
Ground Water and Ecosystems Restoration Division
National Risk Management Research Laboratory
Ada, Oklahoma 74820

National Risk Management Research Laboratory
Office of Research and Development
U.S. Environmental Protection Agency
Cincinnati, Ohio 45268

ADMC Agricultural Drainage Management Coalition

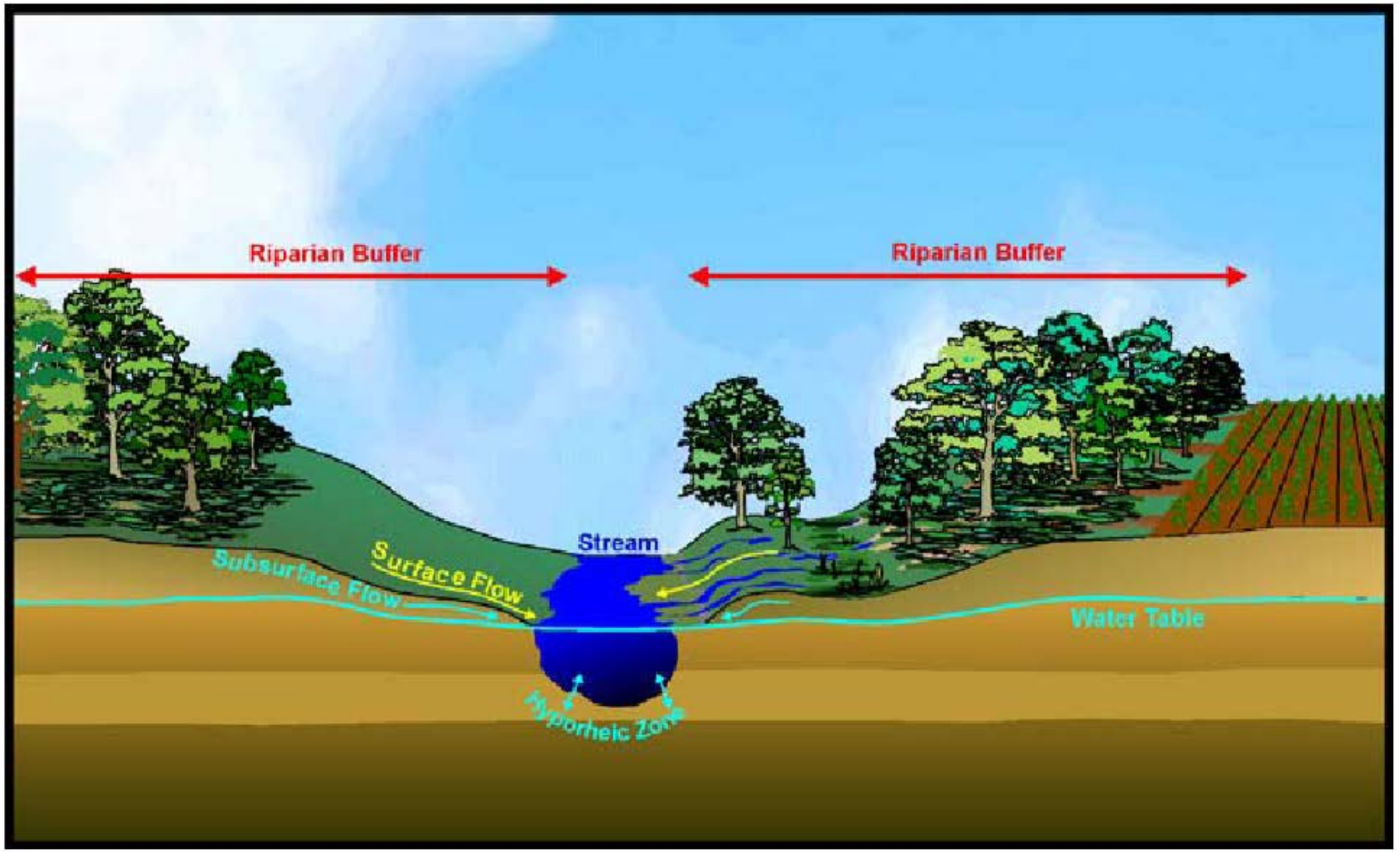
Saturated Buffers---New CIG Proposal





EPA United States Environmental Protection Agency

Riparian Buffers



Need to increase effectiveness of buffers.

