Public Drainage Systems:

Delineating & buffering the top of ditch banks using geospatial analysis

Counties Working Together

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Contents

- Why
- Top of Bank (TOB) Legal Definition
- The Model
- GPS Points & Statistics
- Results
- Future Outputs
- Questions

Why

- Taxing Land use by Type
  - Ditch buffers should take tillable land out of production.
- Ditch Buffer enforcement
  - Prioritize, target, and manage enforcement efforts to:

Minnesota Statute 103F.48 Subd. 2

1. *Protect state water resources from erosion and runoff pollution;*
2. *Stabilize soils, shores, and banks; and*
3. *Protect or provide riparian corridors*

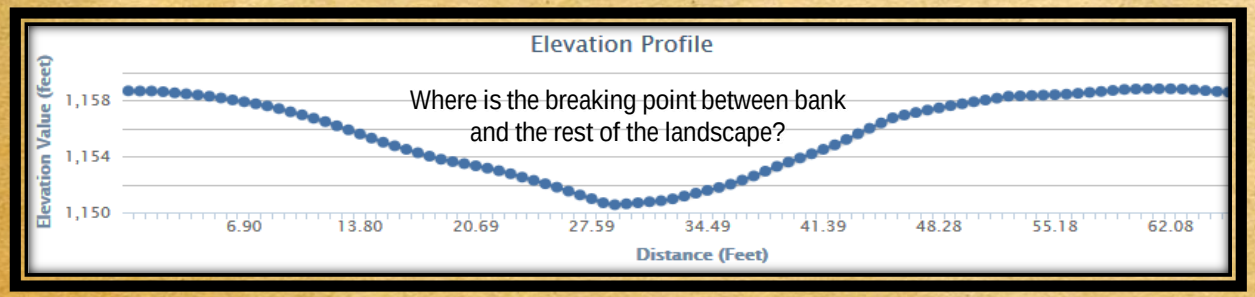
What is Top of Bank?

Minnesota Statute 103F.48 Subd. 3c

- The width of a buffer on public waters must be measured from the ***top or crown of the bank***. Where there is no defined bank, measurement must be from the edge of the normal water level. The width of the buffer on public drainage systems must be measured as provided in section 103E.021, subdivision 1.

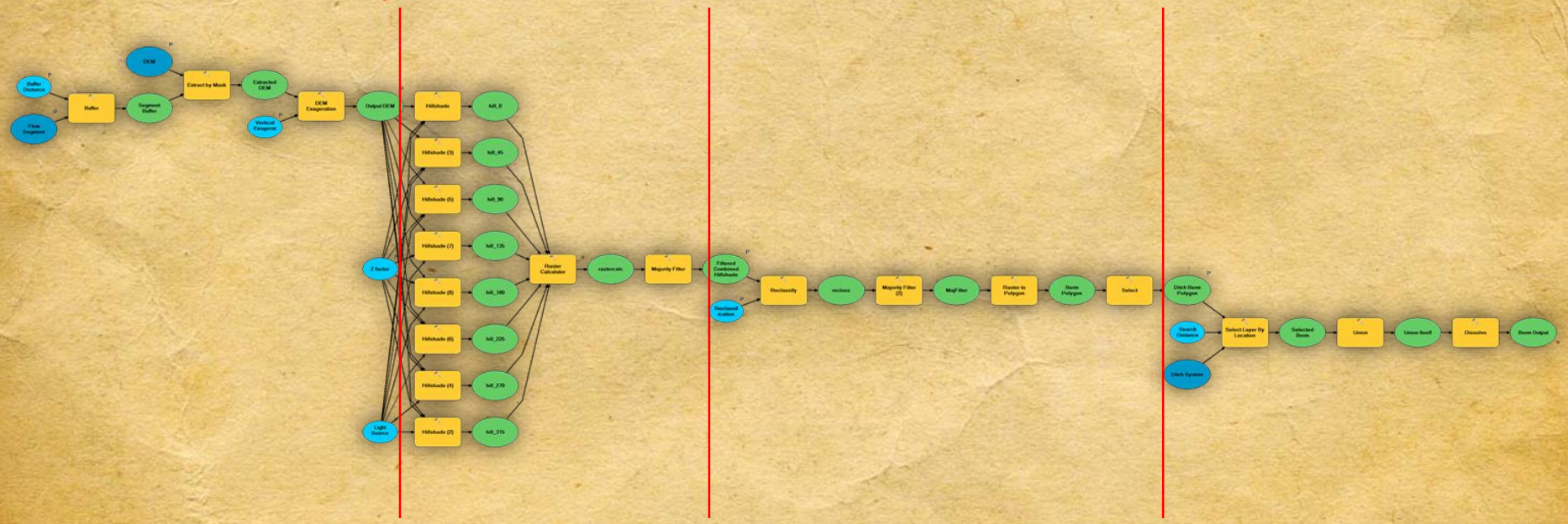
Amended Minnesota Statute 103E.021 Subd. 1

- The permanent strips of perennial vegetation shall be 16-1/2 feet in width measured outward from the top edge of the constructed channel resulting from the proceeding, or to the crown of the leveled spoil bank, which ever is greater, except for an action by a drainage authority that results only in a redetermination of benefits and damages, for which the required width shall be 16-1/2 feet.

