Delaware Conservation Drainage

November 25, 2020

SHORE RIVERS

Maintaining drainage for production while achieving clean water

Big Picture

Sustainable Intensification

- Producing more food, with the same amount of land, with less environmental cost

Conservation Drainage

- **Managing** water as resource
- Farm **resiliency**
- Compatible with **water quality** and **climate change goals**

Importance of Agricultural Drainage

- Increased Yields
- Better Trafficability
  - Ruts
  - Compaction
- Less runoff
- Reduce Flooding/Pests

Impacts of Agricultural Drainage

- Changes hydrology
- Concentrates dissolved nutrients and pesticides
- Reduces effectiveness of some manure management practices
- Circumvents ecosystem services

Drainage Water Management
CAP 130, NRCS 554

Underground Outlet (Blind Inlet)
NRCS 620

Subsurface Drain
NRCS 606

Saturated Buffer
NRCS 604

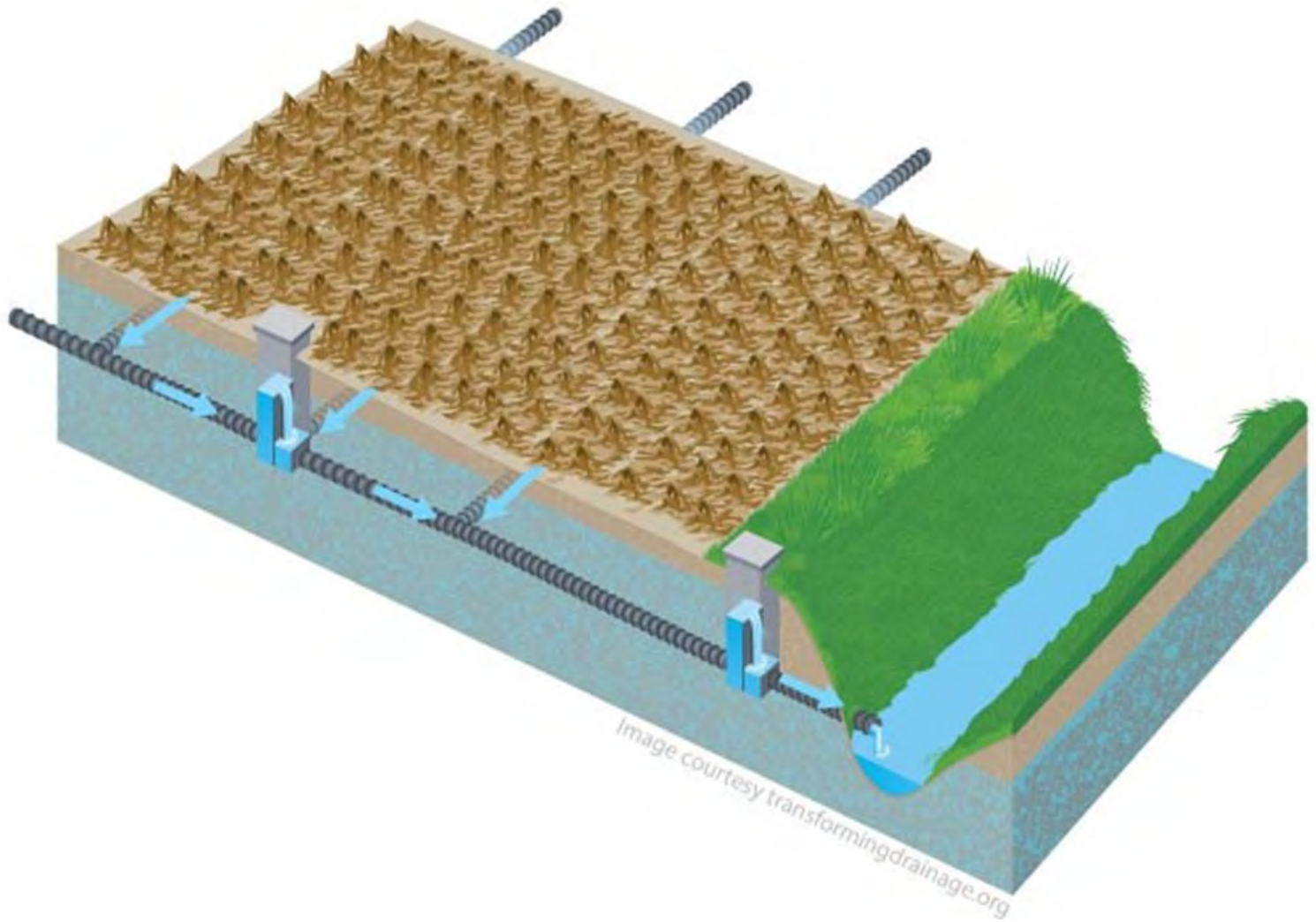
Denitrifying Bioreactor
NRCS 605

Constructed Wetland
656

Drainage Water Management

CAP 130
NRCS 554

- Managing the timing and the amount of water discharged
- Pattern tile
- Flat topography
- WCS and/or additional outlet practice




Legend
4" Tile
N
1 inch = 170 feet


N
1 inch = 130 feet
Tile Size
10
4
6
6
8

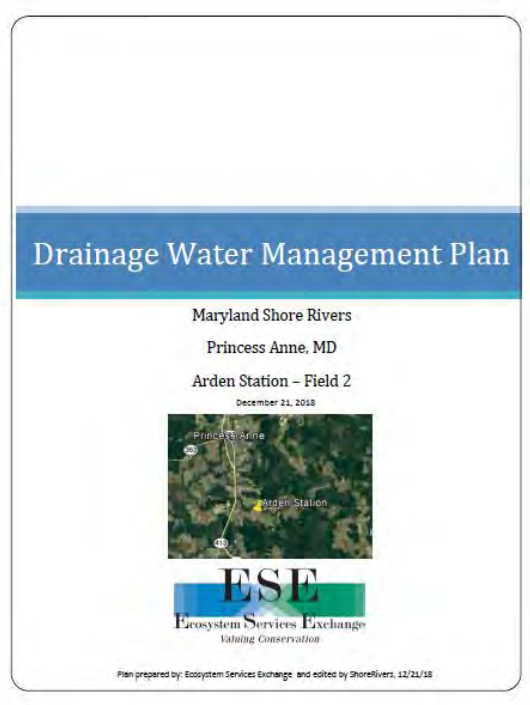
Drainage Water Management

CAP 130
NRCS 554

- New Drainage 30% yield increase
- DWM 3 to 5% Yield Increase
- >30% Nitrate reduction
- Reduced Drainage

Drainage Water Management

CAP 130
NRCS 554



Pipe Considerations

Non-perf pipe is required for 20 ft. above (upstream) and below (downstream) of the above ground structures. It is only required upstream of Water Gates. The table below reflects these values.

Pipe Size	Length (ft)
10" non-perforated	40
10" perforated	69
8" perforated	323
6" perforated	138
5" perforated	203
4" perforated	6,689

Summary of Soil Information

Name	Area (ac)	MU Symbol	Drainage Class
Manokin silt loam	0.3	MdA	Moderately well drained
Quindocqua silt loam	13.6	QuA	Poorly drained

Schedule of Implementations

- NRCS EQIP practices included in this plan:

Field Number	Practice Code	Practice Name	Number	Size	Height	Units
	554	Drainage Water Management	16.4	-----	----	Acres
	378	Structure for Water Control	----	----	----	----
		Stop log type - Above Ground Structure	1	10"	6'	Each
		Float type - WaterGate	----	----	----	Each
	605	Denitrifying Bioreactor	1			Each
	606	Subsurface Drain (Secondary Main)*	898			Feet

*Non- perf pipe to be installed in conjunction w/ SWC should not be included in this number

- Additional practices that could be used in conjunction with this plan:
  - 590 – Nutrient Management
  - 646 – Shallow Water Development and Management
  - 605 – Denitrifying Bioreactor
  - 658 – Wetland Creation
  - 659 – Wetland Enhancement
  - 657 – Wetland Restoration
  - 644 – Wetland Wildlife Habitat Management

Summary of Control Structures

The field currently has some tile that drains directly into the ditch. A main will be added along the north and east ditches. The existing tile shall be destroyed and their old outlets be destroyed. This DWM system was designed on a 75-foot lateral spacing on a drainage coefficient of ½". A bioreactor could be be placed near the outlet. The structure for the potential bioreactor will also be used as the structure for DWM. The one structure will manage 17.0 acres

The water will outlet into the ditch in the northeast corner of the field at an elevation of 11.3 feet.

Zone	Impacted Area (ac)	Pipe Size	Depth	Structure Height	Structure Type
1	17.0	10"	4.5'	6'	Above Ground

Management Instructions

Fallow Season Management:

Insert stop logs in the control structures to the management elevation (6 inches below the ground surface) within 30 days after harvest is completed. Remove stop logs about two weeks before the anticipated start of spring field work. The management elevations will likely need to be modified if growing wheat or cover crops.