ADMC Agricultural Drainage Management Coalition

Riparian Buffers

Great opportunity to build on existing infrastructure investment

ADMC
Agricultural Drainage Management Coalition

Riparian Buffer Width, Vegetative Cover, and Nitrogen Removal Effectiveness

EPA/600/R-05/118
October 2005

Summary & Conclusions

Buffers extending along the length of both stream banks and in which there is prolonged contact time with the root zone will offer greater likelihood of nitrogen uptake by plants.

Buffers will be most effective at controlling nitrogen through denitrification when:

1) *water flow (overland and subsurface) is evenly distributed and soil infiltration rates are high,*
2) *anaerobic (saturated) conditions persist in the subsurface, and*
3) *sufficient organic carbon is present.*

- Riparian buffers are a "best management practice" (BMP) that should be used in conjunction with a comprehensive watershed management plan. (U.S. EPA 1995, NRC 2002).

- Riparian buffers are often protected to achieve multiple goals (e.g. sediment trapping, aesthetics, wildlife habitat), some of which may require wider buffers, specific vegetation types, and/or other special considerations.

Re-saturated riparian buffers

Riparian buffer

Nitrogen removal

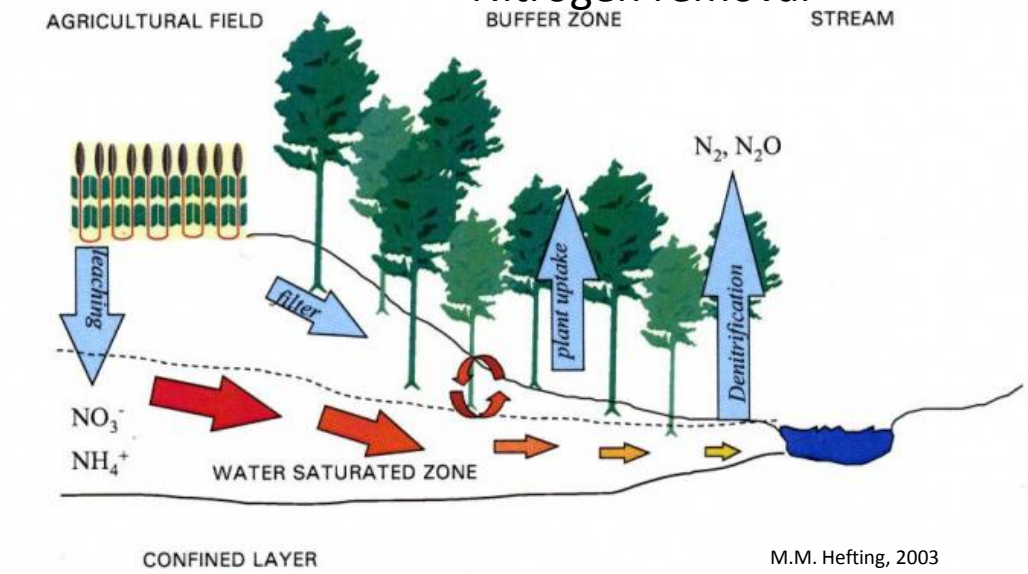
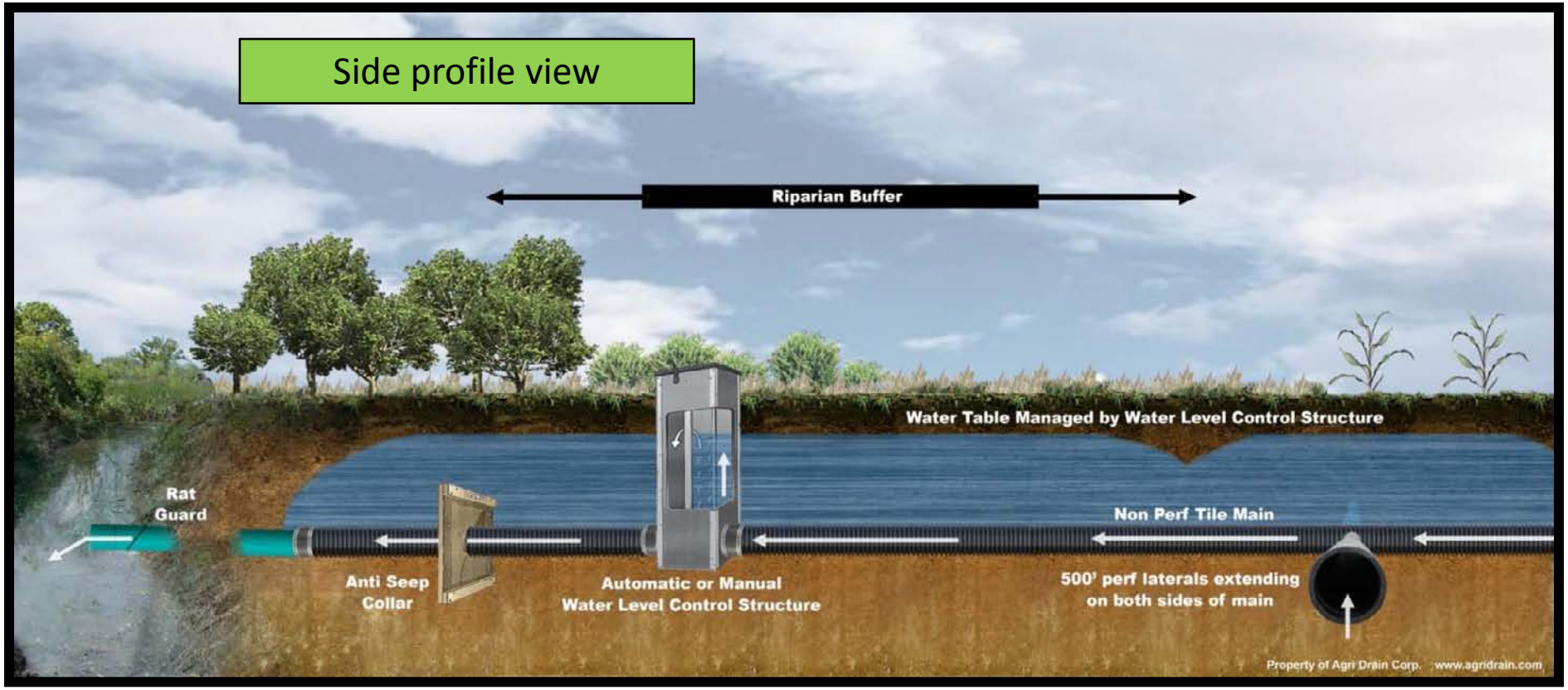