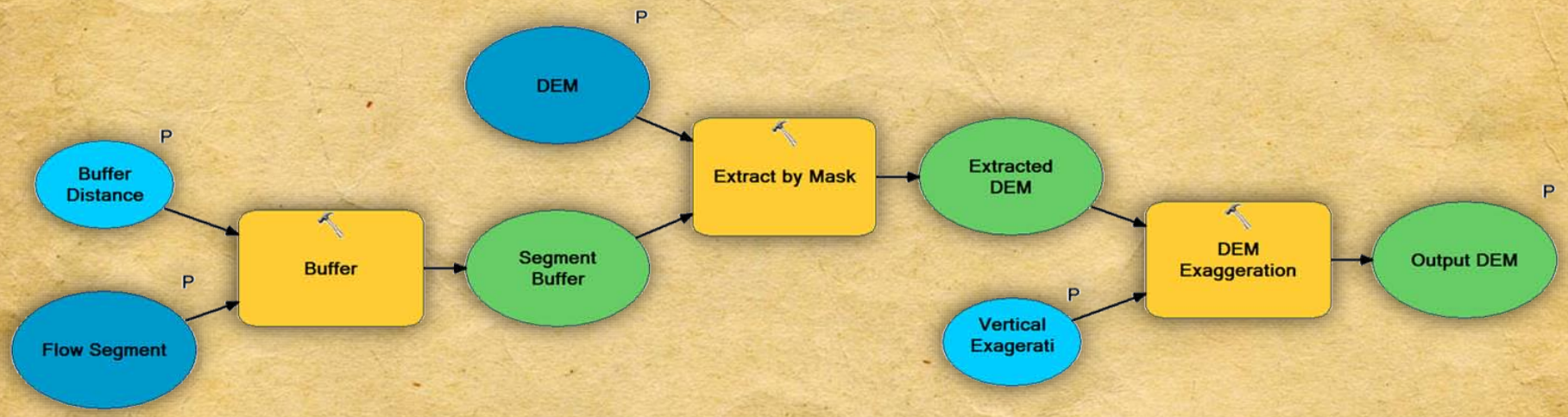


Full Model

Extraction **Hillshade** **Classify** **Create Berms**

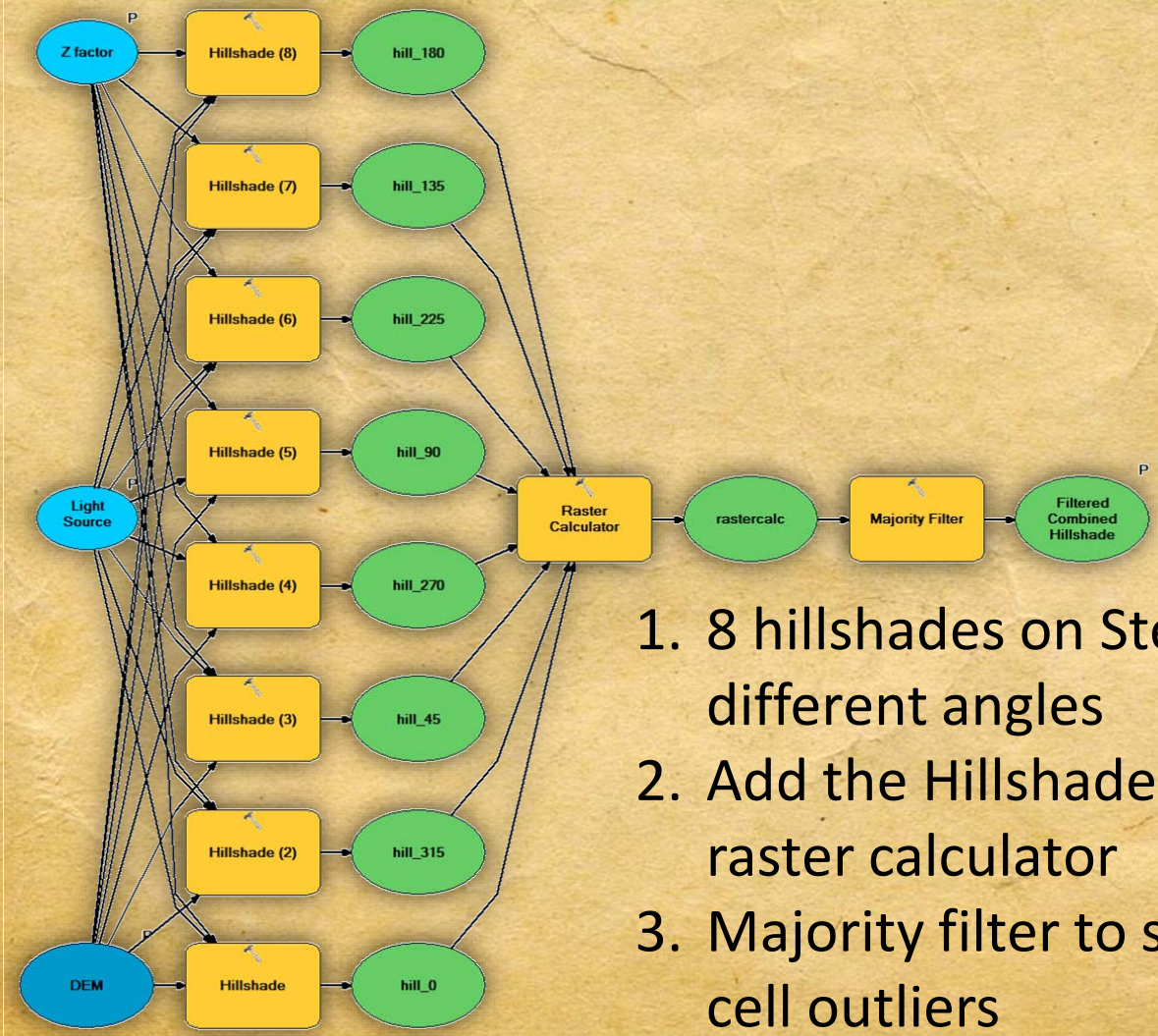


Model: Extraction



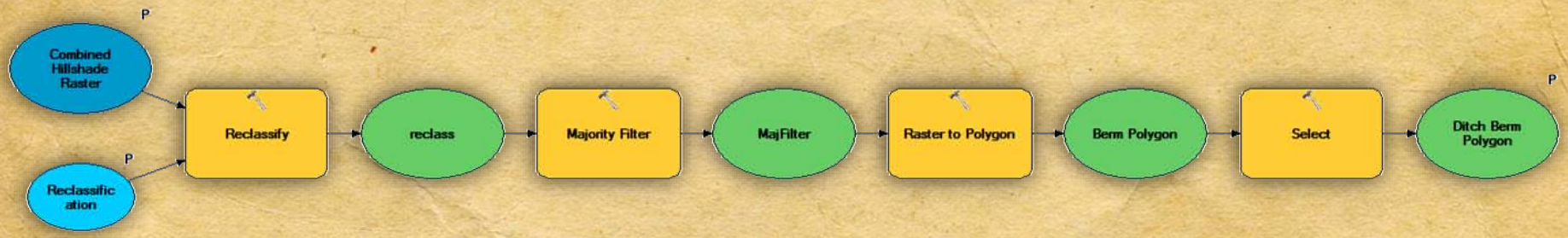
1. Identify the flow segment and buffer distance
2. Extract the DEM by the flow segment buffer
3. Exaggerate the DEM

