Not Your Father's Tax Ditch

Enhancing Delaware’s Drainage Network Through the Use of Natural Channel Design Techniques

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Presented by: Brooks Cahall, Drainage Program Manager
Co-Authors: Matthew Grabowski, Sara Esposito P.E.
A little bit about the First State

- 2 – Physiographic Provinces
  - Appalachian Piedmont
  - **Atlantic Coastal Plain**
- Avg. Elevation is **60 ft.** above mean sea level
  - Lowest in the US
- Avg. Annual Rainfall **45”**
  - Tied for 14th highest in U.S.
Delaware’s Tax Ditch Law

- Title 7, Chapter 41 of the Delaware Code passed in 1951 last revised in 2008
  - Law declared: “... that the drainage and the prevention of flooding of lands and the management of water for resource conservation shall be considered a public benefit and conducive to the public health, safety and welfare.”
  - Sets out a court process that creates the tax ditch organization as a Governmental Subdivision of the State
    - Process starts with a petition
    - Referendum
    - Superior Court Order
Tax Ditch Organizations are formed on a watershed basis to construct and maintain a water management system. The organizations are managed by officers elected by the taxable's.
Statewide Tax Ditch Facts

- 236 Tax Ditch Organizations
- Drainage System is over 2,000 Miles
- Providing benefit to
  - Over 1/3 of Delaware Lands
  - ≈ 1/2 State Maintained Roads
  - Over 37,000 Parcels
- Over 15,000 parcels have a Tax Ditch Right-of-Way
- 56,000 acre Marshyhope Creek
- 2 acre Alban Park
Traditional Tax Ditch Construction & Maintenance
Traditional Tax Ditch Construction & Maintenance
Traditional Tax Ditch Construction & Maintenance
Traditional Tax Ditch Construction & Maintenance
Traditional Tax Ditch Construction & Maintenance
Aging Infrastructure

NUMBER OF TAX DITCHES FORMED IN DELAWARE OVER TIME

90% of the Tax Ditches were constructed prior to 1985
Tax Ditches: Highways for Runoff

• Formed to solve Drainage Problems
• Engineered to remove excess runoff over a 24 hour period
• Landowners pay taxes based on drainage benefit
Tax Ditches: Highways for Runoff

- Dense network of ditches effectively move runoff from the land to receiving water body.
- So they also carry pollutants downstream
  - N, P, & TSS
- Speed limits some natural processes
- Disconnected from Floodplains
Delaware is an Effective Polluter of the Bay

Impact of red areas on Bay water quality at least 10 times higher than blue areas
Delaware is an Effective Polluter of the Bay

Are Tax Ditches the Problem or the Solution?

Maybe Both!
An Opportunity

Degraded Infrastructure
- Age of the Tax Ditch network
- Changes in hydrology from development
- High number of large weather events over last 5 years
- Need for Funding

Chesapeake Bay WIP
- Challenged to meet TMDL goals
- Looking for “In-stream” BMP’s
- Grant Funding for Implementation

Non-Traditional Partnership between Water Quality Programs and Drainage Program
Approaches & Practices

Agricultural Water Control Structure

Are permanent structures placed in a ditch that maintain a desired water surface. This is typically done with flashboard risers and improve water quality by elevating the water table and reducing drainage outflow.

Source: NRCS Conservation Practice Standard 587
Approaches & Practices

Agricultural Water Control Structures

• Cost Effective Projects
  • $5,000 - $7,000 per structure
  • Varies by size and site conditions
• Worked with local metal fabricator to reduce costs.
• Nitrogen Reduction Efficiency of 33%
Hrupsa WCS Project
Installation of Structure
Hrupsa WCS Project
Installed
Hrupsa WCS Project
Complete
Approaches & Practices

Bioengineered Bank Stabilization

defined as the use of living and nonliving plant materials in combination with natural and synthetic support materials for slope stabilization, erosion reduction, and vegetative establishment.

Source: NEH 654 (USDA 2007)
“Natural” Approaches & Practices

Bioengineered Bank Stabilization

Benefits Include:

• Nutrient consumption by plant materials
• Shade
• Habitat
Cart Branch Tax Ditch
Floodplain Creation and Compost Log/Scour Stop Stabilization
Cart Branch Tax Ditch
Before – Town Park – Outer Bend Erosion and Confined Channel
Cart Branch Tax Ditch
During – Town Park – Compost Log Stabilization for Outer Bend
Cart Branch Tax Ditch
During – Town Park – Compost Log Stabilization and Floodplain
Cart Branch Tax Ditch
During – Town Park – Compost Log Stabilization and Floodplain
Cart Branch Tax Ditch
After – Town Park – Compost Log Stabilization and Floodplain
Cart Branch Tax Ditch
After – Town Park – Compost Log Stabilization and Floodplain
Cart Branch Tax Ditch
Before – Town Park – Outer Bend and Culvert Erosion
Cart Branch Tax Ditch
During – Town Park – Scour-Stop Culvert and Bend Protection
Cart Branch Tax Ditch
After – Town Park – Scour-Stop Culvert and Bend Protection
Cart Branch Tax Ditch
After – Town Park – Scour-Stop Culvert and Bend Protection
Approaches & Practices

