Two-Stage Ditch Design at Throckmorton Purdue Agricultural Center (TPAC)

Jacob Niemeier (ANRE), Katie Losekamp (ANRE)

**Problem Statement**

The Throckmorton Purdue Agricultural Center wants to convert approximately 700 feet of its existing ditch into a two-stage ditch that will be stable, protect resources, and will allow for monitoring to determine the performance.

**Societal Impact**

This center devotes most of its time to researching various agricultural and natural resource practices and this two-stage ditch will give the center another practice to monitor and better understand. Also, specific research analyzing the effects of a two-stage ditch versus a traditional agricultural ditch will be conducted. In addition, it will provide a teaching tool for farmers in the area, students at Purdue University, and local employees in the field of natural resource conservation.

**Design Constraints**

1. Max excavation width constrained by agriculture plots
   - West Side: 50 feet
   - East Side: 100 feet
2. Stability: 10 yr, 24 hr peak discharge when un-vegetated
   - Silt Loam Permissible Velocity: 2 ft/s
   - Profile Slope: 1° 300 ft = 0.26%; Last 400 ft = 0.6%
3. Capacity: 10 yr, 24 hr peak discharge when fully vegetated
   - Not to flood out of ditch

**Spoil Management**

- Location 1: Reapply topsoil to benches
  - Depth of application: 4 inches;
- Location 1.1: Feather remaining on banks
  - Width to spread soil: 
    - East Side: 79.75 ft
    - West Side: 29.75 ft
  - Maximum Interior Depth: 8 inches
- Location 2: Fill in gully at NW end of ditch
  - Bench Applied: 160 cu. yd
  - Feathered: 888 cu. yd
  - Transported: 346 cu. yd

**Final Design**

- Bankfull analysis of surveyed data used to determine initial bench height
- Dimensions:
  - Low-flow channel remains untouched
  - Channel Depth/Bench Height: 1.8 ft
  - Ditch Depth: 4.6 ft
  - Bench Width: 9.25 ft
- Stability: Flow velocities exceed permissible levels
  - Calculated Velocities:
    - 1° 300 ft: 5 ft/s
    - Last 400 ft: 7 ft/s
- Capacity: Flow depth does not exceed ditch depth

**Alternative Solutions**

**Option 1 Plan View**

- Key:
  - Magenta: centerline of ditch
  - Blue: best fit centerlines
  - Black: Start of bench
  - Green: End of bench

**Option 2 Plan View**

-Widening of bench due to extreme meandering

**Cost Estimate**

<table>
<thead>
<tr>
<th>Option</th>
<th>Cut (yd³)</th>
<th>Excavation Cost</th>
<th>Surface Area (yd²)</th>
<th>NAG SC-150 (Max Vel. = 6 ft/s)</th>
<th>Surface Area (yd²)</th>
<th>NAG SC-150 (Max Vel. = 8 ft/s)</th>
<th>Total Cost</th>
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**Cross-Section View of Soil Feathering Plan**

**Aerial Photo - Constraints**

**Representative Design Cross-Section**