Conservation Drainage

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Today's Goals

- Understand how drainage and conservation can be compatible and profitable
- Be aware of some different ways to implement conservation drainage
- See how this all fits into the Illinois Nutrient Loss Reduction Strategy
- Find out how to get help from the NRCS

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So, what's the problem?

- Hypoxic Zone or "Dead Zone"
- Excess nutrients (primarily nitrogen but also phosphorus)
- Algal growth → organic matter sinks to bottom, decays, consumes available oxygen
- Oxygen levels fall lower than 2mg/l

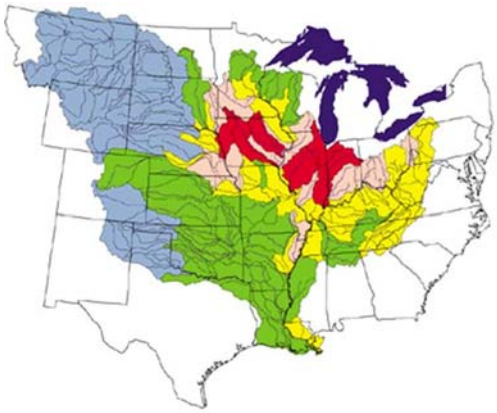
Image courtesy of US Fish and Wildlife Service www.fws.gov

Mississippi River Basin

Average Annual Nitrogen Load in Streams

N Load, lbs/acre
Less than 1.8
1.8 to 4.4
4.5 to 8.9
9.0 to 16.0
16.1 to 27.1

Watershed Average = 2.6



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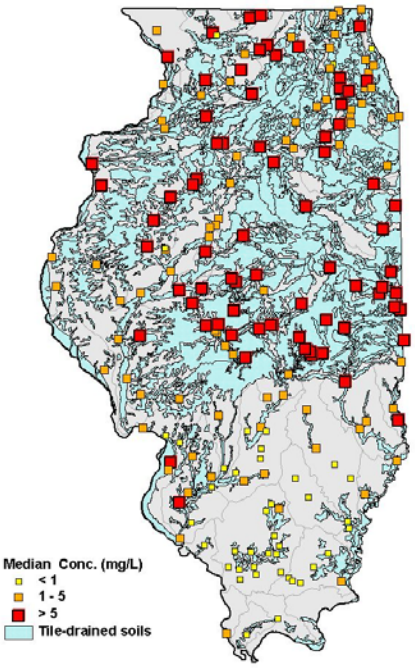
Tile Drainage vs High Nitrate Levels



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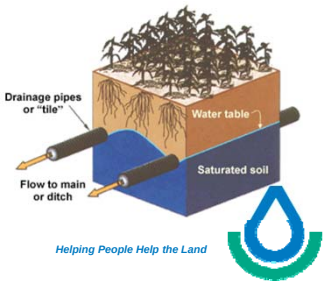
Problem Statement

Drainage is needed for economical crop production in many Illinois fields.

Tile drainage water is a primary source of nitrate to surface water



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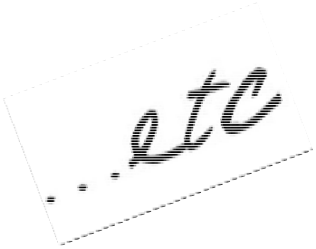
Conservation Drainage Practices

- Drainage Water Management
- Denitrifying Bioreactors
- Constructed Wetlands
- Two-Stage Ditches
- Saturated Buffers



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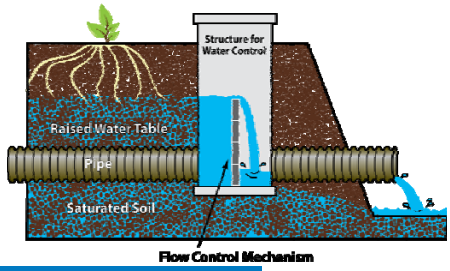
What is Drainage Water Management?

The process of managing the water table elevation and the timing of water discharges from surface and subsurface agricultural drainage systems.