Model: Hillshades



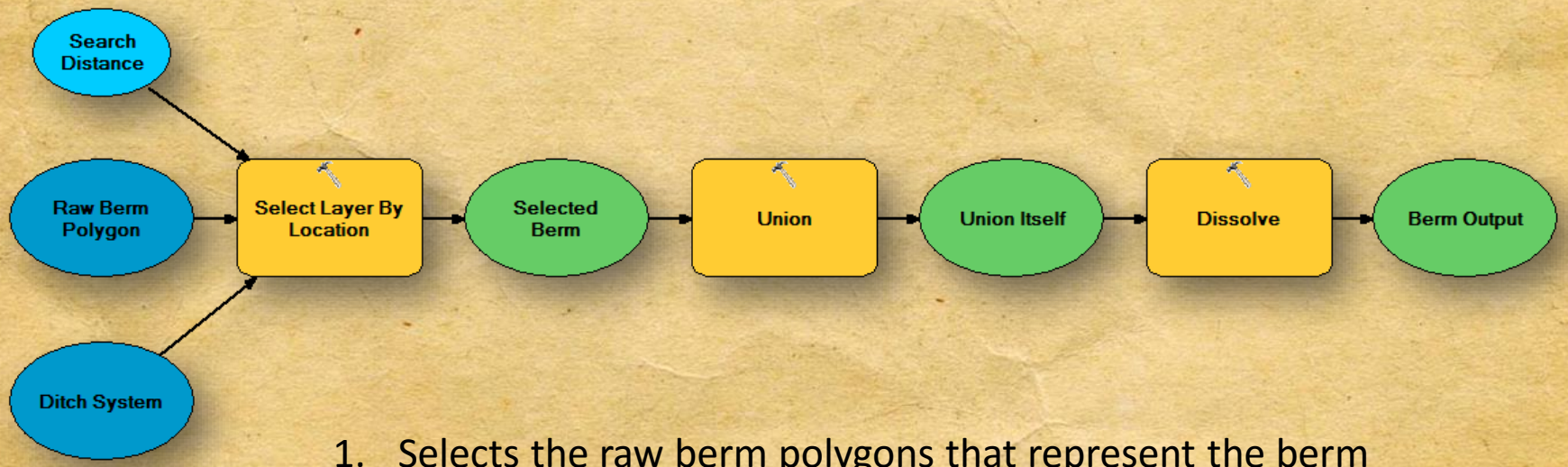
1. 8 hillshades on Step 1 output DEM at different angles
2. Add the Hillshades together using raster calculator
3. Majority filter to smooth out single cell outliers

Model: Classify



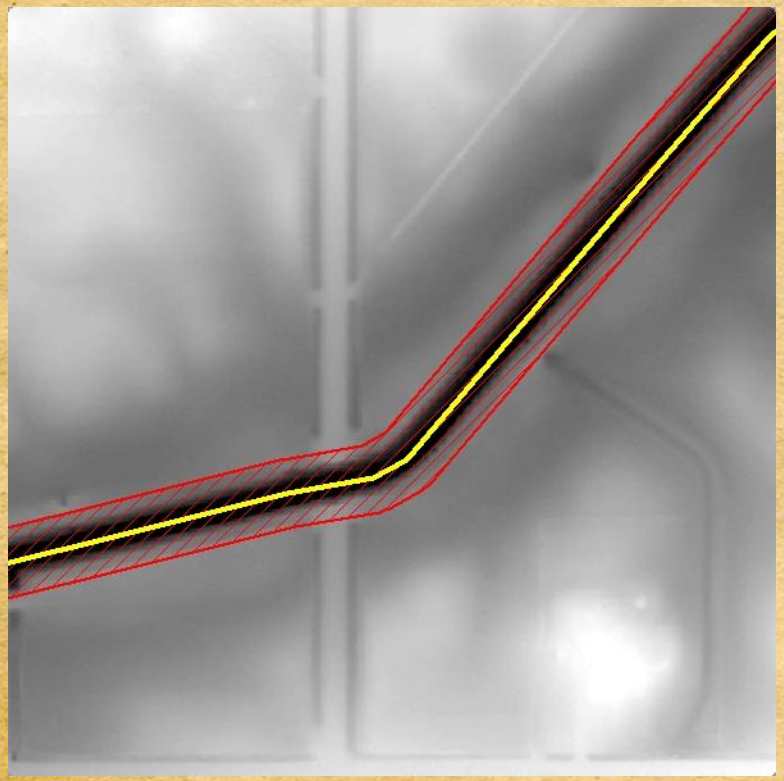
1. Reclassify the combined hillshades
2. Majority filter to remove single cell outliers
3. Convert the raster to polygon
4. Select the polygons that represent the ditch berm

Model: Automated Berm Creation



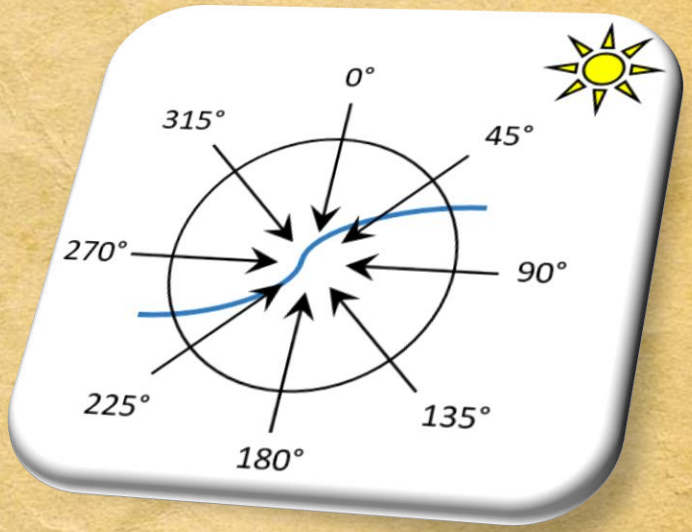
1. Selects the raw berm polygons that represent the berm leaving behind the straggler polygons
2. Union fills in the gaps between the polygons.
3. Dissolve merges adjacent polygons to form a solid berm polygon.

