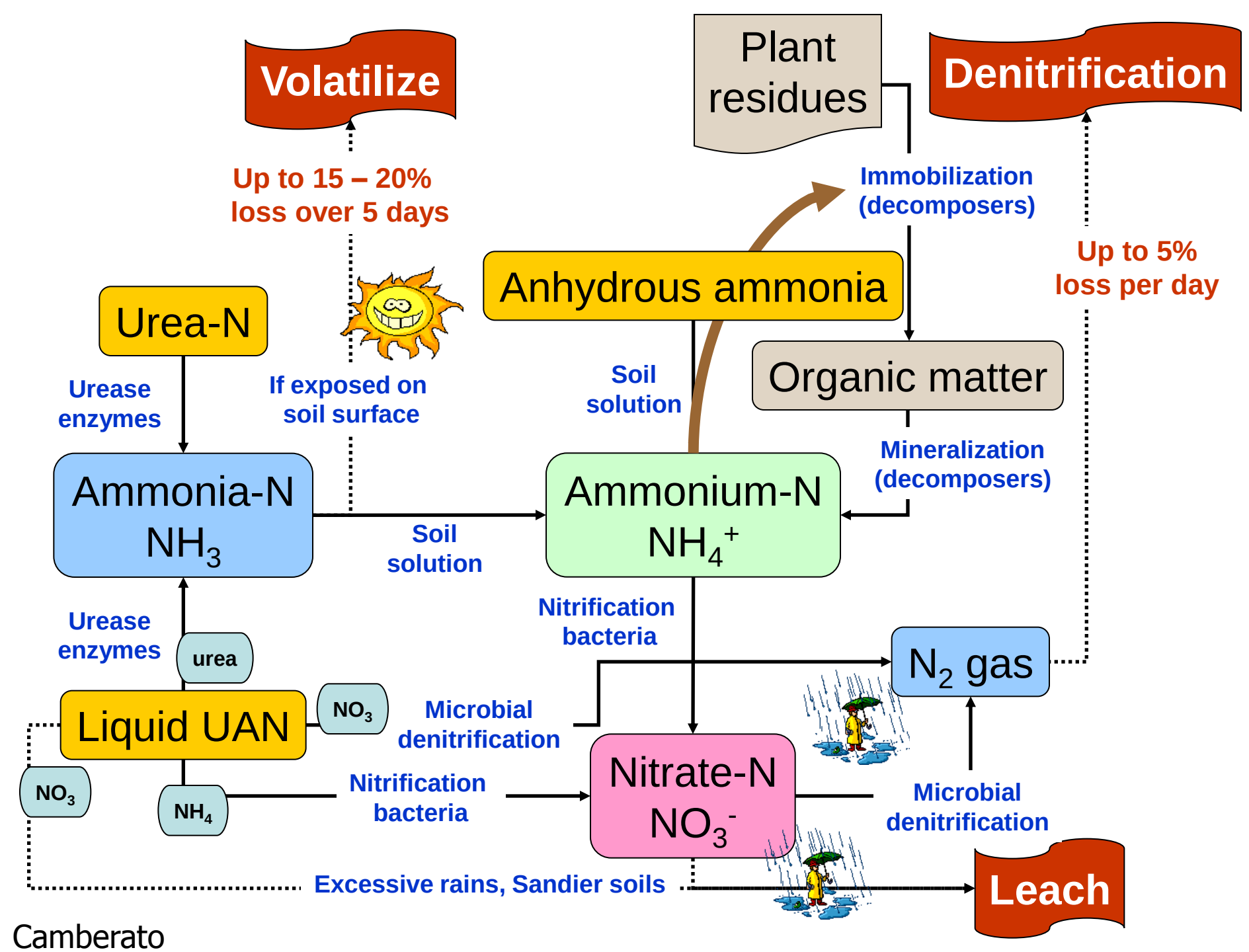
MRBI

MISSISSIPPI RIVER BASIN INITIATIVE

Avoid
Control
Irap


Volatilize
Plant residues
Denitrification
Up to 15 – 20% loss over 5 days
Immobilization (decomposers)
Up to 5% loss per day
Anhydrous ammonia
Urea-N
Soil solution
Organic matter
Urease enzymes
If exposed on soil surface
Mineralization (decomposers)
Ammonia-N NH_3
Ammonium-N NH_4^+
Soil solution
Nitrification bacteria
Urease enzymes
urea
N_2 gas
Liquid UAN
NO_3
Microbial denitrification
NO_3
NH_4
Nitrification bacteria
Nitrate-N NO_3^-
Microbial denitrification
Excessive rains, Sandier soils
Leach
Camberato

Nitrogen Fertilizer Efficiency

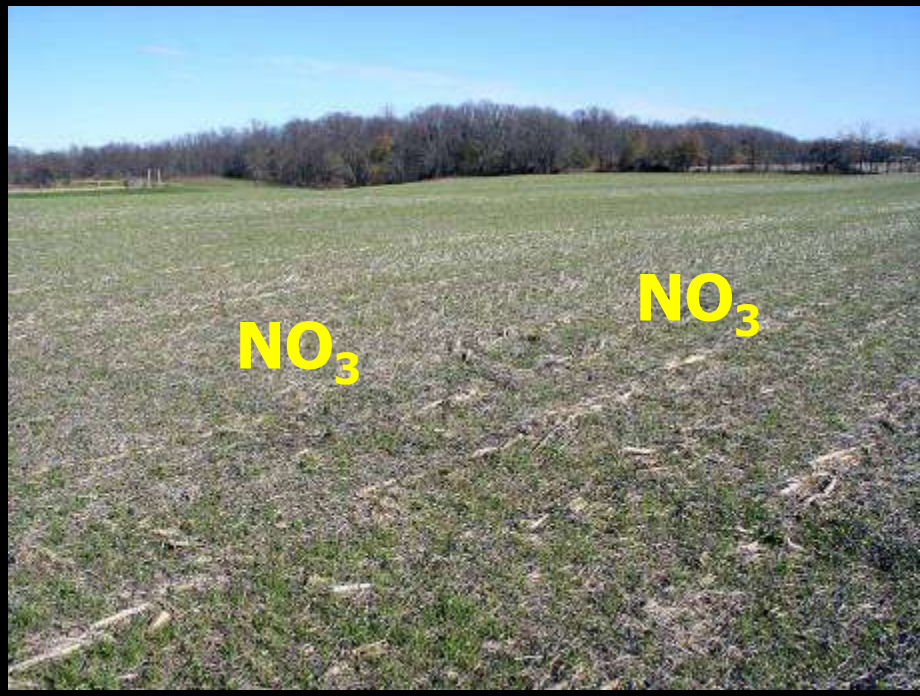
- At best about 60% of the fertilizer added to the field is accumulated by the corn crop
- Where does the rest go?
  - Denitrification
  - Leaching
  - **Ammonia volatilization**
  - Immobilization
- We can do better…

Camberato

Nitrogen Loss

- Applied N and Nitrate mineralized from crop residues and soil OM is highly soluble
- N Leaching can be excessive in a wet spring…massive in springs like 08 & 09.

