WDNR Wisconsin Wetland Inventory(WWI)

How the WWI uses LiDAR to make wetland maps

ASWM Mapping Webinar 1/19/2021

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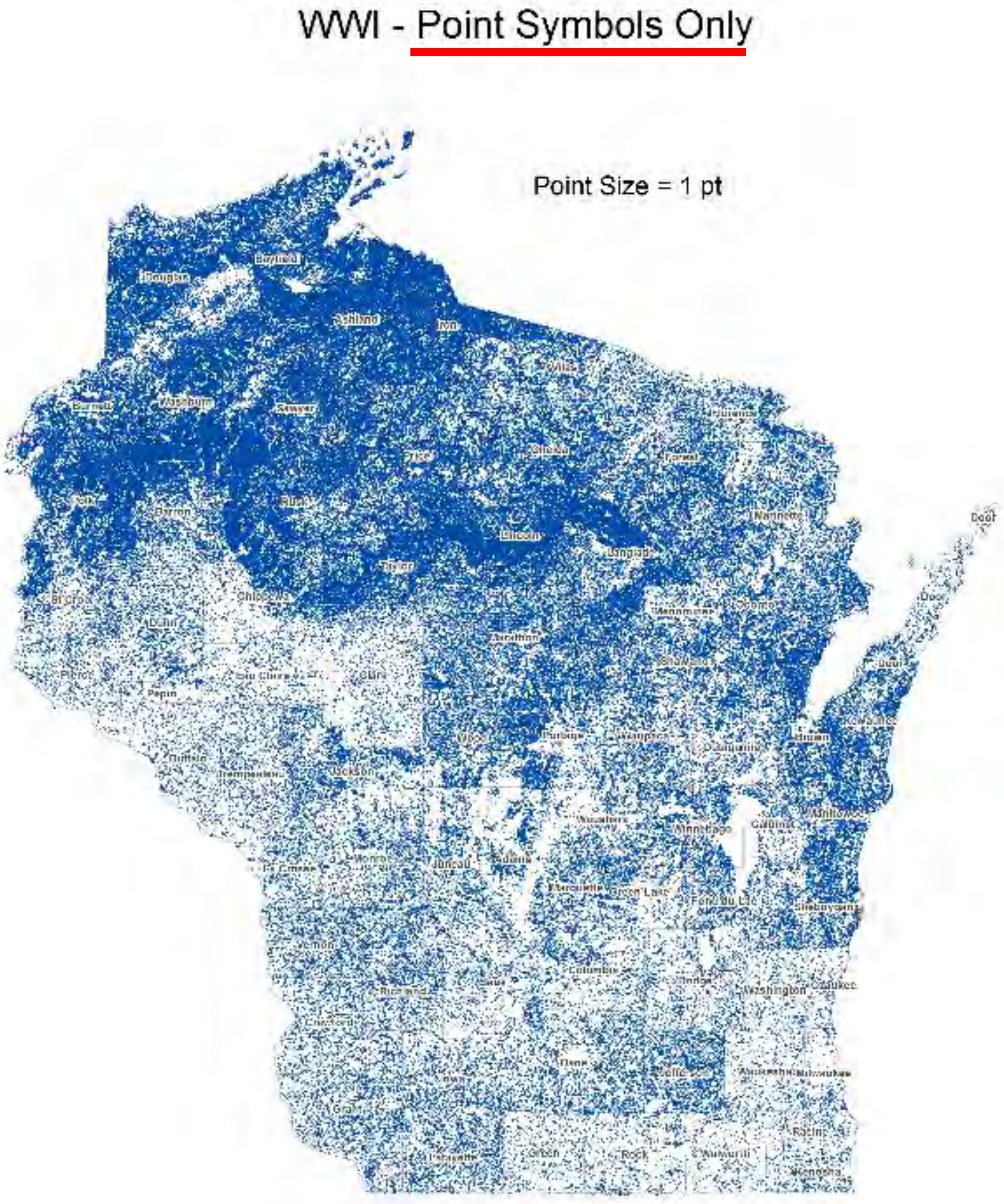
DNR.WI.GOV

The Good Old Days? 1980 – 2015

WWI 2016: Full Coverage

From hard-copy methods…

- 860,000 Attributed Polygons
- 732,000 Wetland Points = *Areas too small to delineate!*



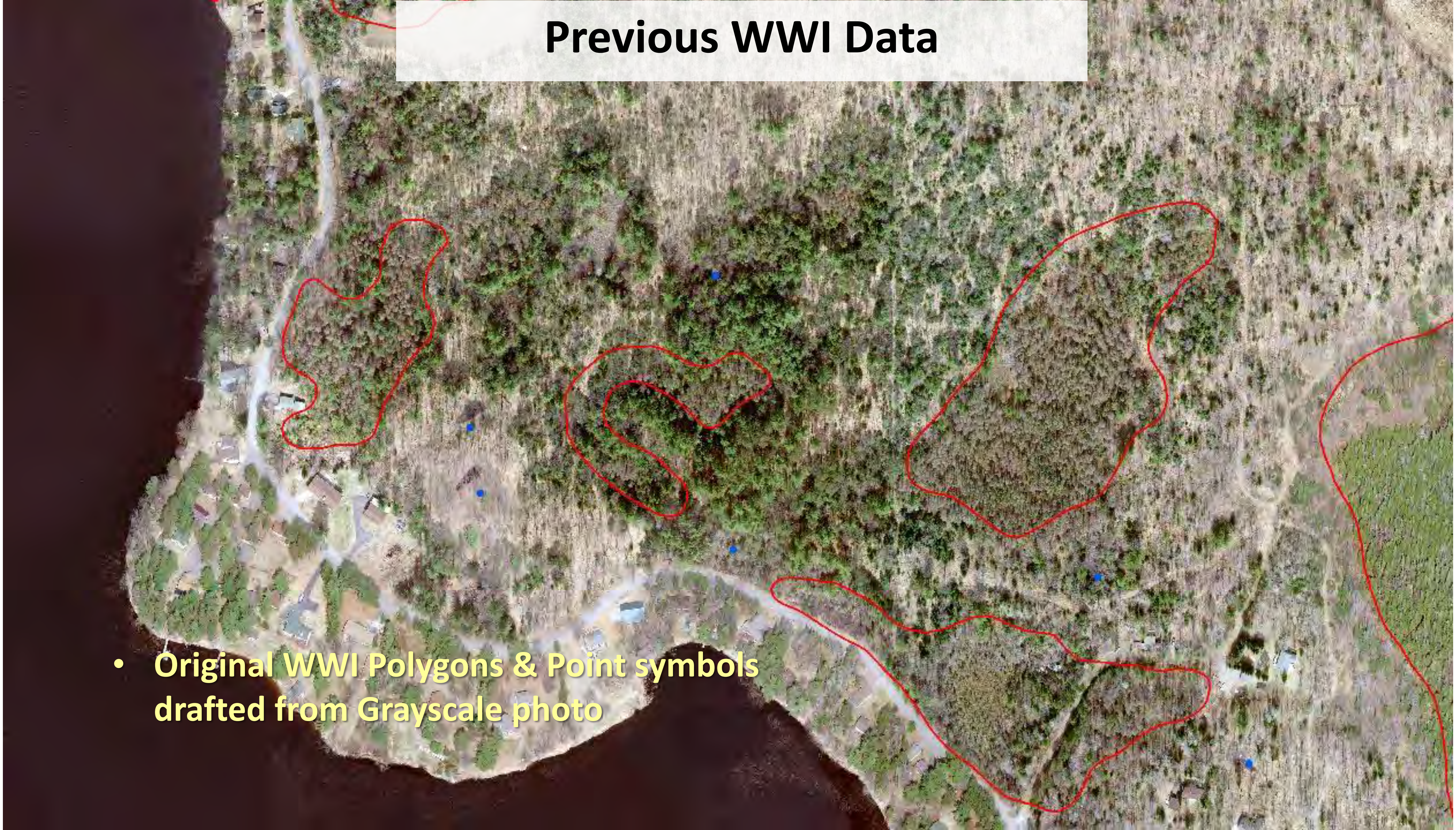
EPA Pilot Study Grant (2016-2020)

- **EPA Wetland Program Development Grant Goals**
  1. **Develop NWI compatible GIS methods for wetland & water mapping and *implement* for:**
     1. **10 HUC-12 watersheds**
     2. **Area equivalent to one county**
        - WDNR worked with GSS at St. Mary’s University on methodology and mapping 5 HUC-12’s
  2. **Perform accuracy assessment of new data**
  3. **Feasibility study of statewide implementation**

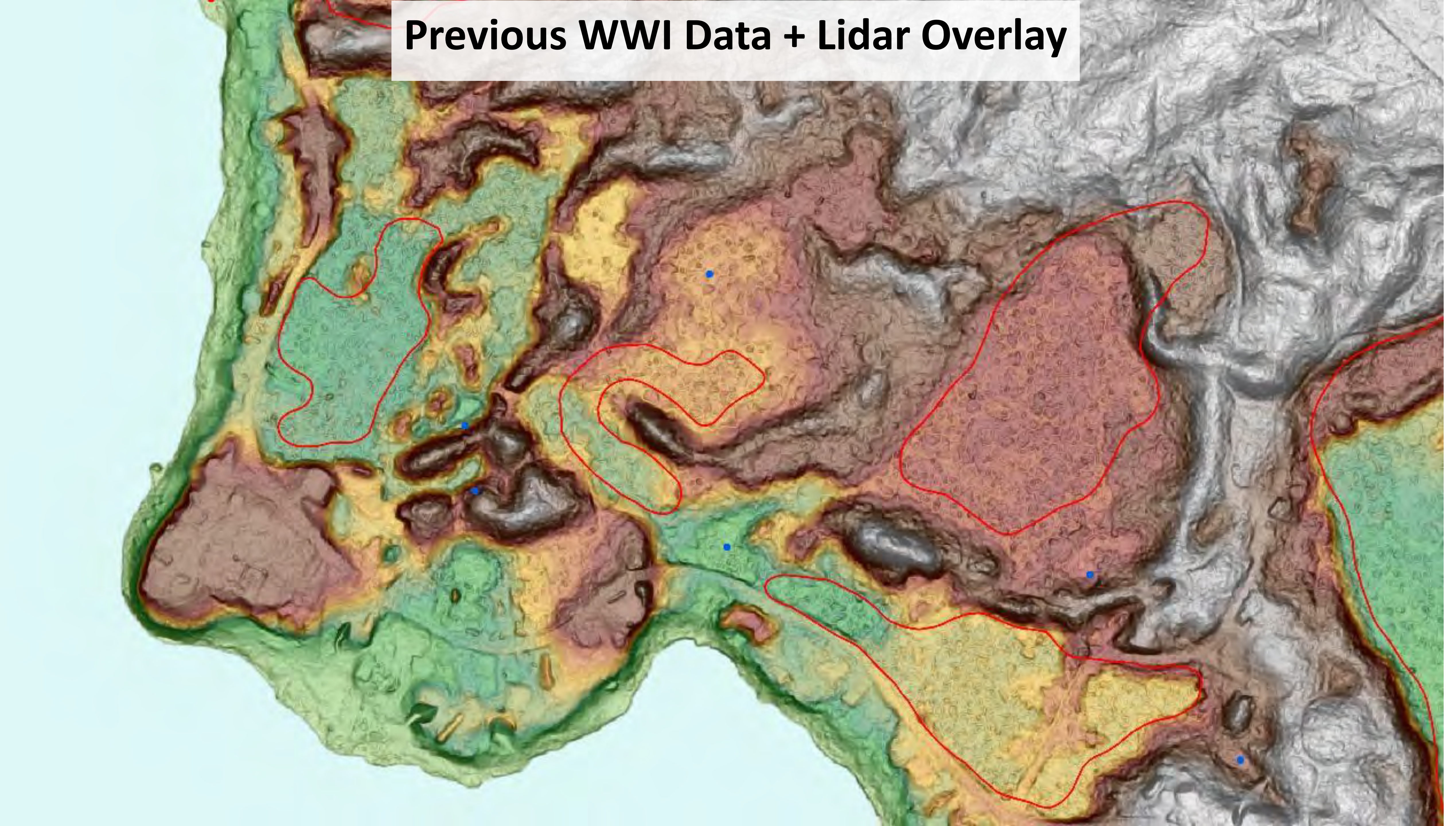
Further Objectives

Use publicly available LiDAR + Hi-Res Imagery to…

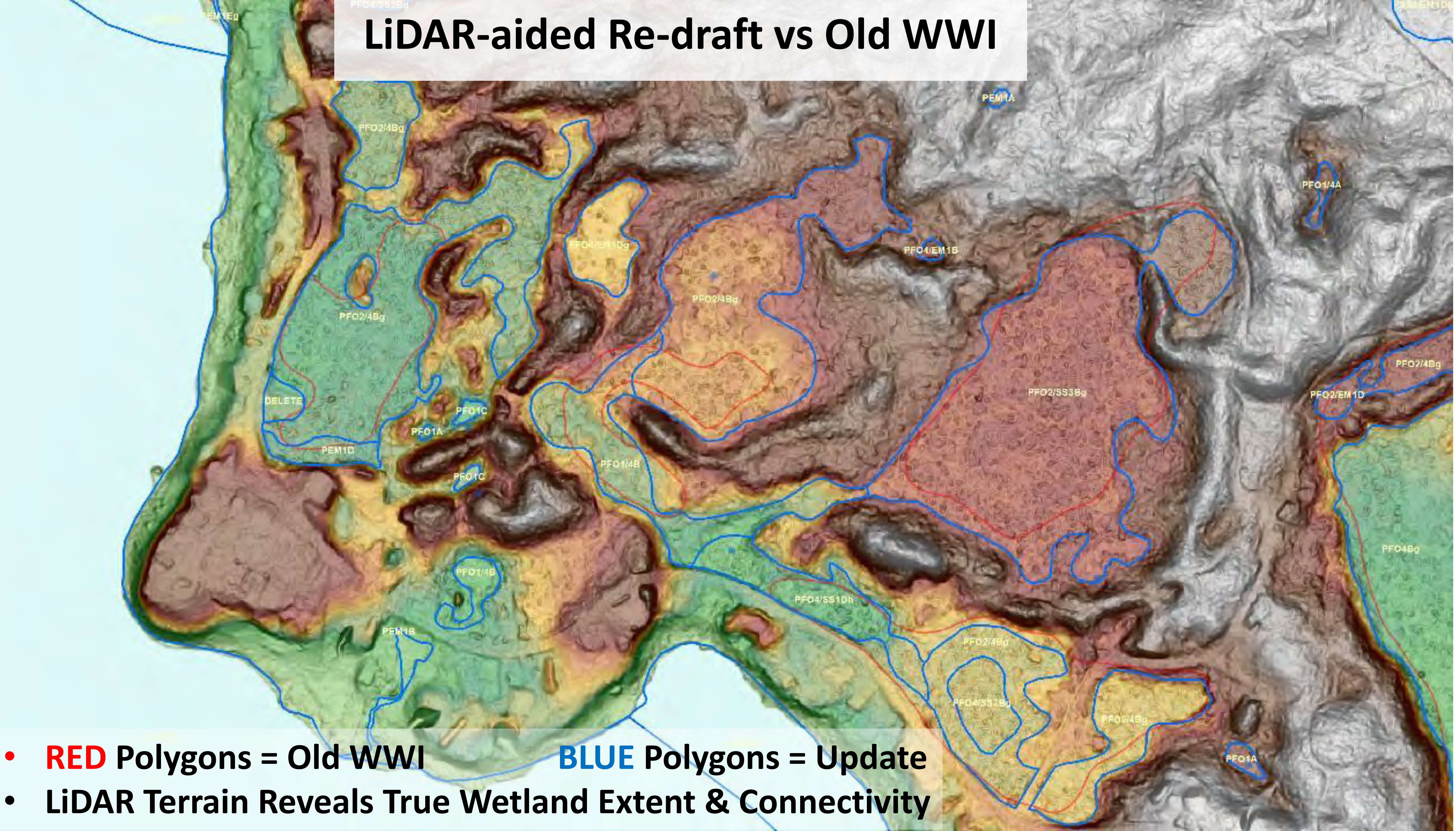
- **Improve wetland detection**
- **Re-map all wetlands and surface waters concurrently**
- **Replace points with delineated polygons**
- **In-house production using Imagery + LiDAR as primary data**
- **Exceed minimum NWI standards**


Previous WWI Data
• Original WWI Polygons & Point symbols drafted from Grayscale photo