If there is manure applied to the field, the structure for water control drain outlet boards shall be raised to fallow season elevations prior to and during manure applications to prevent direct leakage of manure into drainage pipes through soil macro pores (cracks, worm holes, root channels) if a rainfall event should occur shortly after manure application per the NRCS's CPS 554 Drainage Water Management standard. This is especially critical when liquid manure is applied.

Growing Season Management (optional):

Insert stop logs in the control structure to the management elevation immediately after spring field work is complete. Remove stop logs a few weeks before harvest, if necessary. The management elevations given below will allow the water table to be maintained two feet below the ground surface. Additional recommendations from North Carolina State University are given below.

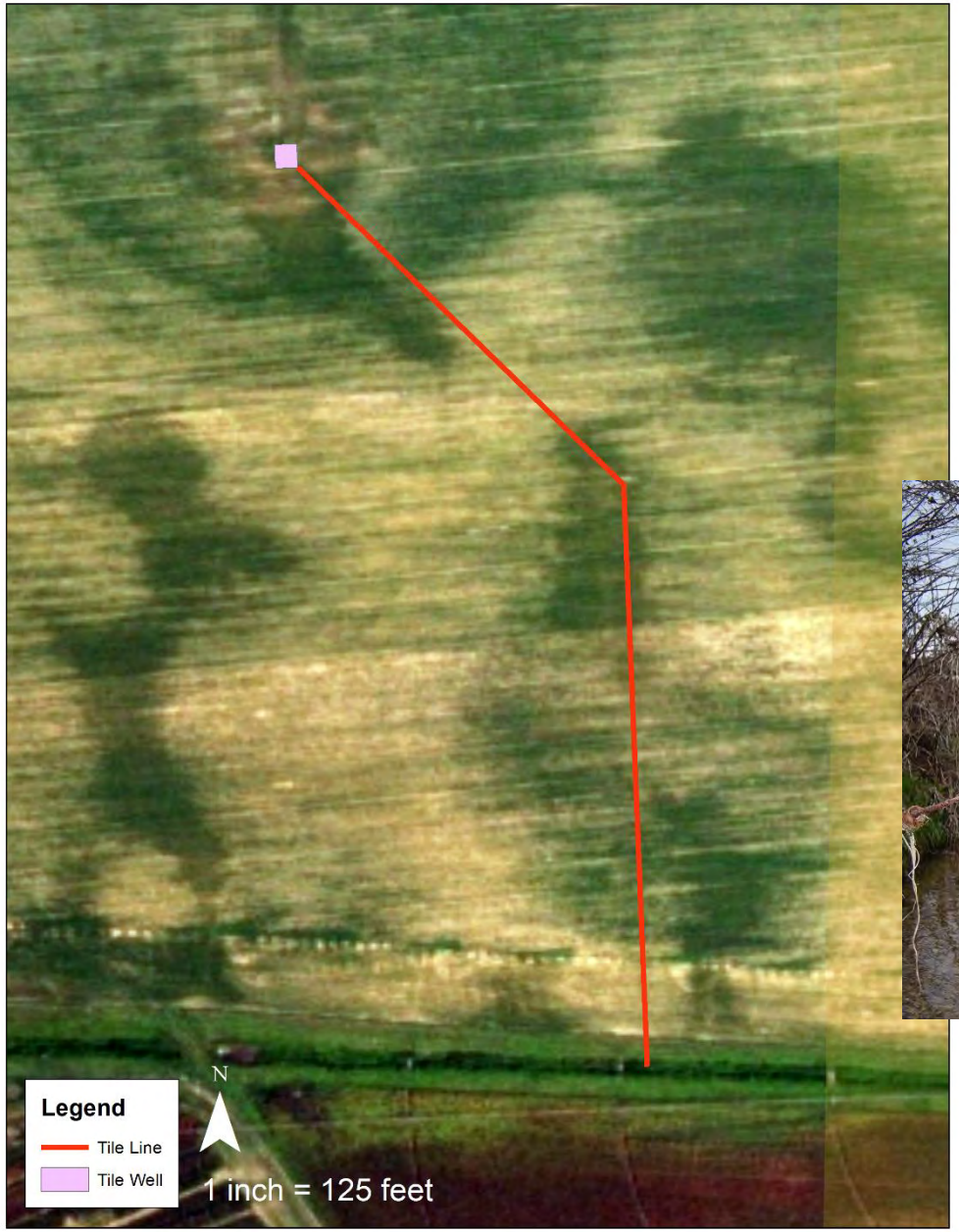
Management Stoplog Elevation (ft) and Board Height (in)			
Zone	Control	Winter	Growing Season
1	16.2'	15.7'	14.2'
		52.8"	34.8"

Additional management recommendations provided by North Carolina State University

Period	Production Activity	Control Setting-Board Height (in)	Comments
Jan 1 – Mar 15	Fallow	53 – 41	Minimize drainage outflow and encourage denitrification
Mar 15 – Apr 5	Tillage, corn seedbed preparation, planting	29 – 23	Just deep enough to provide trafficability and good conditions for seedbed preparation
Apr 15 – May 15	Corn establishment and early growth Nitrogen side dressing	35 – 29 35 – 23	Deep enough to promote good early growth root development Just low enough to allow trafficability
May 15 – Aug 15	Corn Development and maturity	41 – 35	Temporary adjustment during wet periods
Aug 15 – Oct 15	Harvesting, tillage; planting of wheat	29 – 23	Lower enough to provide trafficability
Oct 15 – Mar 1	Wheat establishment	41 – 35	Lower during extremely wet periods
Mar 1 – Mar 15	Side dressing wheat	29 – 23	Low enough to provide trafficability
Mar 15 – Jun 15	Wheat development	41 – 35	Temporary adjustment during wet periods
Jun 15 – Jul 15	Harvesting wheat; tillage, planting of soybeans	29 – 23	Depends of rainfall
July 15 – Nov 1	Soybean development	41 – 35	Temporary adjustment to allow cultivation
Nov 1 – Dec 15	Soybean Harvesting	23 – 17	Low enough to provide trafficability
Dec 15 – Mar 15	Fallow	53 – 41	Minimize drainage outflow and encourage denitrification

a Values shown are the control setting (depth below average surface elevation) and should not be considered the actual water table depth in the field, which will be lower except during drainage periods.
b Most adjustments are related to trafficability and must take into account weather conditions and soil water status at the time.
– In an unusually dry season, control can be 3 to 6 inches higher.
– In an unusually wet season, control should be 3 to 6 inches lower.
– In coarse-textured soils, trafficability can be provided with the water table approximately 6 inches higher.

Information obtained from:
http://www.bae.ncsu.edu/topic/drainageadvisory/guidelines.php



Random Tile

Underground Outlet (Blind Inlet)

NRCS 620

- Replaces tile riser or well
- Farmed closed depressions
- Filters surface water
- Reduces sediment and phosphorus >75%
- Does not impede equipment

Tile Well

Tile Riser

Blind Inlet

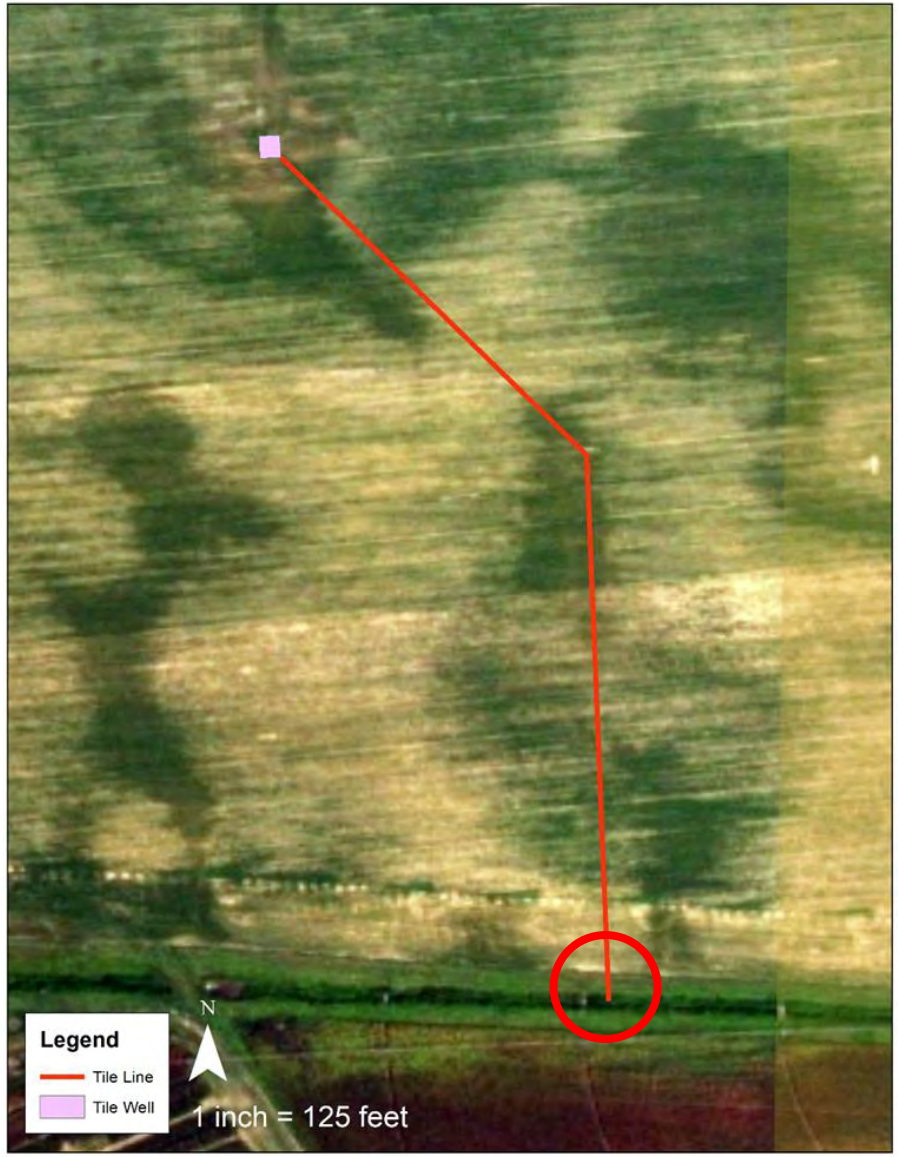

BLESSINGS
Environmental Concepts LLC
EASTON, MD.