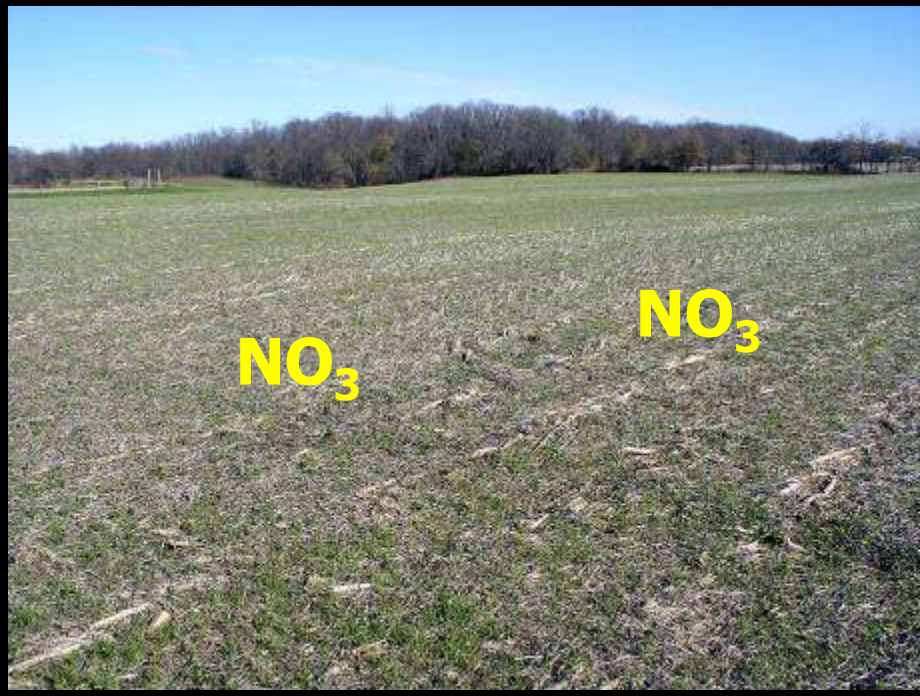
Where Water Goes …Nitrate Goes!

