PURDUE UNIVERSITY

CAPSTONE EXPERIENCE 2014

Water Management for PPAC Muck Soils

Agricultural & Biological ENGINEERING

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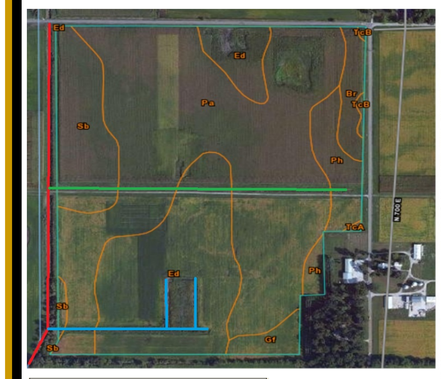
Problem Statement

The Pinney Purdue Agricultural Center located near Wanatah, Indiana has two adjacent fields composed of high organic matter soil. Muck soil, although extremely nutrient rich and desirable for agriculture use, poses several problems in terms of management. In it's natural wet state, the soil is nearly impossible to drive/work on and it will decompose rapidly if over-drained. The current ditch system does not adequately maintain water levels to prevent subsidence. A modern solution for drainage and water management within the ditches must be developed to allow the soil to be worked during planting and harvesting season, as well as protect the soil from decomposition via subsidence.



North Ditch

South Ditch

Porter County, Indiana (IN127)

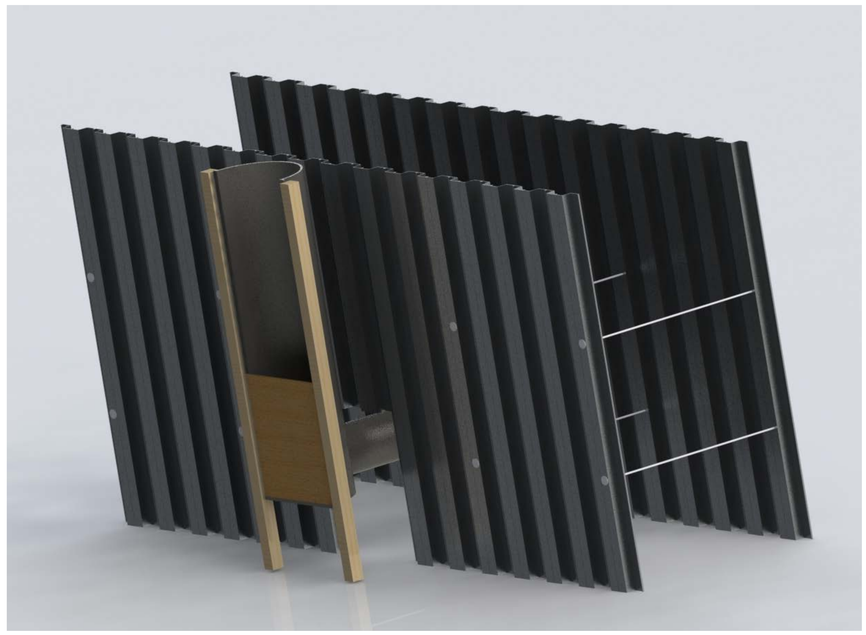
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Br	Bourbon sandy loam	3.0	2.8%
Ed	Edwards muck, drained	27.6	25.8%
Gf	Gilford sandy loam	2.1	2.0%
Pa	Palms muck, drained	57.1	53.3%
Ph	Pinhook loam	5.9	5.5%
Sb	Sebewa loam, shaly sand substratum	10.9	10.2%
TcA	Tracy sandy loam, 0 to 2 percent slopes	0.1	0.1%
TcB	Tracy sandy loam, 2 to 6 percent slopes	0.4	0.3%
Totals for Area of Interest		107.1	100.0%

- Map/table of two muck fields and soil distribution
- Green and blue are drainage ditches
- Red is the county ditch

Constraints

- Cost efficient as possible
- Easy to manage
- Relatively easy installation
- Maintain water levels for crops/seasons
- Avoid the use of concrete
- Avoid large excavation
- Be able to handle severe temperature changes/ corrosive soils
- Comply with county regulations regarding ditch drainage

Final Design



- Two parallel aluminum walls anchored to one another are filled with earth
- The wall holds the water upstream and forces flow through the flashboard device
- The flashboard device is supported by two pine lumber piles driven into the ground and treated to withstand corrosive conditions
- HDPE pipe directs flow through the wall and out the downstream side
- Two structures will ultimately be constructed: the larger in the north ditch and the smaller in the south ditch
- Operator will be able to manage riser from top of wall

Budget

Items	Item #	Price/unit	Total Price
Riser N 4'x13'	1		$2,100
Riser S 4'x10'	1		$1,460
Backfill N/S	358 tons	$36	$12,888
Wooden posts	4	$46	$184
Anchors	16	$90	$1,440
HDPE 24'' N Pipe	1		$1,249
HDPE 18'' S Pipe	1		$823
Aluminum Piling N	2.67 tons	$2500/ton	$6,670
Aluminum Piling S	2.3 tons	$2500/ton	$5,800
Total Costs			$32,614

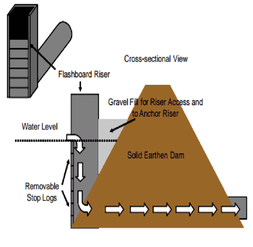
- Pricing based on local and global market prices, shipping varies depending on supplier

Economic Analysis

- Maximizes yield potential of fields
- Cuts down on any financial losses due to fertilizer waste
- Preserves organic rich soil for future seasons
- Although relatively expensive, all materials have high longevity, will not corrode or fall apart

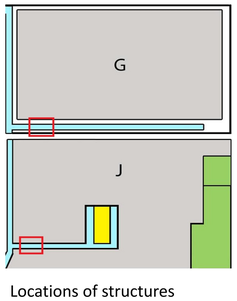
Example of alternative solution

Structure Implementation



Example of water movement through flashboard riser

- Soil tests taken confirmed the presence of silty sand , strong foundation to build on
- Structures in both north and south ditches are at least 75 feet away from county ditch
- Flashboard riser is a water control structure with removable wooden logs to raise and lower water table depending on the crop/season
- Structure is very easy to operate and use of plastic and a stainless steel frame resist corrosive conditions
- Flashboard risers preserve the composition of muck soils and prevent oxidation/decay



Locations of structures

Environmental Impact

- Reduces nutrient releases, particularly phosphorous, which can lead to algae blooms and large-scale fish kills
- Drastic reduction of pesticides that eventually enter streams and rivers
- Prevents the deposition of sediment which can block waterways
- Prevents erosion and loss of nutrient rich soils
- All materials made with environmental safe materials with no damaging chemicals

Alternative Solutions

- Combination of a screw gate and riser
- Use of metal stop log structure
- Levee with flashboard riser
- Implementation of weir gate system
- Use of full round riser

Sponsor: Dr. Steven E. Hawkins, Assistant Director, Agricultural Centers Project Coordinator

Technical Advisor: Dr. Jane Frankenberger, Professor, Agriculture and Biological Engineering

Special Thanks: Mike Wiggington, Soil Scientists, NRCS
Peter Briggs, CEO, Briggs Manufacturing

Course Instructors: Dr. Bernie Engel
Dr. Bob Stwalley

BRIGGS MFG, INC. Precast Concrete

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