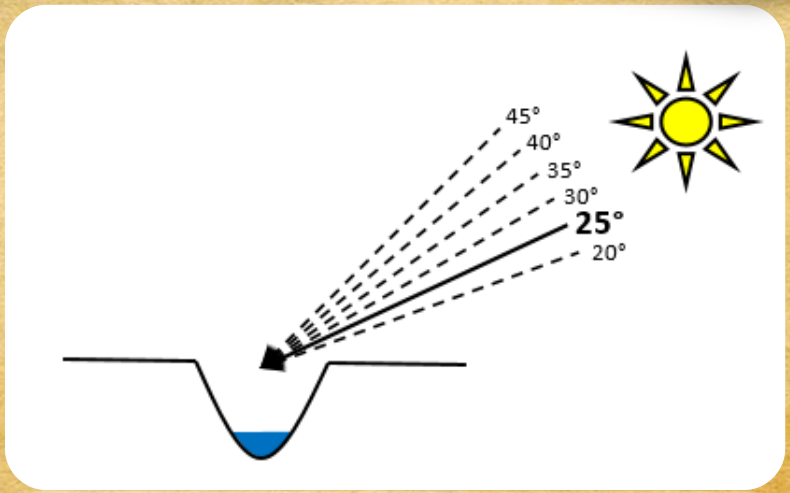
DEM Extraction



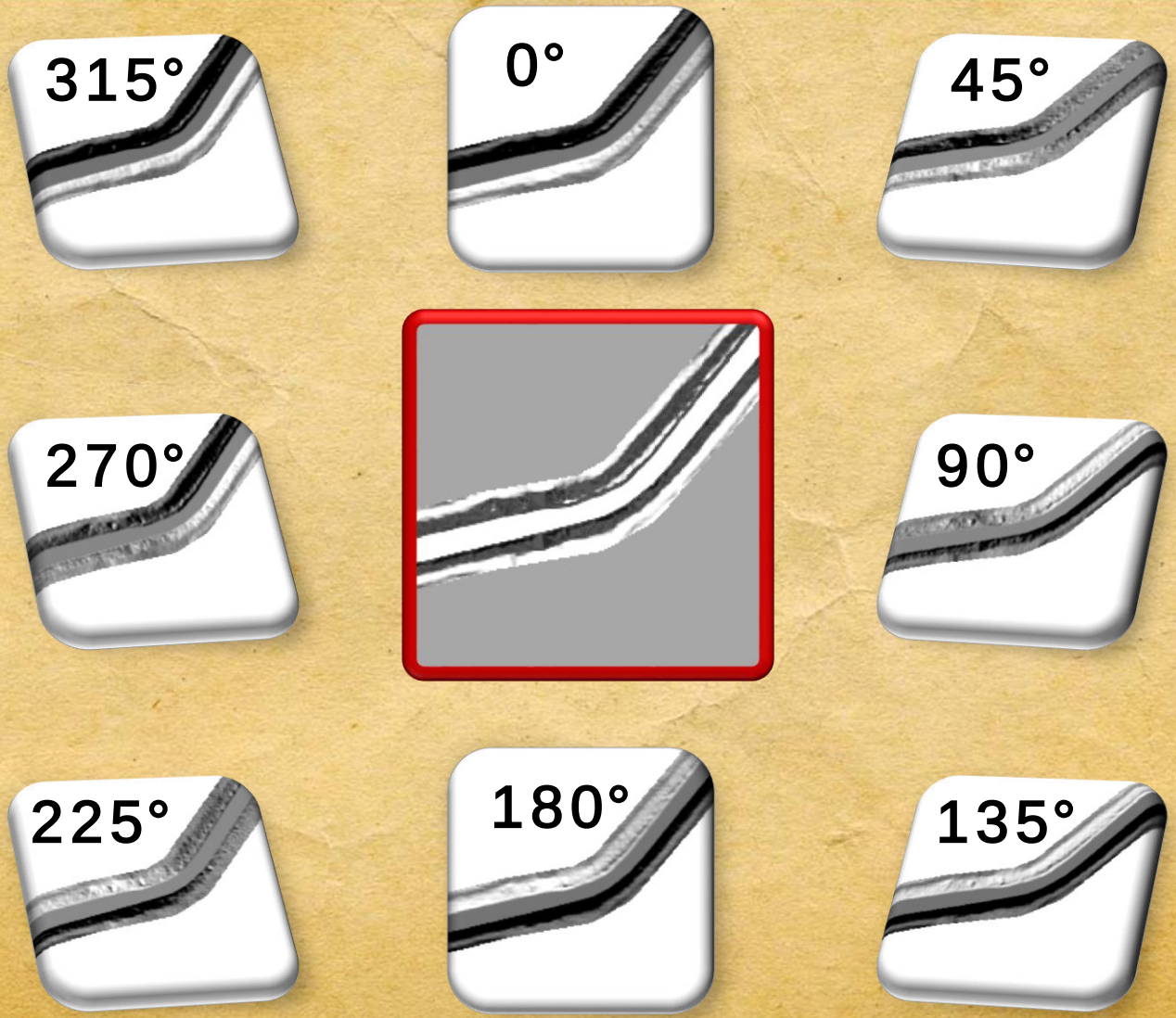
Hillshade

Hillshade creates a shaded relief from a surface raster by considering the illumination source azimuth angle, and altitude angel.

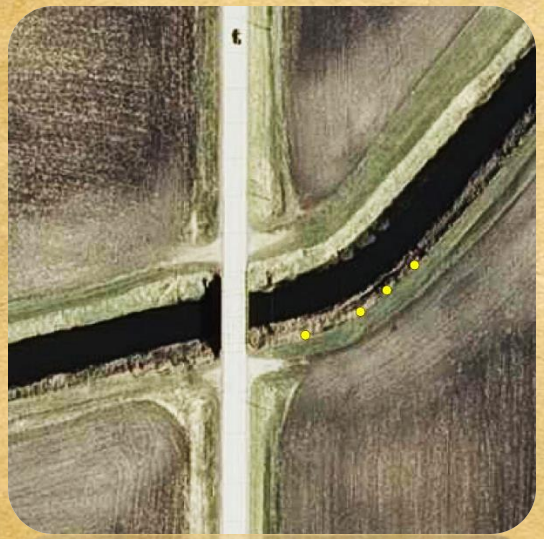




Combined Hillshades



Field to Office: GPS Points



Field Issues

GPS: Transects
A Work In Progress

Waseca County:

October 2016 collection

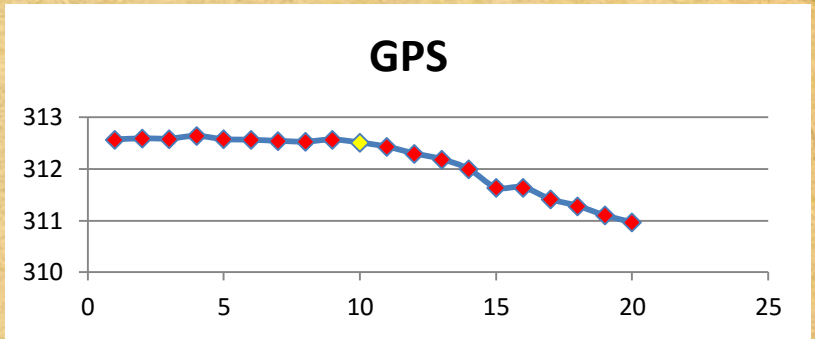
92 transect lines ≈ 1,800 points

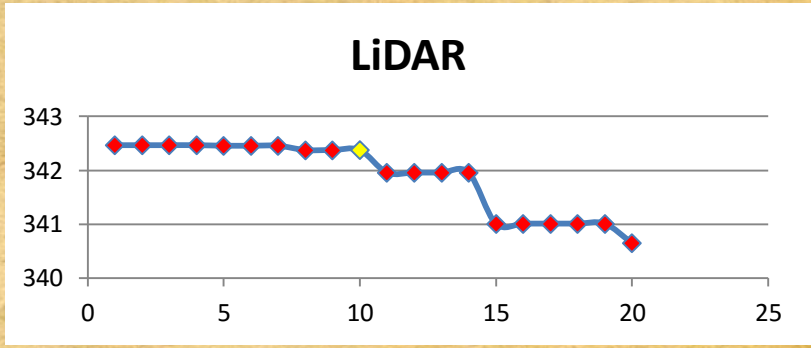
Steele County:

Transect Collection - March 2017

GPS: Profiles

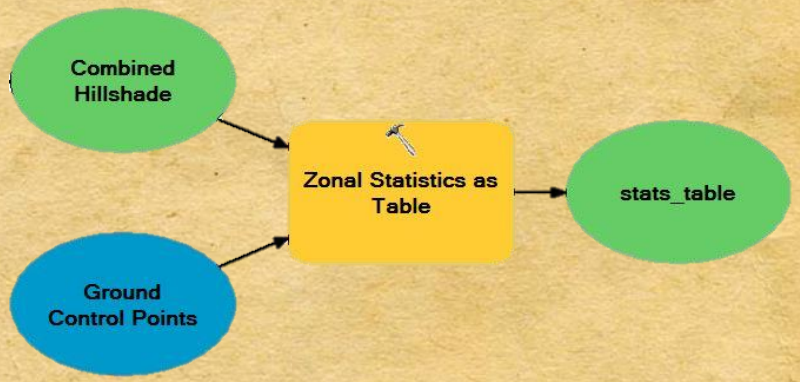
CD 45 Line 4					
Point ID	Estimated Accuracy (ft)	Creation Date/Time	GPS Z Coord (WGS 84)	LiDAR 1m Z Coord (UTM 15N)	Top of Berm Point
CD45-L4-P01	0.33	2016-10-21T13:14:11Z	312.5187	342.42999	N/A
CD45-L4-P02	0.33	2016-10-21T13:14:17Z	312.5103	342.48999	N/A
CD45-L4-P03	0.33	2016-10-21T13:14:23Z	312.5645	342.48999	N/A
CD45-L4-P04	0.33	2016-10-21T13:14:28Z	312.5476	342.48999	N/A
CD45-L4-P05	0.33	2016-10-21T13:14:34Z	312.54	342.47	N/A
CD45-L4-P06	0.33	2016-10-21T13:14:40Z	312.5349	342.47	N/A
CD45-L4-P07	0.33	2016-10-21T13:14:46Z	312.5115	342.47	N/A
CD45-L4-P08	0.33	2016-10-21T13:14:52Z	312.4773	342.47	YES
CD45-L4-P09	0.33	2016-10-21T13:14:59Z	312.4204	342.29001	N/A
CD45-L4-P10	0.33	2016-10-21T13:15:06Z	312.3271	342.29001	N/A
CD45-L4-P11	0.33	2016-10-21T13:15:11Z	312.2887	342.29001	N/A
CD45-L4-P12	0.33	2016-10-21T13:15:17Z	312.1357	341.82001	N/A
CD45-L4-P13	0.33	2016-10-21T13:15:24Z	312.0537	341.82001	N/A
CD45-L4-P14	0.33	2016-10-21T13:15:31Z	311.9334	341.82001	N/A
CD45-L4-P15	0.33	2016-10-21T13:15:38Z	311.7654	341.82001	N/A
CD45-L4-P16	0.33	2016-10-21T13:15:43Z	311.5678	341.23999	N/A
CD45-L4-P17	0.33	2016-10-21T13:15:50Z	311.311	341.26999	N/A
CD45-L4-P18	0.33	2016-10-21T13:15:58Z	311.0591	341.26999	N/A
CD45-L4-P19	0.33	2016-10-21T13:16:07Z	311.0463	340.54999	N/A
CD45-L4-P20	0.33	2016-10-21T13:16:13Z	310.8829	340.54999	N/A





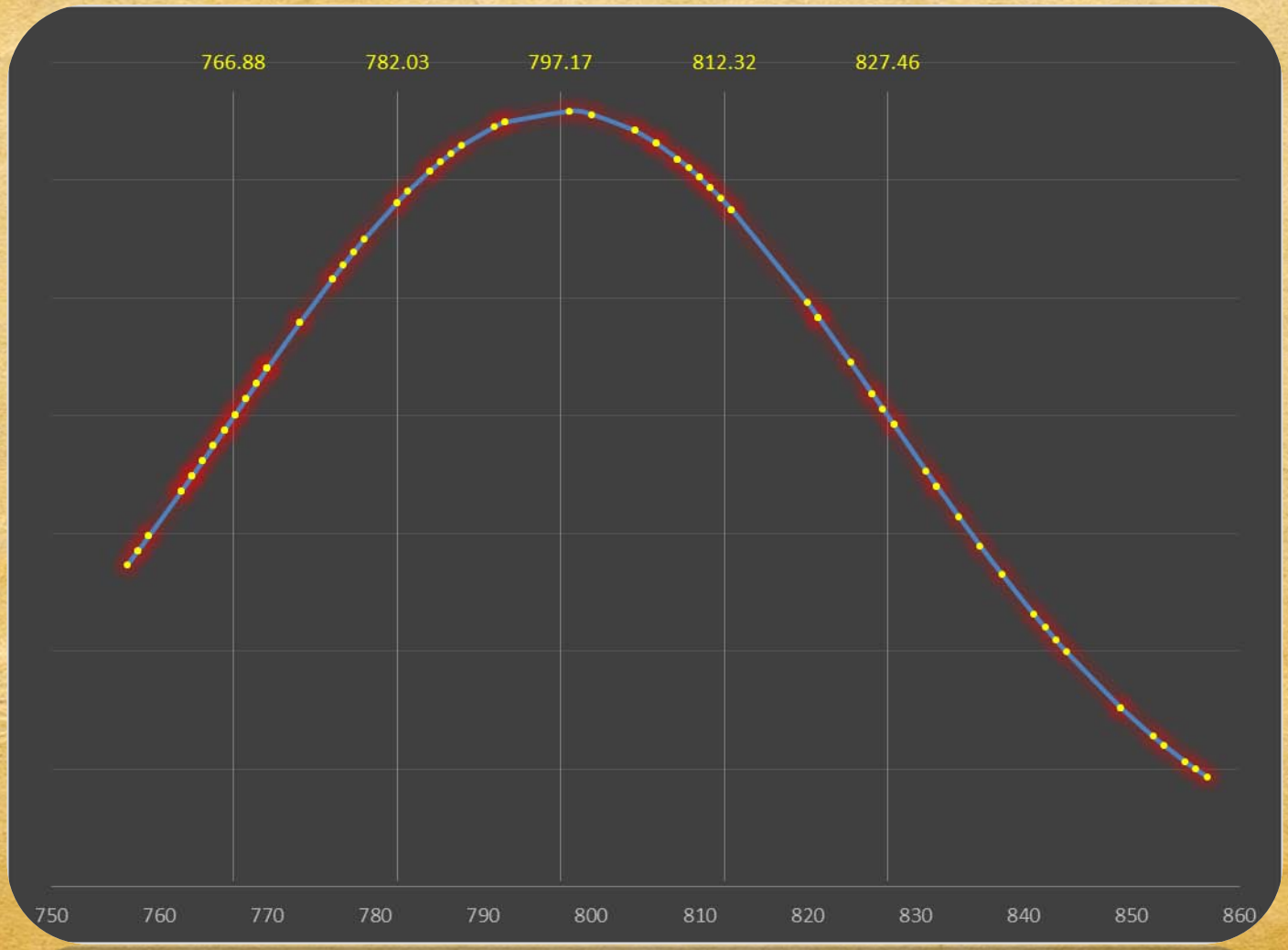
Extracting Break Point Statistics

- Zonal Statistics
  - Extract combined hillshade cell values for intersecting GPS ground control points