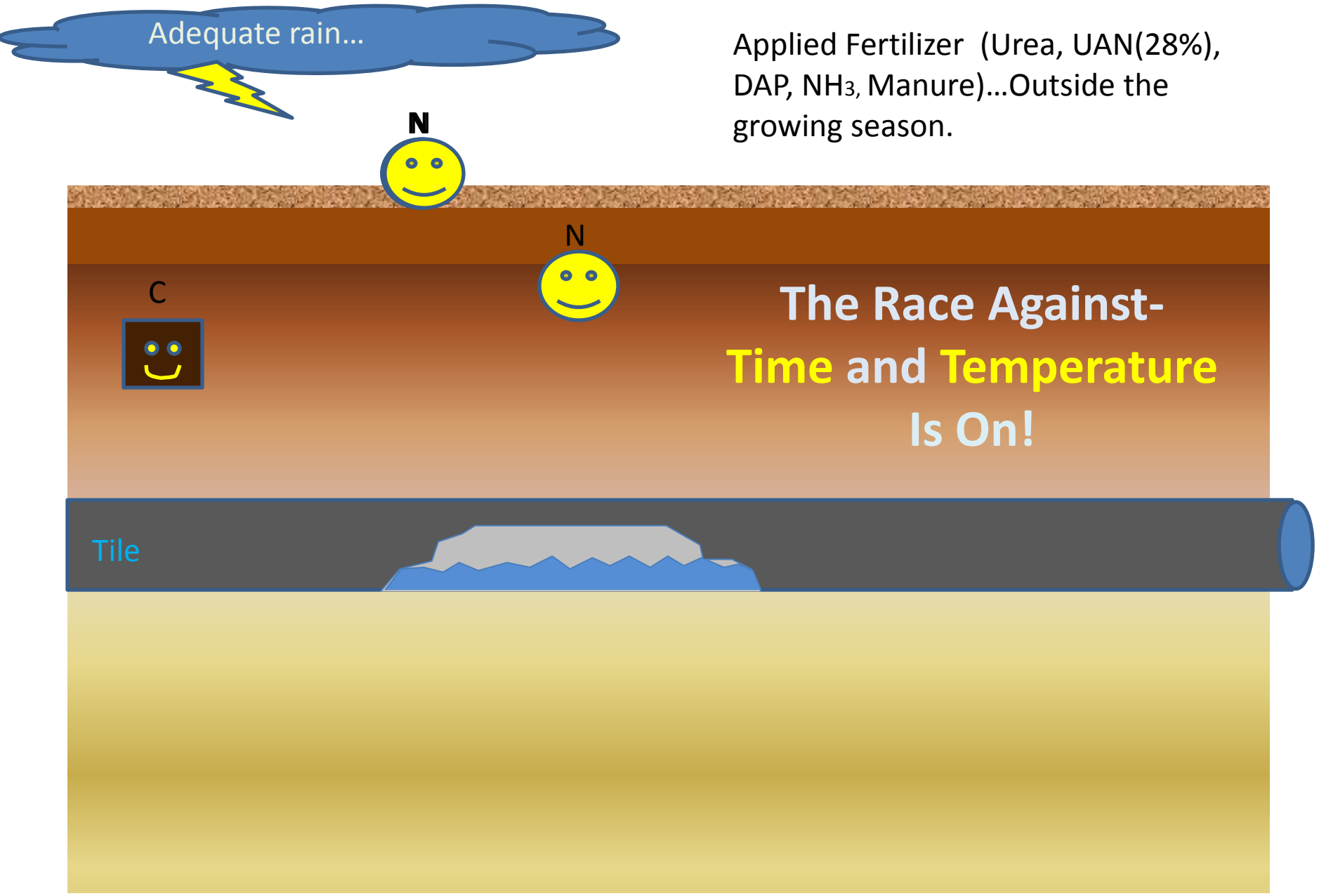


Nitrogen Loss

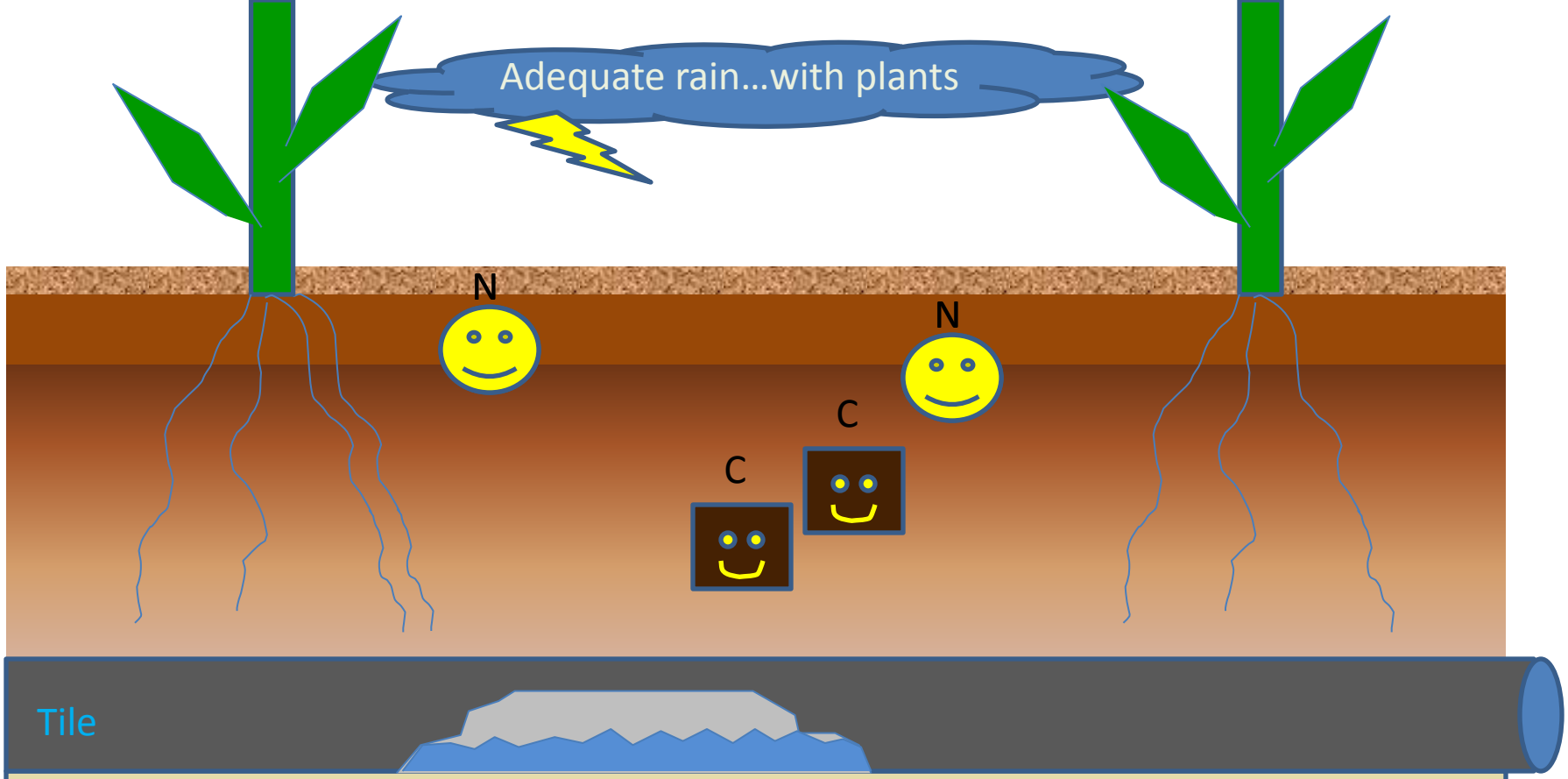
N Leaching can exceed 50lb/ac.

- Every effort should be made to capture this N





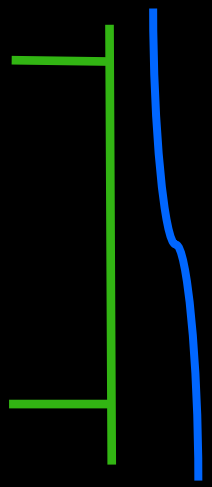
Applied Fertilizer (Urea, UAN(28%), DAP, NH_3, Manure)…Outside the growing season.



Properly Applied Fertilizer (Urea, UAN(28%), DAP, NH3, Manure)…During the growing season will always have the lowest risk of loss.

Avoid Control Trap

Nitrate Nitrogen



Management Practices

- Conservation Crop Rotation
- Cover Crop
- Prescribed Grazing
- Nutrient Management
- Waste Utilization

- Can reduce concentration of N in all water leaving the field
- Can reduce concentration of P in all water leaving the field
- May have additional benefits: decrease runoff erosion and energy
- Cost is annual, variable and dependent on management

Prescribed Grazing

Conservation
Cropping Systems
IN itiative
Nutrient Management
& Waste Utilization

Cover Crops

Crop Rotation
& Stripcropping

Nutrient Management

- Establish realistic yield expectations
- Take credit for previous legume crop
- Avoid fall N applications from any N source
- Make sidedress or late pre-plant N applications, whenever possible
- Use anhydrous ammonia-N for pre-plant N because of its reduced risk for N loss.
- Use a nitrification inhibitor with early pre-plant N applications, especially on poorly drained and sandy soils