Theory: hold nutrients in field when drainage is not needed for production



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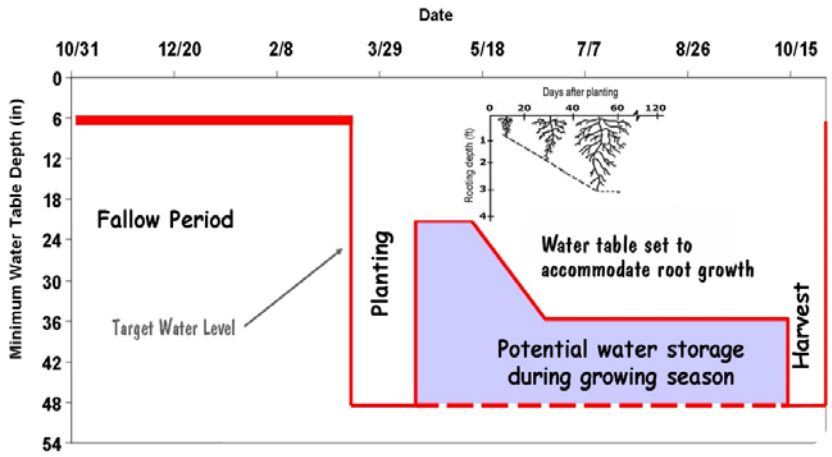
Example Crop Year



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Nutrient Load Reduction

FACT:

Less flow from drainage system → Less nitrates to surface water

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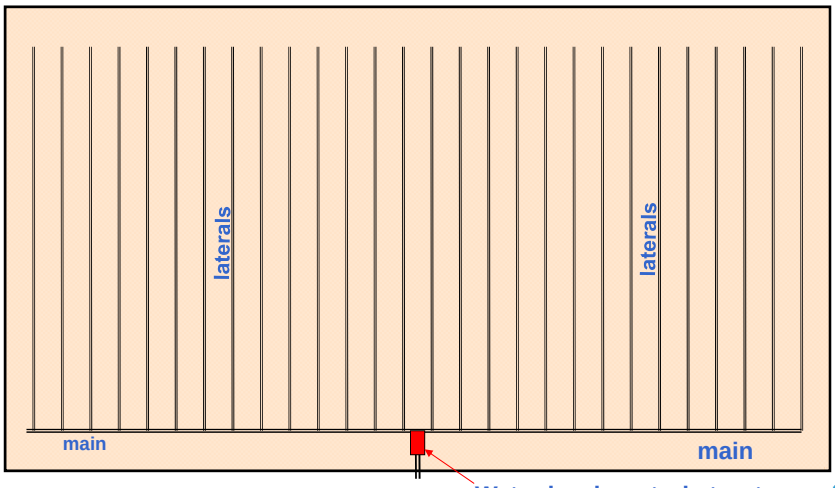
Ideal Drainage Management



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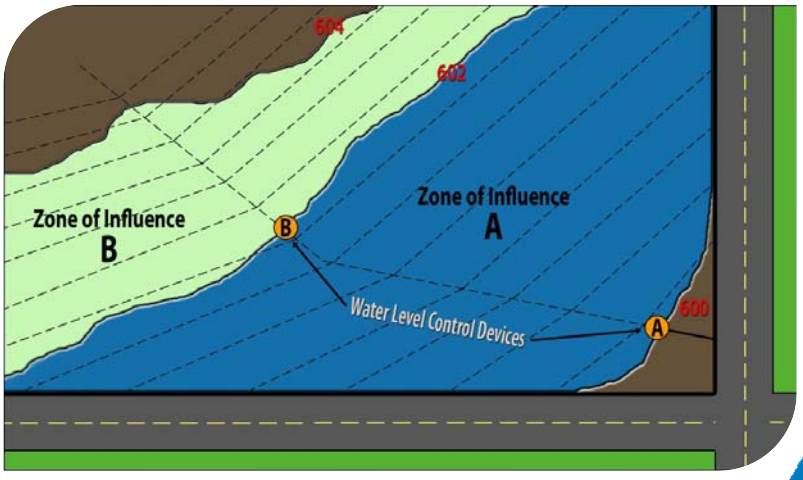
But what if it's real life?



