The Ditch Project: Soils, Phosphorus, and the Black Ooze

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The Ditch Project

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USDA National Integrated Water Quality Program
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Why ditches?

- Unique ecosystems integral to many farming systems.
- Fundamental processes controlling the fate and transport of nutrients within ditch-drained agroecosystems.
- Ditch management to mitigate nutrient losses.

University of Maryland Eastern Shore Research Farm

- Princess Anne, MD
- Acquired in 1996
- 30 years of poultry litter application
- High nutrient concentrations in soils and waters

UMES Drainage Ditch Profile Descriptions

Sample Locations

Streams

(n = 73 descriptions)

Meters

0 50 100 200 300

These ditches are hopping

- Bubbling slimy ooze
- Vegetation
- Algae
- Critters

Ditch Soils

- Recent alluvium over native Atlantic Coastal Plain sediments
- Generally loamy A over sandy C horizons

Soil Structure Formation

OM Littering, Decomposition, and Accumulation

Pedoturbation

Iron oxidation and reduction

Oxidation

Reduction

Concern: Fe-bound P may be released upon Fe oxidation

Mapping and Classification

Type I

Shallow Primary Ditches

- Intermittently submerged
- Hydrology: recharge
- Stormflow and stagnant
- Consolidated
- Structure
- Similar to wetland soils

Type II

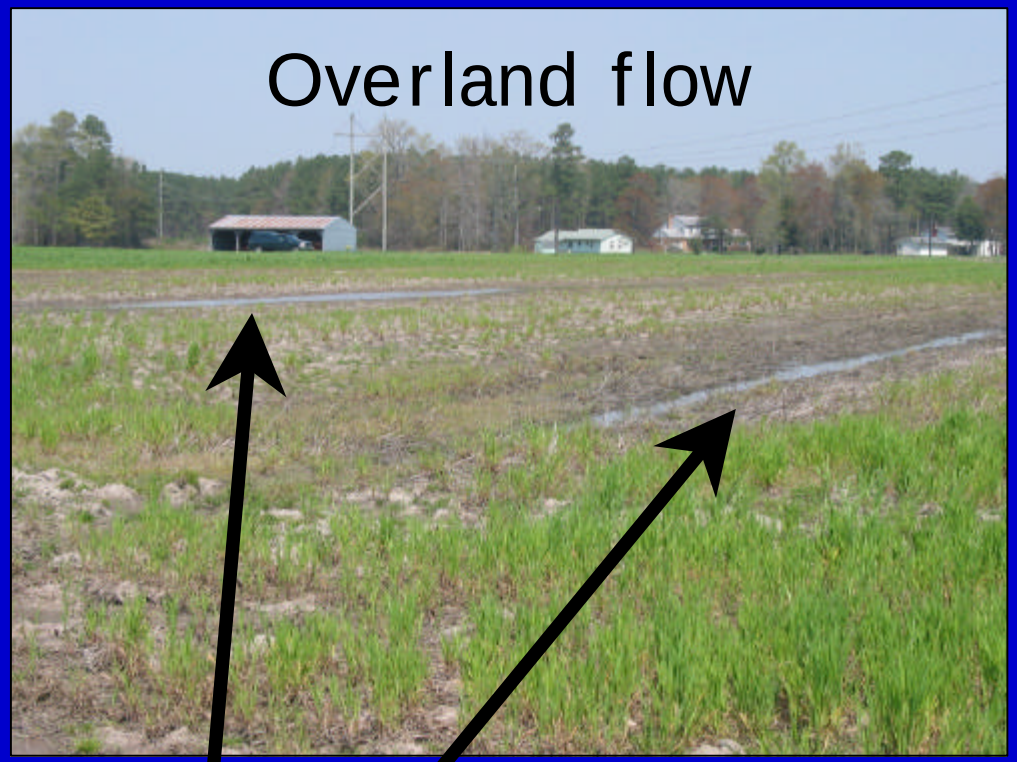
Deep-collection Ditches

- Permanently submerged
- Hydrology: Discharge
- Stormflow and baseflow
- Unconsolidated
- No structure
- Similar to subaqueous soils

Monosulfidic Black Ooze (MBO)