Purdue ID-179

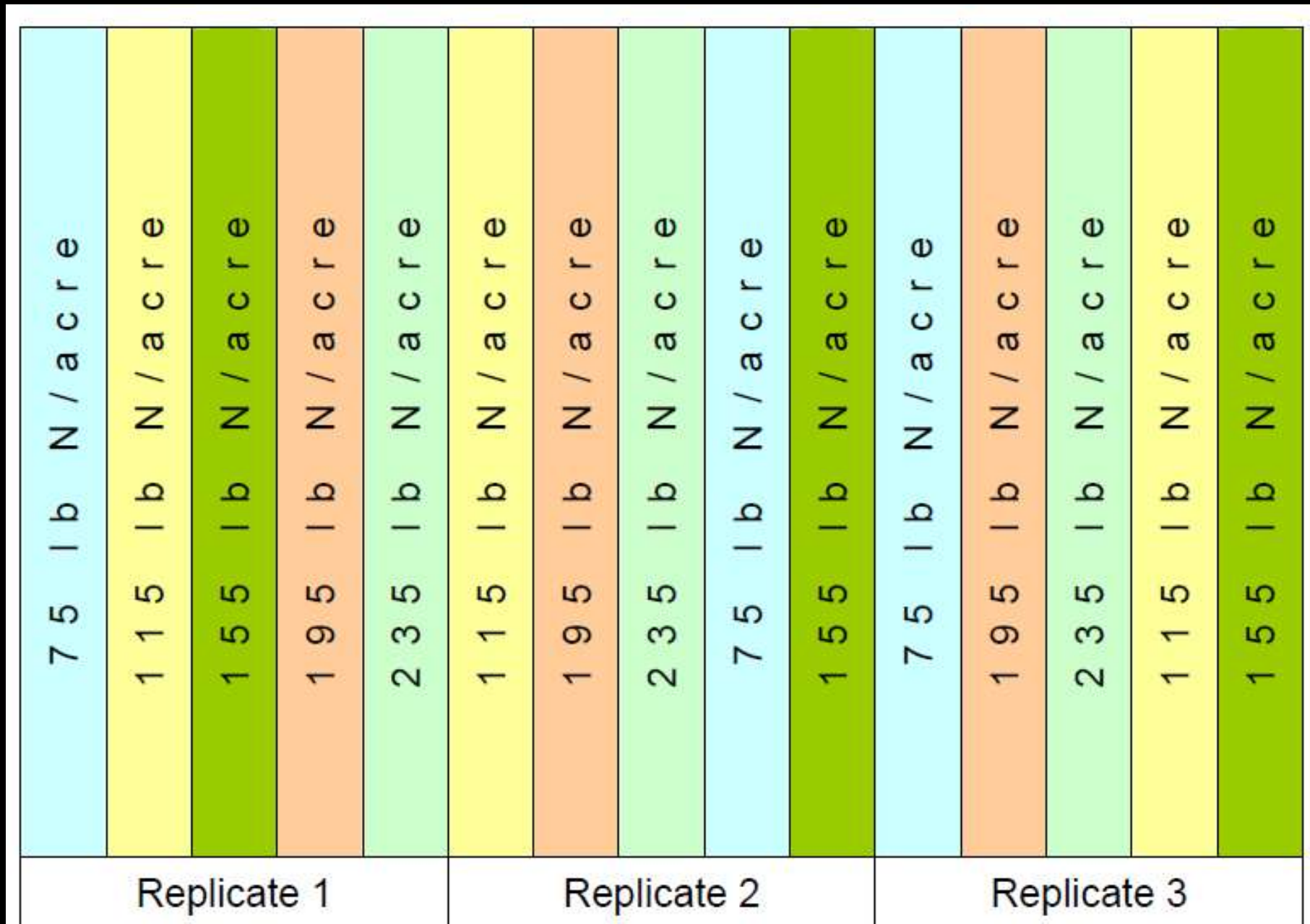
The Fertilizer Institute – 4Rs

- Right Source
  - Match fertilizer type to crop needs
- Right Time
  - Match nutrients available when crops need them
- Right Place
  - Keep nutrients where crops can use them
- Right Rate
  - Match amount of fertilizer to crop needs

Waste Utilization

- Manure analysis
- Soil testing
- Apply based on planned crop N needs
- Don't over apply manure based on estimated losses of N due to timing and method of application
- Use the pre-sidedress nitrate test (PSNT) to determine soil N status in manured fields. Chlorophyll meter & stalk nitrate test.
- Apply no additional manure if soil test P >200 ppm
- Avoid summer / early fall applications (use nitrification inhibitor and/or Cover Crops)

Getting a better handle on N…



Cereal Rye

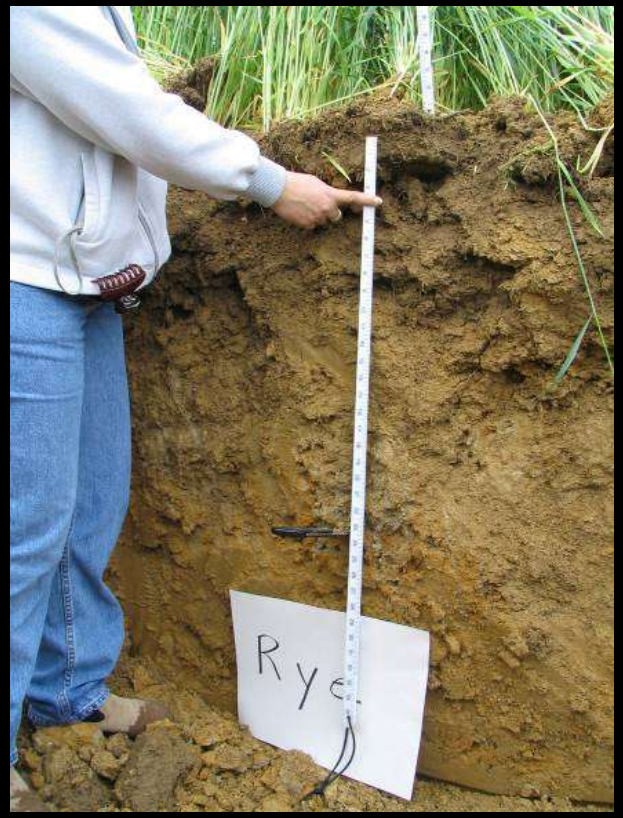
Managing the Fate of Nitrogen!

Purdue University

Dr. Eileen Kladivko

- Nutrient management, no-till, crop rotation and cover crops were implemented.

- Nitrate concentrations in tile water dropped from over 30 mg/l to under 10 mg/l



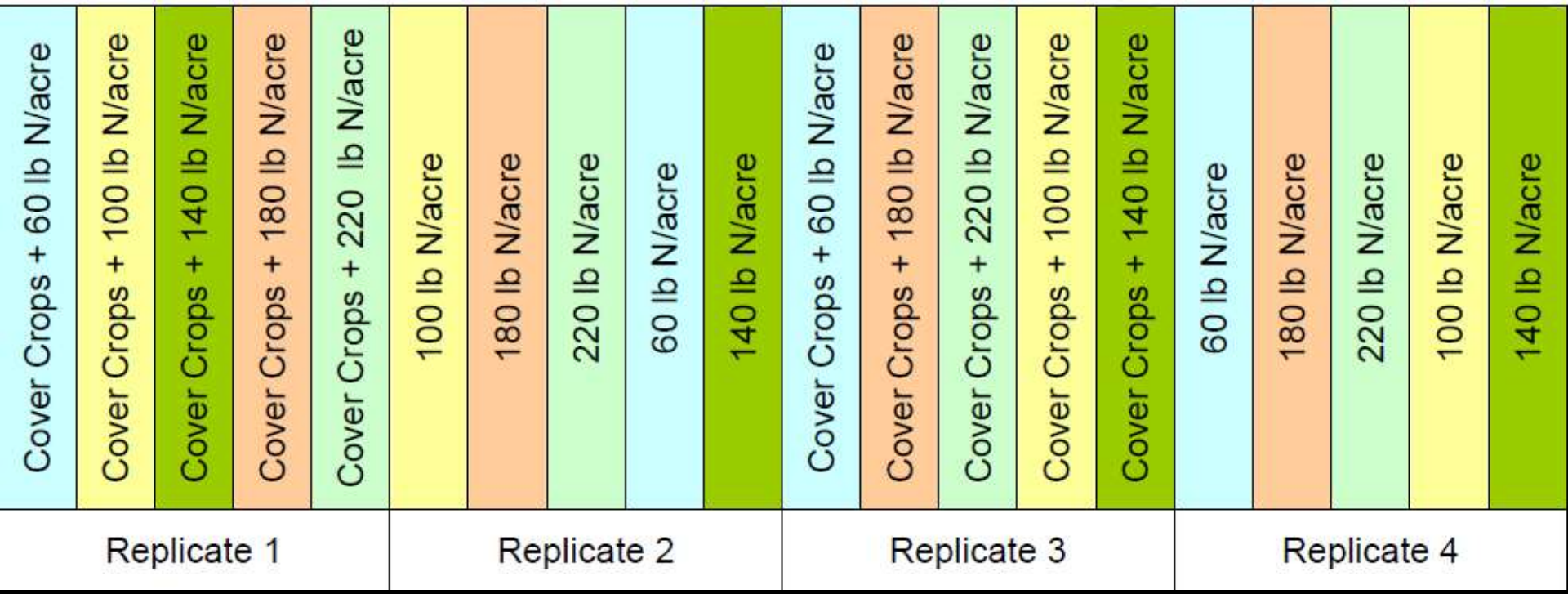
Cereal Rye

Iowa- ARS

Dr. Tom Kasper

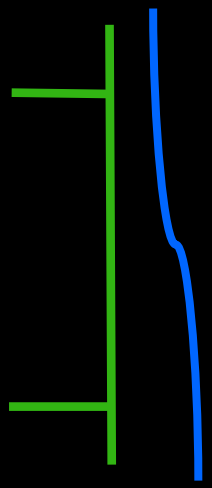
Reduced Nitrate leaching by 60 lbs. /ac. With a cover crop of Cereal Rye