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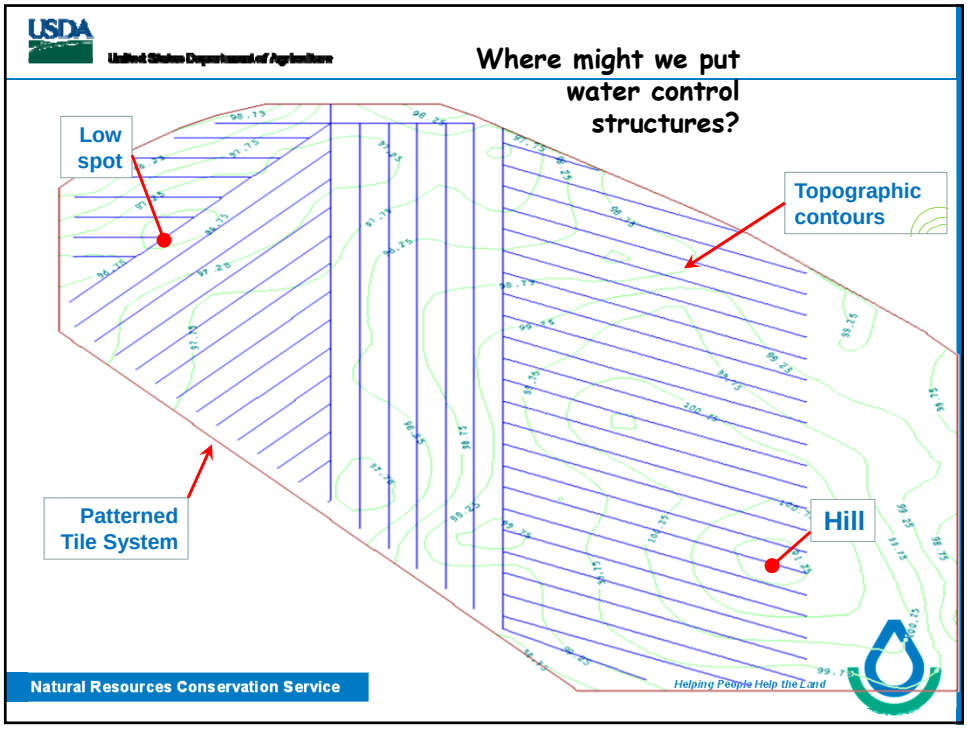
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Where might we put water control structures?
Low spot
Topographic contours
Patterned Tile System
Hill
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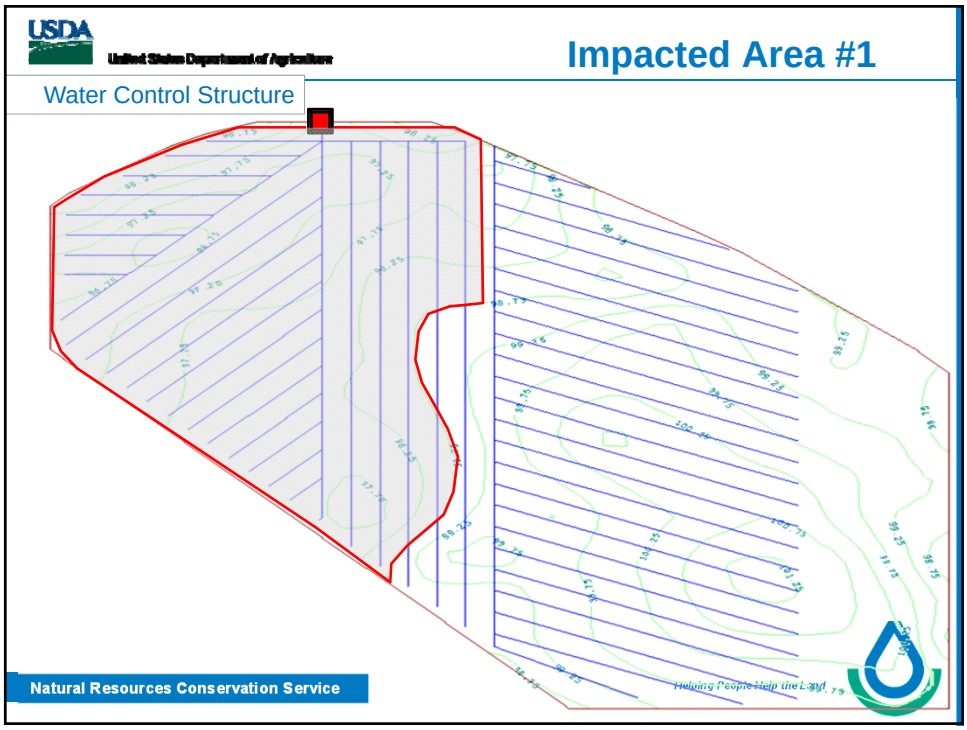
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Impacted Area #1
Water Control Structure
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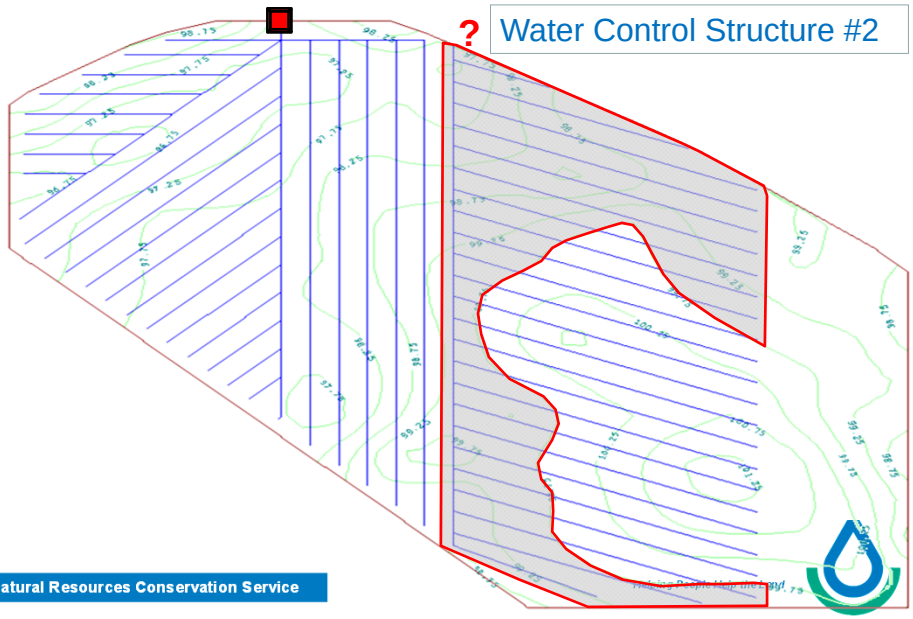
Impacted Area #2