Figure 3 Schematic presentation of nitrogen transformation and retention in riparian buffer zones.

Dan Jaynes, Soil Scientist; USDA-ARS, National Laboratory for Agriculture and the Environment (515-294-8243; dan.jaynes@ars.usda.gov)

ADMC Agricultural Drainage Management Coalition

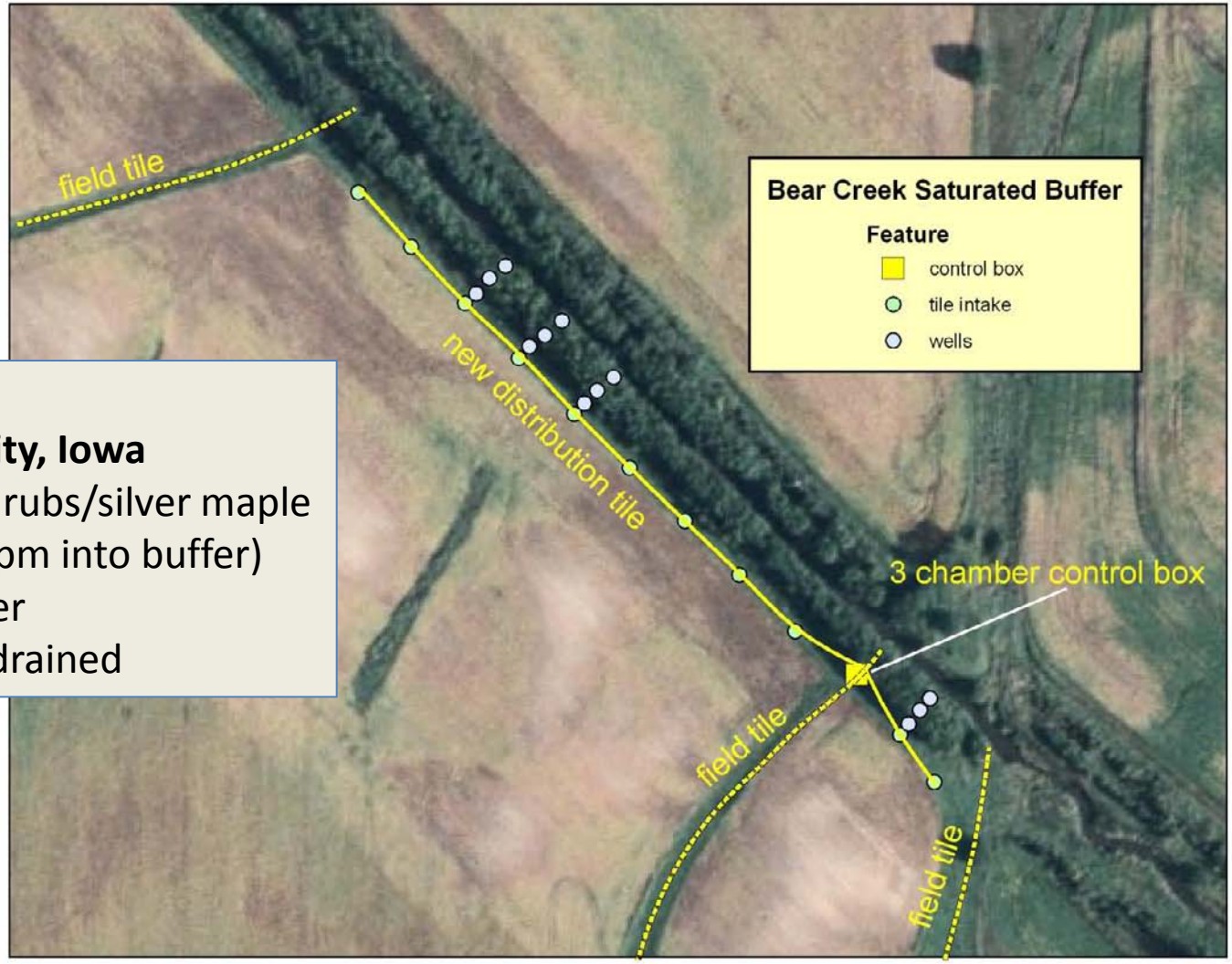
Saturated Buffer



- Cover crop can be used for forage, wildlife habitat, or bio-fuel.
- Can remove up to 100 % of the nitrates in tile effluent.
- 2 million (+/-) miles of buffers in U.S.---*that we are currently paying for*---that could be improved through DWM

ADMC Agricultural Drainage Management Coalition

Saturated Buffers



Bear Creek---Story City, Iowa

- 60’ buffer---grass/shrubs/silver maple
- Existing 4” tile (50 gpm into buffer)
- 1000’ lateral in buffer
- Estimated 40 acres drained

Dan Jaynes, Soil Scientist; USDA-ARS, National Laboratory for Agriculture and the Environment (515-294-8243; dan.jaynes@ars.usda.gov)

ADMC Agricultural Drainage Management Coalition

View of lateral distribution line in buffer

View of control structure installation

Dan Jaynes, Soil Scientist; USDA-ARS, National Laboratory for Agriculture and the Environment (515-294-8243; dan.jaynes@ars.usda.gov)