Previous WWI Data + Lidar Overlay

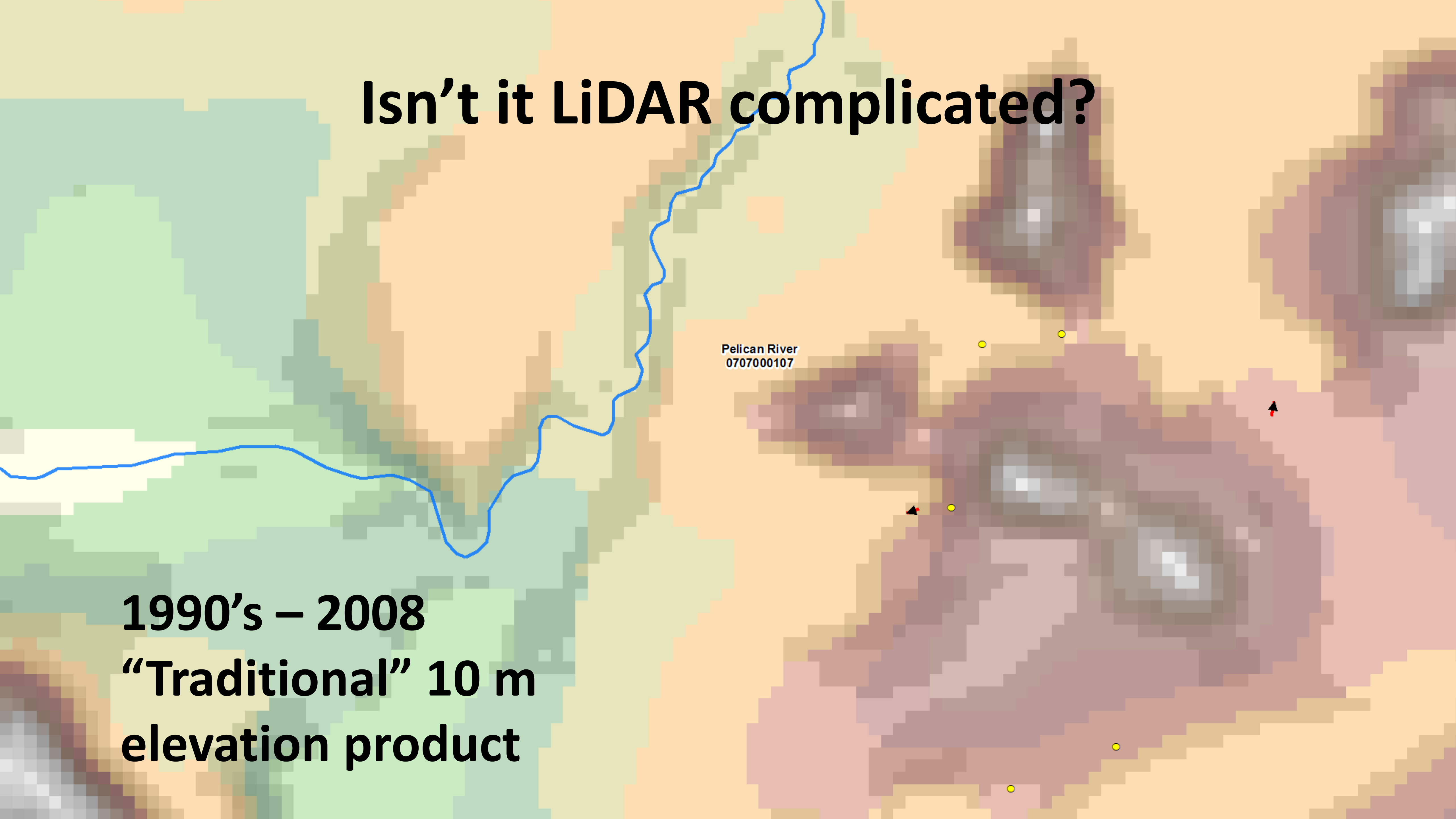


LiDAR-aided Re-draft vs Old WWI

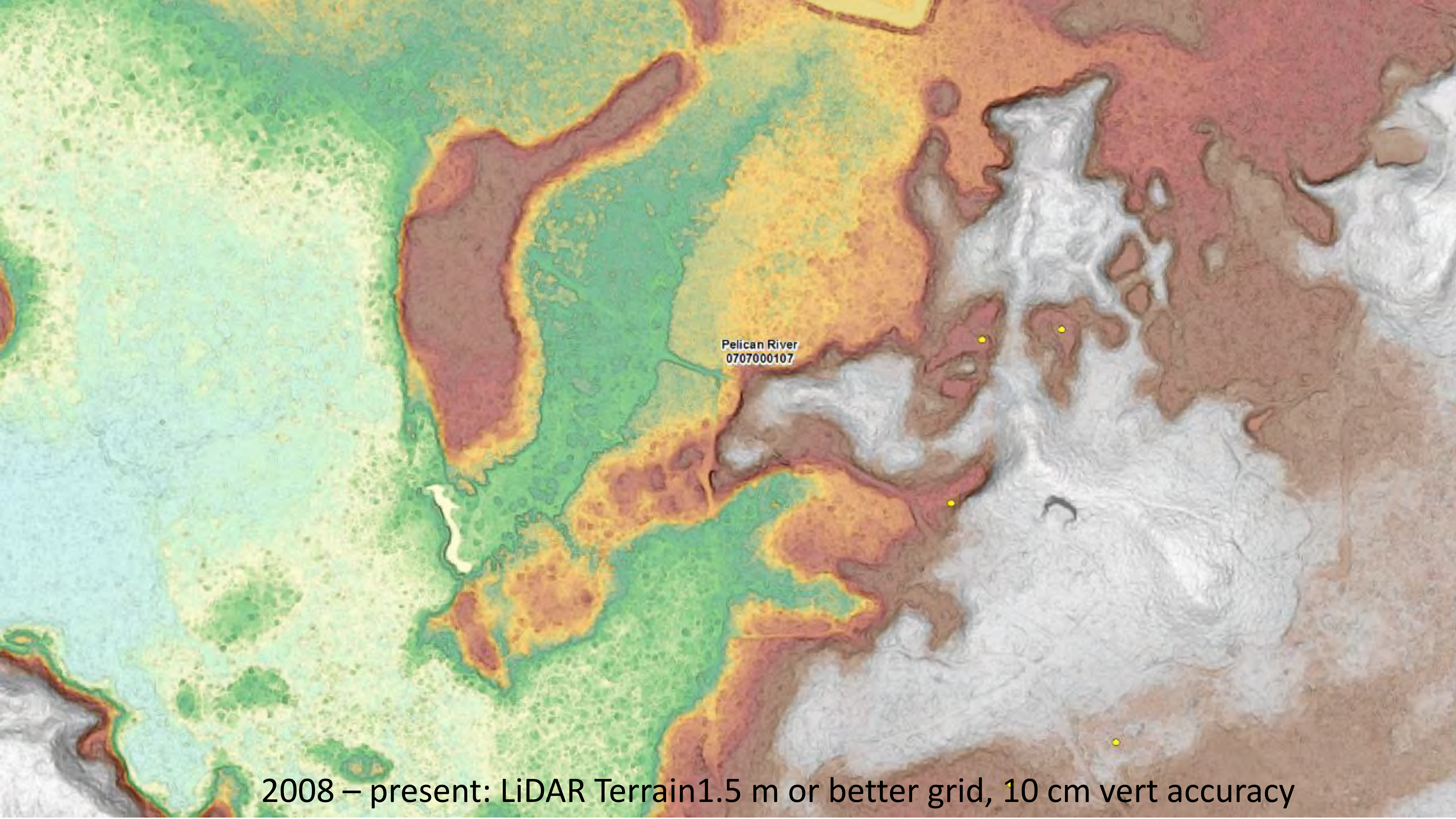


- RED Polygons = Old WWI BLUE Polygons = Update
- LiDAR Terrain Reveals True Wetland Extent & Connectivity

Isn’t it LiDAR complicated?



1990’s – 2008
“Traditional” 10 m elevation product

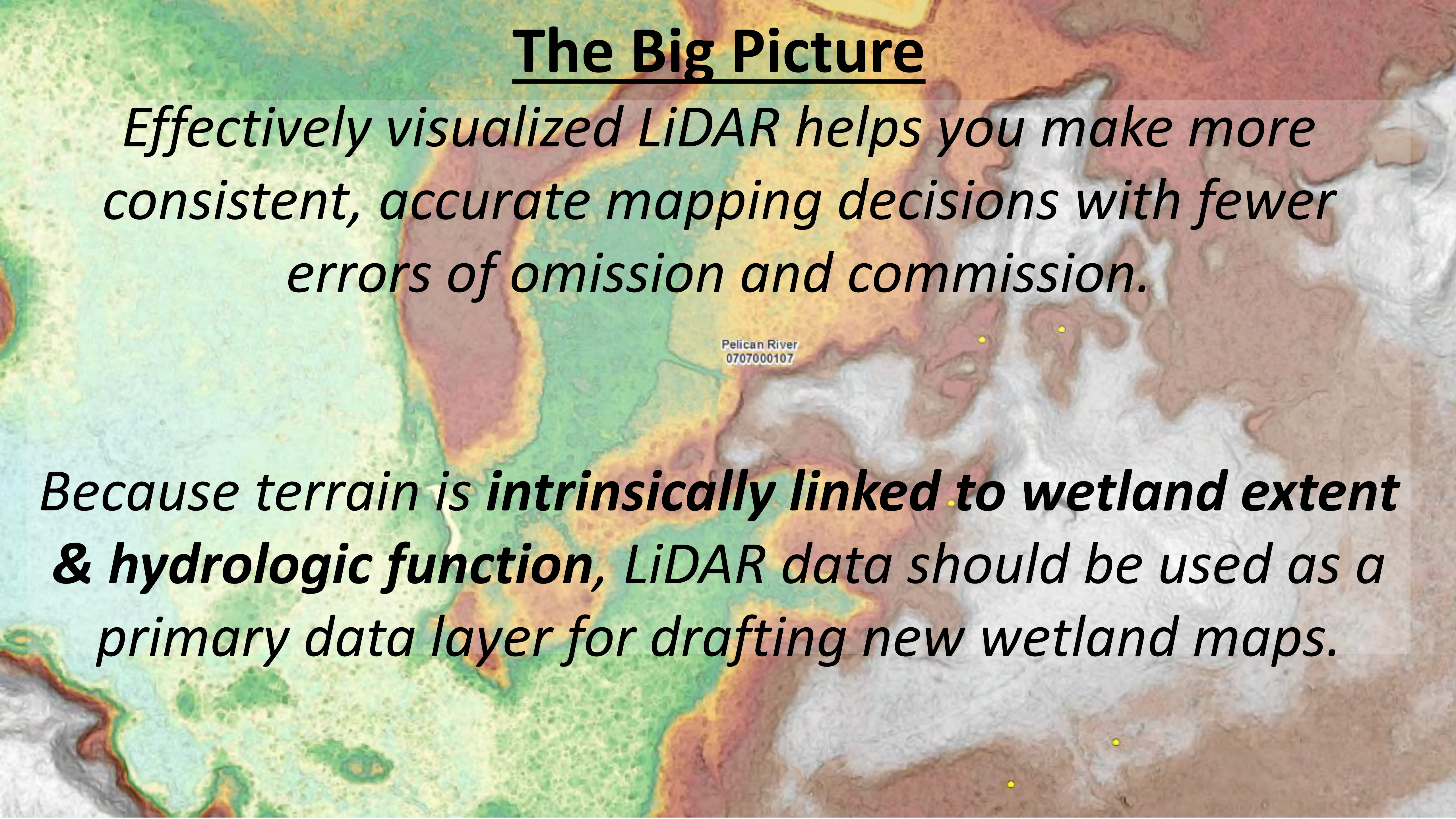


2008 – present: LiDAR Terrain1.5 m or better grid, 10 cm vert accuracy

The Big Picture

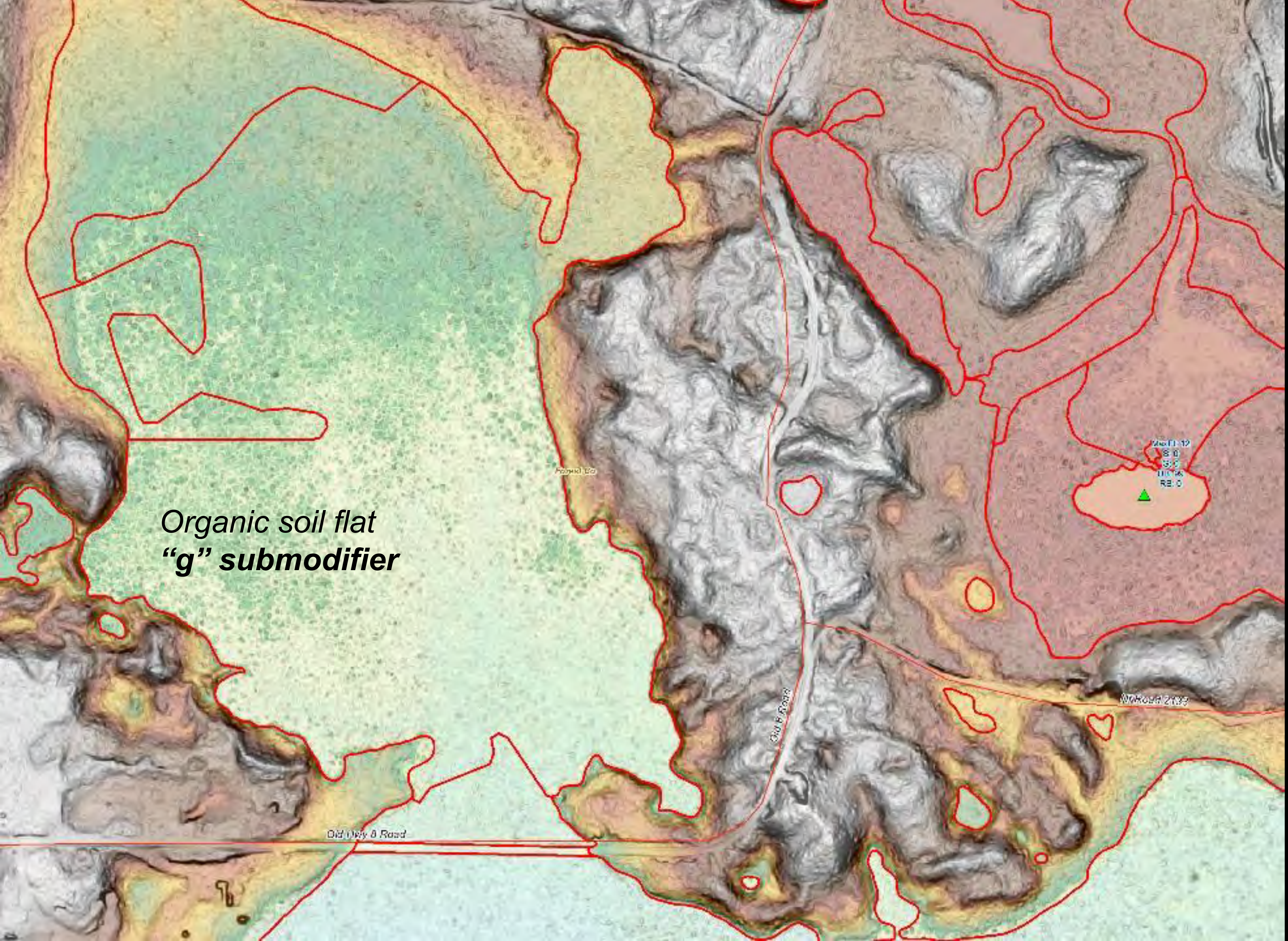
Effectively visualized LiDAR helps you make more consistent, accurate mapping decisions with fewer errors of omission and commission.

*Because terrain is **intrinsically linked to wetland extent & hydrologic function**, LiDAR data should be used as a primary data layer for drafting new wetland maps.*



Forest Co, WI

Photo-interpreting wetland extent in a landscape with mixed conifer & hardwood uplands is needlessly challenging!



Forest Co, WI

LiDAR View – Outer wetland boundaries practically jump off the image!

Seepage slope HGM type, organic Soil “g” Flats become obvious

Better able to discern surface connectivity between wetlands

Forest Co, WI

Could you draw outer boundaries as accurately without visualized bare-earth LiDAR?

Ashland Co Lake Superior Clay Plain

- Recent Photo-interpretation based delineation from 2015 image

Ashland Co Lake Superior Clay Plain

- **Photo-interpretation based delineation requires signature shift between up/wet**
- **Works in wetter, shrubbier areas, however…**
- **Forested areas dominated by FAC species like quaking aspen *(Populus tremuloides)***

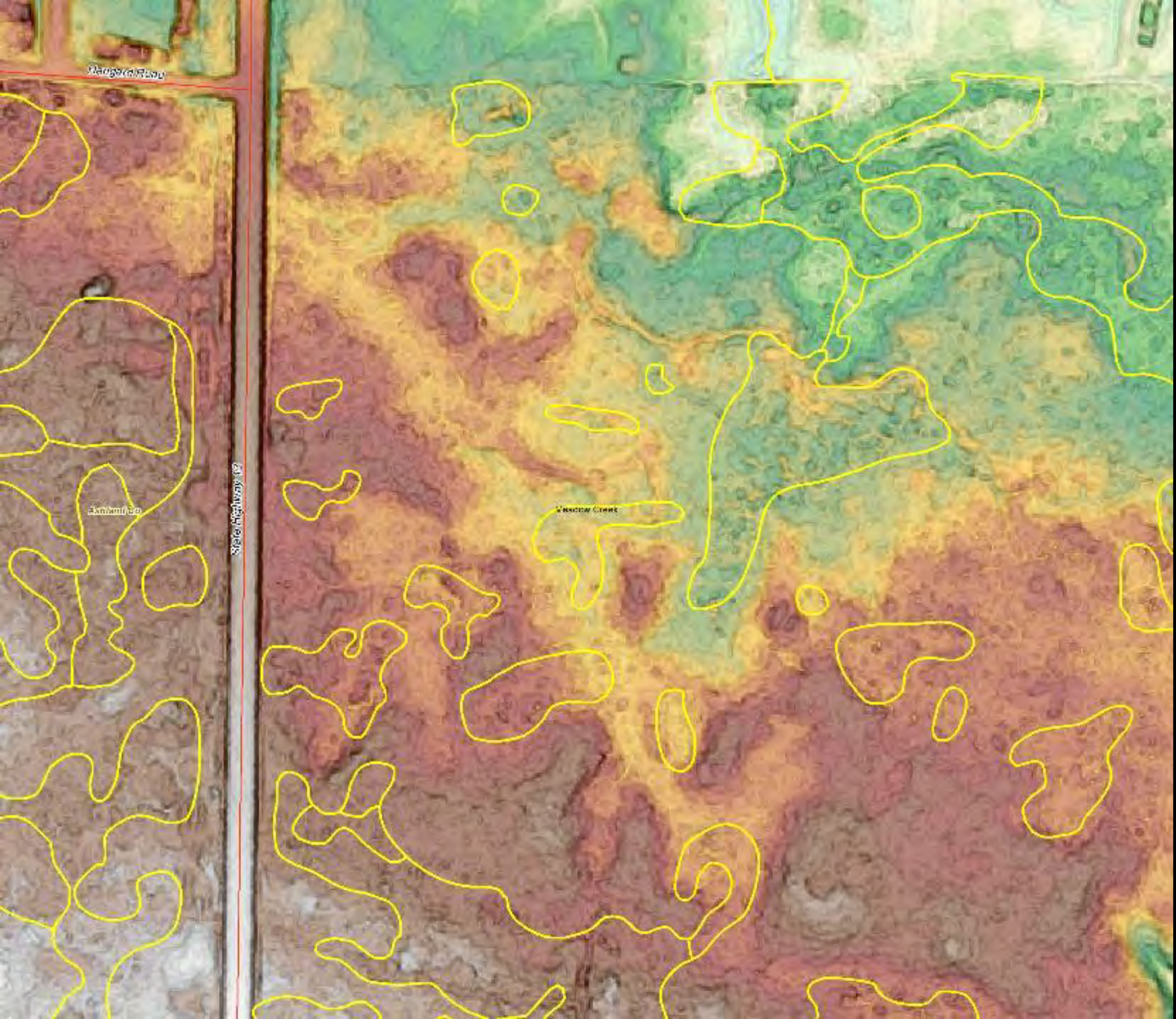
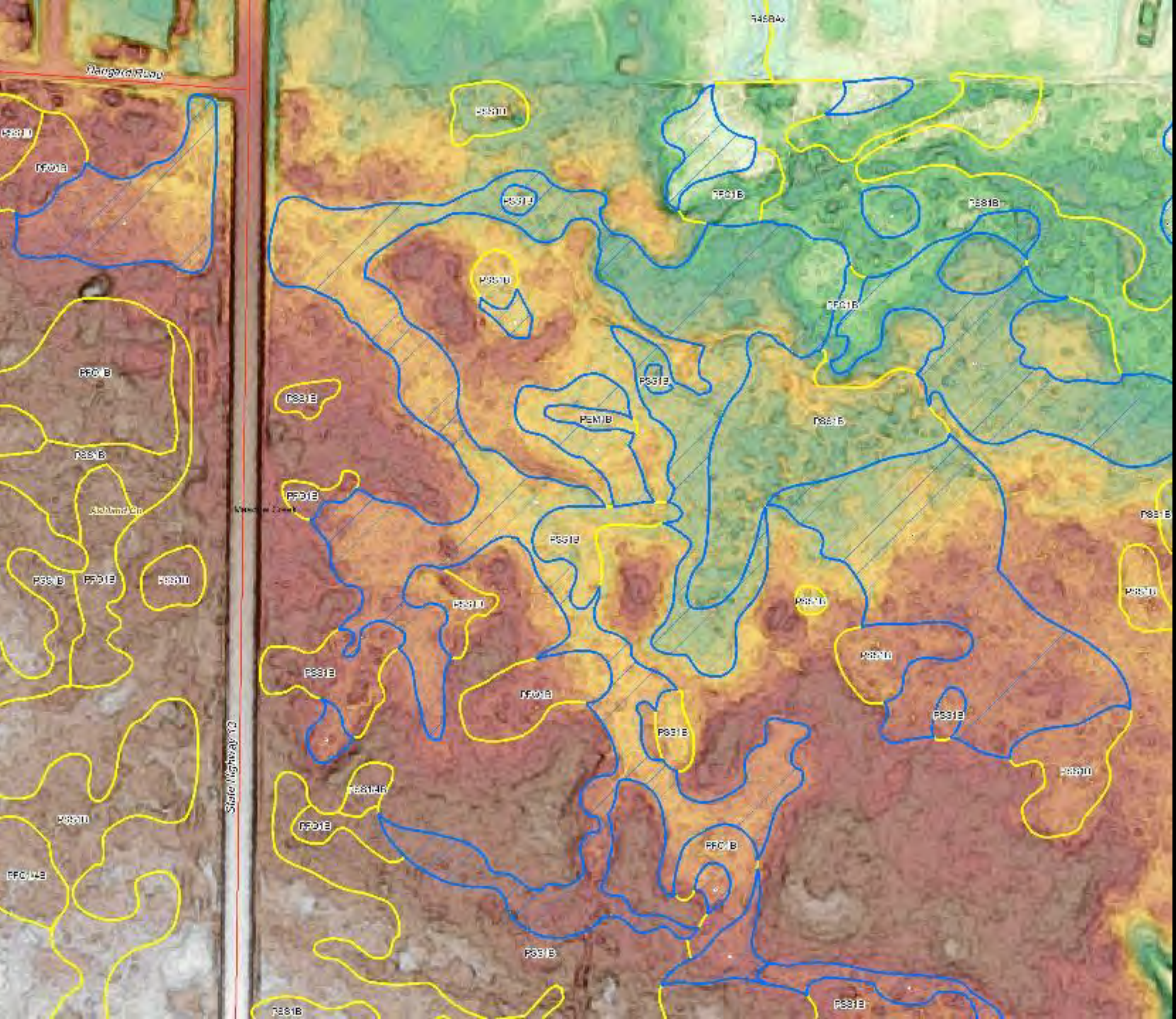