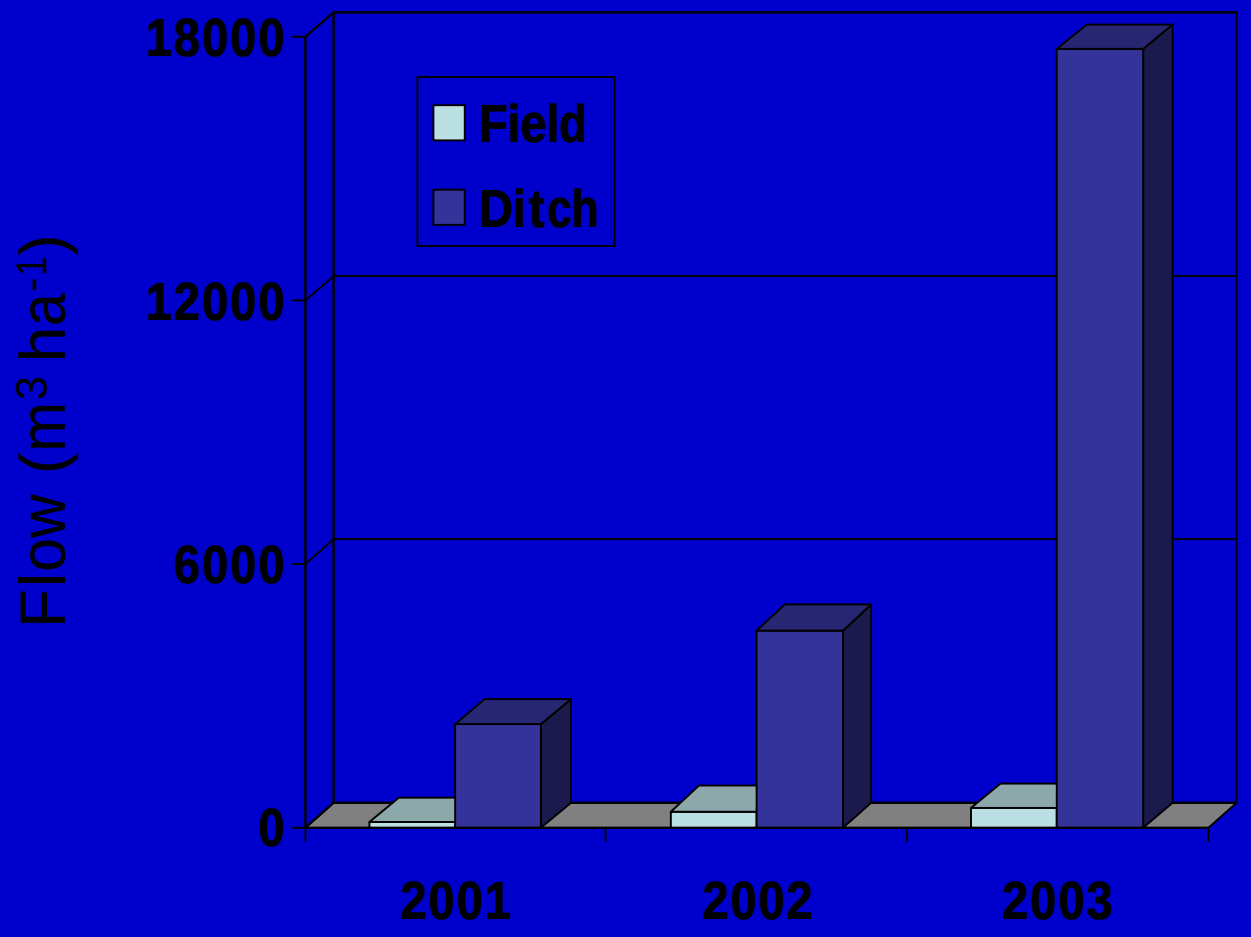
Concern: Sulfide oxidation releases acidity and can rapidly deoxygenate waters

