Soil Collapse Phenomenon

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Wild Things 2015
Exploring a Holey Mystery in McHenry County

- Discovery of Holes, 2013
- Expansion of Holes, 2014
- Investigation of Holes, 2014-15
- Collapse Mechanism
- Conclusions
- Questions
Discovery of Holes, 2013

Holes had appeared in and near a path leading from the residence through a degraded former wet prairie site to the woodlot.
Expansion of Holes, 2014

The following year we noted more holes, and deeper holes.

Something was changing...
Investigation of Holes, 2014

Not dug by animals (no evidence of spoil piles)

Soils appear to be lacustrine in origin (visible shell fragments)
Our assumption was that dewatering of wetland soils was behind the phenomenon, but it didn’t explain the collapse mechanism or the cause.
Investigation of Holes, 2014-2015

We looked at vegetation patterns

We looked at drainage patterns
Effects of deepening the ditch upstream: Increased Flow and Increased Velocity

Scoured steps cut down to gravel

Eroded banks expose tree root
The Development of Wetland Collapse Features
Present Course of Tryon Creek

1st order stream through wetland

Study Area

Tryon Creek

Nippersink Creek
The 1872 Plat Map

No 1st order stream through wetland

Tryon Creek
The 1892 Plat Map
The 1908 Plat Map

No 1st order stream through wetland

Tryon Creek
The 1939 Aerial Photograph

Stream channel extends westward

Tryon Creek
The 1961 Aerial Photograph

Stream channel extends westward

Tryon Creek
The 1970 Aerial Photograph

Tile outlet and stream head south of property boundary
The 1974 Aerial Photograph

Tile failure and back-cutting of stream has reached field
2005 What has changed?

Malfunctioning tile system
What has changed?

Further de-watering of field
Energy Policy and Wetland Drainage

Between 2005 and 2008 corn prices more than doubled.
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Energy Policy Act 2005

Increase in ethanol production
Energy Policy and Wetland Drainage

Energy Policy Act 2005

Increase in ethanol production

Between 2005 and 2008 corn prices more than doubled

Increase in Tile Installation
Cross-Section of Moraine Surface and Lake Sediment
Reconstruction of Original Fen Profile

Hypothetical Pre-European Settlement Cross-Section Through Wetland

- Property Boundary
- Original organic surface of fen
HISTORICAL DEVELOPMENT:
Deposition of Glacial Till

14,000 years ago

Sandy Loam Glacial Till
Post-Glacial Erosion of Moraine Leaves Gravel Lag Deposit

14,000 years ago

Gravel deposit from Post-Glacial Erosion

Sandy Loam Glacial Till
Deposition of Lake Deposit by Lake Wauconda

14,000 years ago

Marly Lake Sediment
Gravel deposit from Post-Glacial Erosion
Sandy Loam Glacial Till
Fen Formation due to Upwelling Groundwater

- Fen Vegetation
- Organic-Muck Fen Soil
- Marly Lake Sediment
- Gravel deposit from Post-Glacial Erosion
- Sandy Loam Glacial Till

Upwelling Ground Water
Drainage Tile and Reversal in Movement of Soil Water

Late 19th or early 20th century

- Degraded Fen/Pasture Vegetation
- Organic-Muck Fen Soil
- Marly Lake Sediment
- Gravel deposit from Post-Glacial Erosion
- Sandy Loam Glacial Till
Oxidation of Organic Soil

From late 19th or early 20th century to late 20th century

- Degraded Fen/Pasture Vegetation
- Marly Lake Sediment
- Gravel deposit from Post-Glacial Erosion
- Sandy Loam Glacial Till

Upwelling Ground Water
Collapse & Plugging of Original Tile System
Rewetting of Surface Soil

Late 20th century: 1970s

Degraded Fen/Pasture Vegetation
Marly Lake Sediment
Gravel deposit from Post-Glacial Erosion
Sandy Loam Glacial Till
Ditching and Draining of Farm Field

1. water table drops abruptly
2. rainwater moves rapidly down through and around old tile lines
3. creating underground conduits by eroding and dissolving calcareous lake sediment

2005-2008

Degraded Fen/Pasture Vegetation
Marly Lake Sediment
Gravel deposit from Post-Glacial Erosion
Sandy Loam Glacial Till
Collapse Features form at Surface

1. surface sediment collapses into underground conduits
2. as collapse feature grows, surface water flows toward hole
3. which accelerates growth of hole and underground passages

2010-2014

- Degraded Fen/Pasture Vegetation
- Marly Lake Sediment
- Gravel deposit from Post-Glacial Erosion
- Sandy Loam Glacial Till

Upwelling Ground Water
Important Themes to Remember

- Effect of de-watering and oxidation on organic soils
- Possibility of “karst” collapse features in de-watered calcareous sediment
- Causal relation between agriculture-energy policy, corn price, and land drainage
- Origin of 1st order stream systems
  - Accelerated surface runoff from farm fields
  - Tiling and subsequent tile failure
- Multiple mechanisms of de-watering
  - Tiling on-site and off-site
  - Ditching
  - 1st order stream formation
  - Entrenching of streams with increased water flow and drop in base level
Thank You!

Questions?