Stream Restoration

Utilizing principles of stream geomorphology to create a state of dynamic equilibrium among water, sediment, and vegetation to stabilize stream channels

*Source: Good Recipes for the Bay Pollution Diet; U-4 Urban Stream Restoration*
Approaches & Practices

Stream Restoration

- Projects have been priority level 2-3
- Projects are expensive.
  - $175 - $200 per lf

- Urban Removal Rates (lb/ft/yr):
  - TN = 0.075
  - TP = 0.068
  - TSS = 15.13 (coastal plain)
Bridgeville Branch Tax Ditch Restoration Project

- 1,500 ft. of Stream Restoration
- Construction started in Sept. 2015
- Completion projected for Dec. 2015
- Construction Cost $460,000
- Drainage Area ≈ 8 sq. mi.
- TD Design Bottom Width = 20’
- Bank Full Discharge = 82 cfs
Bridgeville Branch Tax Ditch
Design – Concept Plan
Bridgeville Branch Tax Ditch
Before – Exposed Water Main
Bridgeville Branch Tax Ditch
During – Protected Water Main
Bridgeville Branch Tax Ditch
After – Protected Water Main
Bridgeville Branch Tax Ditch
During – Transformed Tax Ditch with Floodplain and Scour Protection
Bridgeville Branch Tax Ditch
Before – Traditional “Ditch” with 1:1 Side Slopes and Culvert Erosion
Bridgeville Branch Tax Ditch
During – Transformed Tax Ditch with Floodplain and Riffles/Pools
Bridgeville Branch Tax Ditch
During – Transformed Tax Ditch with Floodplain and Riffles/Pools
Bridgeville Branch Tax Ditch
After – Transformed Tax Ditch with Floodplain and Riffles/Pools
Bridgeville Branch Tax Ditch
After – Transformed Tax Ditch with Floodplain and Riffles/Pools
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Before – Traditional “Ditch” with 1:1 side slopes
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During – Transformed Tax Ditch with Floodplain and Riffles/Pools
Bridgeville Branch Tax Ditch
After – Transformed Tax Ditch with Floodplain and Riffles/Pools
Bridgeville Branch Tax Ditch
After – April 2016
Bridgeville Branch Tax Ditch
After – April 2016
Bridgeville Branch Tax Ditch
Before – Scour Around Bend Jeopardizing Sewer Main
Bridgeville Branch Tax Ditch
During – Soil Lift and Live Layering
Bridgeville Branch Tax Ditch

During – Soil Lift and Live Layering
Bridgeville Branch Tax Ditch
During – Soil Lift and Live Layering
Bridgeville Branch Tax Ditch
During – Soil Lift and Live Layering
Bridgeville Branch Tax Ditch
After – Soil Lift and Live Layering
Bridgeville Branch Tax Ditch
After – April 2016
Bridgeville Branch Tax Ditch

After – Soil Lift and Live Layering
Nanticoke River Tax Ditch
Stream Restoration Project

- 4,300 ft. of Stream Restoration
- Completion projected for June 2016
- Construction Cost $850,000
- Drainage Area ≈ 70 sq. mi.
- TD Design Bottom Width = 45’
- Bank Full Discharge = 220 cfs
Nanticoke River Tax Ditch
Stream Restoration Project

- 40 years of sediment deposition significantly reduced conveyance capacity
- Thalweg was degrading
- Planform changes impacting right of way.
Nanticoke River Tax Ditch
Grade Control
Nanticoke River Tax Ditch
Rock Cross Vane with Step
Nanticoke River Tax Ditch
Rock Cross Vane with Step
Nanticoke River Tax Ditch
Rock Cross Vane with Step
Nanticoke River Tax Ditch
Rock Cross Vane with Step
Nanticoke River Tax Ditch
Severely Eroded Banks
Nanticoke River Tax Ditch
Toe Wood
Nanticoke River Tax Ditch
Toe Wood
Nanticoke River Tax Ditch
Severely Eroded Banks
Nanticoke River Tax Ditch
Toe Wood
Nanticoke River Tax Ditch
Severely Eroded Banks
What’s Next?

- Wood Chip Bio-Reactor
- NRCS Regional Conservation Partnership Program
  - Watershed Channel Restoration Projects in Sussex County, Delaware
- Stream Assessment and Prioritization of Degraded Tax Ditches
Partners
Questions?

Brooks Cahall
Drainage Program Manager
Brooks.cahall@state.de.us
(302) 855-1930