Photo-interpretation Based Boundaries

- Unreliable where FAC Species are dominant!
- Many unmapped areas & missed surface connections
- Topographic inconsistencies



LiDAR Guided Boundary Delineation

- **Reveals significant areas of likely missed wetland (blue outline) and greater connectivity**

Optimally Viewing LiDAR

Optimally Viewing LiDAR

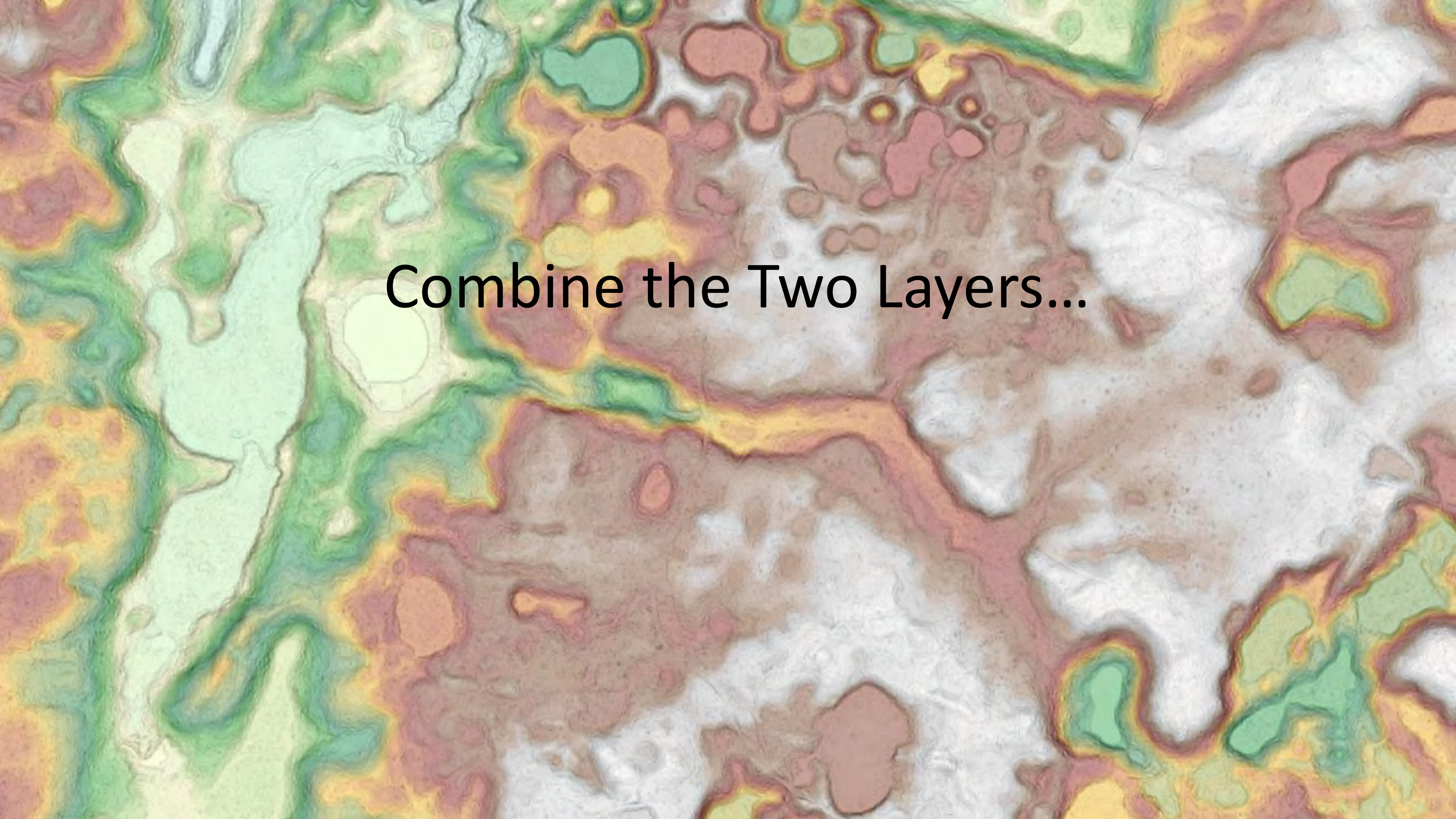
- Apply a hypsometric color ramp to DEM
- Best **Stretch** for *most* areas = **Histogram Equalize**
  - Thresholds out very low and very high values, adds color contrast to flat expanses wetland
  - Some landscapes benefit from Min-Max, custom stretches, or Std Deviation.
  - Don't' be afraid to experiment!
- **Statistics** – "Current Display Extent"
- Set DEM **semi-transparent,** as desired, 40-60%

Optimally Viewing LiDAR

Create a **Slope Raster**

- Apply a grayscale color ramp
  - Low slope values = White
  - High Slope values = Black
- Percent Clip usually works well

- Place slope layer *underneath colorized elevation*



Combine the Two Layers…

Visualized LiDAR + Slope Enhance Topographic Breaks

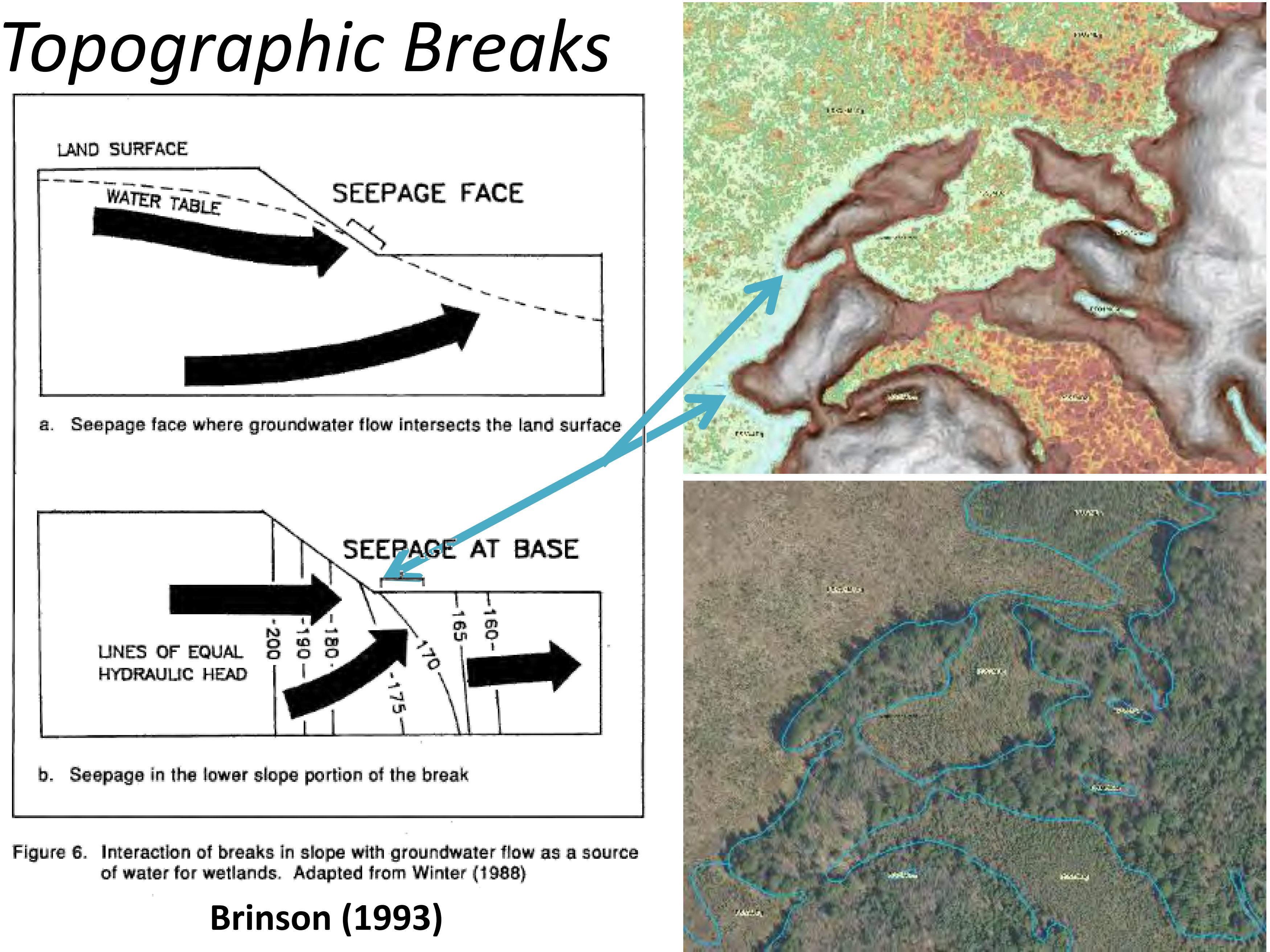
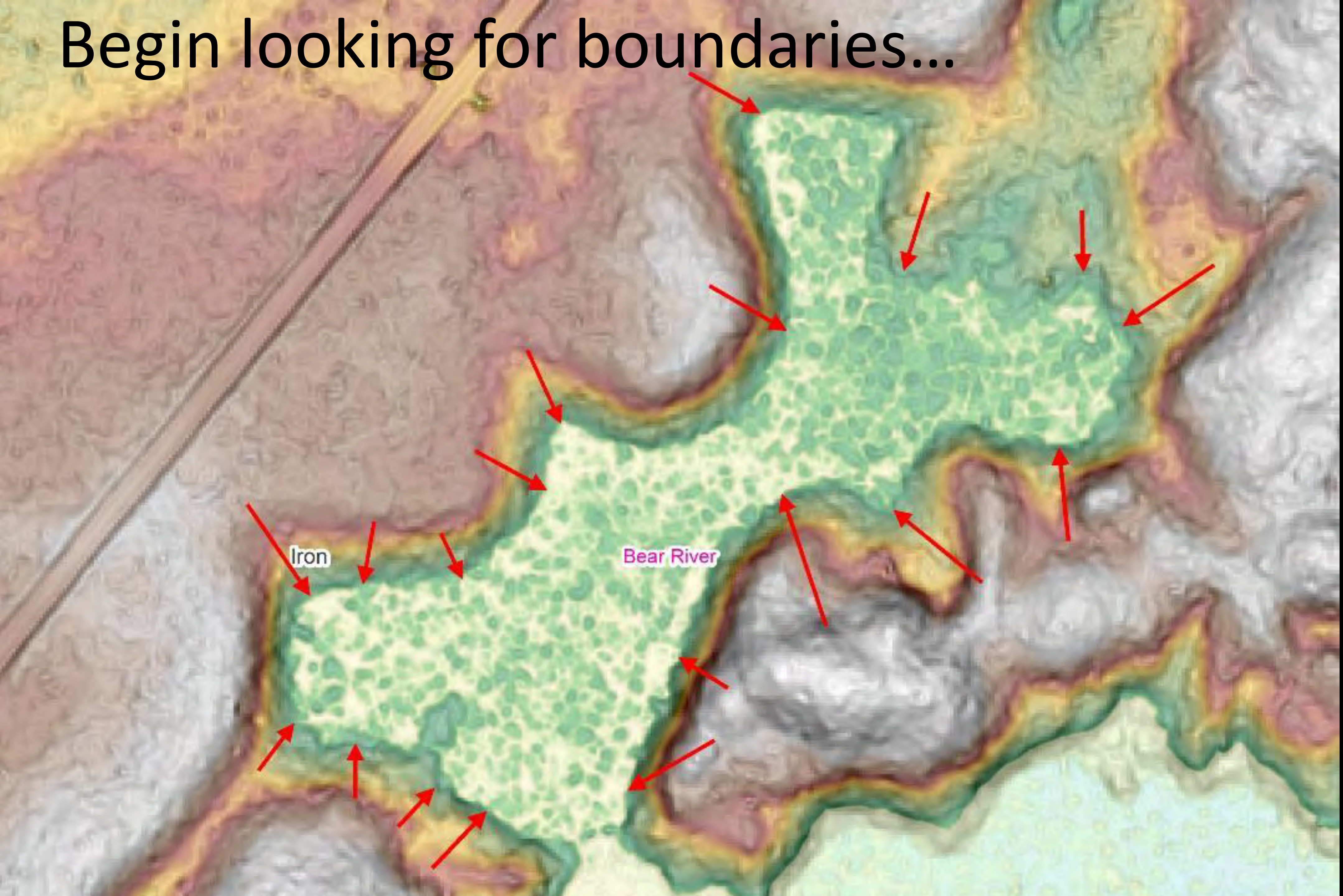


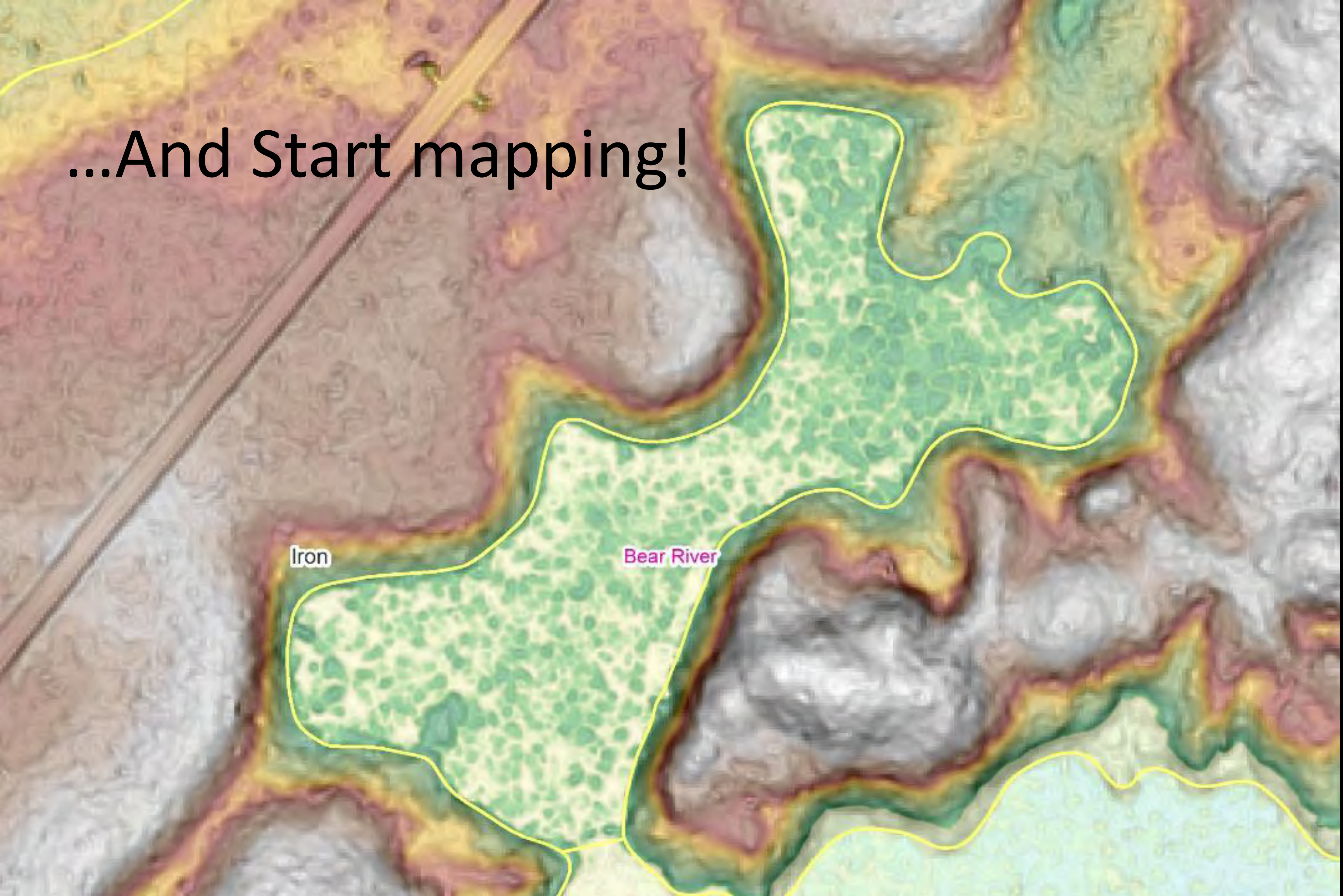
Figure 6. Interaction of breaks in slope with groundwater flow as a source of water for wetlands. Adapted from Winter (1988)

Brinson (1993)

Begin looking for boundaries…



…And Start mapping!



Can’t I just use a Hillshade?

No!

Hillshades are inappropriate visualizations for determining wetland extent. Use them to make pretty maps. Do not use them while drafting new data.

Use SLOPE instead.