ADMC Agricultural Drainage Management Coalition

Saturated Buffers

- **Early results---**
  - *Buffers have a large capacity to remove nitrates*
  - *Saturated buffer removed 100% of the nitrate from the tile water routed through the buffer.*
  - *Low installation investment*
  - *Very little management/maintenance cost*

Dan Jaynes, Soil Scientist; USDA-ARS, National Laboratory for Agriculture and the Environment (515-294-8243; dan.jaynes@ars.usda.gov)

ADMC Agricultural Drainage Management Coalition

Table 1. Nitrate concentration in wells by date and distance from distributory tile.

			Date		
Transect #	Well #	Distance from tile (ft)	12/10/2010	12/22/2010	2/28/2011
			mg L^{-1}		
1	01	18.6	5.9	6.9	7.9
1	02	41.6	< 0.3	< 0.3	< 0.3
1	03	62.1	< 0.3	< 0.3	< 0.3
2	04	18.7	< 0.3	< 0.3	0.8
2	05	42.3	< 0.3	< 0.3	< 0.3
2	06	70.3	< 0.3	< 0.3	< 0.3
3	07	21.5	1.8	7.4	4.1
3	08	46.4	< 0.3	< 0.3	< 0.3
3	09	75.2	< 0.3	< 0.3	< 0.3
4	10	19.6	0.7	1.4	1.8
4	11	46.4	< 0.3	< 0.3	5.1
4	12	72.8	< 0.3	< 0.3	< 0.3

Dan Jaynes, Soil Scientist; USDA-ARS, National Laboratory for Agriculture and the Environment
(515-294-8243; dan.jaynes@ars.usda.gov)