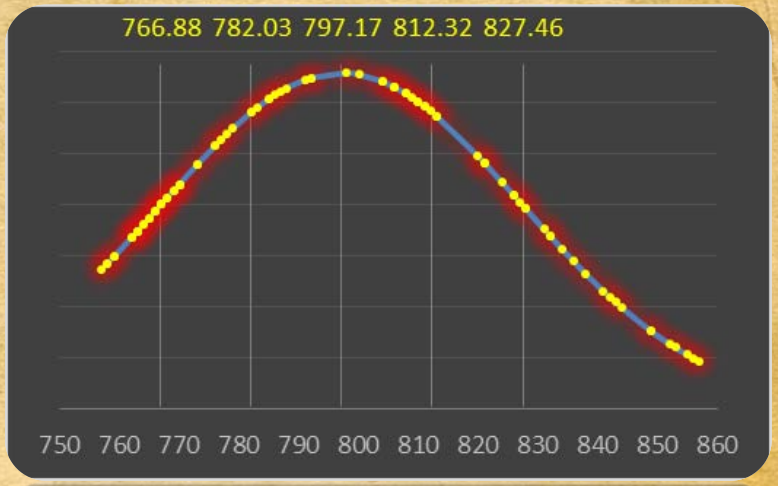
Rowid	POINT_ID	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM	VARIETY	MAJORITY	MINORITY	MEDIAN
1	1	1	1	809	809	0	809	0	809	1	809	809	809
2	2	1	1	811	811	0	811	0	811	1	811	811	811
3	3	1	1	793	793	0	793	0	793	1	793	793	793
4	4	1	1	822	822	0	822	0	822	1	822	822	822
5	5	1	1	834	834	0	834	0	834	1	834	834	834
6	6	1	1	828	828	0	828	0	828	1	828	828	828

Statistics: The Data Curve



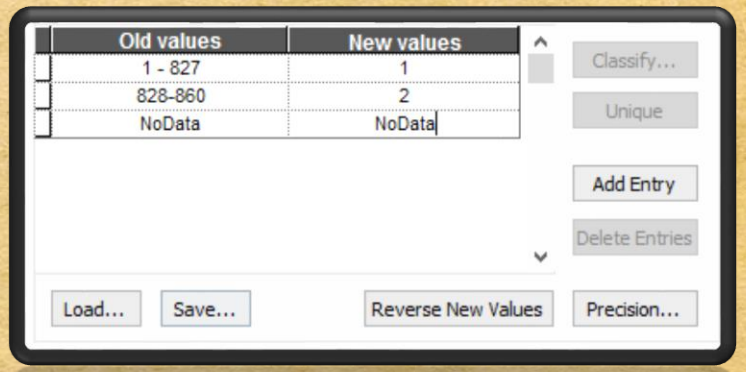
Statistics: Stats

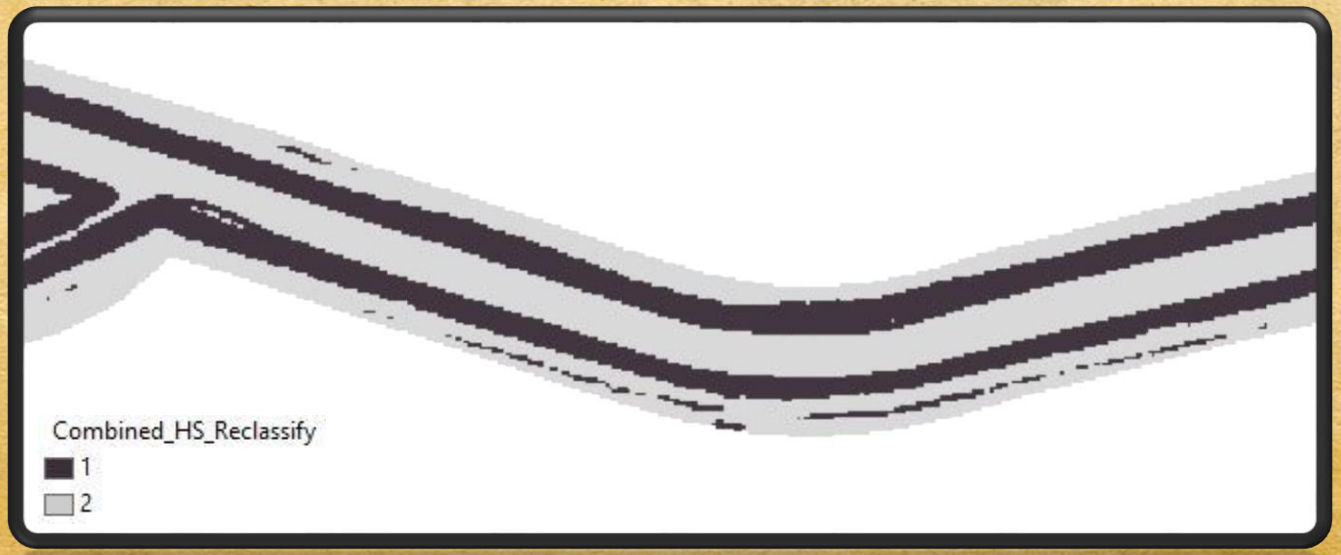
Total Points: _____92
Highest Value:_____857
Lowest Value: _____757
Mean: _____797.17
Mode: _____763
Standard Deviation: _____30.29
+1 Standard Deviation: _____**827.46**
+1/2 Standard Deviation: _____**812.32**
-1/2 Standard Deviation: _____782.03
-1 Standard Deviation: _____766.88
Skewness: _____0.39