Outlet Practices

Saturated Buffer

Denitrifying Bioreactor

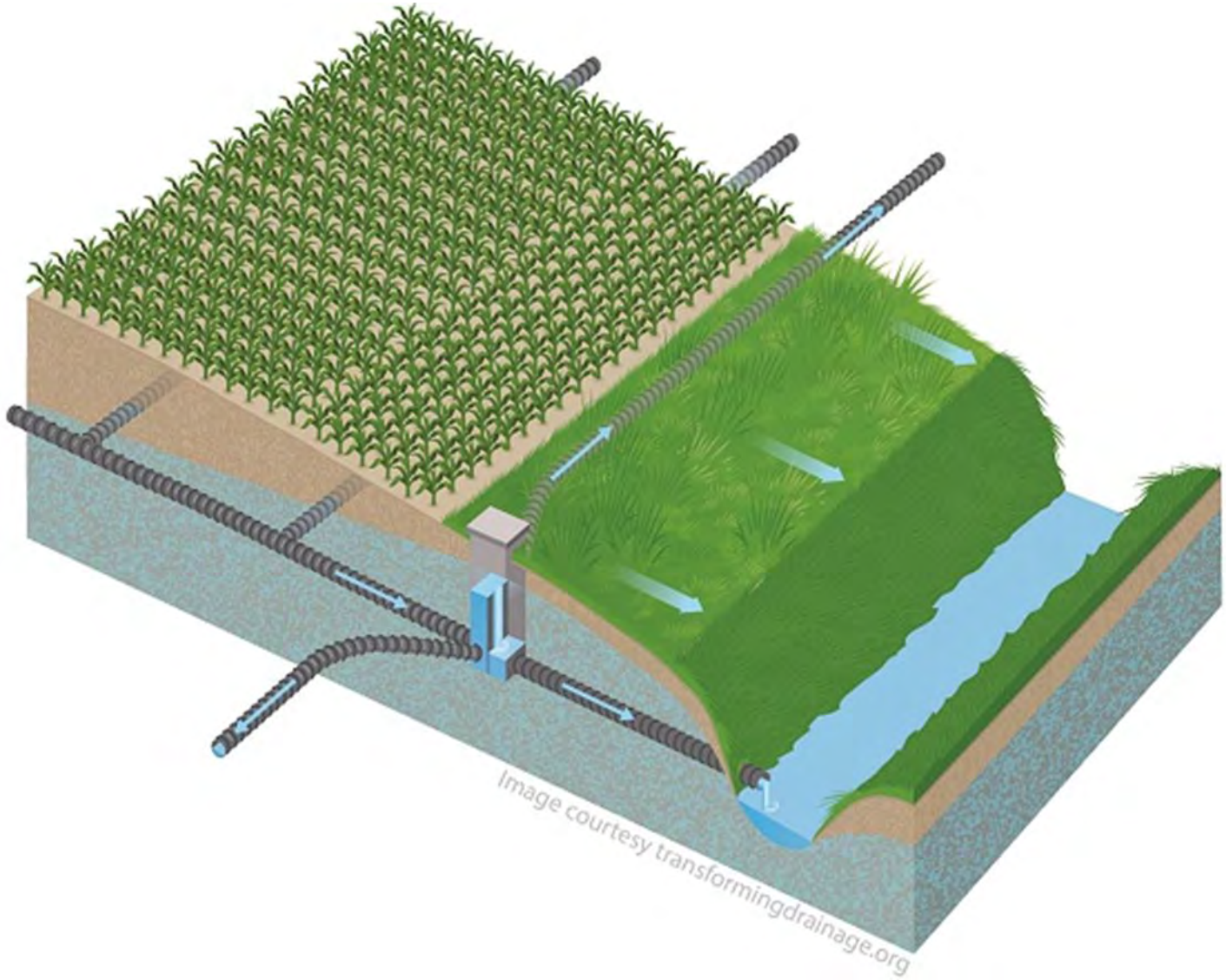
Treatment Wetland



Saturated Buffer

NRCS 604

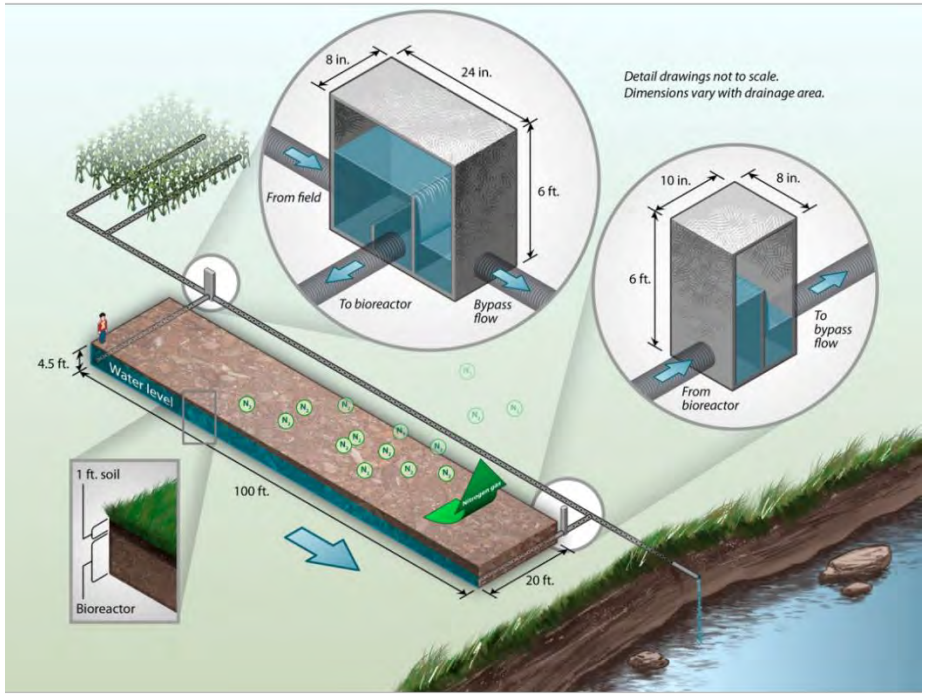
- Outlet practice
- Random or Pattern
- Inexpensive
- Buffer width >30’
- 100% Nitrate Concentration Reduction
- 50% nitrate load reduction