ADMC Agricultural Drainage Management Coalition

Expected Benefits of Saturated Buffers

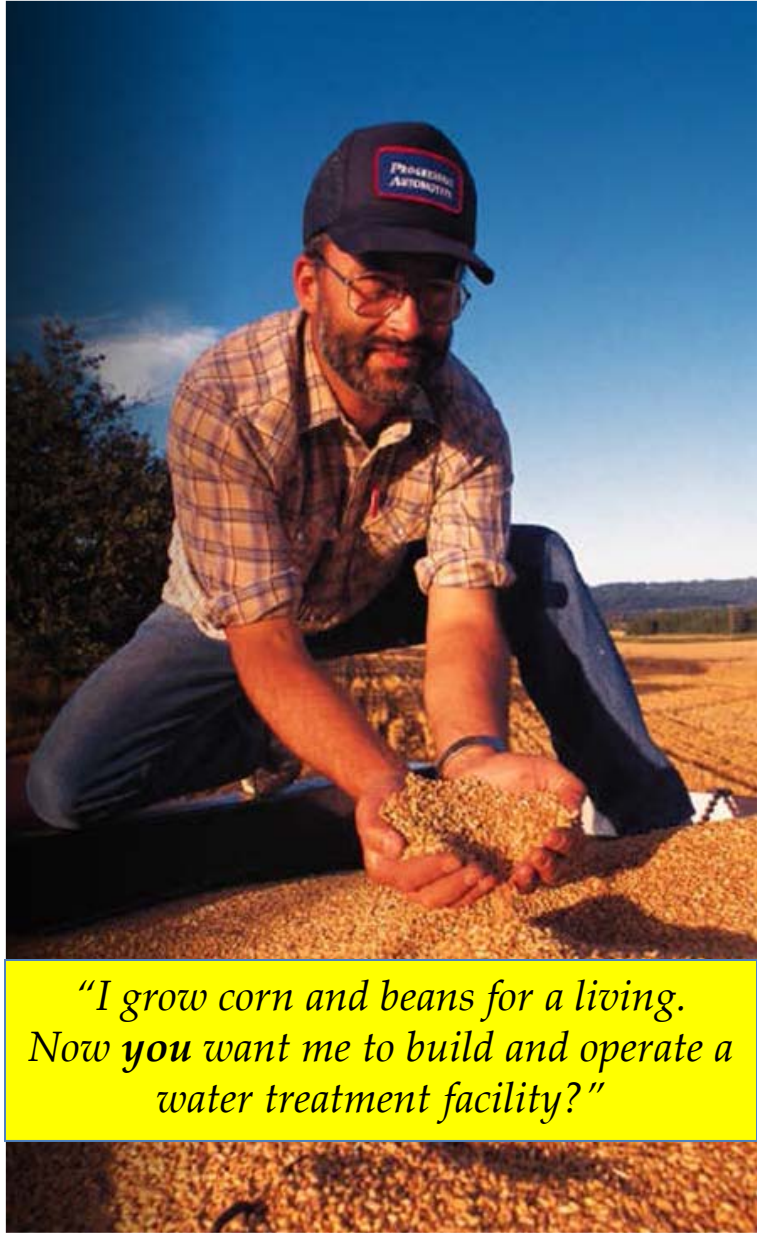
- Lower peak flows
- More sustained low flows
- Potential reduced downstream flooding
- Increased yield
- Potential bio-energy crop cover
- Improved wildlife habitat
- Improved water table recharge
- Accelerate the adoption of drainage water management
- Increase the value of ecosystem services provided.
- Encourage maintenance of existing buffers and installation of new ones

ADMC Agricultural Drainage Management Coalition

The best management practices in the world are only effective <u>with the farmer's participation</u>.

What's In It For Me?

- Apply for financial and technical assistance
- Install the practices
- Pay out of pocket expenses
- Sacrifice tillable acres
- Maintain and manage the practices and structures
- \+ Ecosystem services markets?
  - *Cost-share of installation investment*
  - *Management incentives*



*"I grow corn and beans for a living. Now **you** want me to build and operate a water treatment facility?"*

ADMC Agricultural Drainage Management Coalition

Thank You!

"Soil erosion and poor water quality are symptoms of inadequate infrastructure and mismanaged resources."

Dr. Harold Reetz, Executive Director
Agricultural Drainage Management Coalition
Monticello, Illinois
Phone: 217-762-2074
E-mail: hreetz@ADMCoalition.com

ADMC Agricultural Drainage Management Coalition