Getting a better handle on Cover Crops and N…



Avoid Control Trap

Nitrate Nitrogen



Vegetative & Management Practices

- Residue & Tillage Management
  - No-till/Strip-till
  - Mulch-till
- Stripcropping
- Pasture & Hayland Planting
- Cover Crops

- Can reduce concentration of N primarily in surface water leaving the field
- Can reduce total phosphorus loads
- Can increase soluble P and requires management
- Will have additional benefits: decrease runoff, erosion and energy. Improve SOM & AQ
- Cost is annual, variable and dependent on management

No-Till/Strip-Till

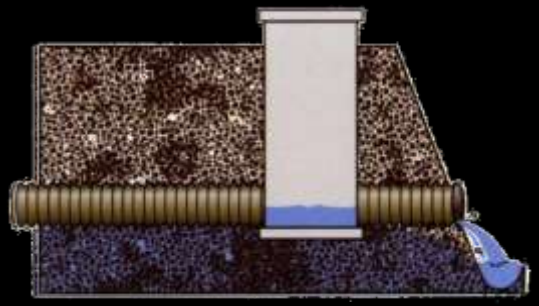
Crop Rotation
And Stripcropping

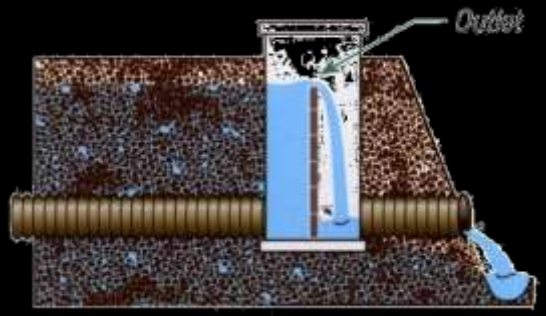
Conservation
Cropping Systems
IN itiative
Perennial cover
•We can Control the movement of nutrients with many soil quality practices!

Cover Crops

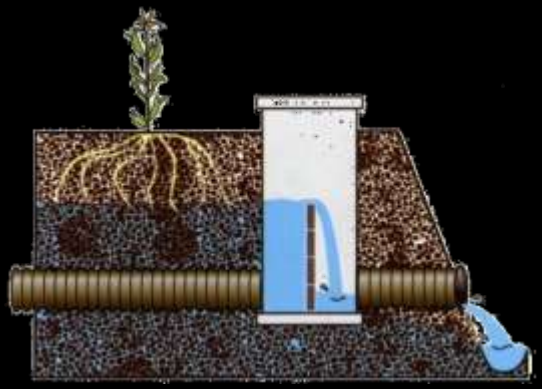
- Year-round bio-mass production should be targeted.
- Sequester these Nutrients by integration of cover crops into Conservation Cropping Systems

Drainage Water Management (DWM)



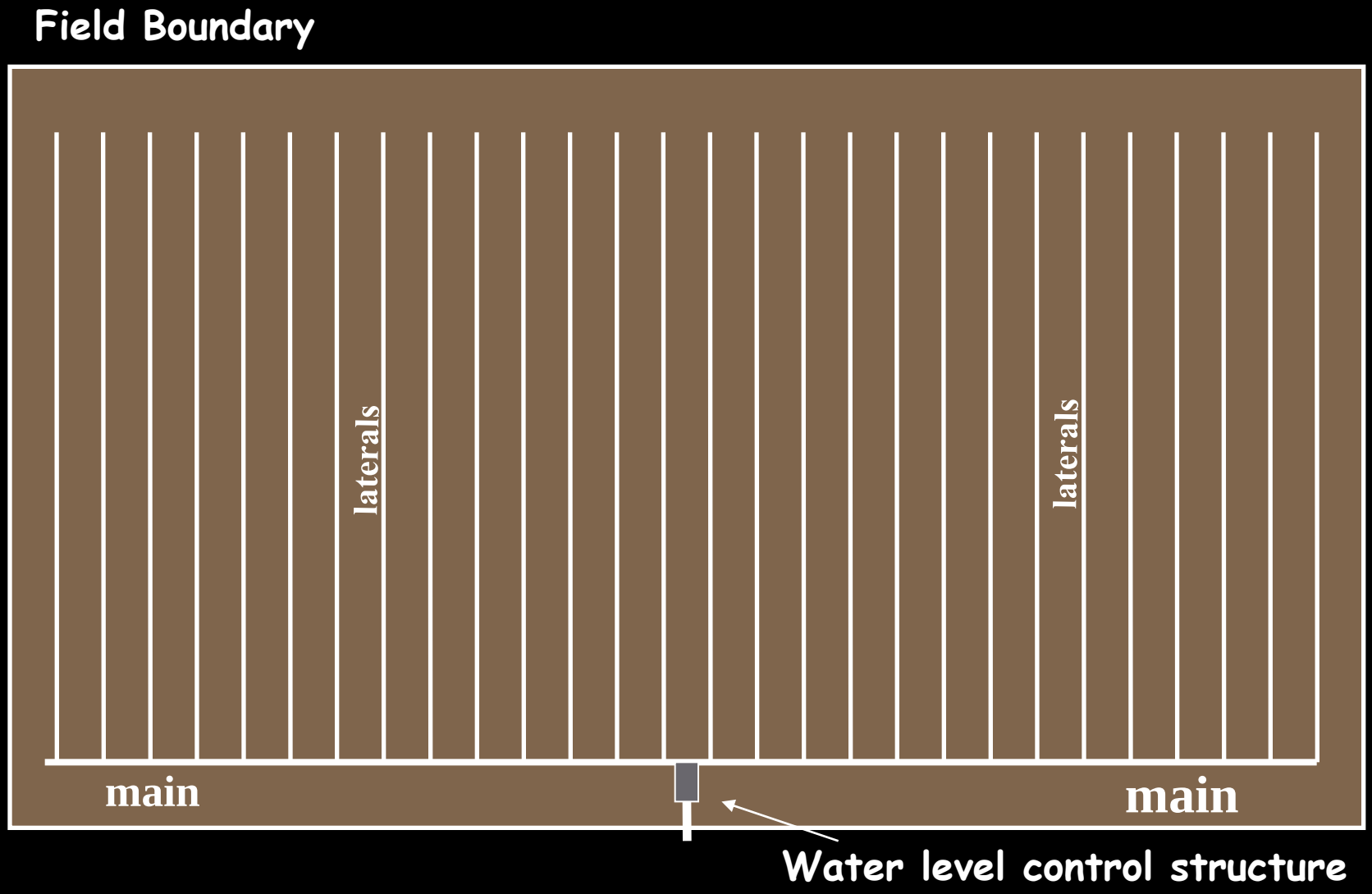


The outlet is raised after harvest to reduce nitrate delivery during winter.