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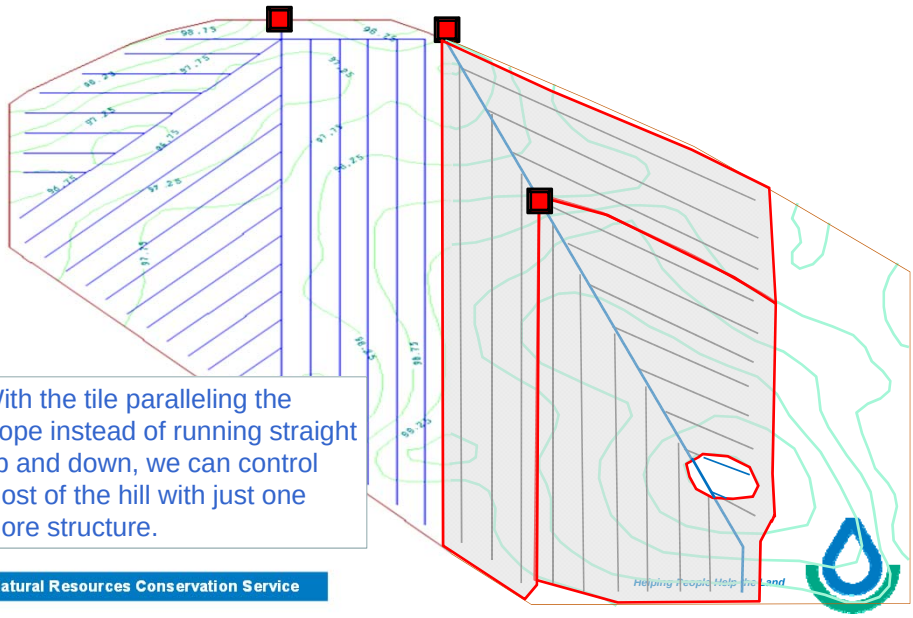
What if…