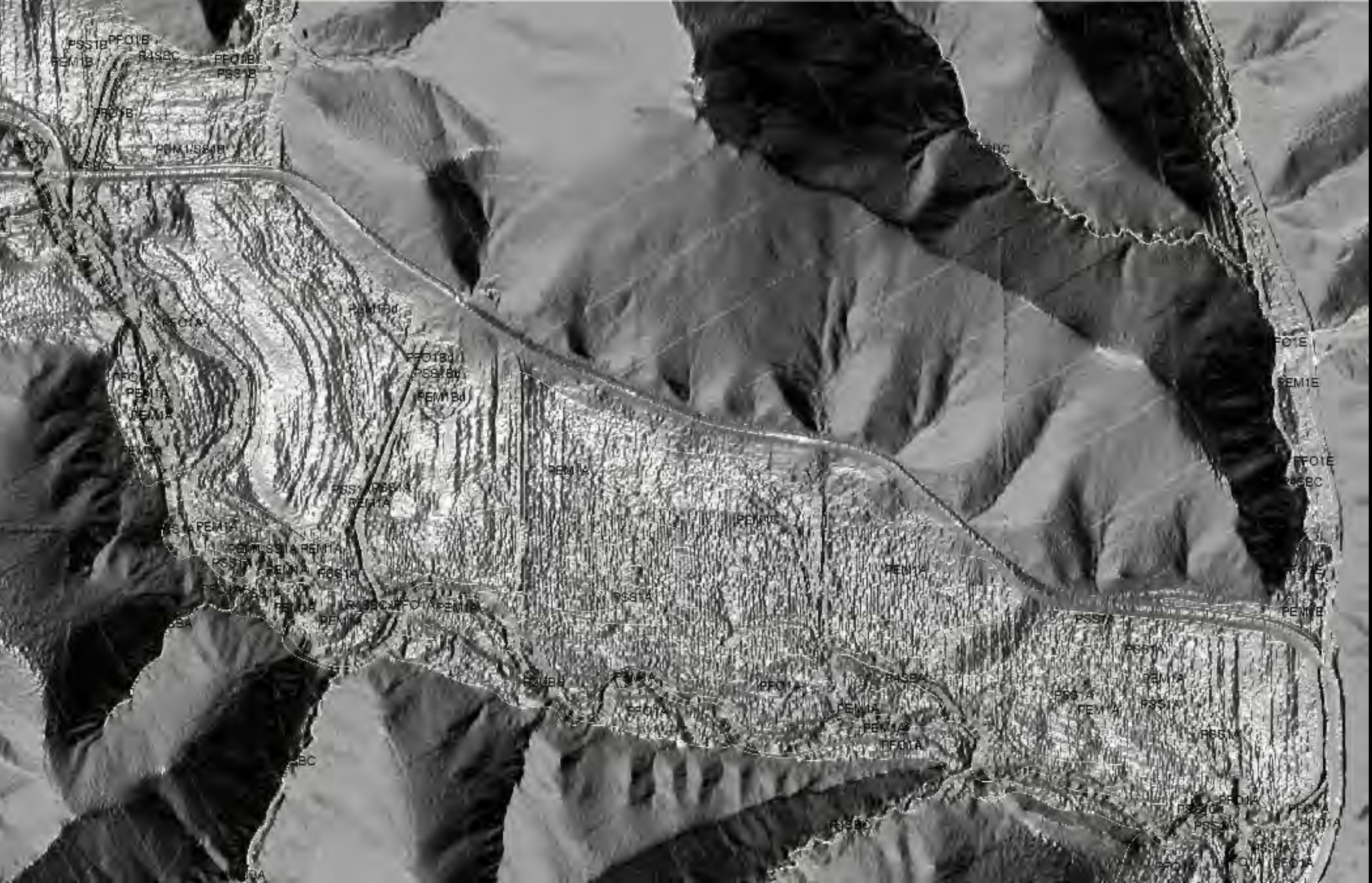
<u>Why?</u>

Hillshades = Product of Modifiable equation simulating sun and shadow to generate derived, unitless values.

Slope = Clearly defined, consistently representable, *and highly relevant to wetland function*. Also allows optimal overlay with bare earth DEM

Vs.

Driftless Area – Vernon Co. Hillshade Representation



Driftless Area – Vernon Co.

Semi-transparent Elevation + Slope Overlay. Stretch = Histogram Equalize, Stats from "Current display extent"

HILLSHADE

vs.

SLOPE + Bare Earth DEM Overlay

Frequently, Cowardin Water Regime Codes *cannot* be accurately assigned using imagery alone. LiDAR helps answer:

What is the wetland's hydrogeomorphology? *Depressional/Riverine* (A, C, and E) *or seepage slope/Organic Soil Flat* (B and D)*?*

https://water-research.net/Waterlibrary/geologicdata/riverinehydrodynamics.pdf

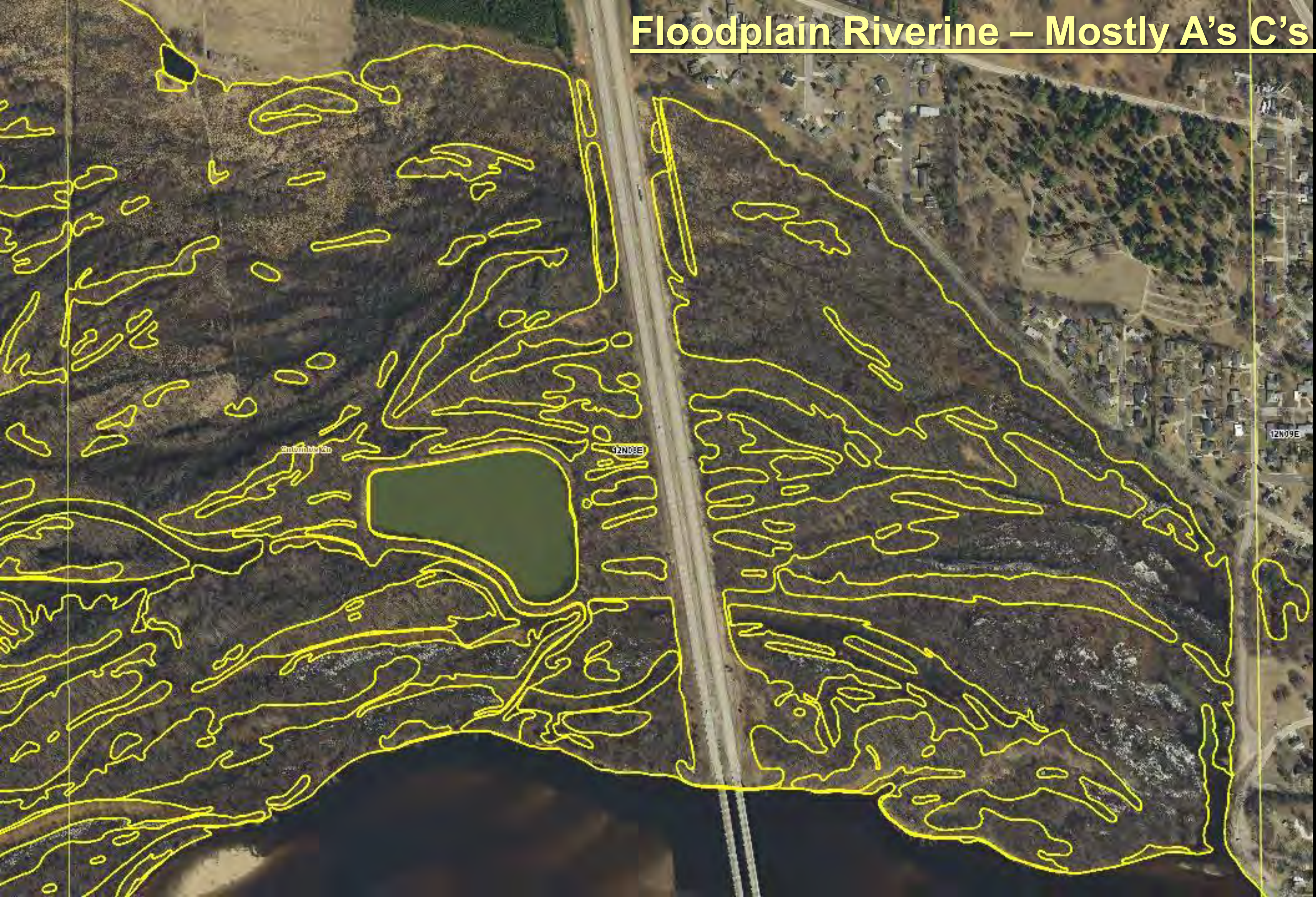
Cowardin Water Regime Modifiers

Do your mapping assumptions “hold water”?

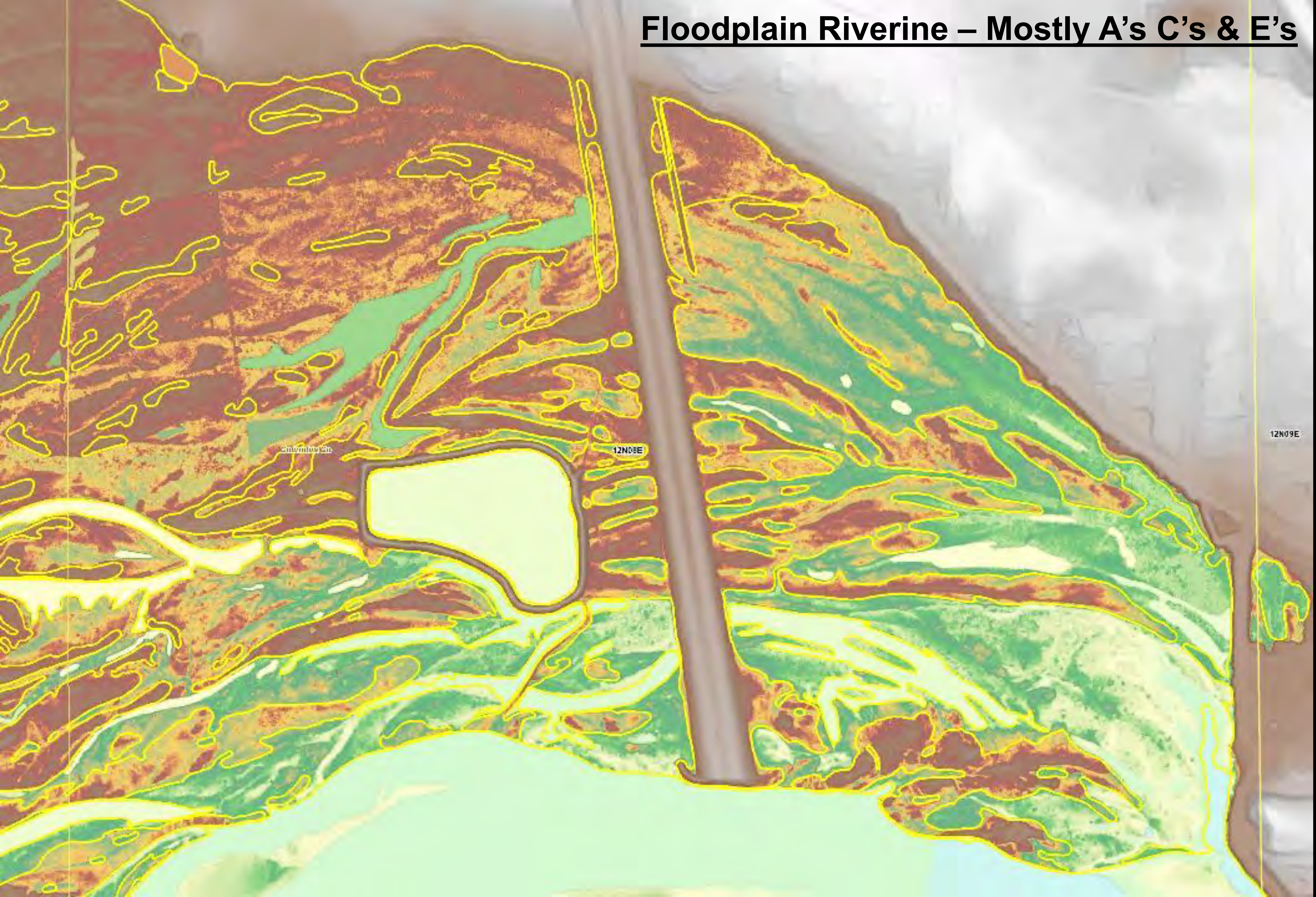
- A, C, & E = Share Periods of Inundation as defining character
  - *Restricted to Bowl Shaped Depressions, Floodplains, impoundments, and other landforms capable of supporting ponded surface water.*

- B & D = Defined by Duration of Saturation *at or near the surface*. Inundation is <u>uncommon</u>
  - *Seepage slopes, organic soil flats, ombrotrophic bogs, floating mats, etc.*

Floodplain Riverine – Mostly A's C's & E's

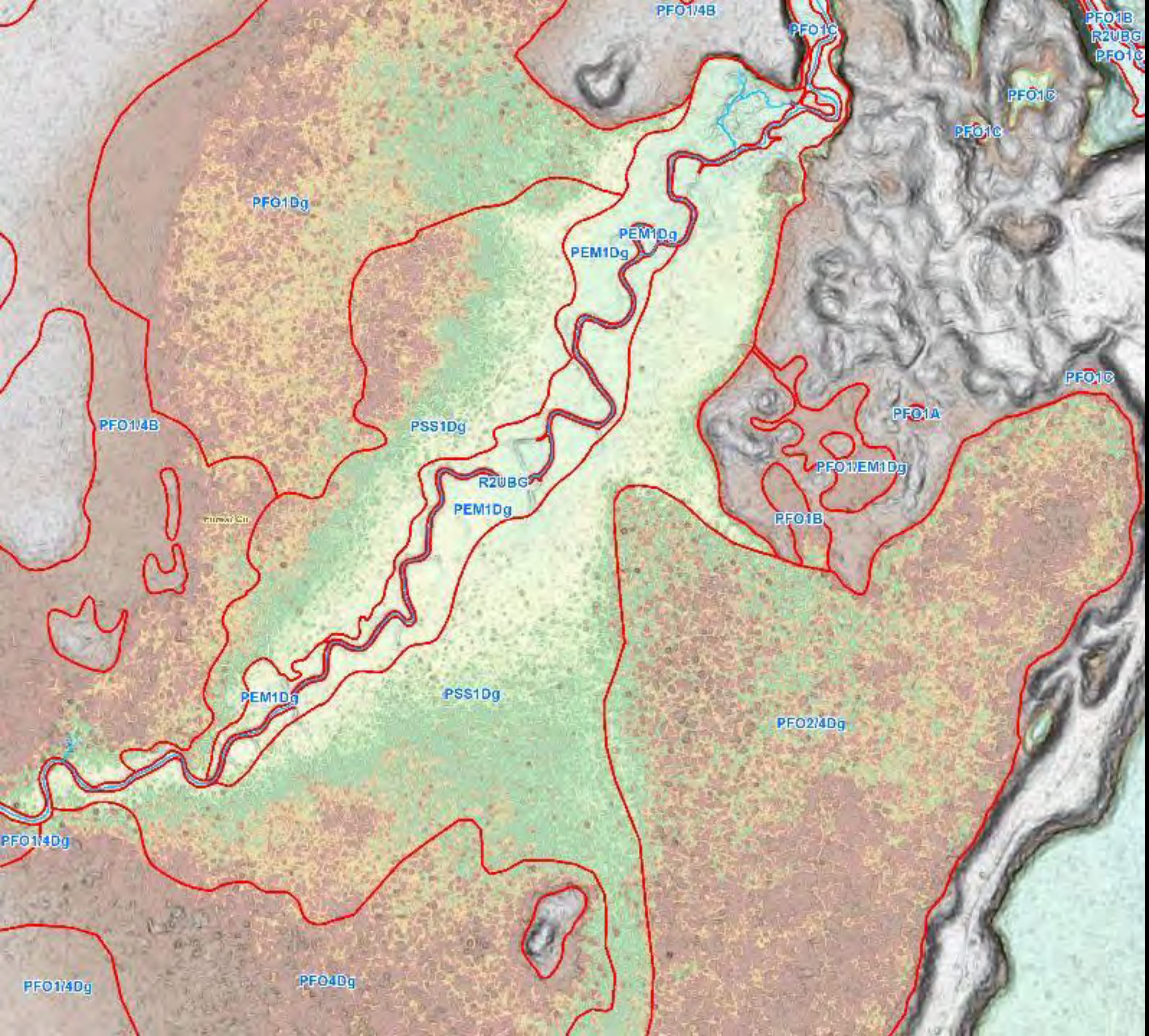


Floodplain Riverine – Mostly A's C's & E's



Organic soil <u>seepage slope wetlands</u> bisected by a perennial river (Forest Co, WI)

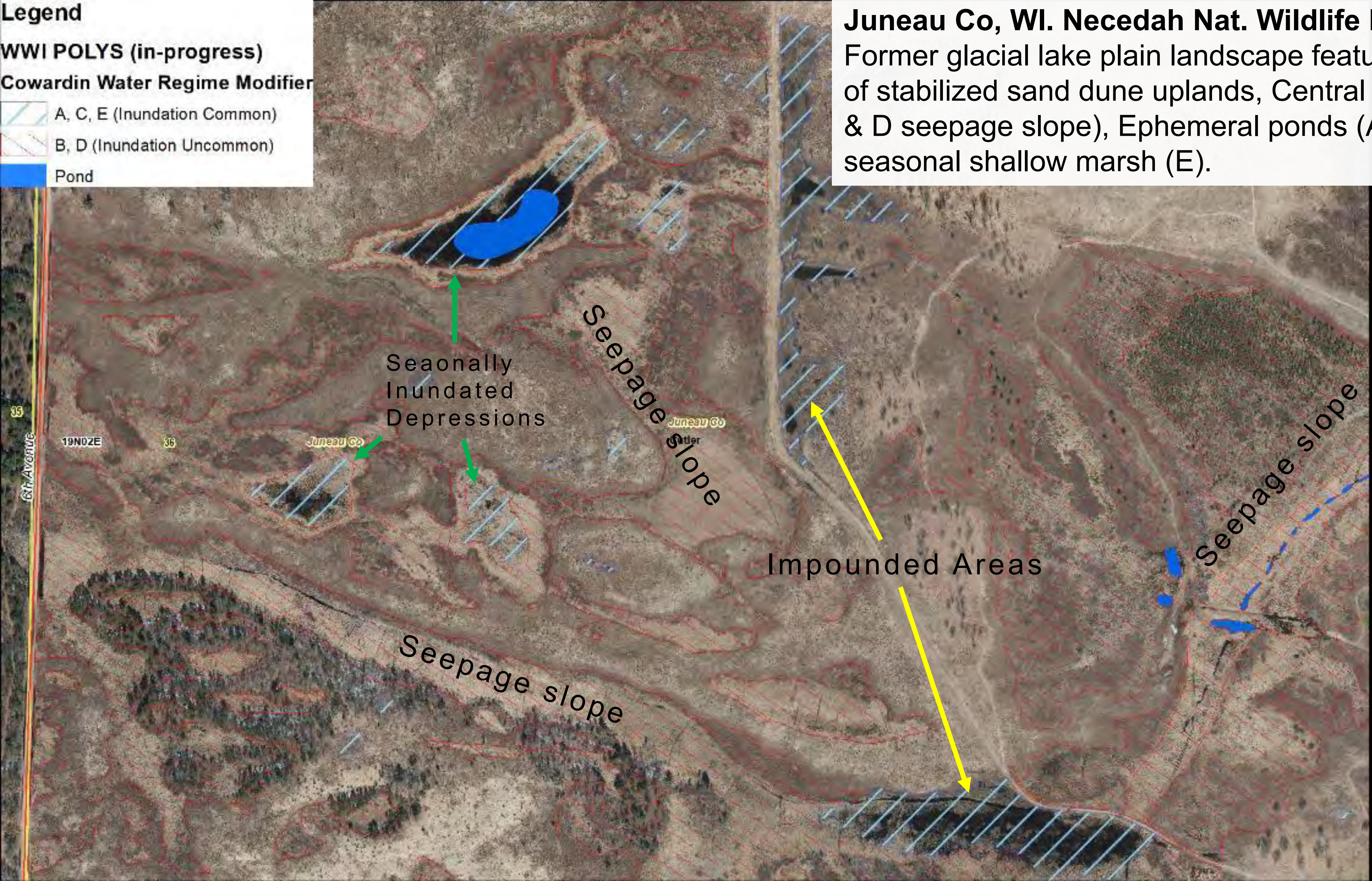
- **Mostly D water regime, few B's on upper flanks**



Organic soil <u>seepage slope wetlands</u> bisected by a perennial river (Forest Co, WI)

- **Mostly D water regime, few B's on upper flanks**
- ***Not a floodplain!***
  - **Groundwater fed, sloped terrain can't hold standing water**
  - **Floods rare & too short in duration**

Juneau Co, WI. Necedah Nat. Wildlife Refuge.
Former glacial lake plain landscape featuring a mosaic of stabilized sand dune uplands, Central Poor Fen (B & D seepage slope), Ephemeral ponds (A’s & C’s) and seasonal shallow marsh (E).