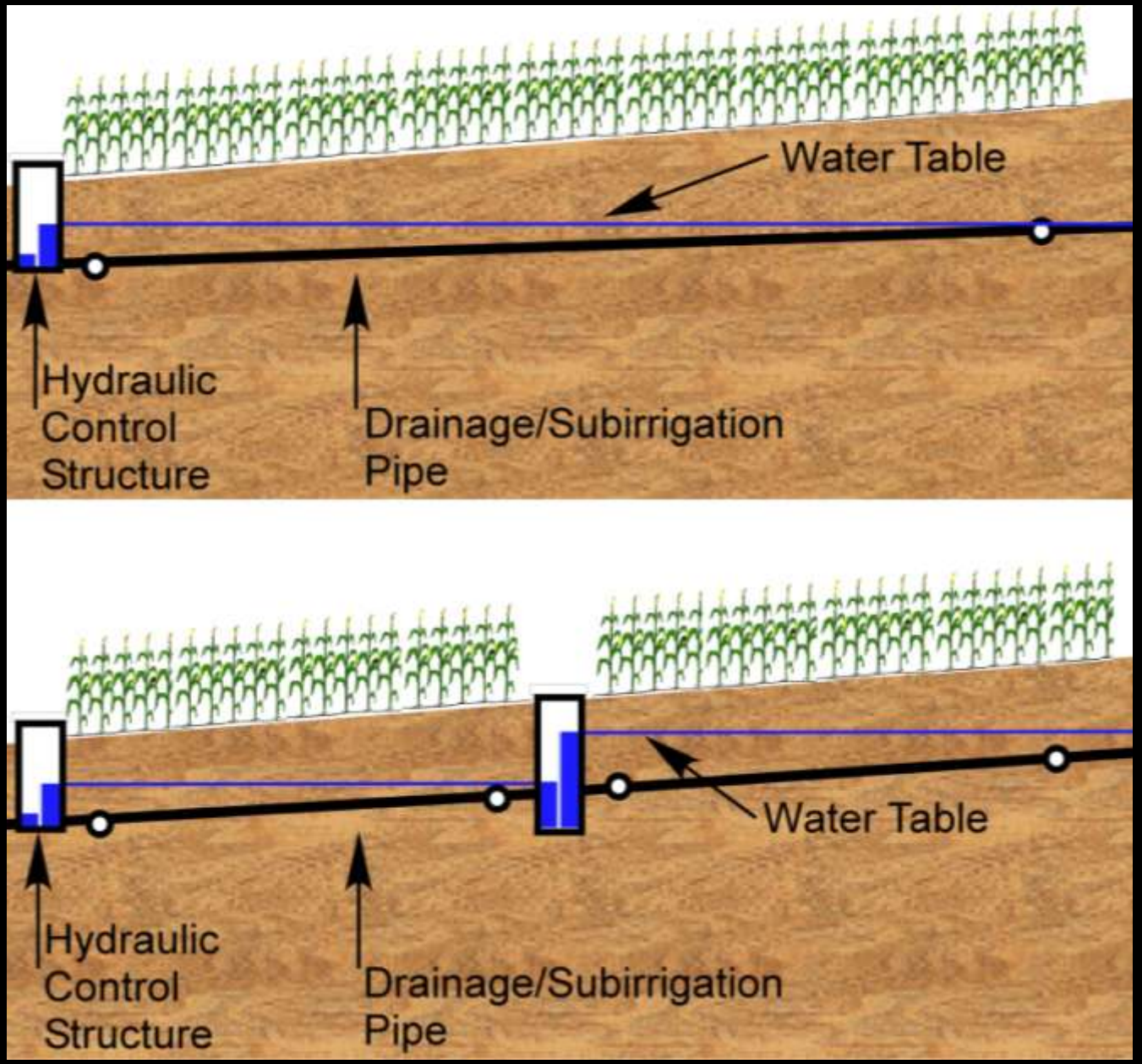


The outlet is raised after planting to potentially store water for crops.

Drainage Water Management
(Parallel System and Flat Topography)



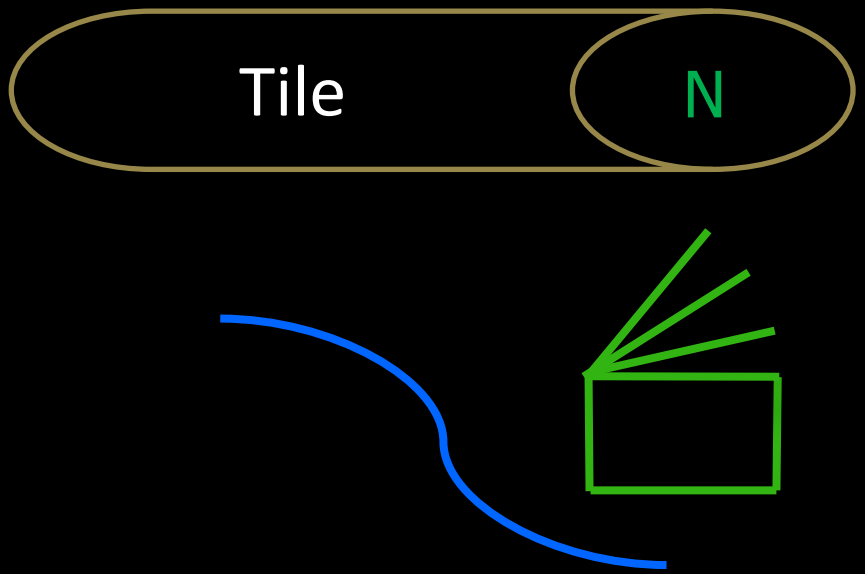
Field Installation Solutions



Drainage Water Management

- Reduces N by amount of water that does not drain (~30%?)
- N Denitrifies, taken up by plants, seeps down, treated by soil
- Concentration of N in water does not change
- Cost is for structure and management
- May increase runoff

Avoid Control **TRAP**

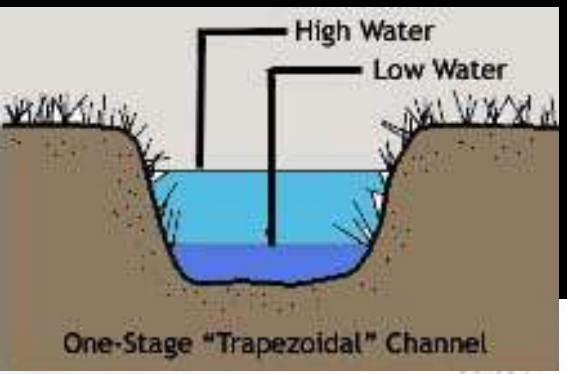


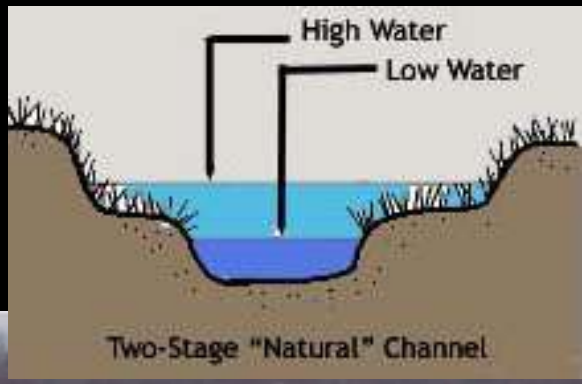
Vegetative & Management Practices

- Buffers

- Can reduce concentration of N and P in surface water leaving the field
- Can reduce total phosphorus loads
- Can capture soluble P and Nitrate from runoff and entering tile
- Will have additional benefits: decrease runoff, erosion and energy. Improve SOM & AQ