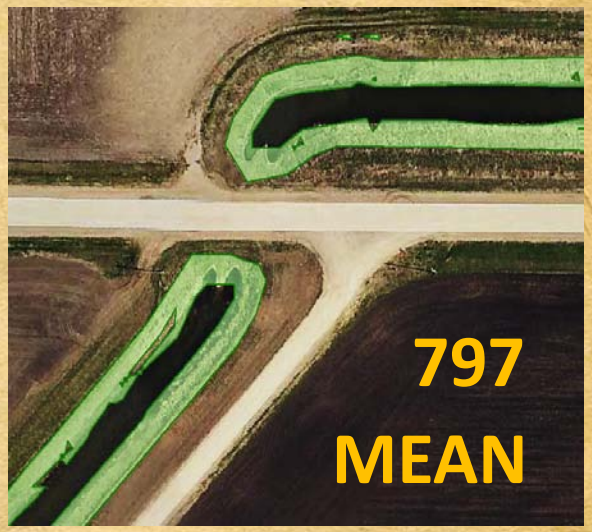
Reclass

- Reclassify
  - Overwrite cell values based on break point values extracted by zonal statistic



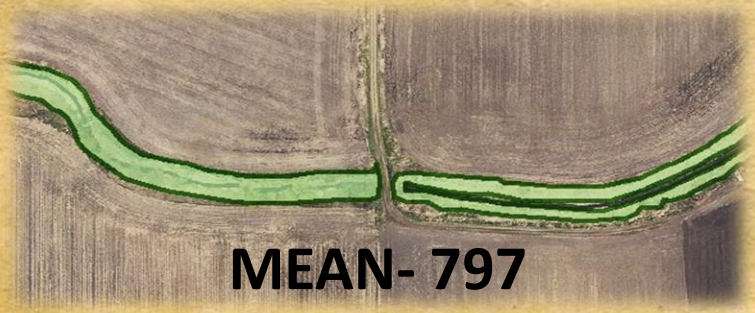


Berm Extraction



Berm Extraction

Completing the Berm



Percentage of Complete Berms		
STDEV	Extract Value	% Ditch Length Berms Completed
1	827	79.79%
0.5	812	67.31%
Mean	797	51.68%
-0.5	782	38.70%
-1	766	3.15%

Needs Attention

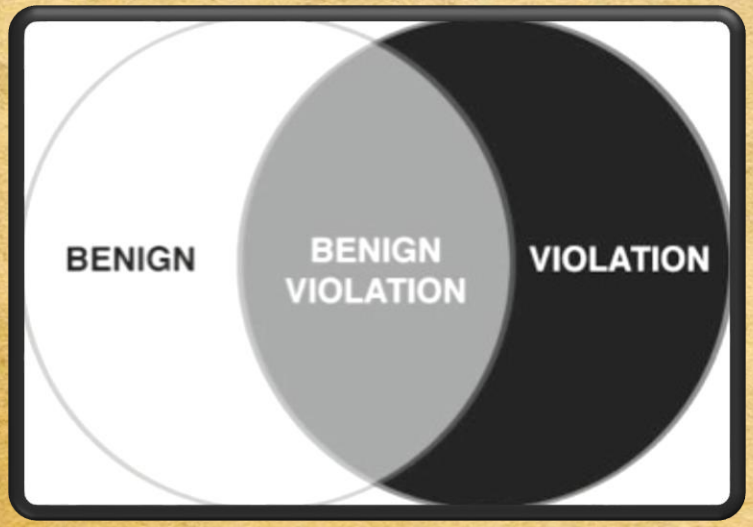
- Depression Areas
  - Exaggerating Z values by 1.5-3 for better results in areas of contour depressions
- Non-depression Flat Land
  - Where ditches run through wetlands, banks are hard to identify.

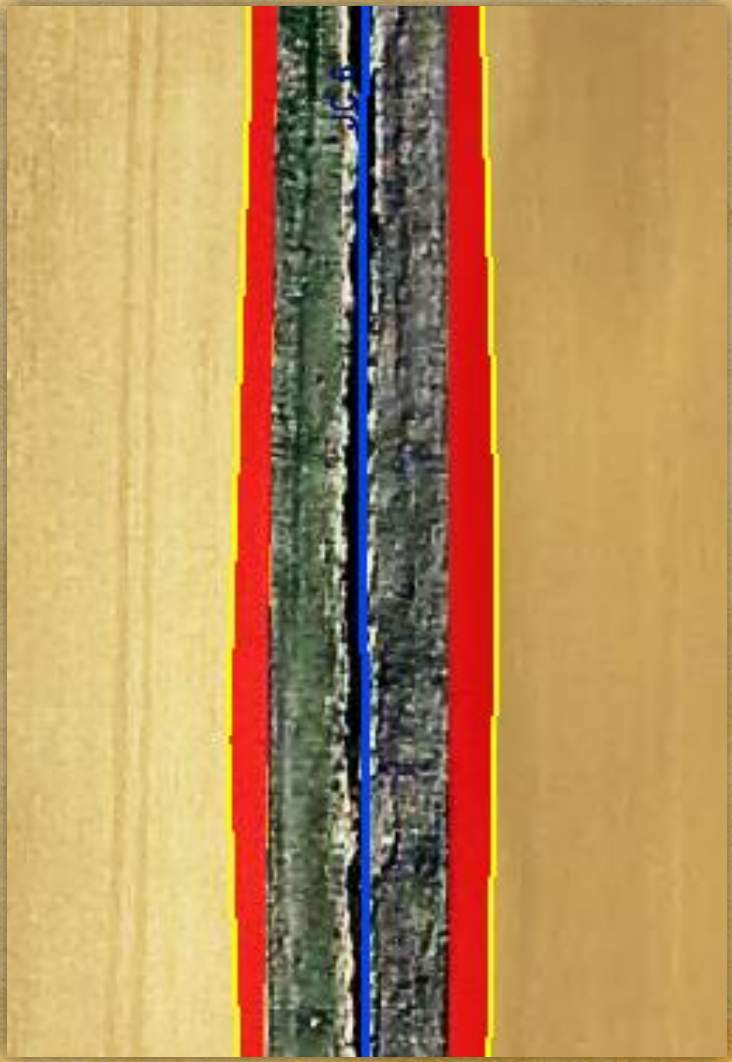
The Ditch Buffer

- Raster to Polygon
- Buffer 1 Rod (16.5 ft)
- More or Less accurate to 3’ in most places