With the tile paralleling the slope instead of running straight up and down, we can control most of the hill with just one more structure.

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DWM on Surface Drains

Courtesy:
North Carolina State University

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DWM by Pumping

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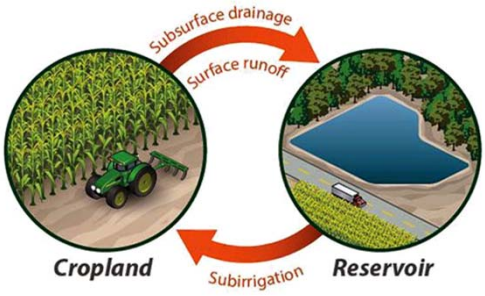
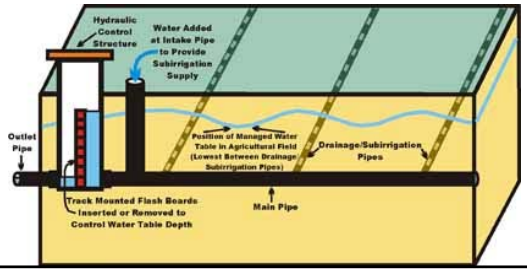
Recycling Drainage Water?

- Subirrigation
- Pairs well with DWM (but tile lines need to be closer)
- Water quality benefit is mostly in the DWM
- Great crop yield improvements
- Financial assistance is rarely available for the irrigation part





Courtesy:
Purdue University

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Limitations for Standard DWM

- Economics
  - Flat topography *(0.5% average slope; minimum 15-20 acre impacted area per structure)*
  - Patterned (systematic) subsurface tile system exists
  - Tile map exists
- Land Type and Use
  - Need to be able to hold a water table! (soil type)
  - No negative impact on neighbors

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DWM Benefits

As a part of a conservation system, DWM:

- **Improves water quality**

  Documented 35-81% nitrate load reduction in Illinois

- **But also, it can be used to:**
  - ***Improve soil environment*** *for better vegetative growth*
  - *Reduce rate of soil* ***organic matter oxidation***
  - ***Reduce wind erosion*** *and particulates (dust)*
  - ***Enable seasonal flooding*** *for wildlife habitat*

- **Improves Crop Yield?**
  - *Maybe in dry years*
  - *Anecdotal evidence: up to 10% increase*

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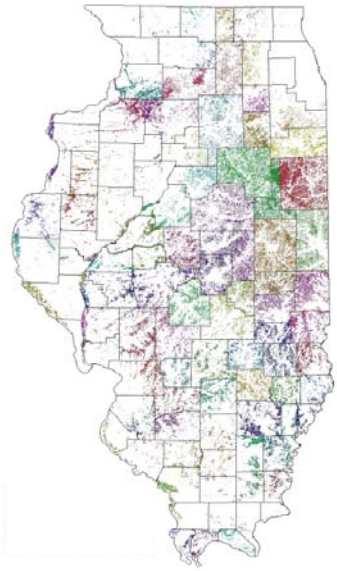
Potential for DWM in Illinois