Structural Practices
2-Stage Ditch





Structural Practices
2-Stage Ditch

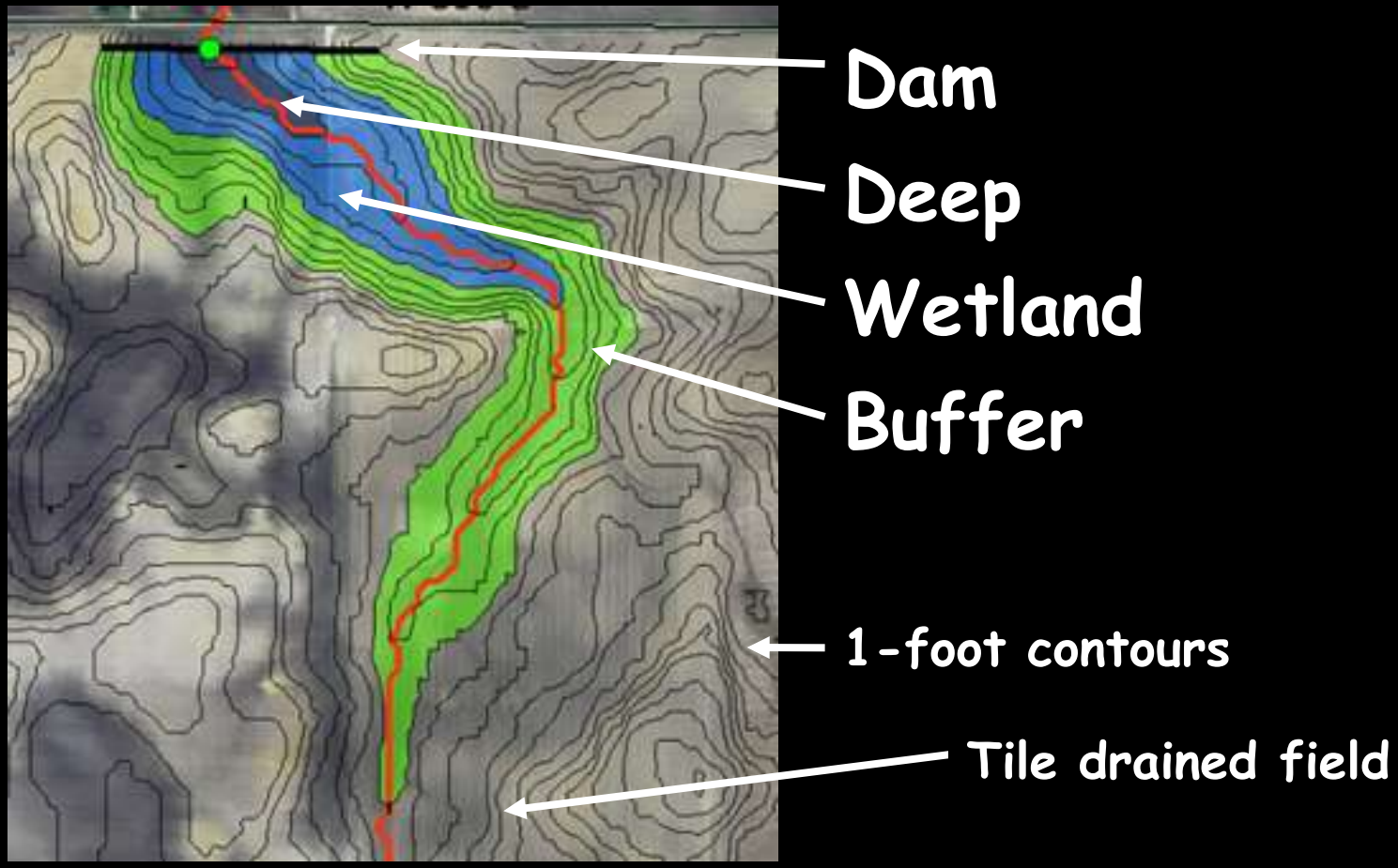
- "Normal ditch" is widened to 3Xs original width
- Cost depends on size, but usually $8-$12/ft to construct
- Benefits other than N removal include less maintenance of ditch, more stable banks and less turbid (wildlife beneficial) water

Structural Practices
Constructed Wetland to Treat N from Tile

Looks like any other wetland…

Structural Practices
Constructed Wetland to Treat N from Tile

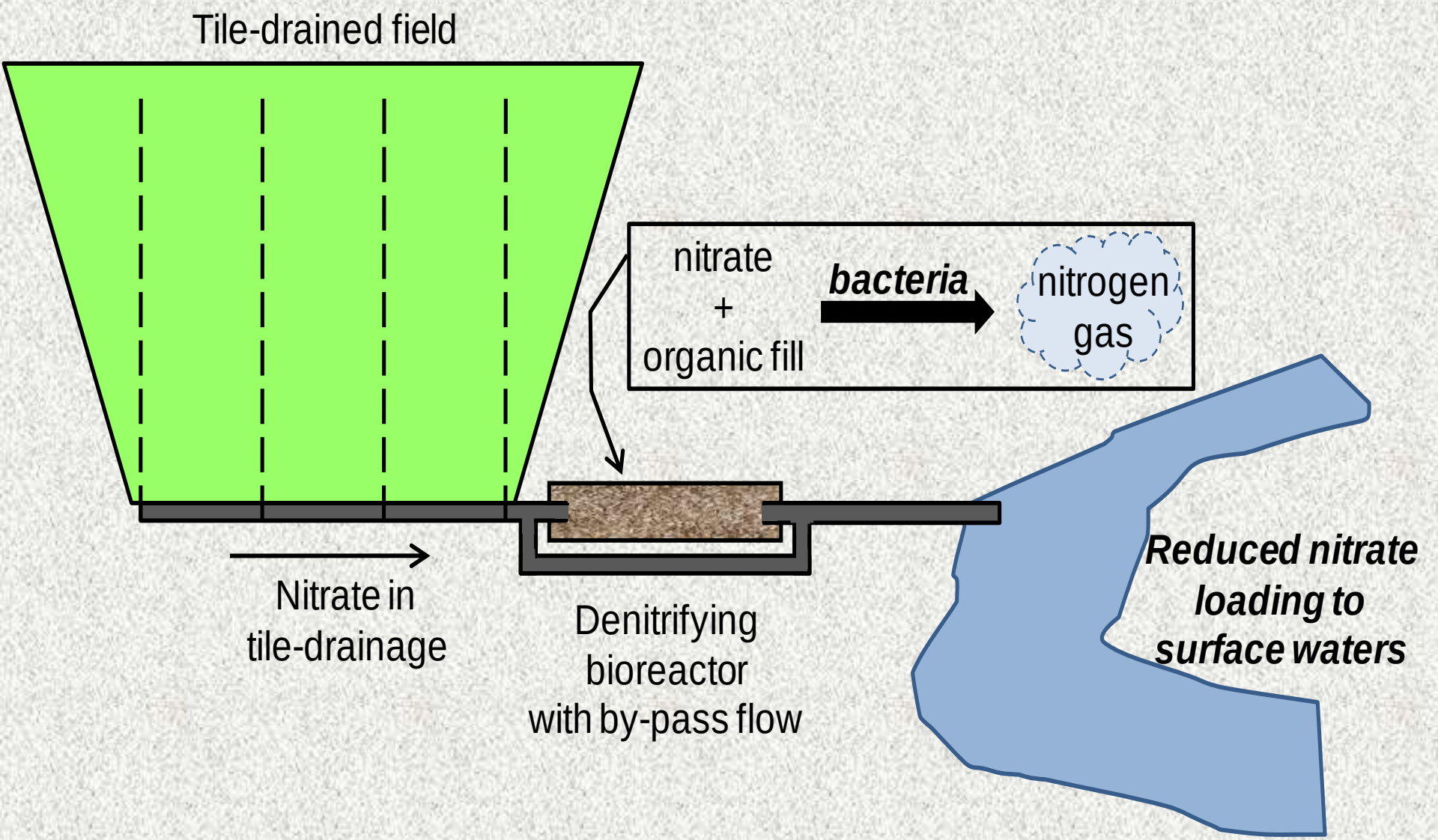
Structural Practices
Constructed Wetland to Treat N from Tile