Denitrifying Bioreactor

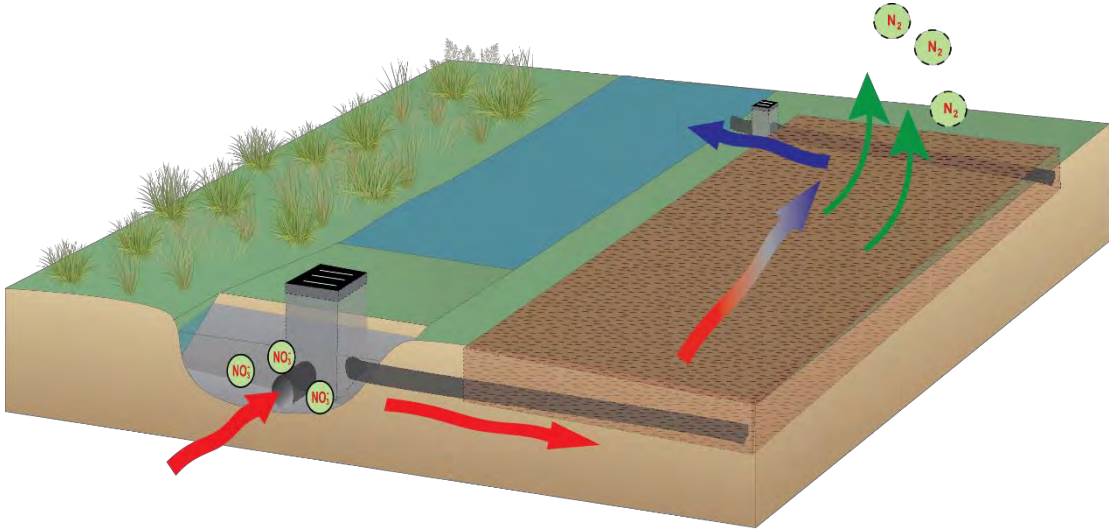
NRCS 605

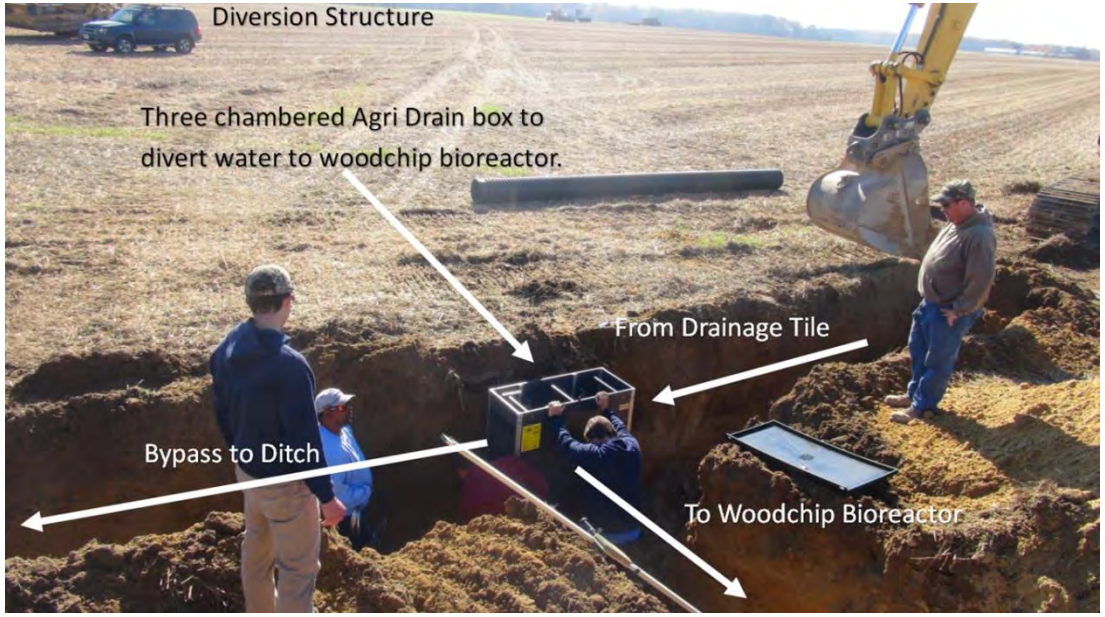
- Treats base flow
- Uses chipped wood
- Some management
- 20-60% Nitrogen Reduction