Mapping assumptions:
- Flat cropland
- Likely to be tile drained
- Minimum15 acre parcels

Simplification: land ownership and tile configuration not considered

By the Numbers:
- 24 million cropland acres
- 10 million drained
- ~2 million suitable for DWM



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Denitrifying Bioreactor

- Edge-of-field
- Practical limit 70 - 100 acres of drainage
- Works on steeper ground
- Let natural denitrifying bacteria “clean” the tile water
- Organisms “eat” the carbon in the wood chips and “breathe” the nitrate from the water

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Bioreactor Contents

- A hole in the ground *(at the end of a tile line)*
- Plastic lining *to prevent seepage before treatment*
- Wood chips *(need a good supply!)*
- An upstream (diversion) structure *to bypass high flow and control inlet elevation in bioreactor*
- Distribution manifold plumbing
- A downstream (capacity) structure *to control treatment level and allow drain down of the bioreactor*

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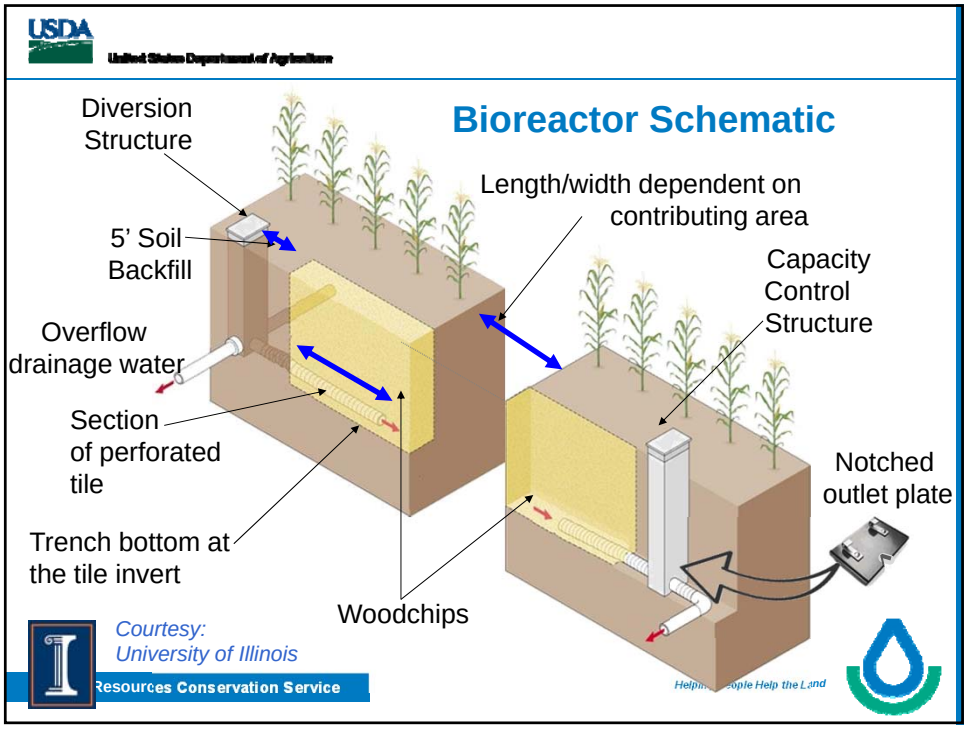
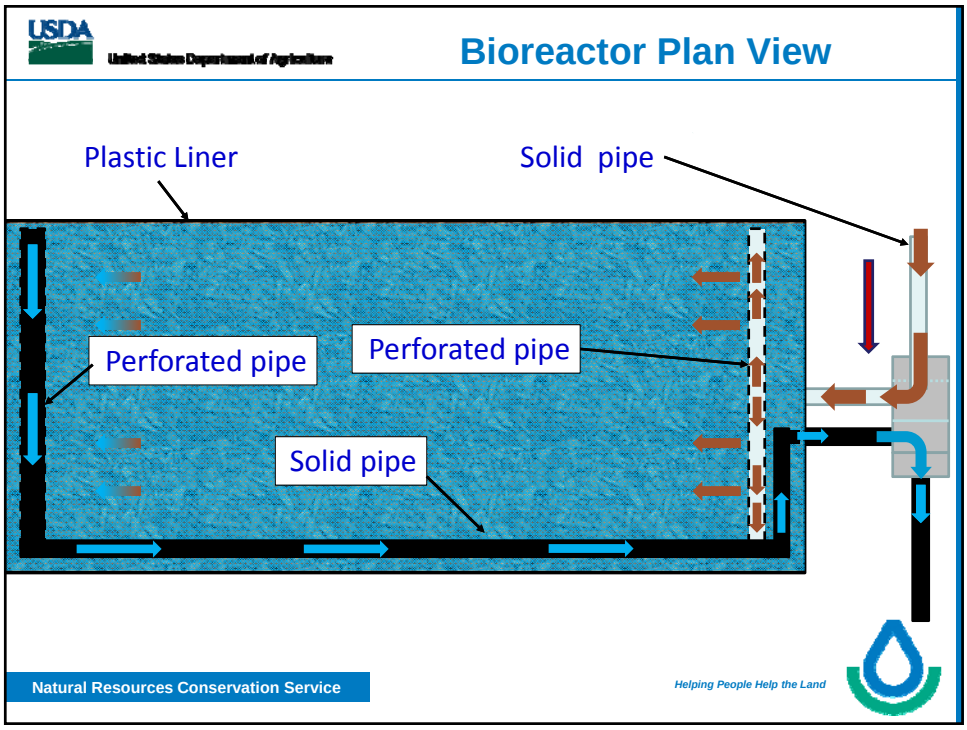