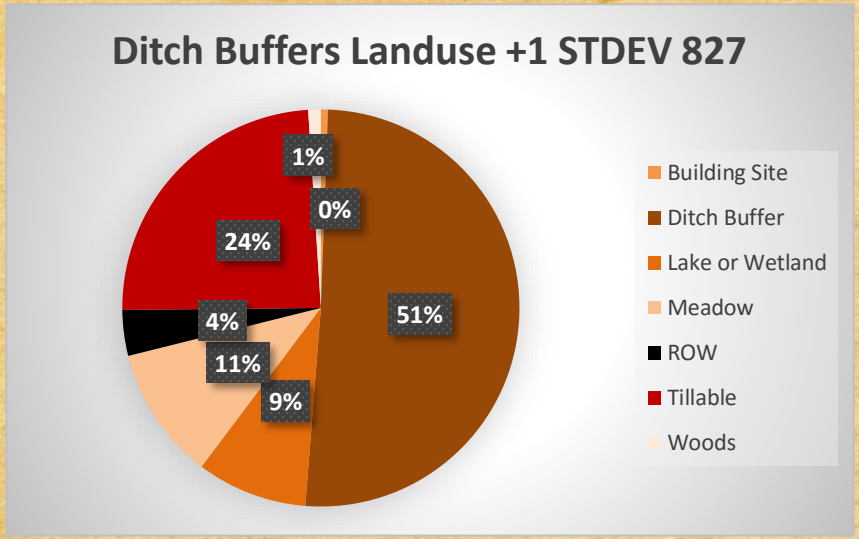
Buffer Violations

Target enforcement resources by the area of the violation by property

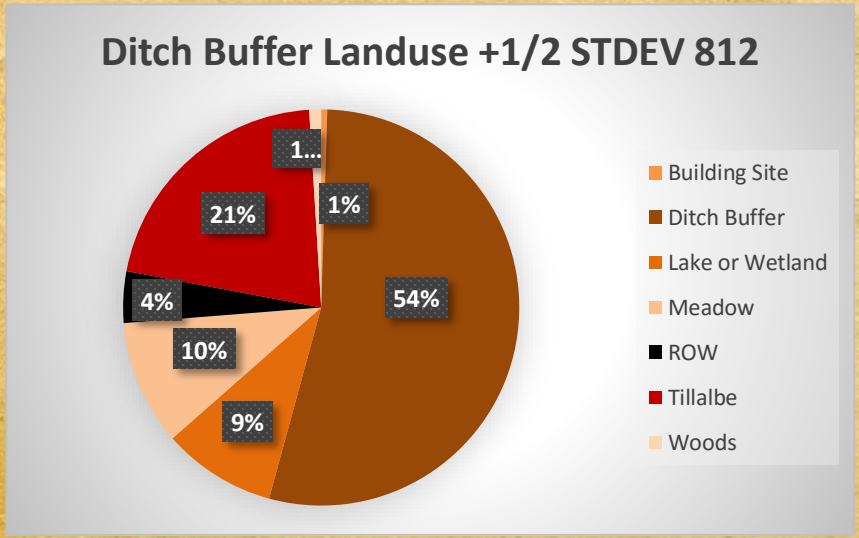




Buffer Violations

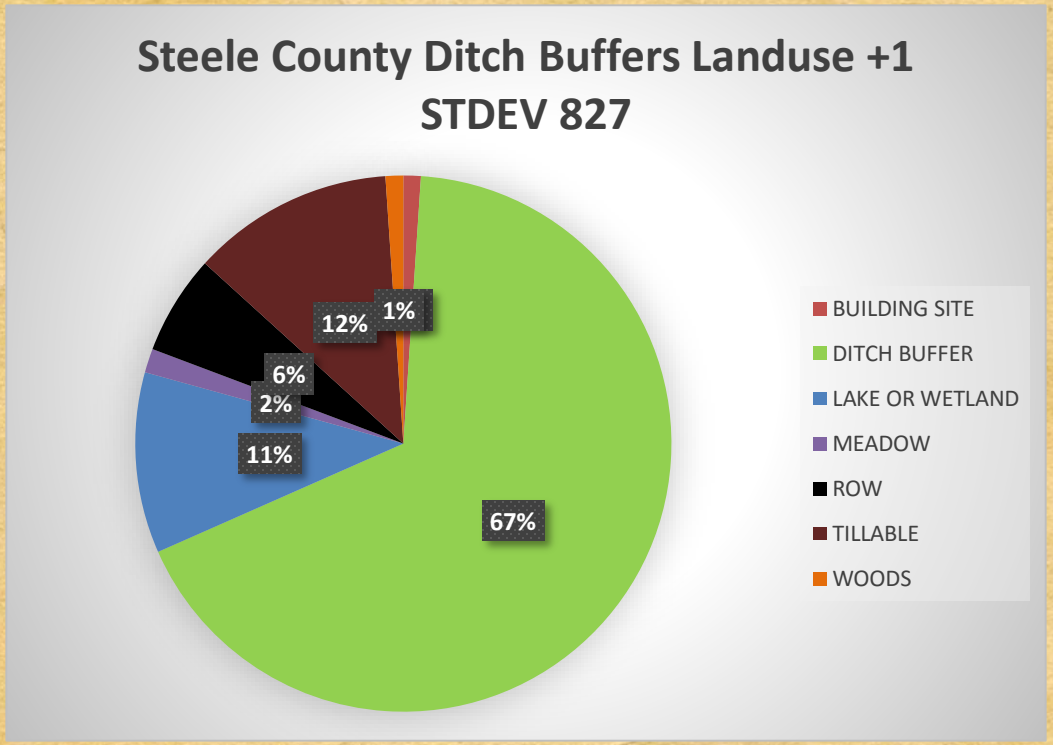


Total Buffer Acres: ~429
Average Ditch Width: 44.4 ft



Total Buffer Acres: ~429
Average Ditch Width: 38.83 ft

Buffer Violations

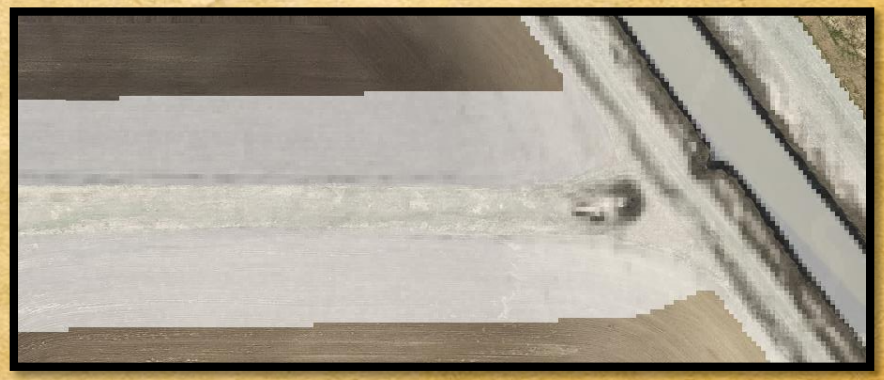


Total Buffer Acres: ~370

- Tilled Acres: ~45
- Existing Buffer Acres: ~250

Features Possibly Identified

- Hillshade analysis may identify:
  - Tile outlets
  - Bank erosion
  - Grass waterways
  - Berms
  - Public Water Stream Courses



Contacts

TO BE CONTINUED…

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