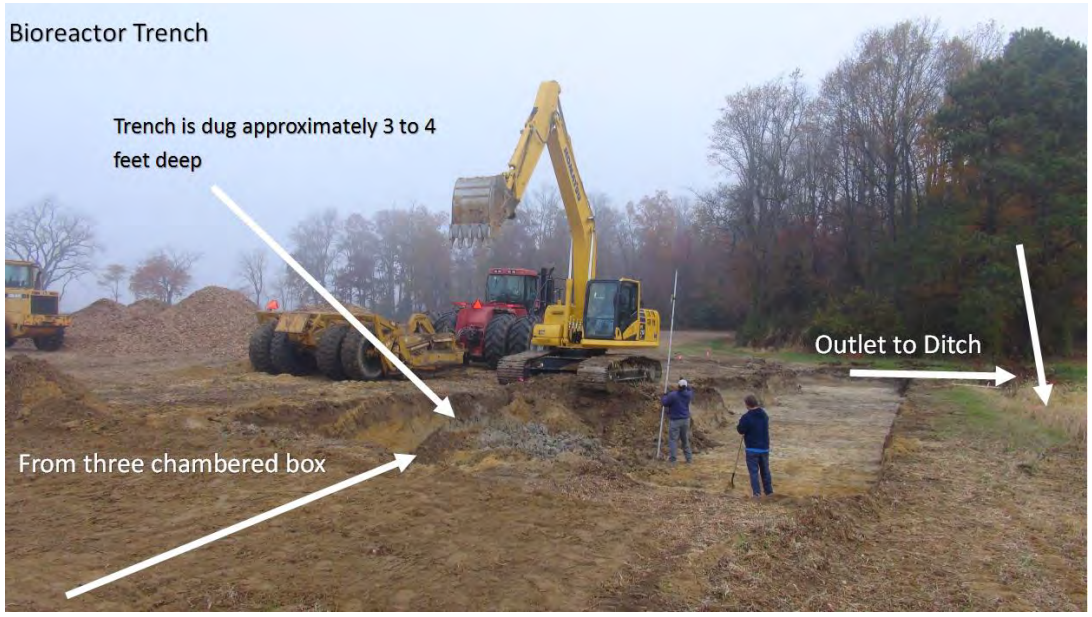


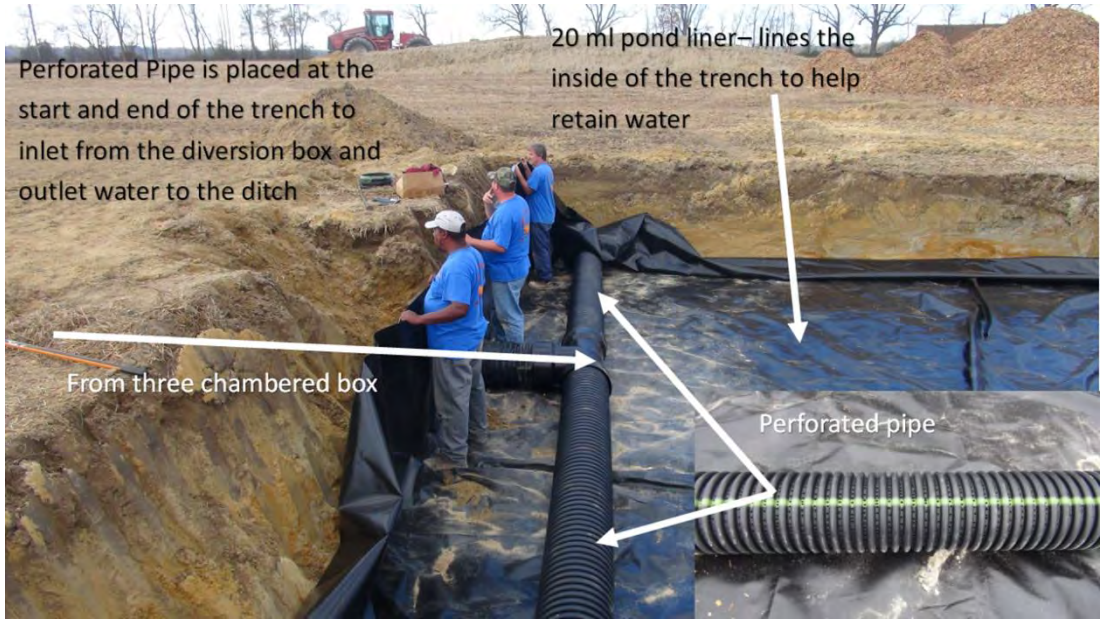
From Tile Drainage

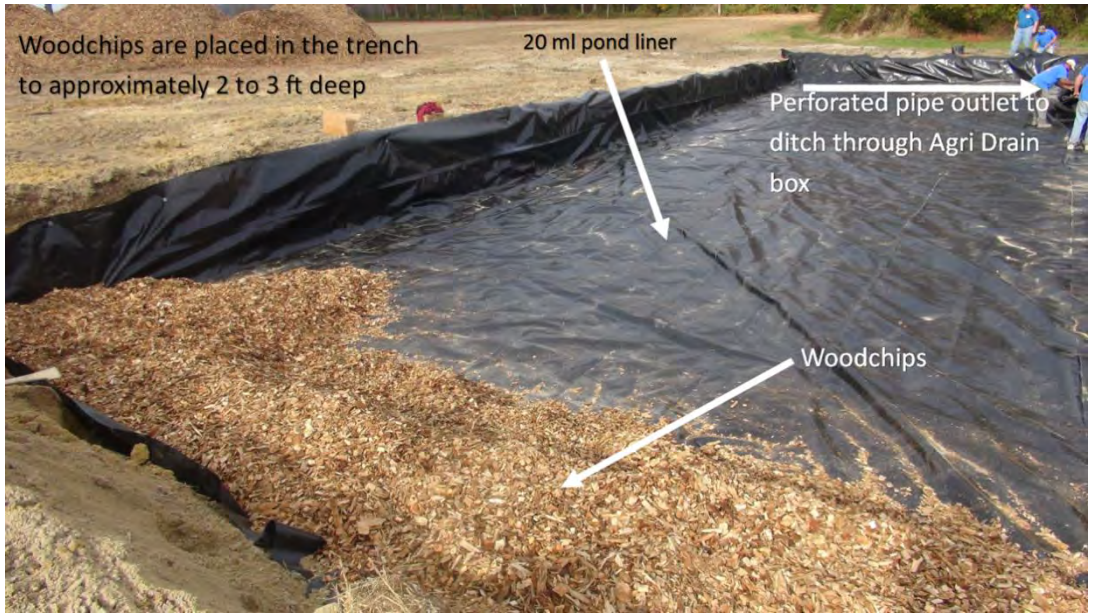
From Ditch Drainage



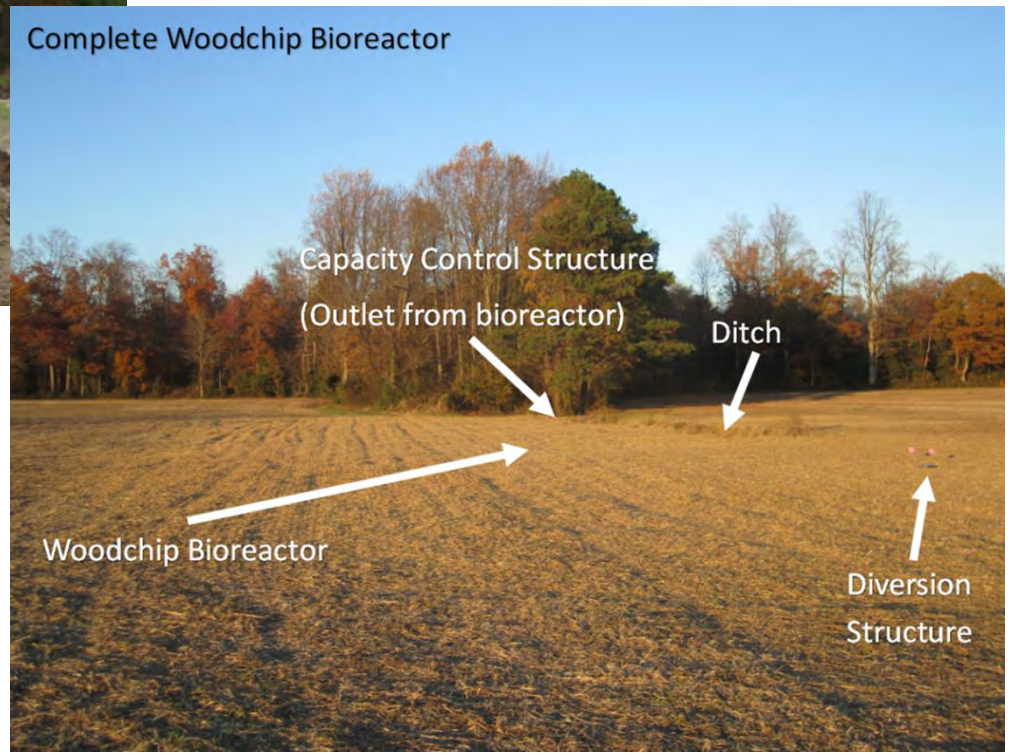

Diversion Structure
Three chambered Agri Drain box to divert water to woodchip bioreactor.
From Drainage Tile
Bypass to Ditch
To Woodchip Bioreactor


Bioreactor Trench
Trench is dug approximately 3 to 4 feet deep
Outlet to Ditch
From three chambered box


Perforated Pipe is placed at the start and end of the trench to inlet from the diversion box and outlet water to the ditch
20 ml pond liner– lines the inside of the trench to help retain water
From three chambered box
Perforated pipe


Woodchips are placed in the trench to approximately 2 to 3 ft deep
20 ml pond liner
Perforated pipe outlet to ditch through Agri Drain box
Woodchips

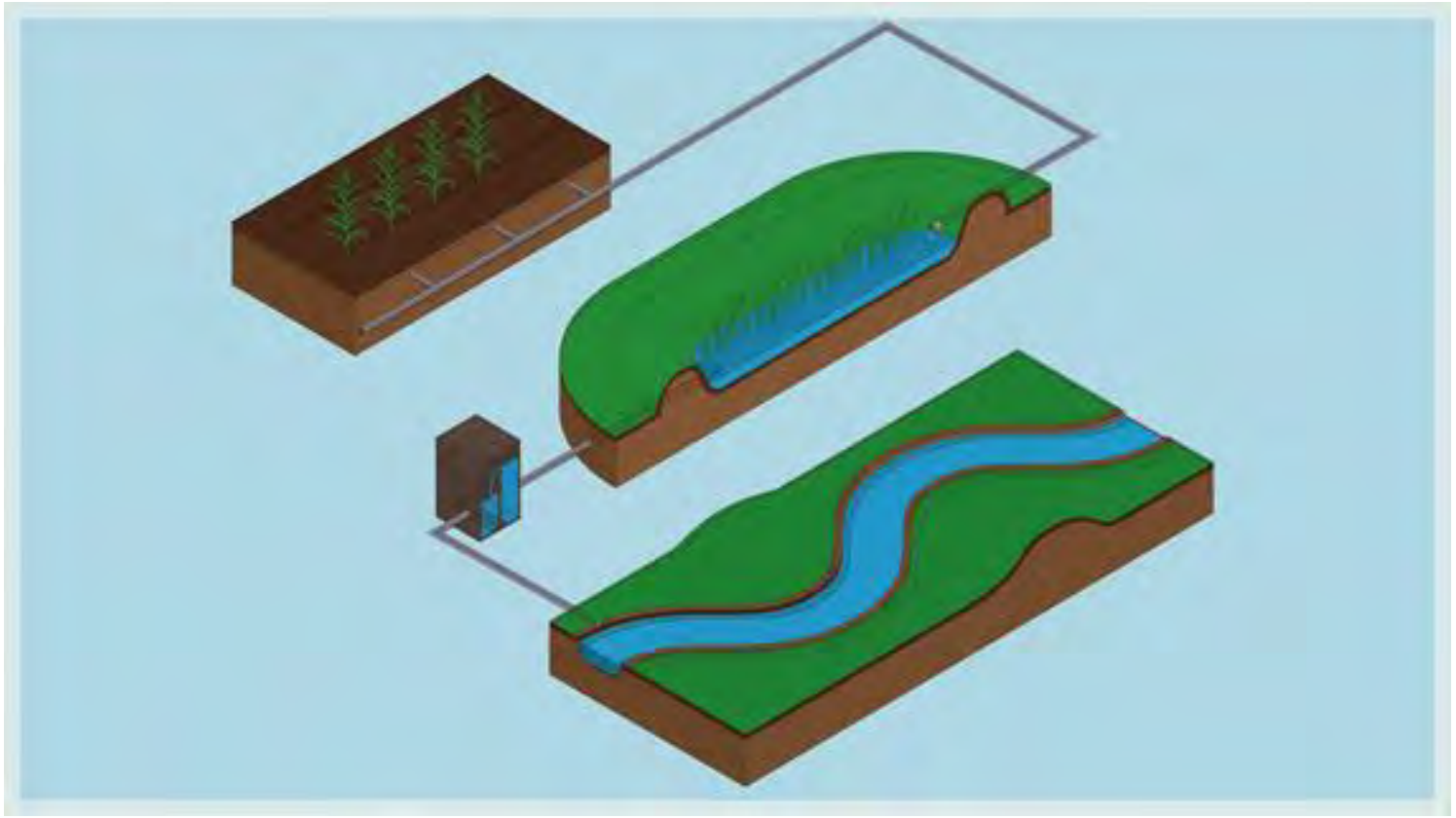
Trench is backfilled to surface elevation on the edge with slight crown in center



Treatment Wetland

NRCS 656

- Habitat and nutrient removal
- 20-60% N and P removal



DE WIP Goals

Annual Practice- No $$- Adoption?