Bioreactor Schematic
Diversion Structure
5' Soil Backfill
Overflow drainage water
Section of perforated tile
Trench bottom at the tile invert
Woodchips
Length/width dependent on contributing area
Capacity Control Structure
Notched outlet plate
Courtesy: University of Illinois
Resources Conservation Service


Bioreactor Plan View
Plastic Liner
Solid pipe
Perforated pipe
Perforated pipe
Solid pipe
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Installing a Bioreactor

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Ongoing Research

- Enhanced Nitrate removal with iron upstream of wood chips
- Soluble Phosphorus (orthophosphate) removal with iron downstream of wood chips

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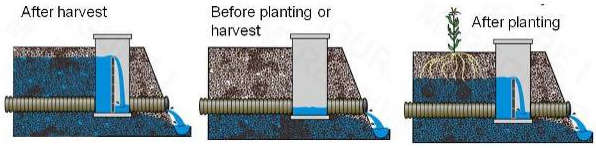
Bioreactor + DWM = More Benefits

Did You Know?

You can use the upstream structure for a bit of drainage water management too.

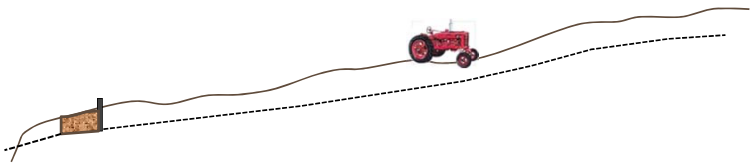
May be able to hold back water and nutrients for crop production.

Remember, the bioreactor handles the entire tile system, but DWM would only be effective near the structure.



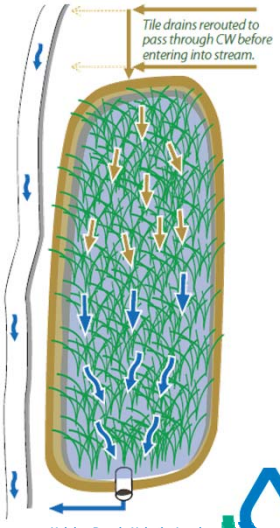
Set it and forget it

- If topography allows, set bioreactor lower in elevation so it can operate year round without affecting field trafficability.