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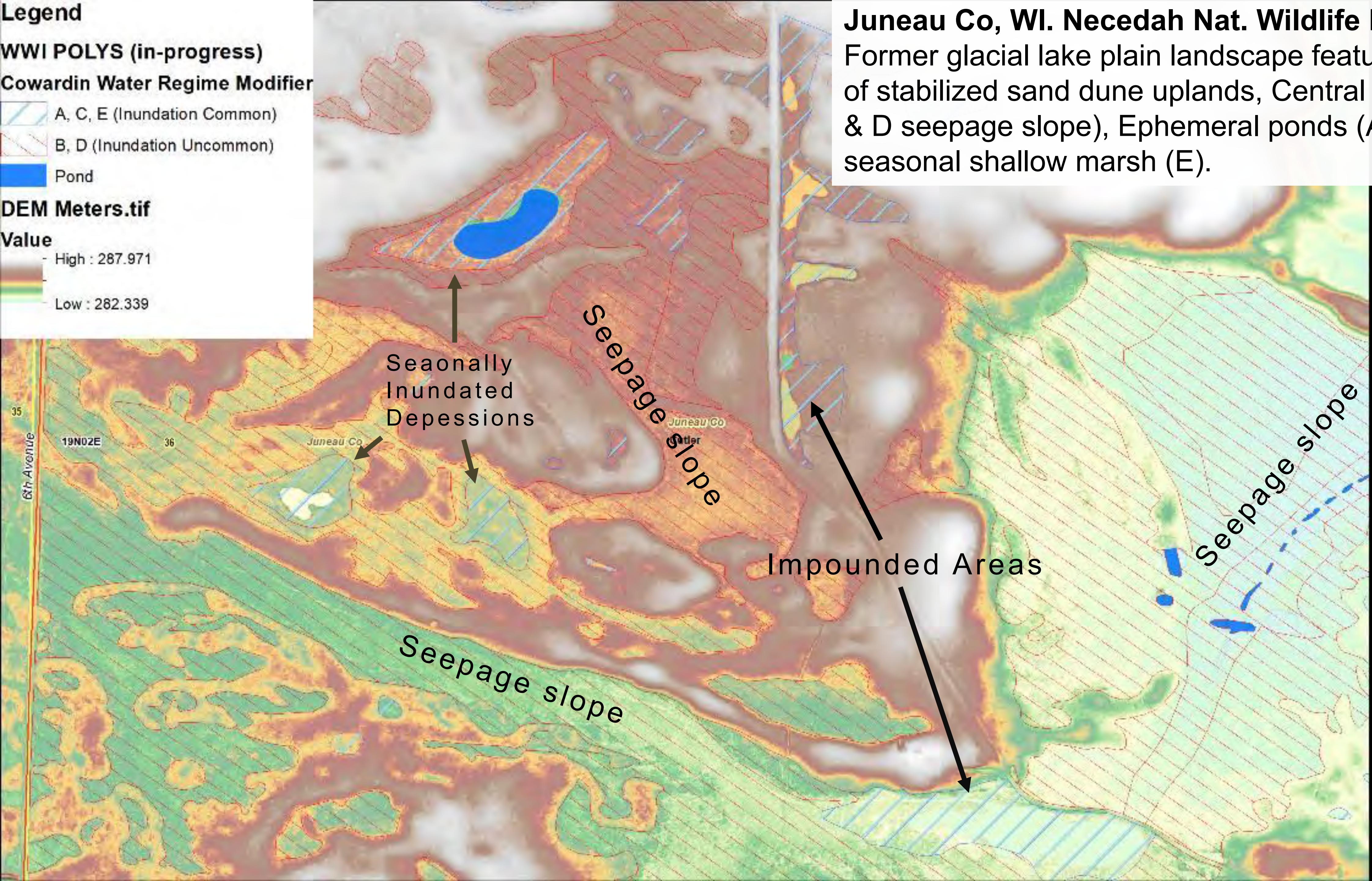
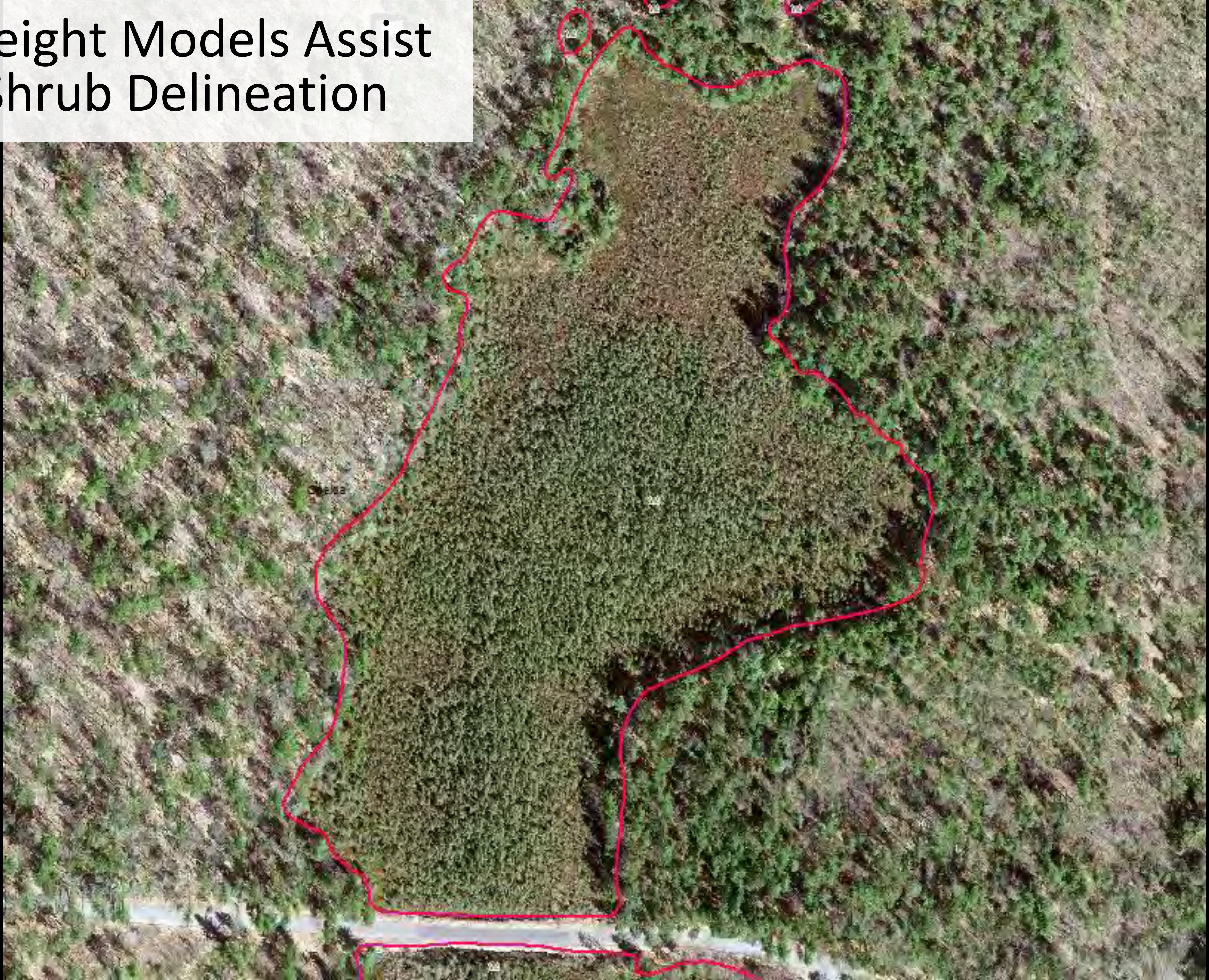


Canopy Height Models Assist Tree & Shrub Delineation

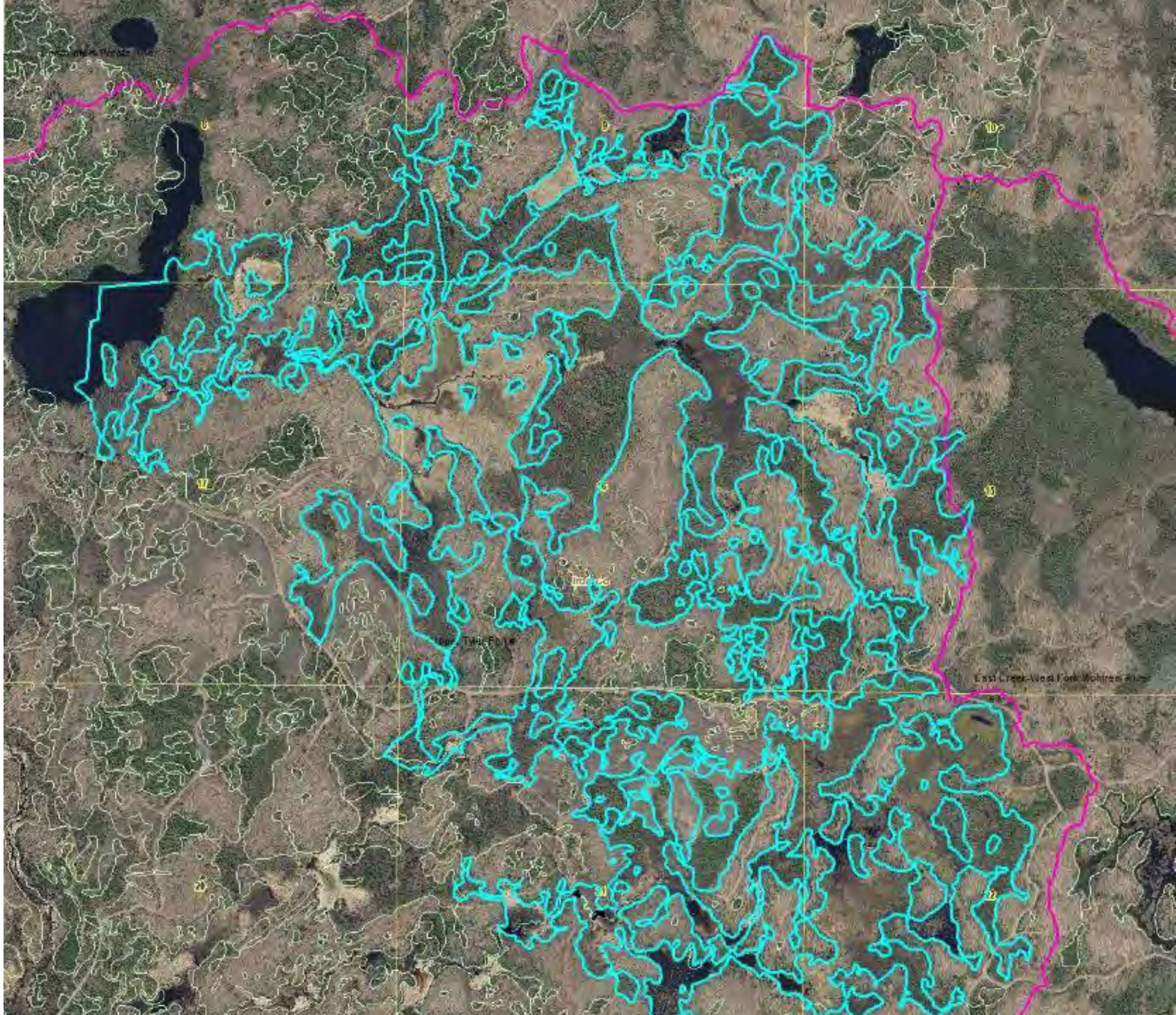


Digital Surface Model (DSM) *minus* Bare Earth DEM = Vegetation Height

PSS3/4Dg & PSS4Dg

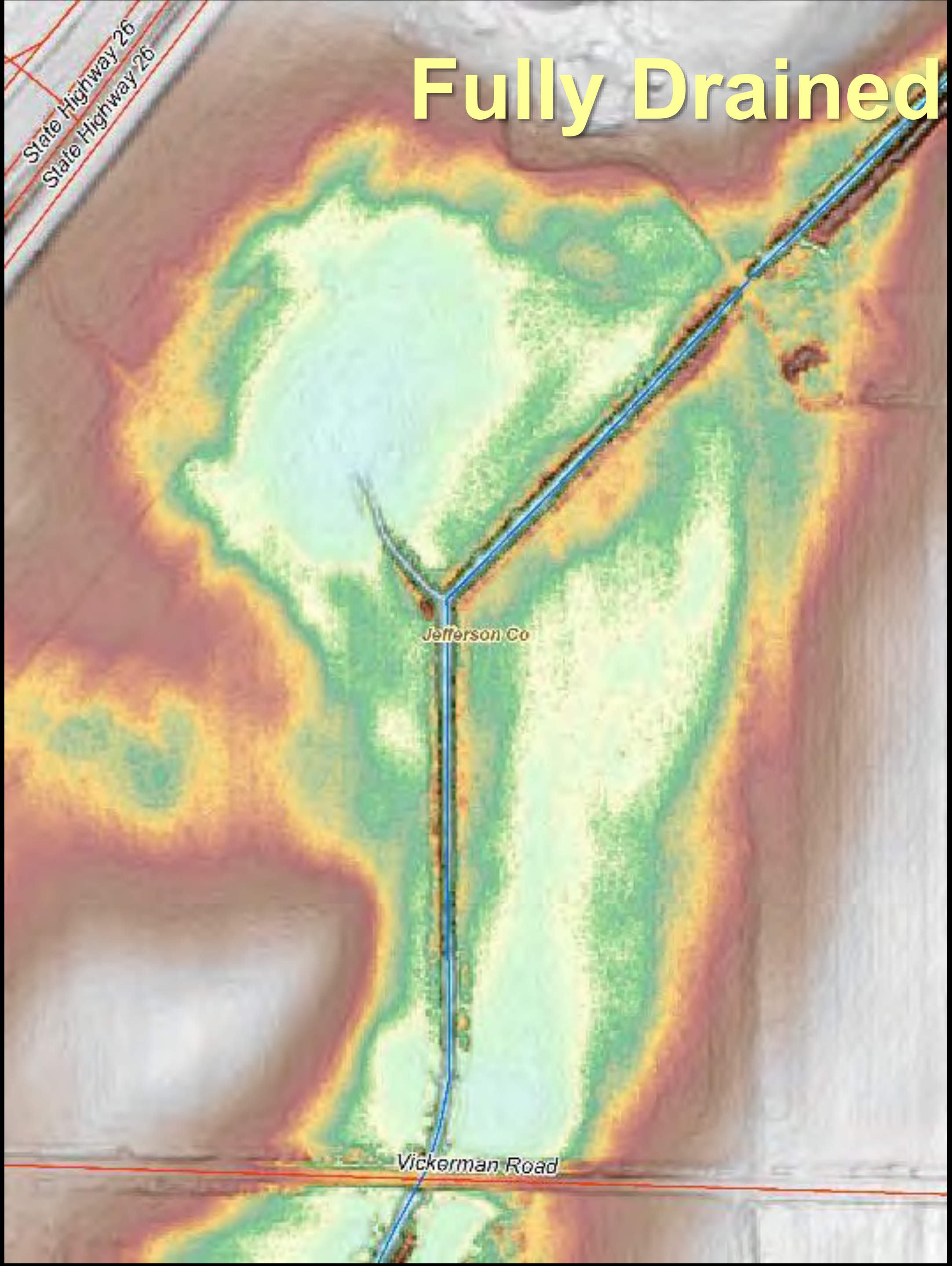
(Superior Data + Defensible linework) > “Eyeballing It”

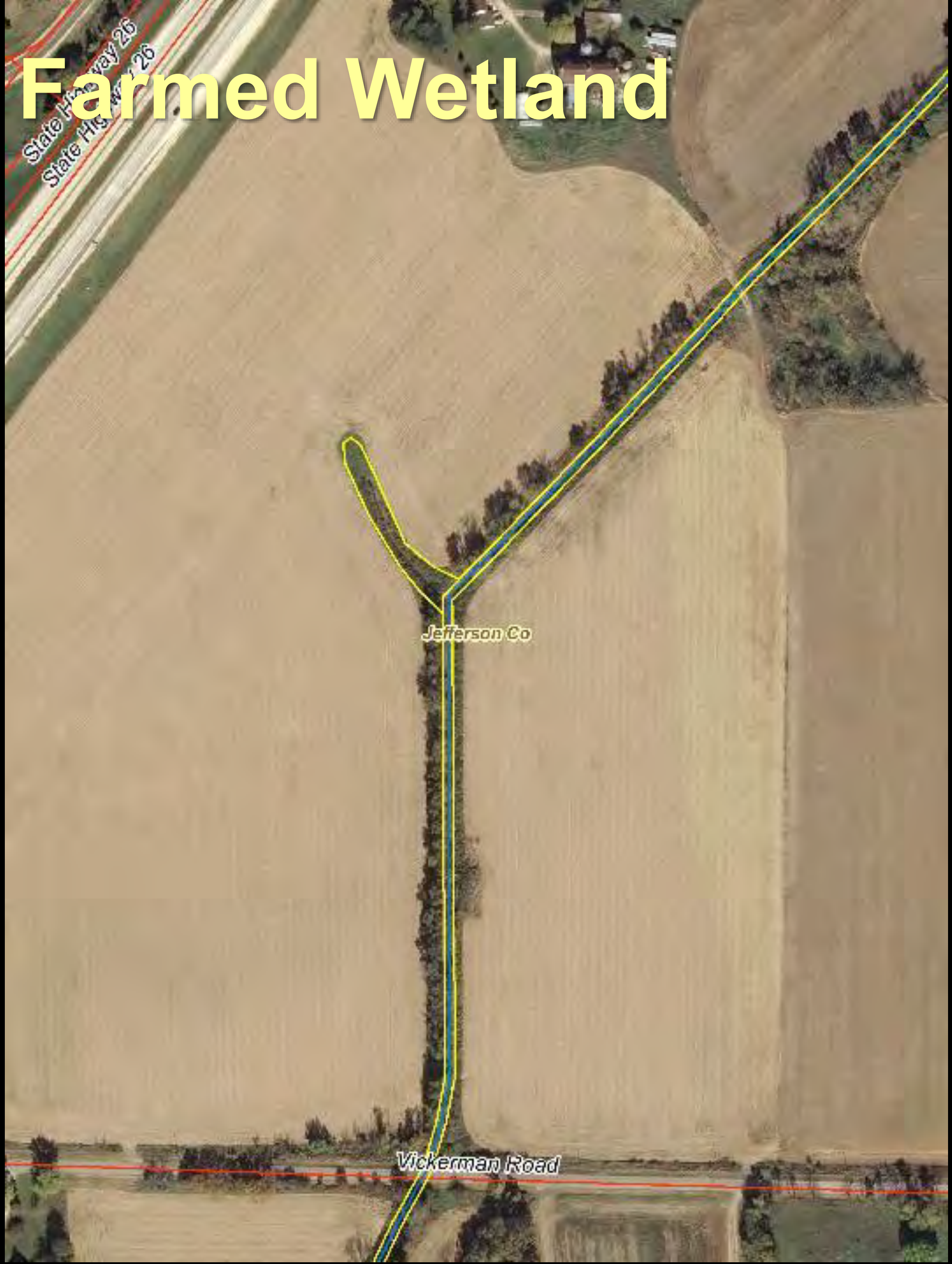
Without LiDAR, you will probably miss a great deal of wetland surface connections.