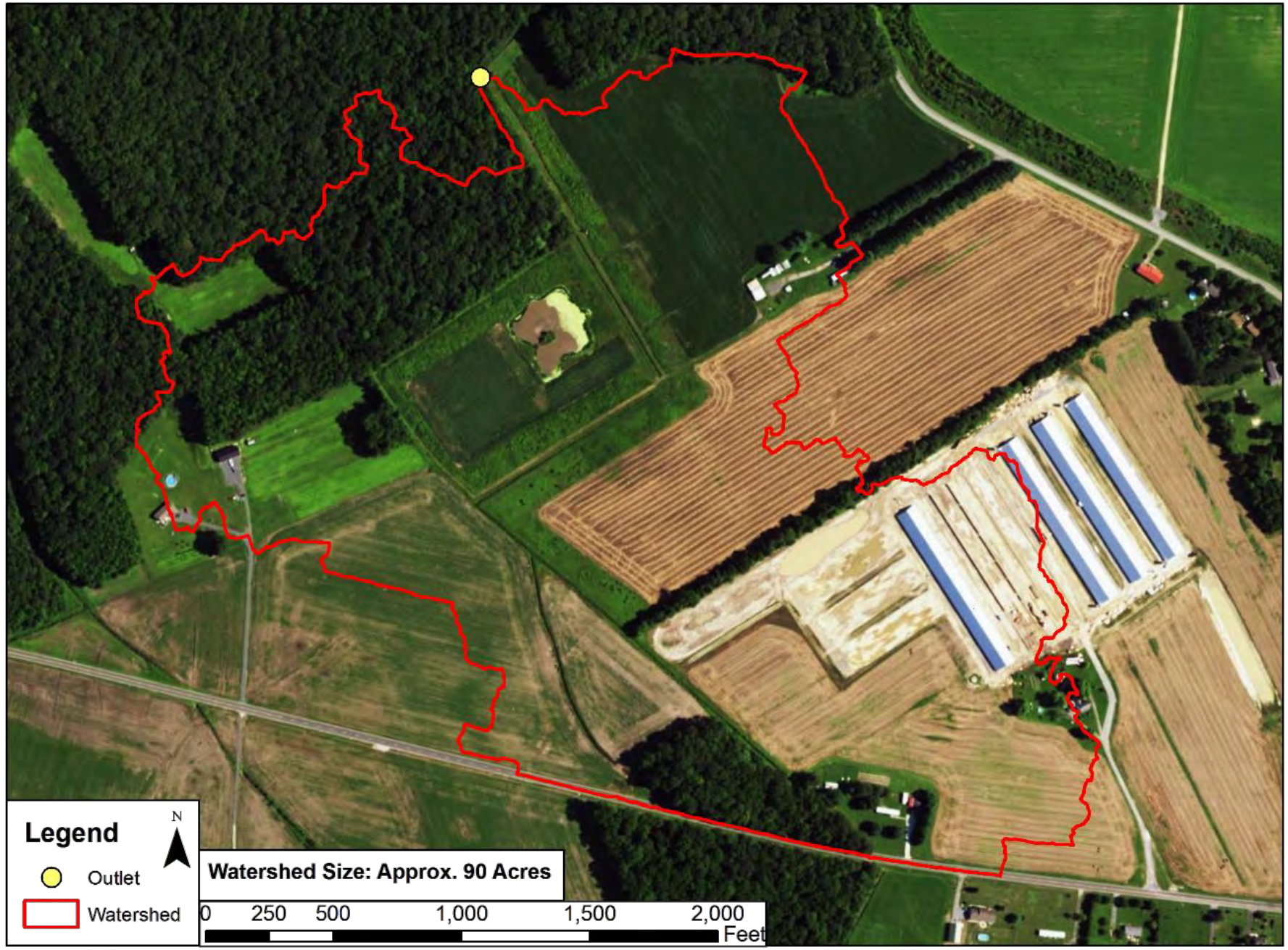
BMP Name	Phase III WIP 2025 Goal (acres)	Progress to Date (% of goal met)
Cover Crops	142,508	37%
Wetlands	54,597	11%
Drainage Mgmt.	3,317	89%

Long-term Structural

Projects in Delaware

- Ditch diversion bioreactor

- Blind Inlets (with slag) and Saturated Buffer



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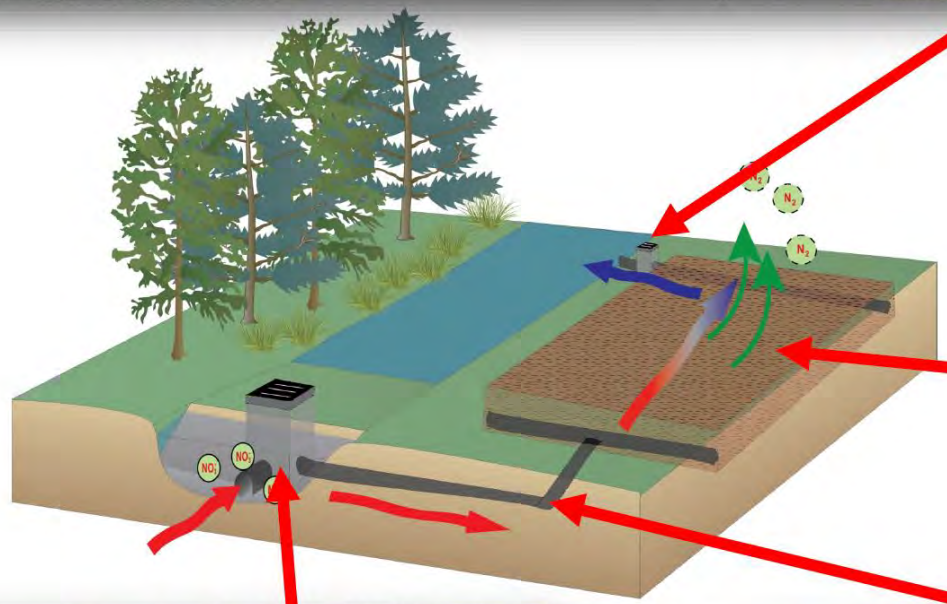
Capacity Control Box– Bioreactor Outlet