Hydrology and nutrient transport

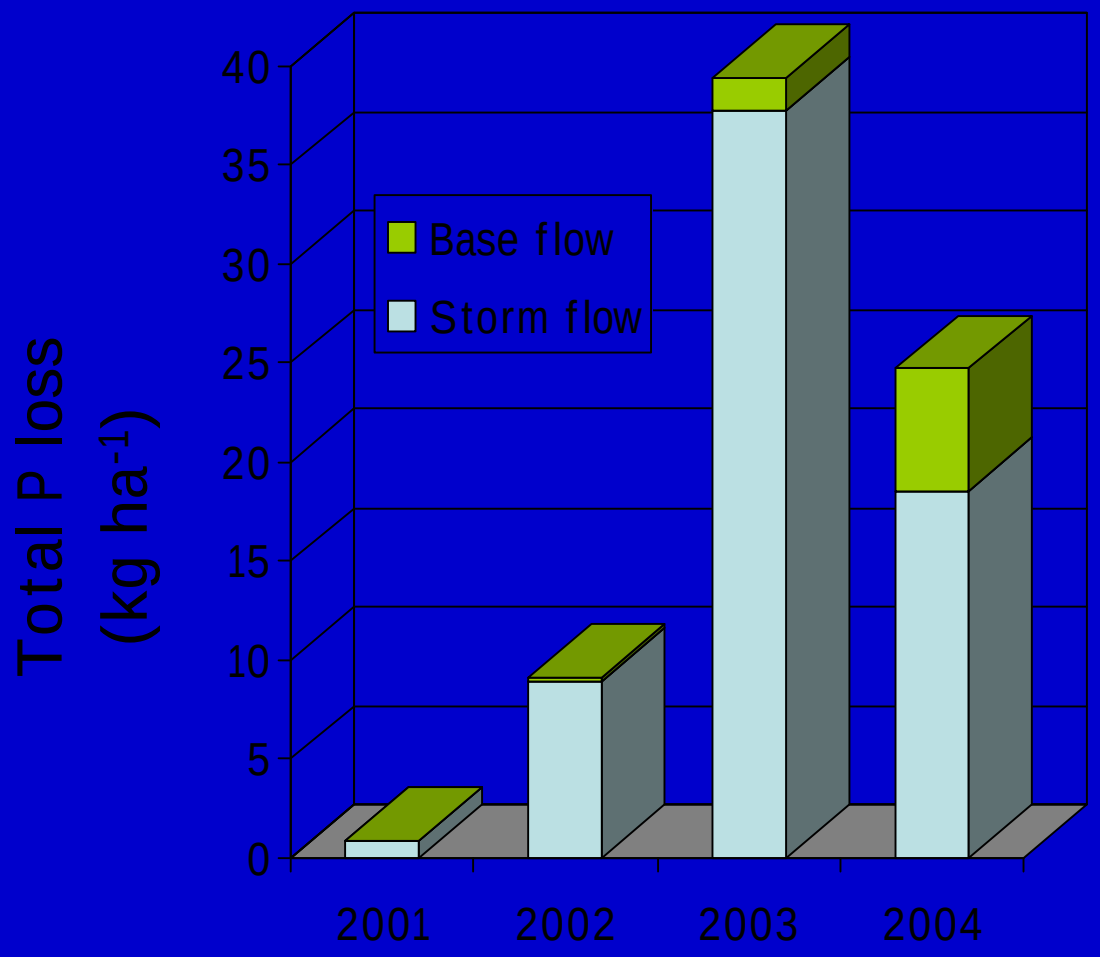


Where's the ditch water coming from?

Subsurface flow dominates

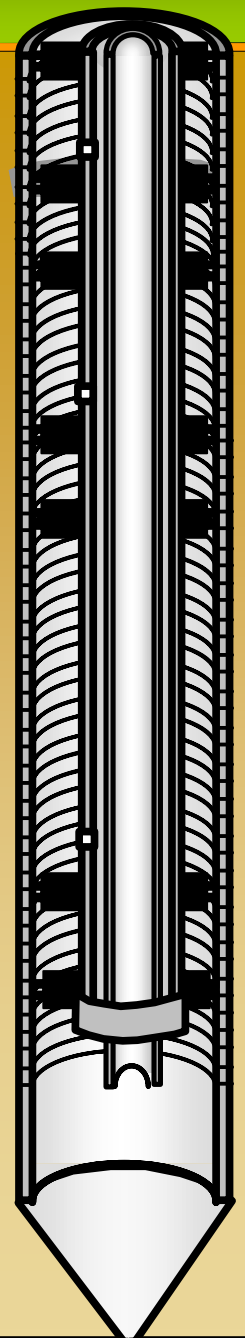


Extremely high P losses from shallow ditches



Storm flow accounts for 75-97% of total annual P export from the drainage ditches

Sampling Zones	Observed Dissolved P Concentrations (mg L^{-1})
0-30 cm	Range: 0.01 – 4.6 Average: 0.83
30-75 cm	Range: 0.004 – 5.4 Average: 0.36
75-133 cm	Range: 0.003 – 1.5 Average: 0.10
> 133 cm	Range: 0.004 – 0.2 Average: 0.03



16% of samples > 0.2 mg L^{-1}

Ditch Soil Ammonium Oxalate-extractable P

Oi: 714-4631 mg kg^{-1}; mean 2093

A: 54-3165 mg kg^{-1}; mean 564

C: 4-570 mg kg^{-1}; mean 49

Ditch Management

- Direct manure application
- Vegetation management
- Pocket wetlands
- Buffer strips
- Water course enhancements
- Tile drainage
- Clean outs
- Water-control structures with P sinks

Water-control structures

- Excellent at increasing sediment retention
- Increased denitrification

- Concern: Increased anoxia may cause increases in soluble P losses
- Solution: P-sorbing materials integrated into flow-control structure

Extension: Ditch management at four local farms

HIGH SCHOOL STUDENT SUMMER INTERNSHIP PROGRAM

Thank you!
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