LiDAR will lead you astray if over-relied upon and not applied with a cohesive understanding of the landscape. Interpretation of good primary imagery is still a must.

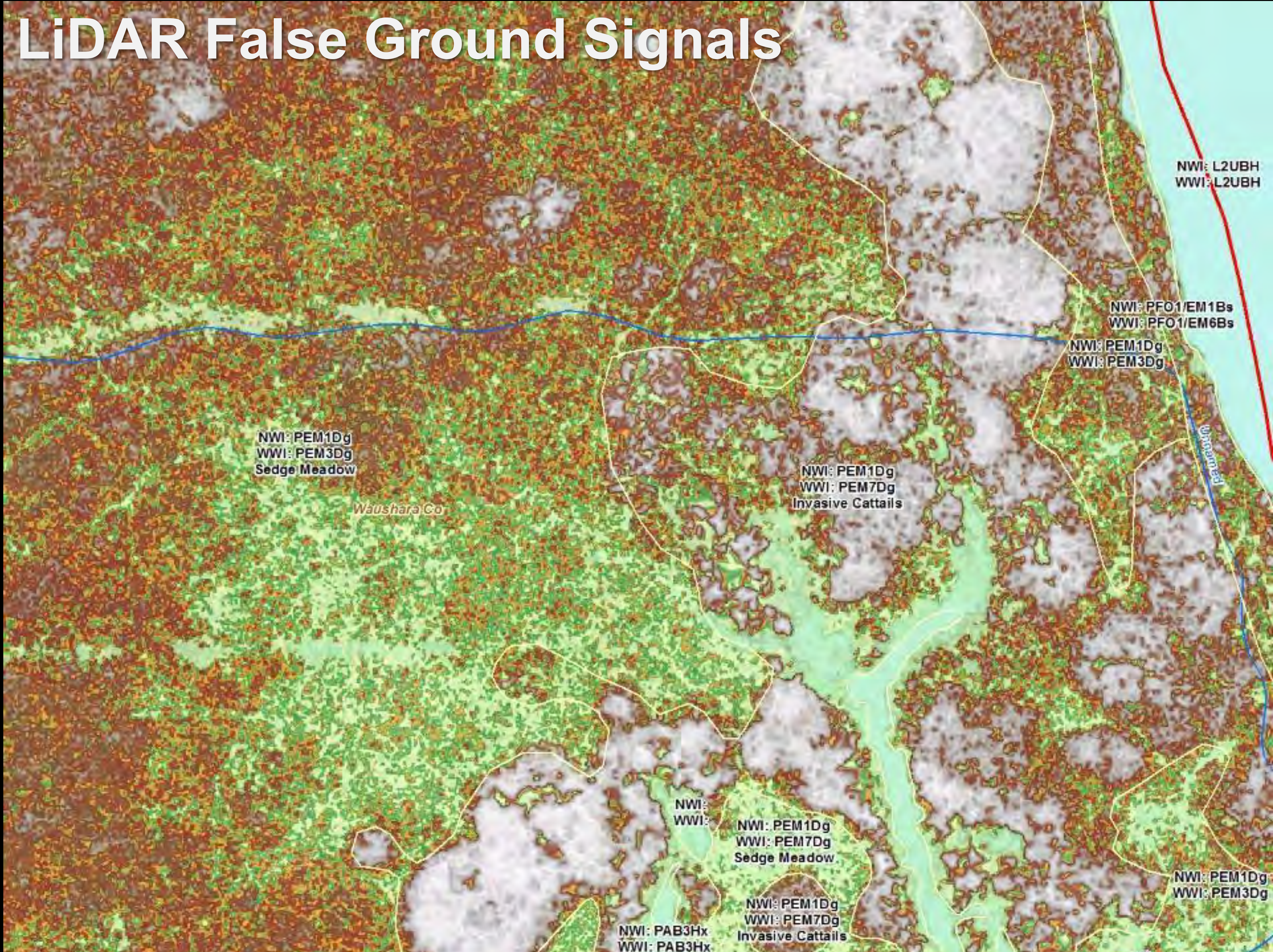
Fully Drained & Farmed Wetland





LiDAR False Ground Signals

Dense vegetation litter prevents laser from reaching ground, may appear as upland

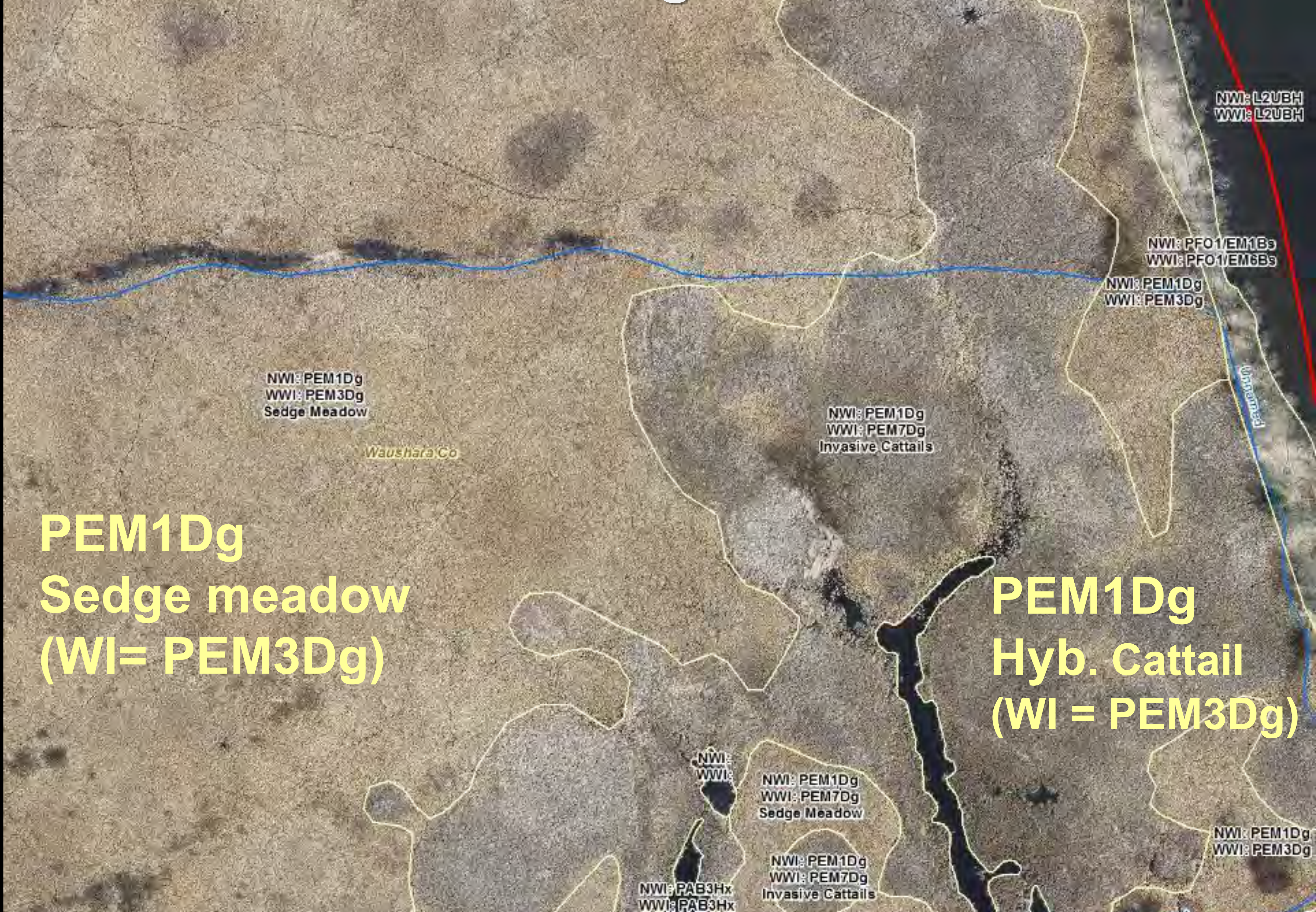


LiDAR False Ground Signals

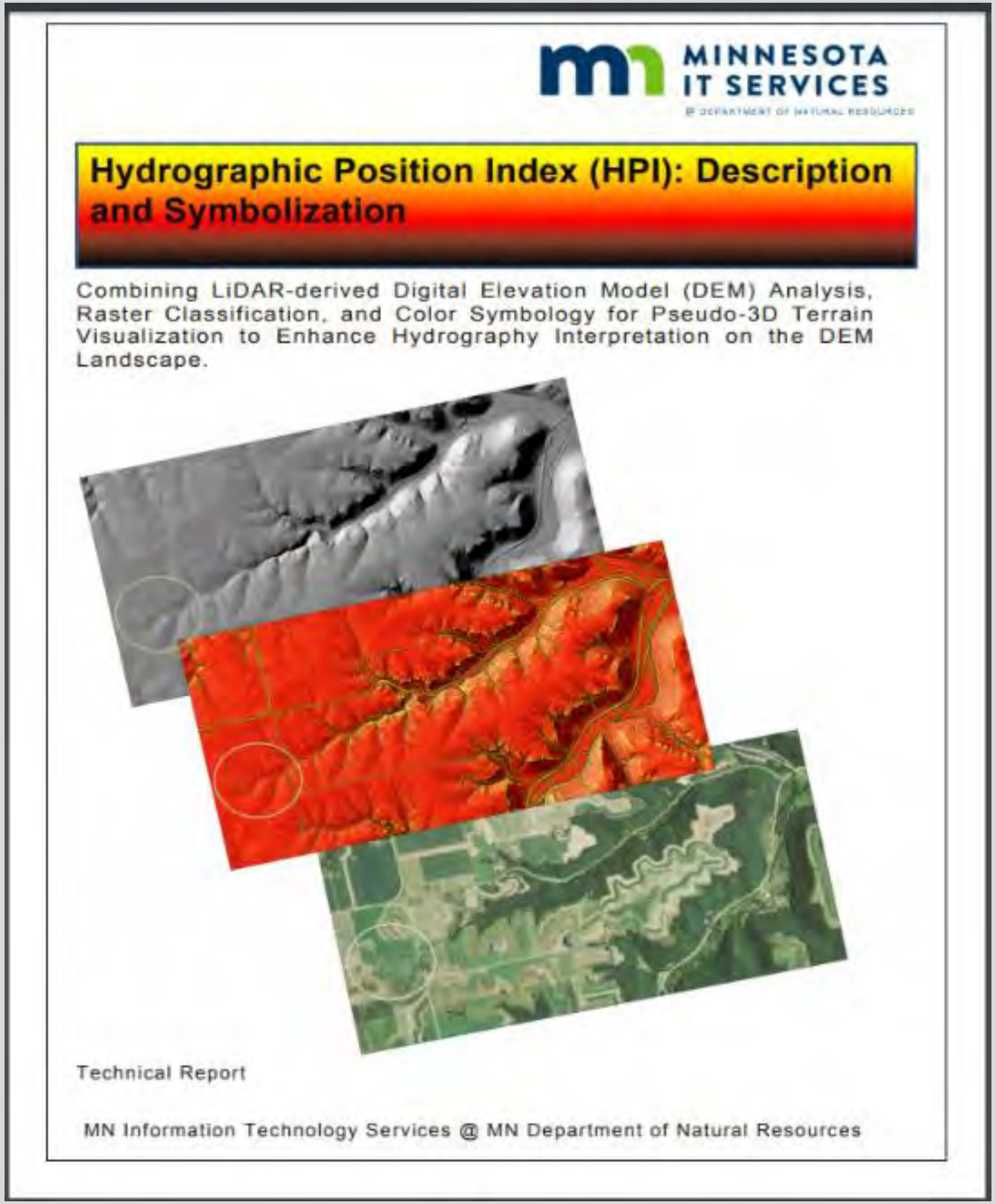
If understood, signals can also be used as a feature, not a bug

Separating native wetland veg from invading hybrid cattail

Similar application for *Phragmities* (EM5)



Seek them out, but visually proof each feature before incorporating into a map!


MINNESOTA IT SERVICES
@ DEPARTMENT OF NATURAL RESOURCES

Hydrographic Position Index (HPI): Description and Symbolization

Combining LiDAR-derived Digital Elevation Model (DEM) Analysis, Raster Classification, and Color Symbology for Pseudo-3D Terrain Visualization to Enhance Hydrography Interpretation on the DEM Landscape.

Technical Report

MN Information Technology Services @ MN Department of Natural Resources

Hydrographic Position Index

Terrain normalization & Visualization highlights *potential* flow paths

Vaughn, S.R., (2017). Hydrographic Position Index - Description and Symbolization. Technical manuscript. MNIT at Minnesota Department of Natural Resources – Ecological and Water Resources.

http://www.mngeo.state.mn.us/chouse/elevation/HPI_Description_and_Symbolization.pdf

HPI Opportunities

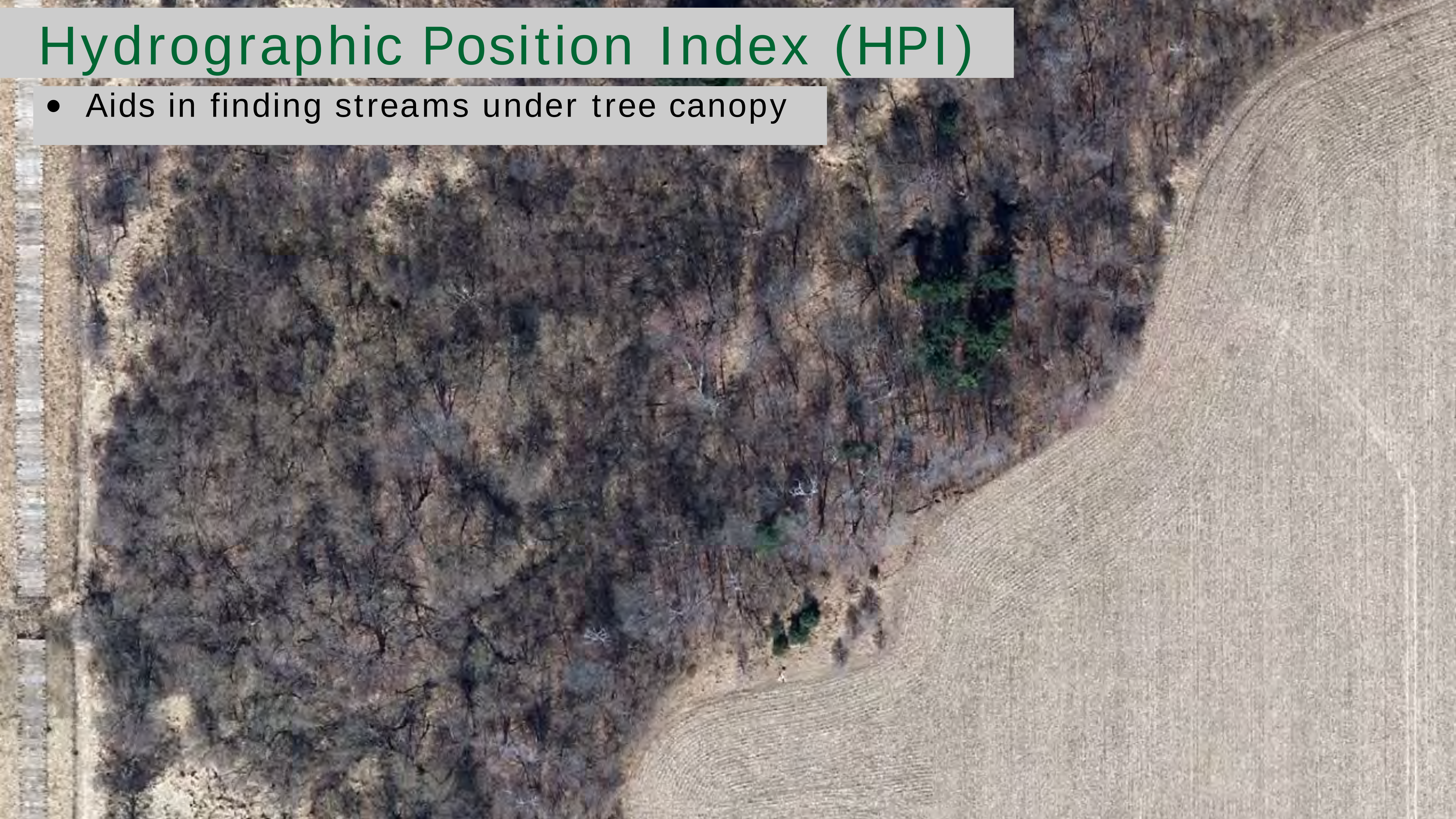
- Helps find narrow incised streams, ditches
  - Especially in areas of dense tree canopy

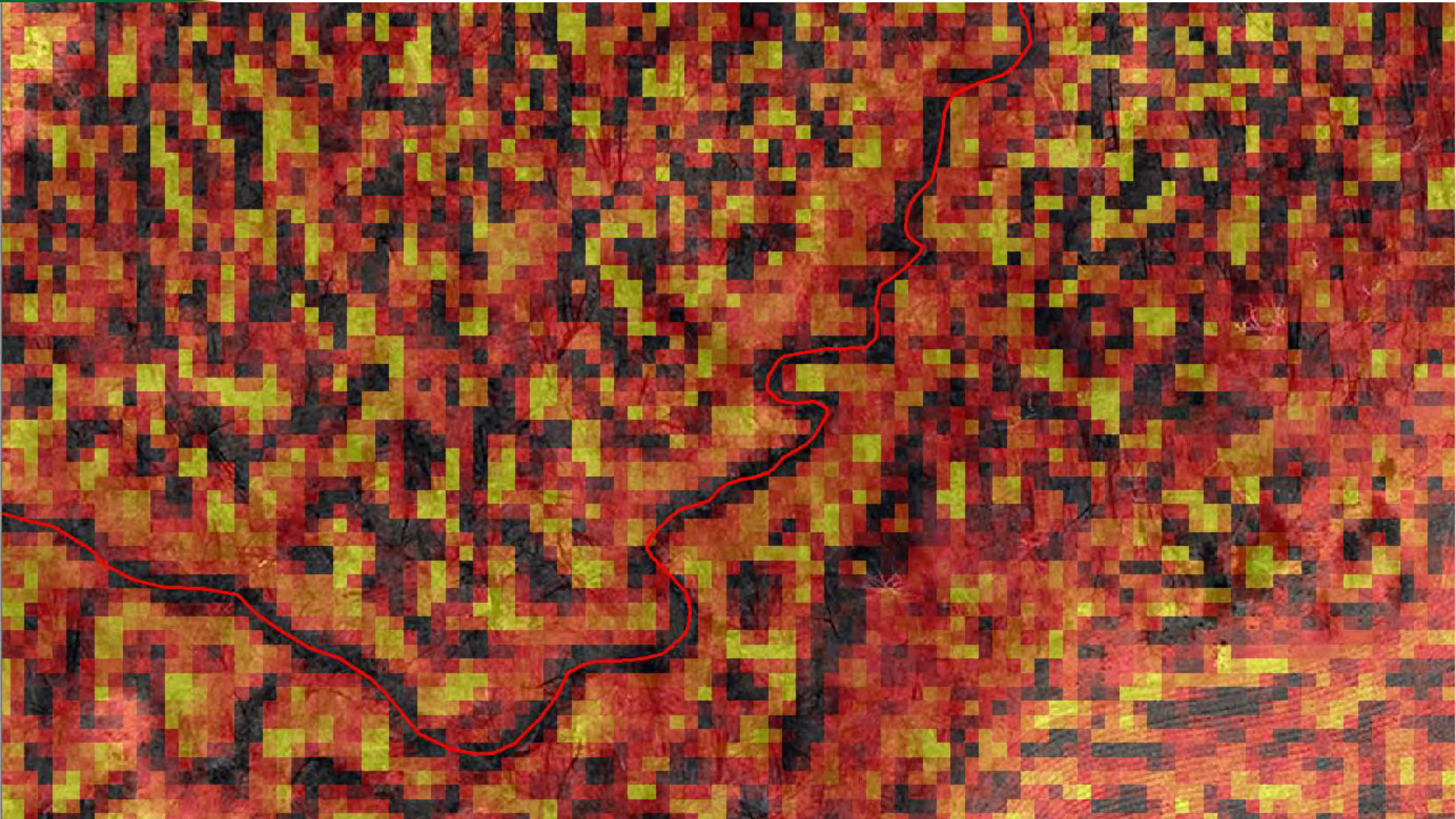
- Supplement LiDAR hydro break-lines with semi-automatically produced* riverine centerlines & polygons.