Constructed Wetland

- Purpose is for water treatment, not wildlife
- Mature technology – very effective
- Takes significant land out of production
- Surface area at least 1% of contributing watershed
- Can be expensive



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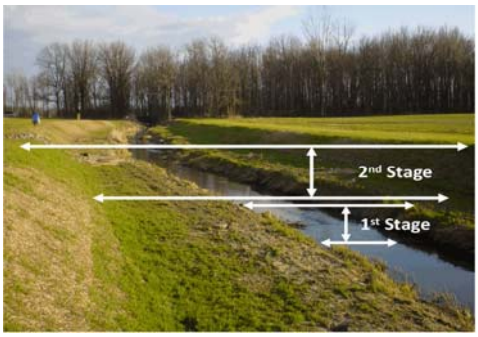
Two-Stage Ditch

- Great for bank erosion
- Set bench at “bankfull”
- Wide footprint
- Can be expensive



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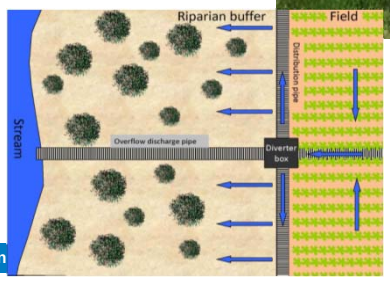
Saturated Buffer

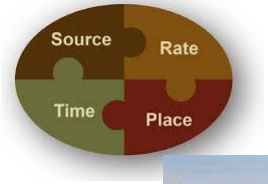
a.k.a. “Vegetated Subsurface Drain Outlet”

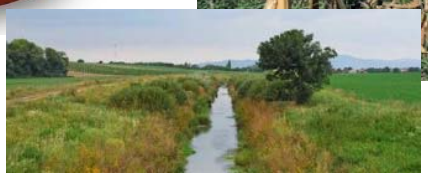
- Still in the learning phase:
  - How far away from the streambank *to prevent bank sloughing*
  - Length/capacity of tile *vs size of drainage system, to achieve what performance*
  - Design features *vs soil type*



Other Supporting Practices

- Including but not limited to:
  - Nutrient Management
  - Filter Strips
  - Cover Crops





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How can Conservation Drainage help Profitability?

- Better use of nutrients
- Better control of subsurface water
- Maintain and improve soil health
- Potential crop yield improvements

Long Term Gains

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"The best part of this practice? It puts you in charge of the water for a change!"

--Christian County, IL Landowners

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Contacting NRCS in Illinois

- Field Offices in almost every county
- Co-located with the county's *Soil and Water Conservation District*
- www.il.nrcs.usda.gov
- Or look in your phone book:
  - United States Government
  - Department of Agriculture
  - Natural Resources Conservation Service

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Synergy

- Voluntary conservation!
- Who will do this work?

ILLINOIS NUTRIENT LOSS REDUCTION STRATEGY

Improving our water resources with collaboration and innovation

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Financial and Technical Assistance

- Some Financial Assistance Programs
  - Environmental Quality Incentives Program (EQIP)
  - Conservation Stewardship Program (CSP)
- Continuous “signup” with batching periods
- Technical assistance to help plan and design the practices

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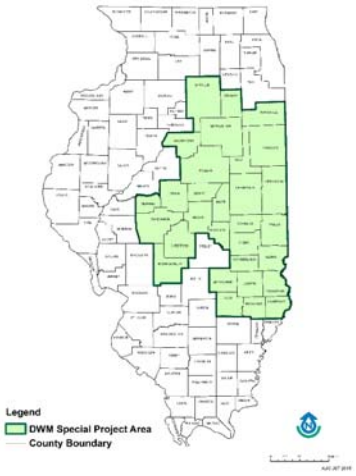
Special Project Area

- Focus on:
  - Drainage Water Management
  - Nutrient Management
  - Cover Crops
  - Denitrifying Bioreactor
- Less competition for funds
- Have a DWM Plan: preferably sign up for a “CAP 130” first.



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