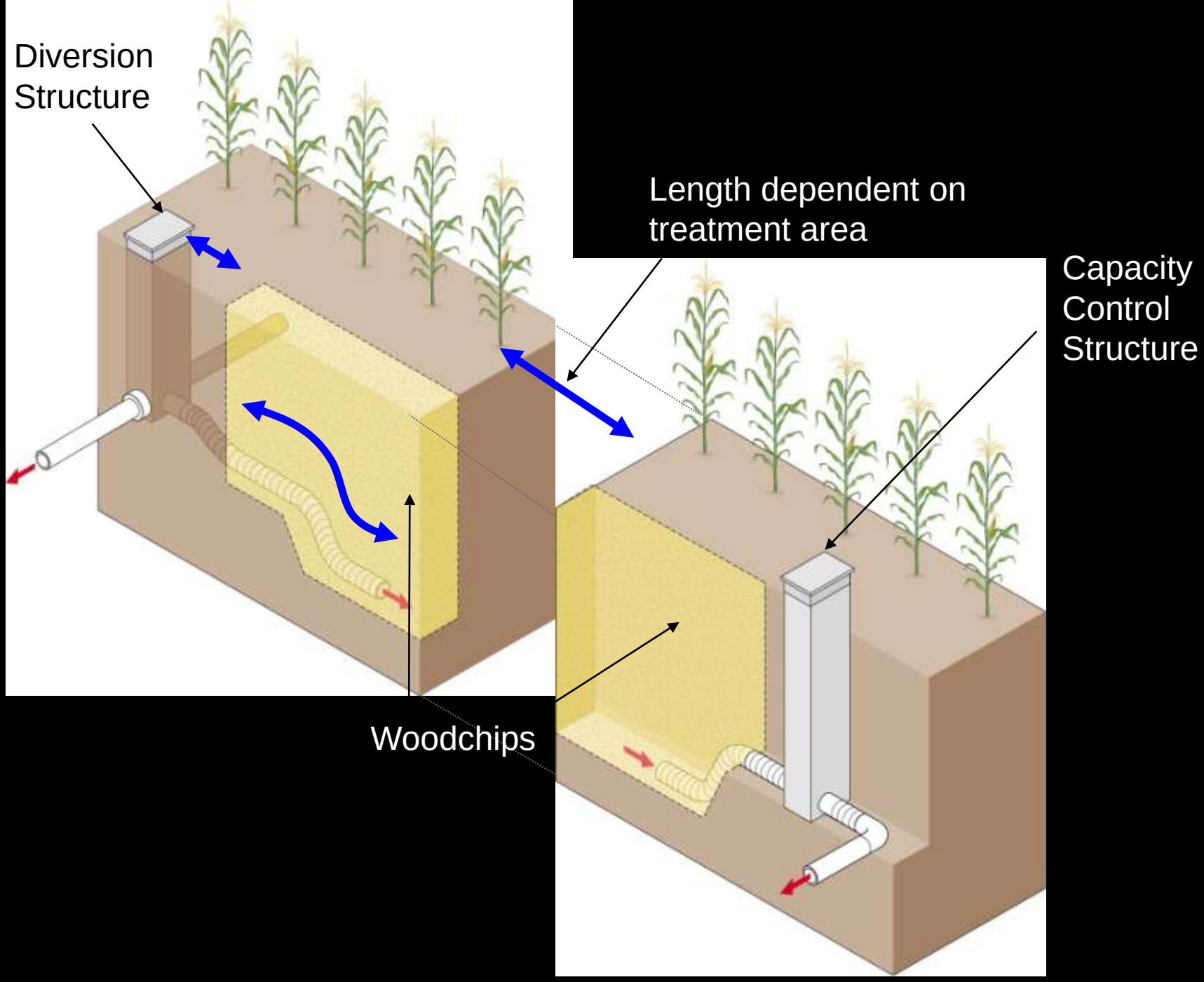


Structural Practices
Constructed Wetland to Treat N from Tile

- Fits in limited places
- Removes 40-90% of N and 90% herbicides, depending on size
- Cost ranges from $1000 to several thousand (size dependent)
- May be excavation, levee, structure
- Must outlet existing tile and not affect neighbors
- Can have large footprint

Denitrifying Bioreactor




Diversion Structure
Length dependent on treatment area
Capacity Control Structure
Woodchips

How do Bioreactors Work?

- Denitrification: a natural biochemical process that happens in all soils by “good” bacteria
- Denitrifier bacteria need:
  - Anaerobic conditions: low oxygen (under water)
  - Food: carbon source (the woodchips)
  - Something to breathe: nitrate, not oxygen
  - Place to live: on woodchips

Construction of Bioreactors

Bioreactor Installed October 2009

Structural Practices
Denitrifying Bioreactor

- Normally Removes 50-60% of the N
- Fits where Constructed Wetland does not
- Cost ~$8000 for 8" tile drain of 30 acres
- Fits at edge of field
- Water control structure controls flow
- Geotextile wraps wood chip trench
- Requires water quality monitoring

Vegetative Practices

Cover Crops

- Cover Crops trap nutrients
- Farmer trials - tissue tests of cover crops =70# N/ac. by Dec.
- If half is available… That's $14/ac of N for next year's crop
- (@ $.40/lb)

Success is Possible!

New Technology

Conservation Cropping Systems Initiative

…Is Probable!

QUESTIONS