  *under ideal landscape circumstances

Hydrographic Position Index (HPI)

- Aids in finding streams under tree canopy

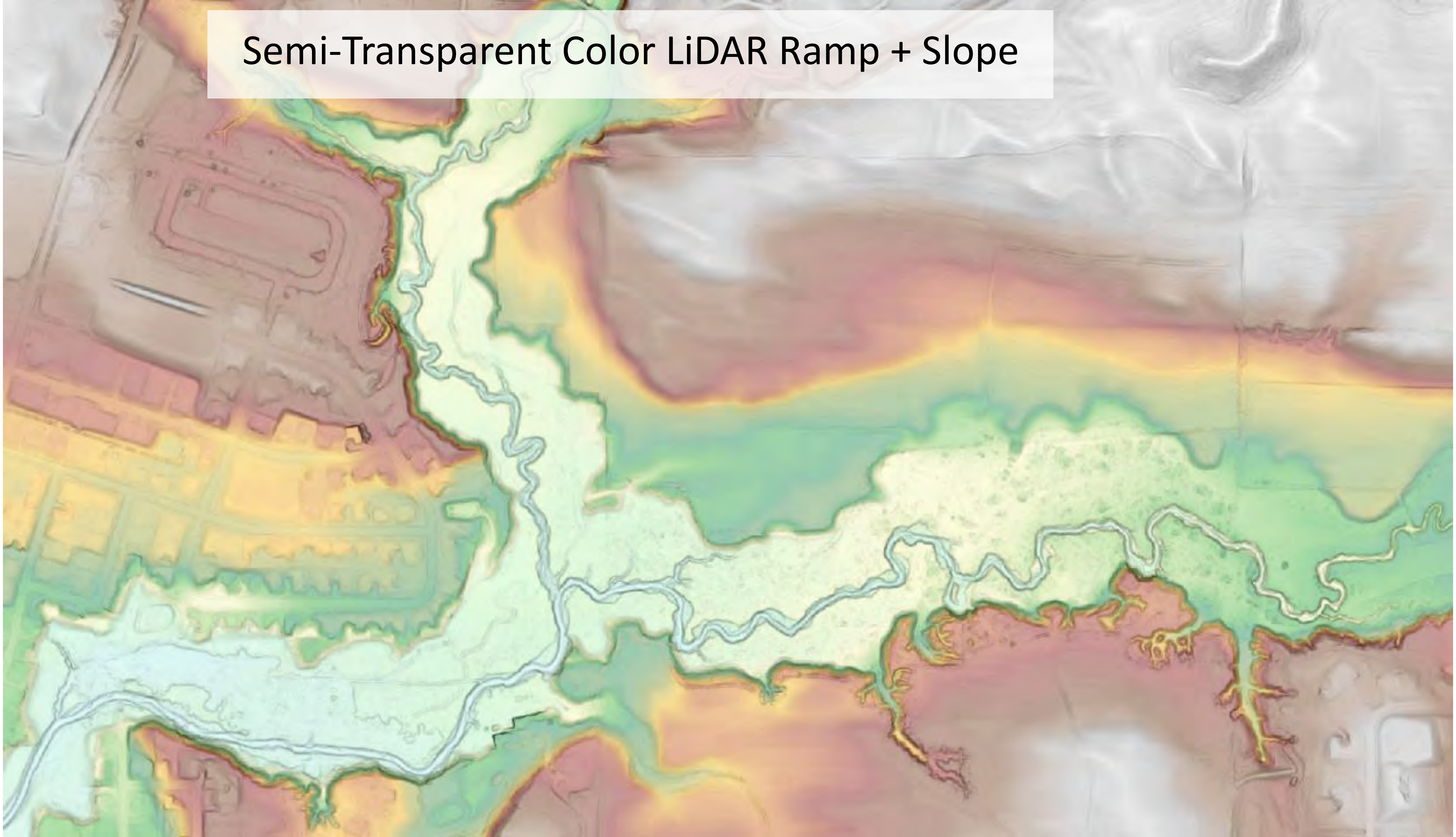




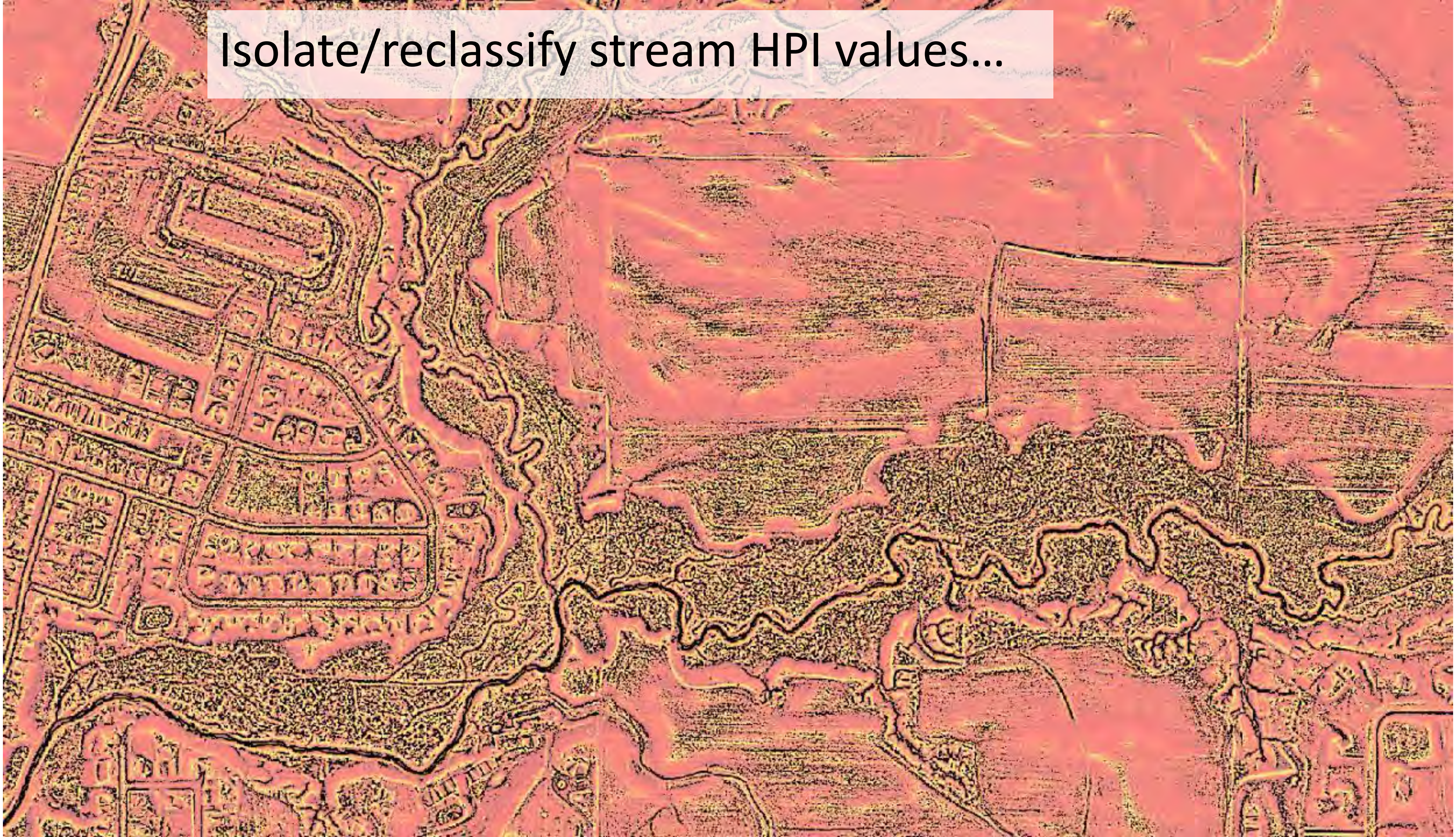

PFO1/SS1B
PFO1/4Bd
PFO1/4Bd
PEM1B


La Crosse Co.

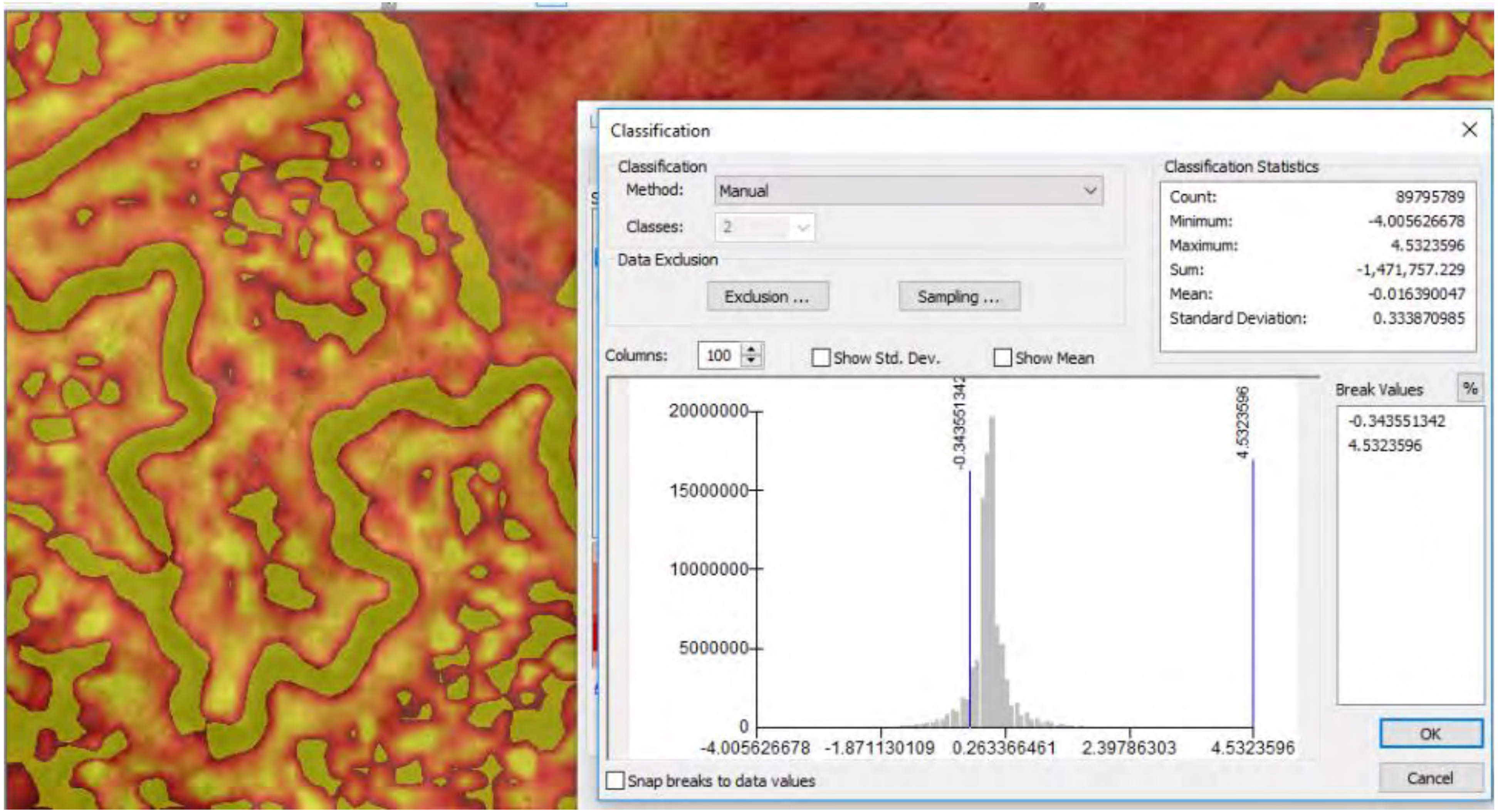
Semi-Transparent Color LiDAR Ramp + Slope