N_2
N_2
N_2
NO_3
NO_3

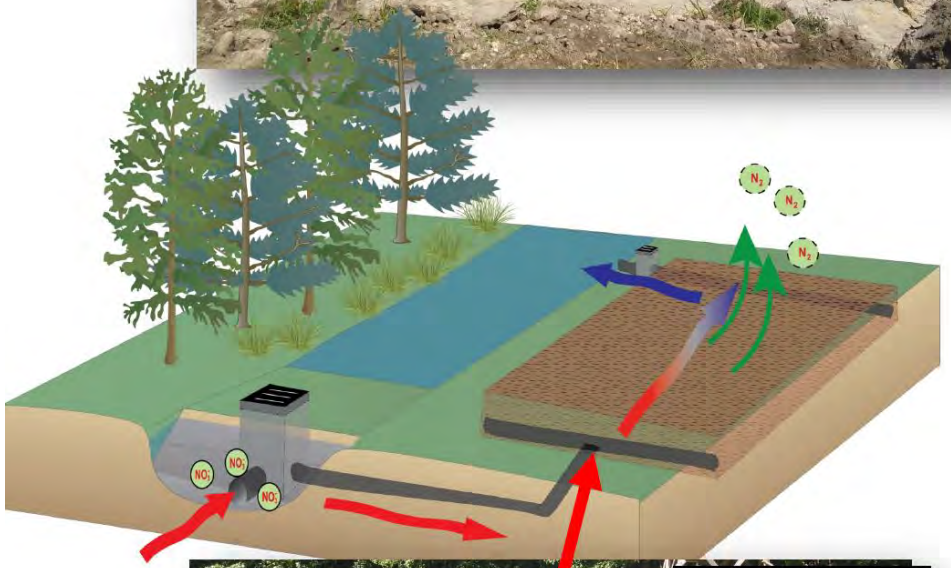

DEERE
Trench Excavation


Diversion Box


Pipe from Diversion Box


Trench Excavation


Trench Flooded after Rain Event


N_2
N_2
N_2
NO_3
NO_3
NO_3


Liner Installation


Pipe From Diversion
Box Through Liner


Liner Installation


Woodchip Delivery and Installation


Woodchip Delivery and Installation
DEERE

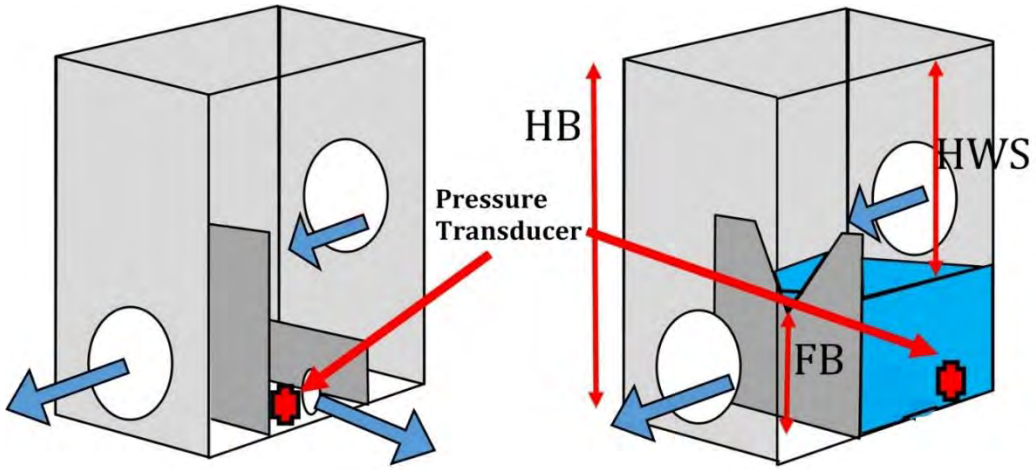

Filter Fabric Covers Woodchips and is Backfilled

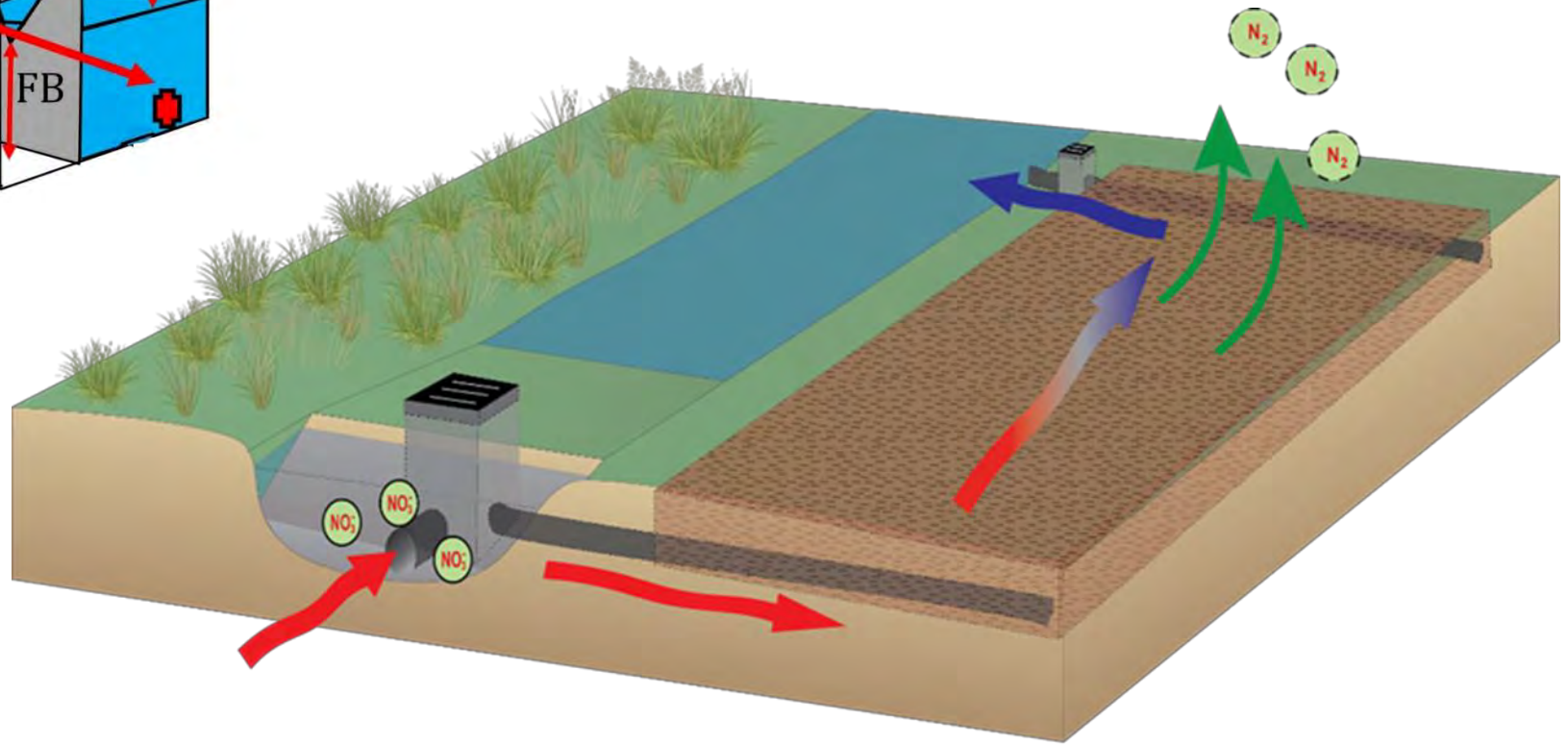

Completed Project

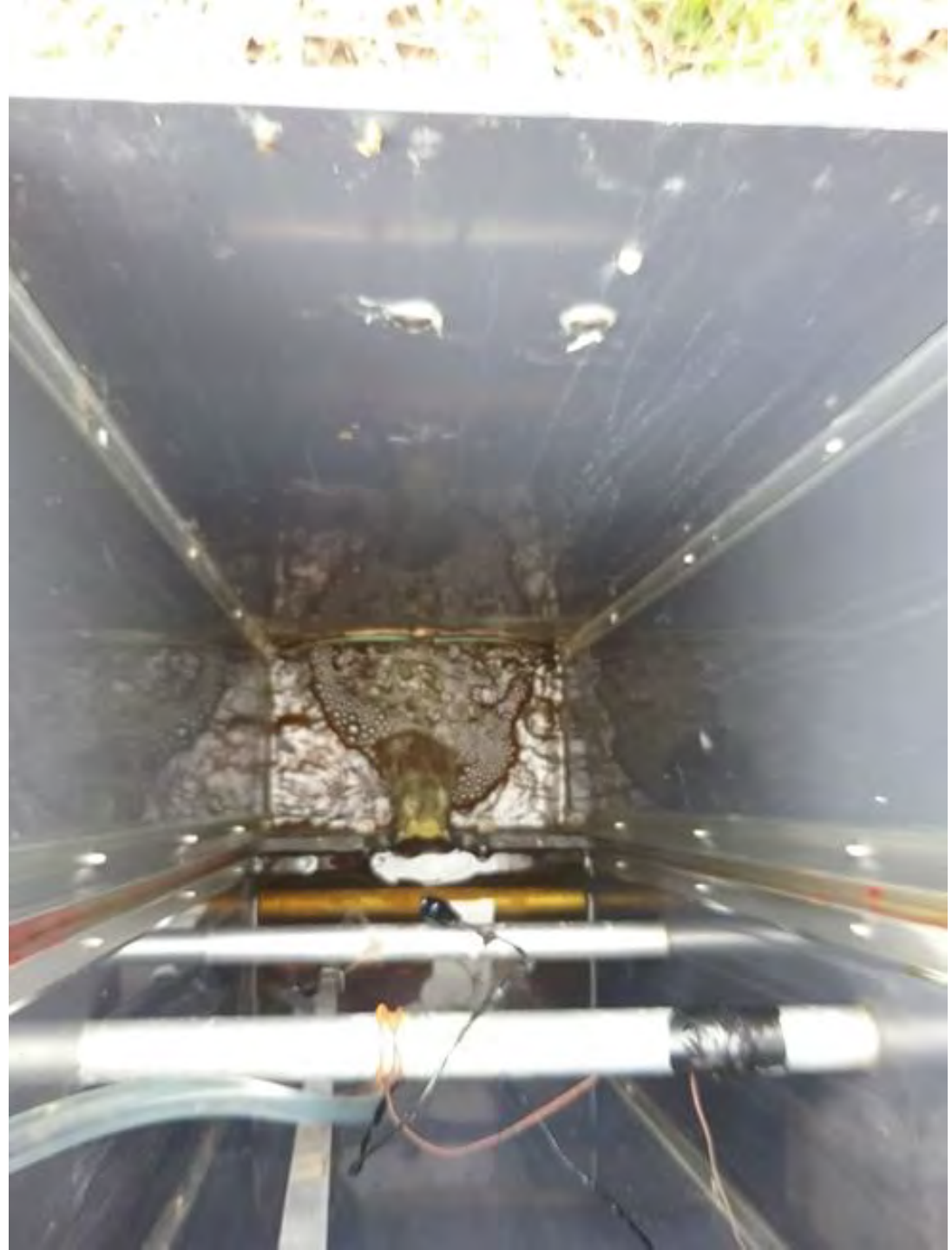
Sampling Setup

Diversion Box

Outlet Box







Total Treatment

	Discharge (CF)			
Water Year	**Bypass**	**Outlet**	**Total**	**%**
2017	23,955,591	2,849,040	26,804,631	10.63%
2018	19,699,119	1,676,368	21,375,487	7.84%
2019	34,193,417	3,157,719	37,351,136	8.45%
			Average	8.98%

Nutrients

	IN (mg/l)			OUT (mg/l)		
	Nitrate	**Ammonium**	**Orthophosphate**	**Nitrate**	**Ammonium**	**Orthophosphate**
Mean	0.72	0.3	0.09	0.58	0.09	0.07
Max	3.6	4.23	0.74	0.82	0.84	0.31
Min	0	0	0.005	0	0	0.004

% Reduction		
Nitrate	**Ammonium**	**Orthophosphate**
19.44%	70.00%	22.22%

Load Reduction

Nitrate Pounds		
Load Before	**Load After**	**% Reduction**
3,844	3,777	1.74%

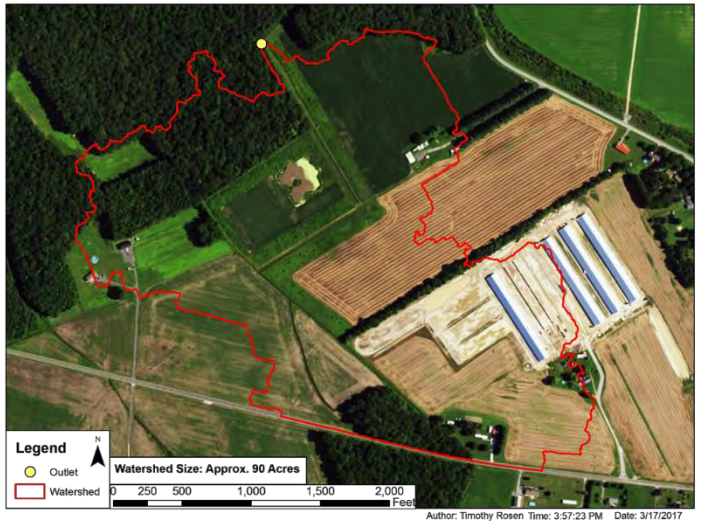
Ammonium Pounds		
Load Before	**Load After**	**% Reduction**
1,602	1,501	6.30%