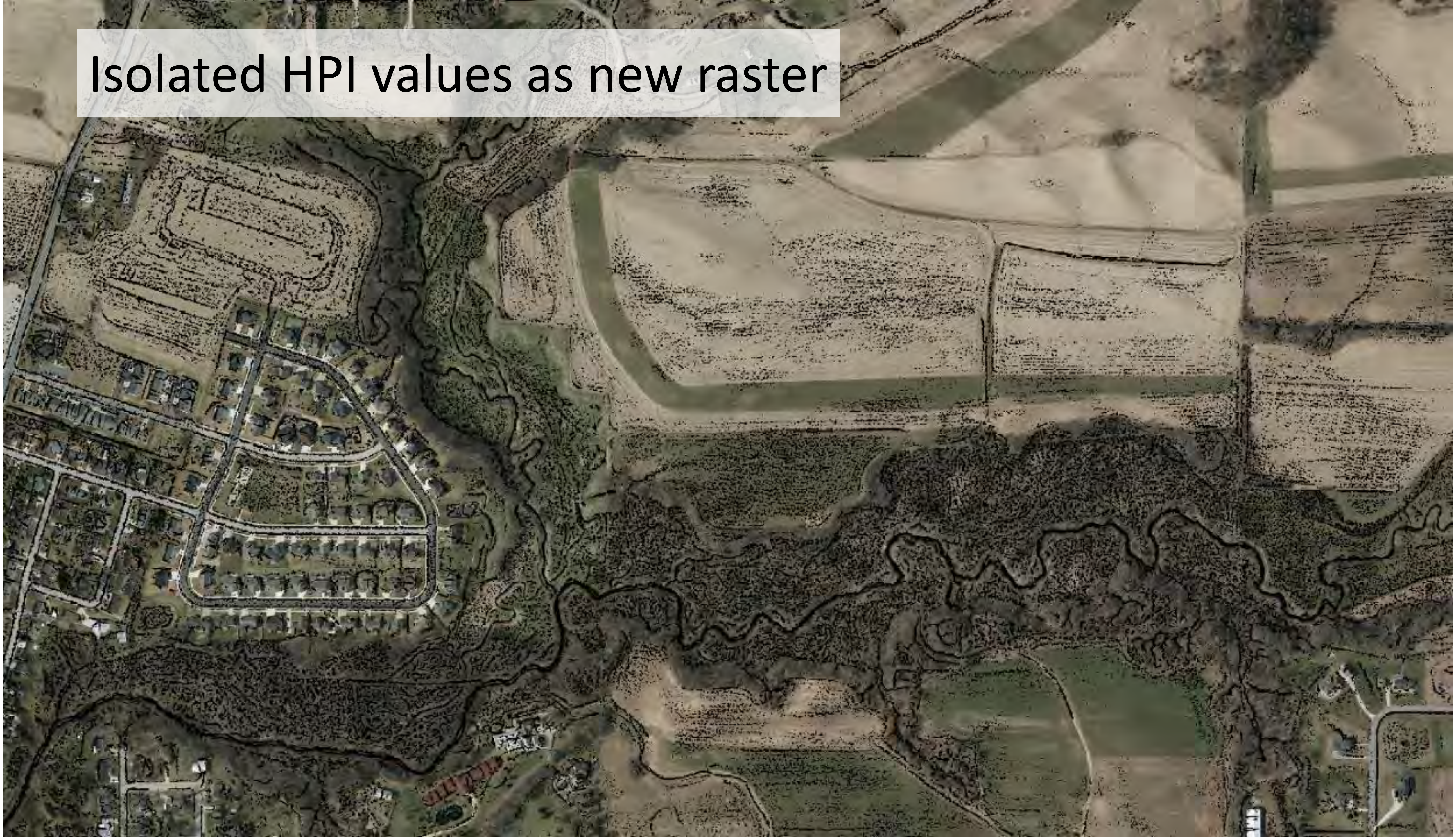
Isolate/reclassify stream HPI values…



Reclassify HPI for streambed

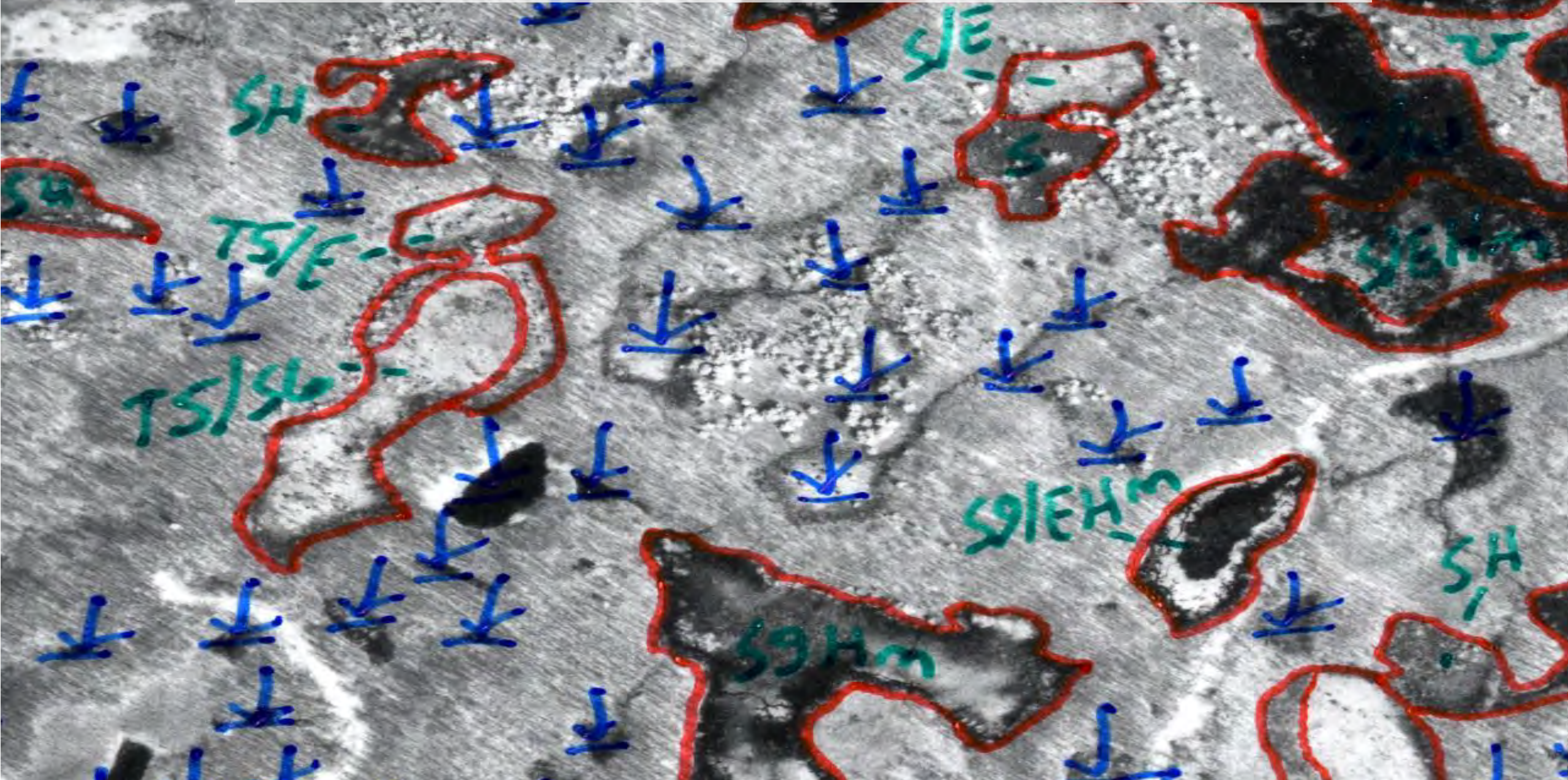


Isolated HPI values as new raster

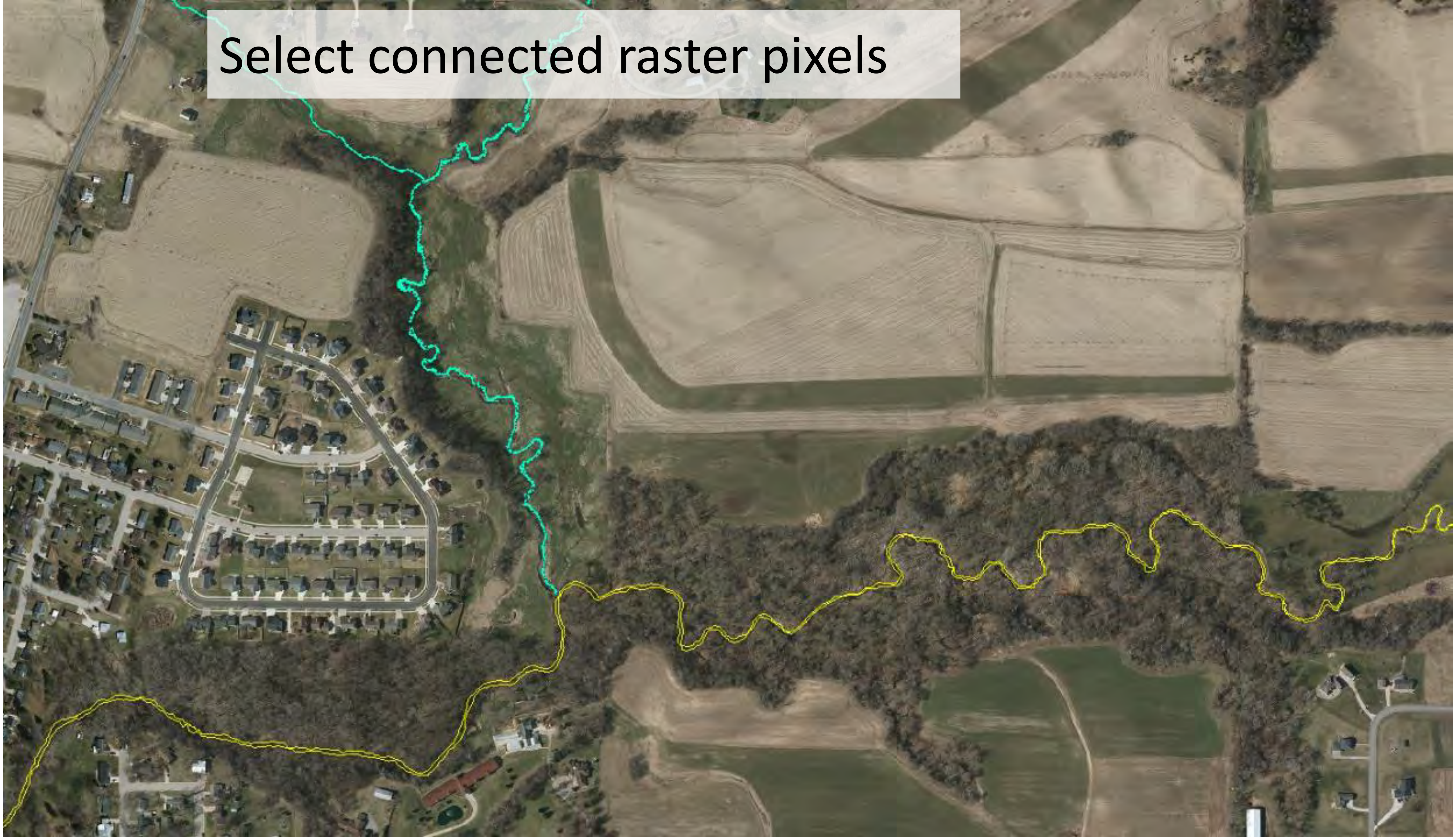


ArcScan, Select connected pixels…

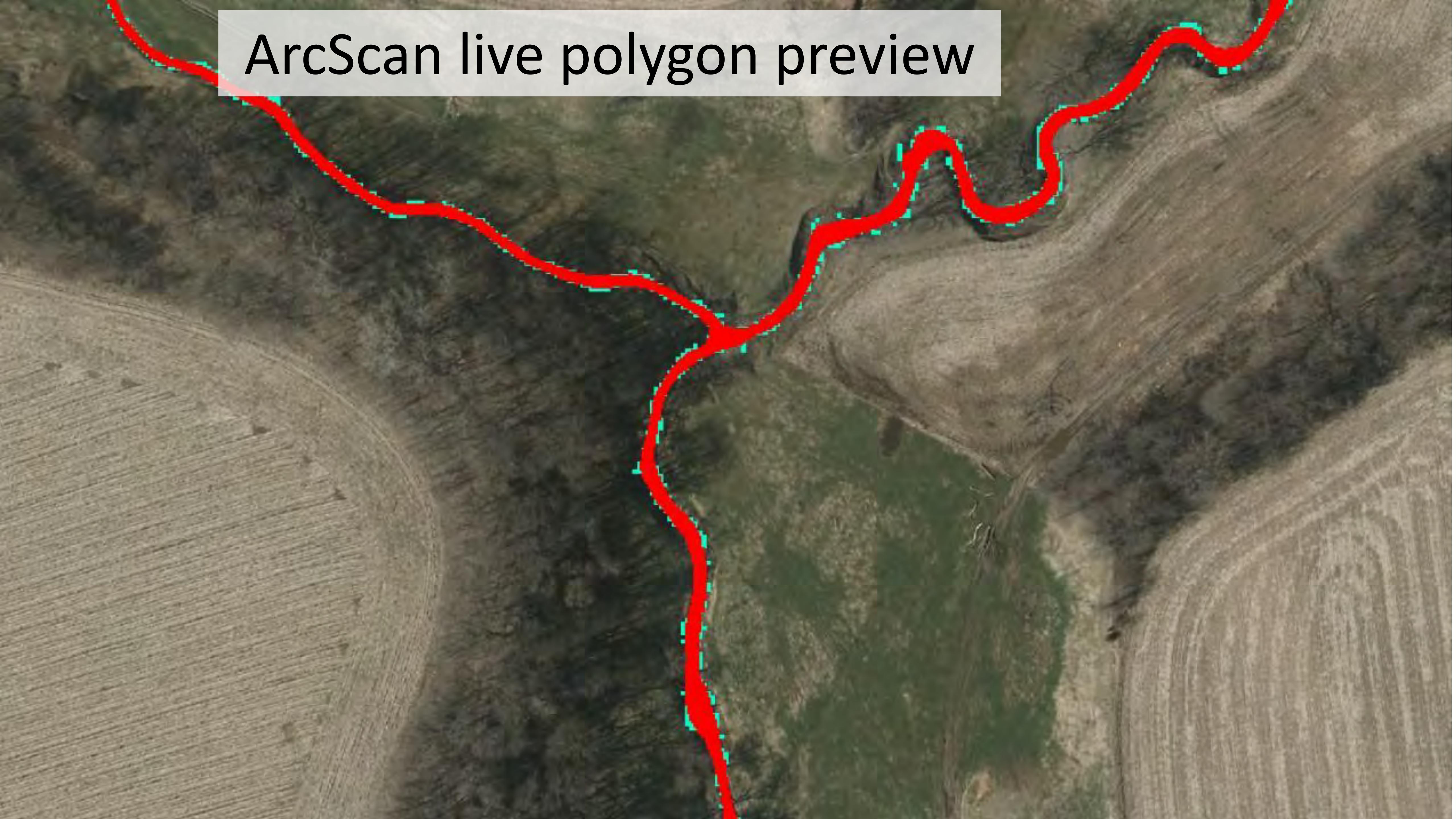
ArcScan previously used to vectorize red lines



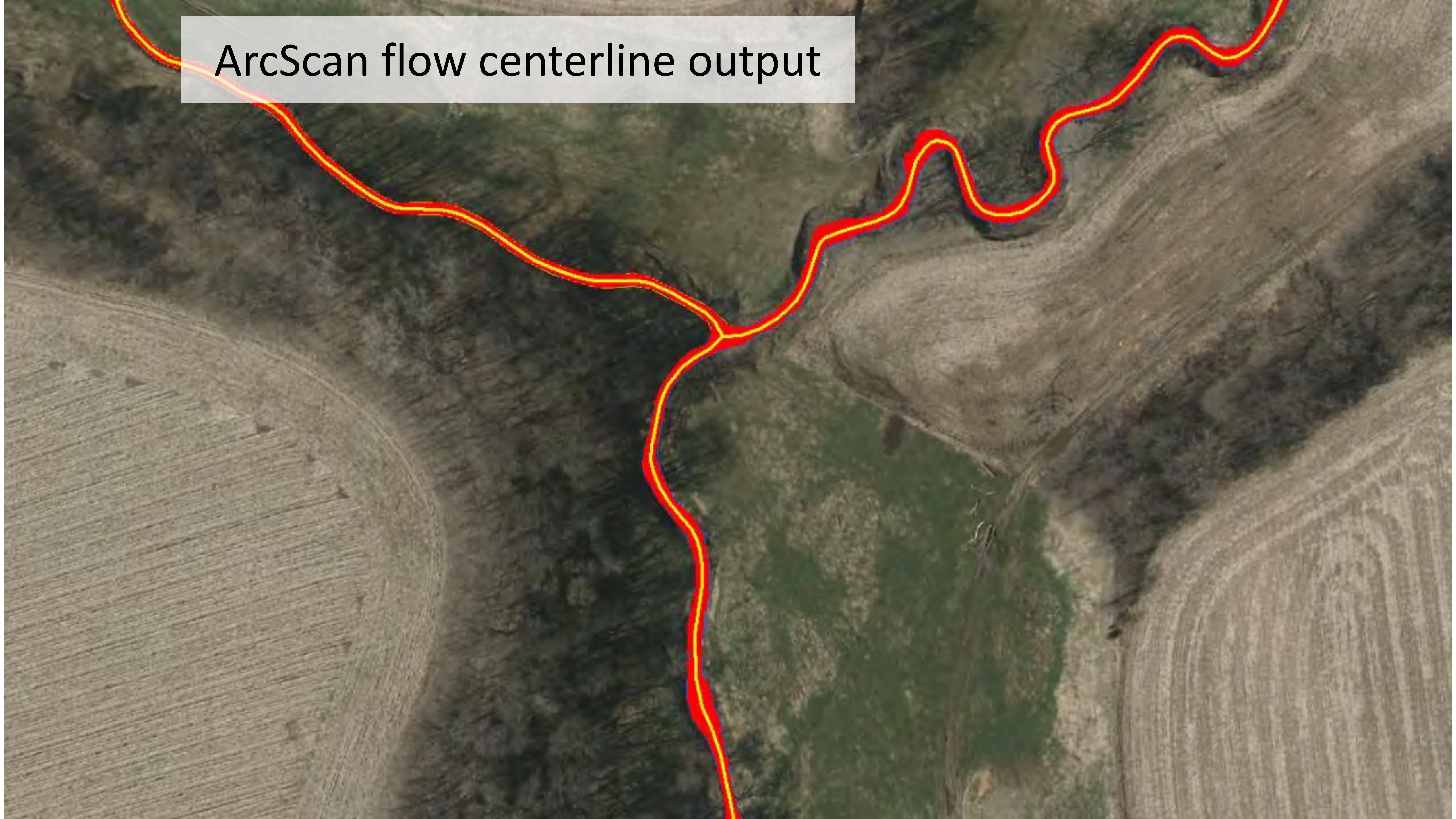
Select connected raster pixels



ArcScan live polygon preview

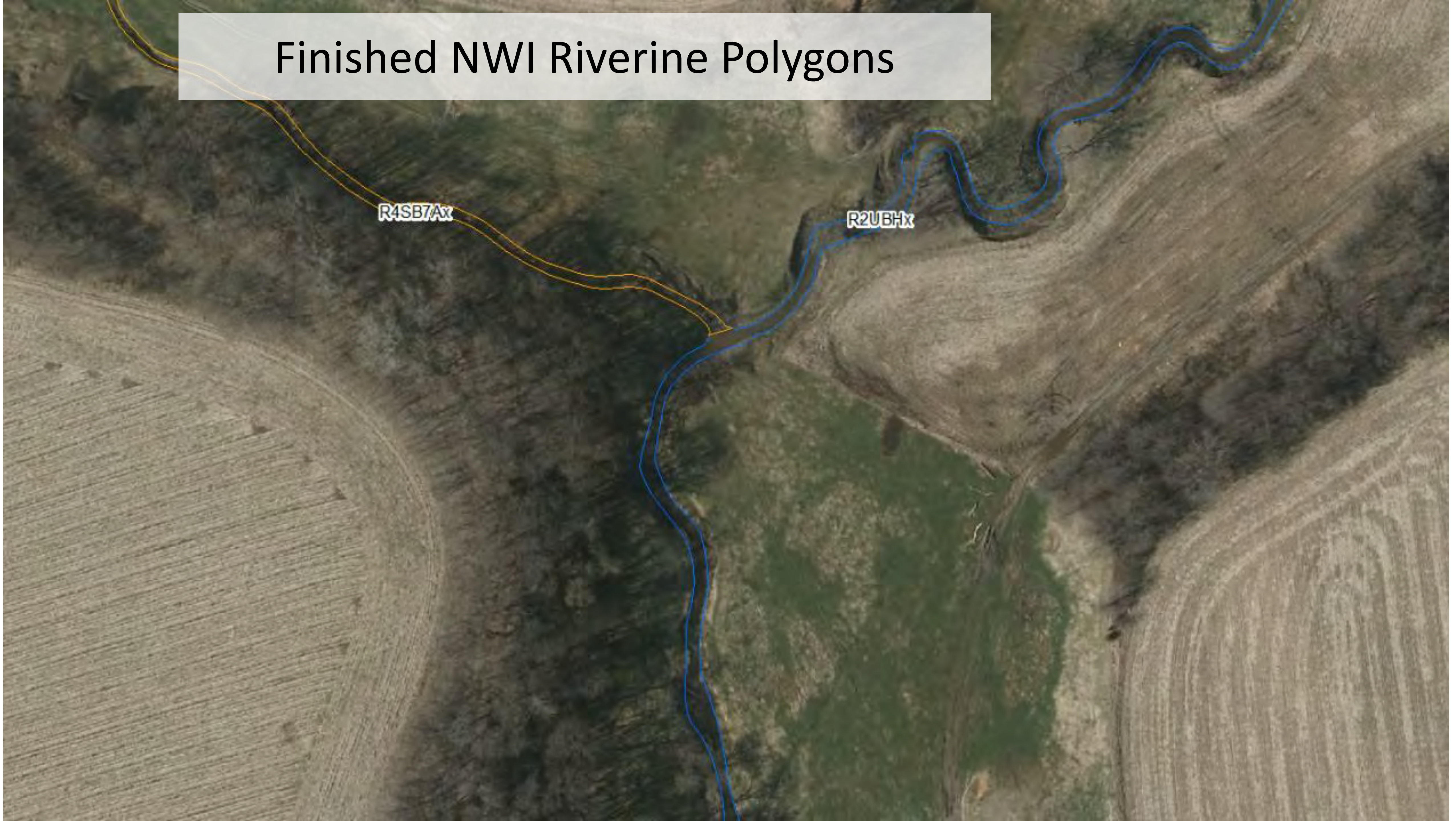


ArcScan flow centerline output



Potential new flowlines

Finished NWI Riverine Polygons



Previous WWI Data (2003)

Newly Drafted Data (2020)

In One Square Mile…

- Old =124.2 ac → new = 177.6 ac
- 126 Points replaced with polys
- Increase mapped connectivity
- Added two intermittent streams

Special Thanks to

- Funded by the Wisconsin Coastal Management Program and the National Oceanic and Atmospheric Administration, Office for Coastal Management under the Coastal Zone Management Act, Grant #NA19NOS4190087.

- EPA Region 5 Wetland Program Development Grant #CD00E02075

WISCONSIN COASTAL MANAGEMENT PROGRAM

EPA United States Environmental Protection Agency

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

Questions?

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- Mandy Minks – Waterway and Wetland Section Chief Amanda.minks@Wisconsin.gov

WWI Links for Documentation

WWI Mapping Draft SOP https://dnr.wisconsin.gov/sites/default/files/topic/Wetlands/WWI_SOP.pdf

WWI Main Page: https://dnr.wisconsin.gov/topic/Wetlands/inventory.html