Phosphorus Pounds		
Load Before	**Load After**	**% Reduction**
481	471	2.09%

Practice Considerations

Structure for Water Control or Denitrifying Bioreactor

1. Nitrogen Concentrations
2. Land Use
3. Drainage Intensity
4. Ditch Riparian Area



Blind Inlets and Saturated Buffer

Opportunity in Delaware

- Outreach and Design Contract between USDA and Ecosystem Services Exchange to complete conservation drainage design and trainings
  - ShoreRivers subcontractor to help with outreach and with fieldwork
  - Drainage water management
  - Saturated buffer
  - Denitrifying bioreactors
  - Blind inlets

ESE
Ecosystem Services Exchange
Valuing Conservation

USDA NRCS
U.S. Department of Agriculture
Natural Resources Conservation Service

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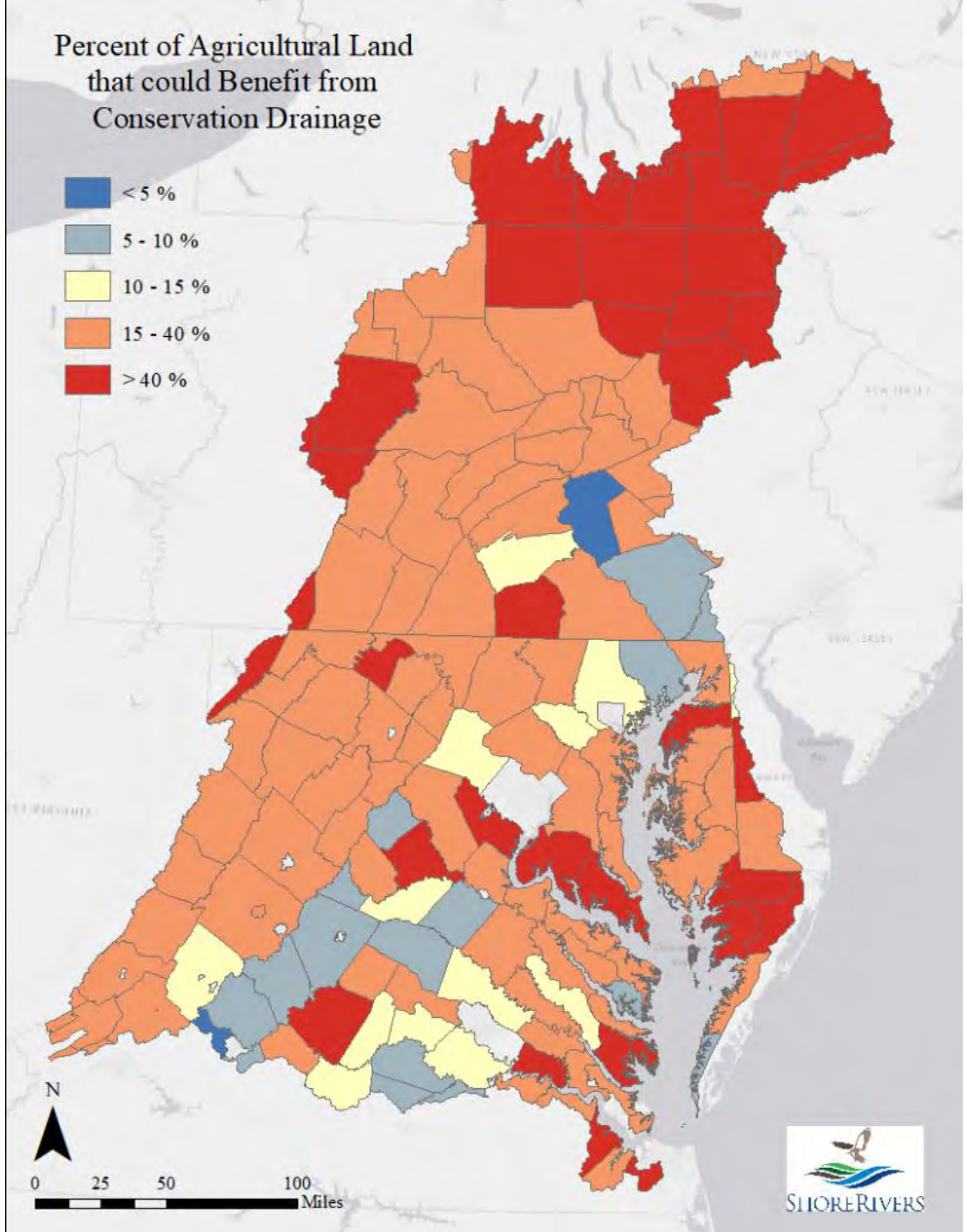
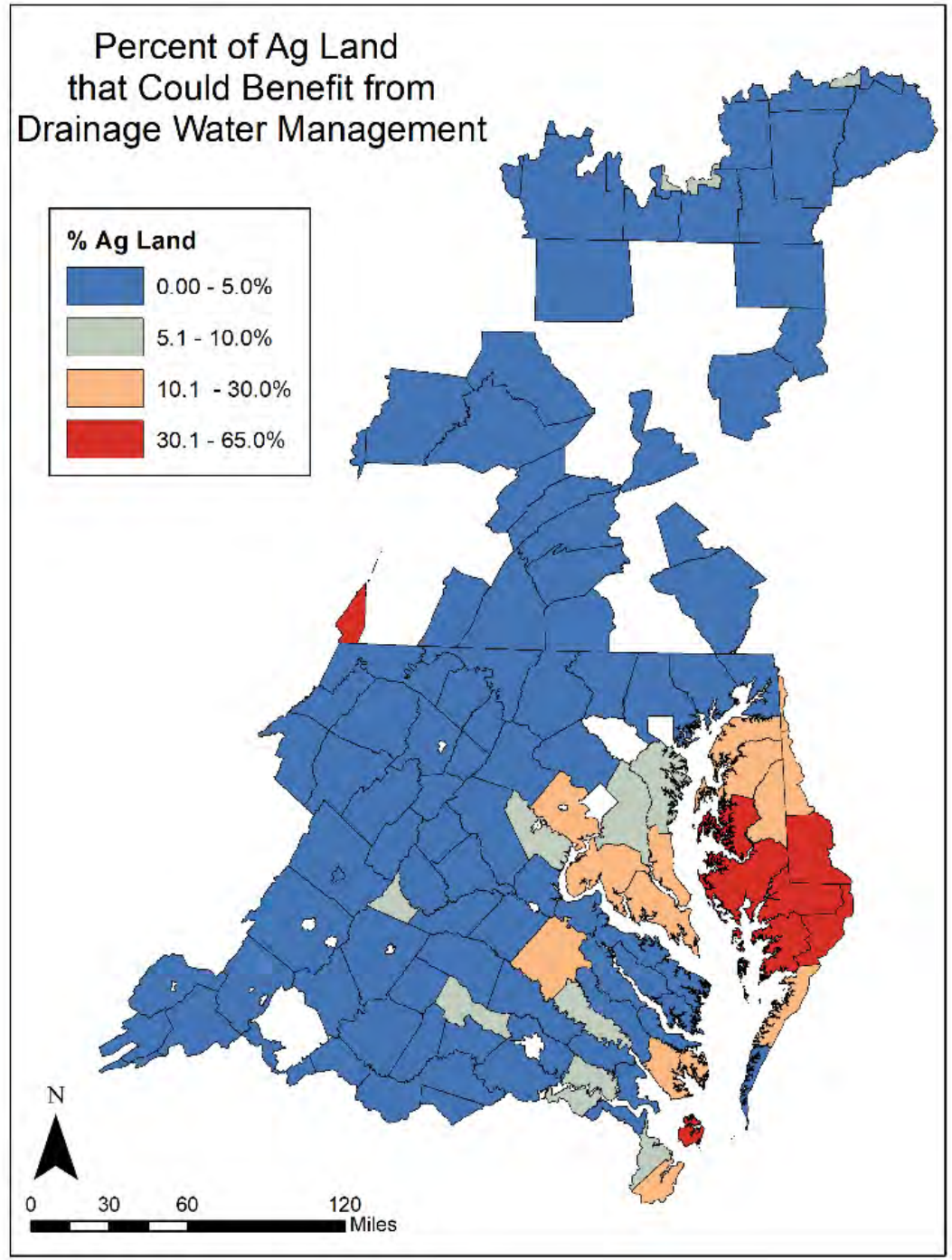

Percent of Agricultural Land
that could Benefit from
Conservation Drainage
< 5 %
5 - 10 %
10 - 15 %
15 - 40 %
> 40 %
N
0
25
50
100
Miles
SHORE RIVERS


Percent of Ag Land
that Could Benefit from
Drainage Water Management
% Ag Land
0.00 - 5.0%
5.1 - 10.0%
10.1 - 30.0%
30.1 - 65.0%
N
0
30
60
120
Miles