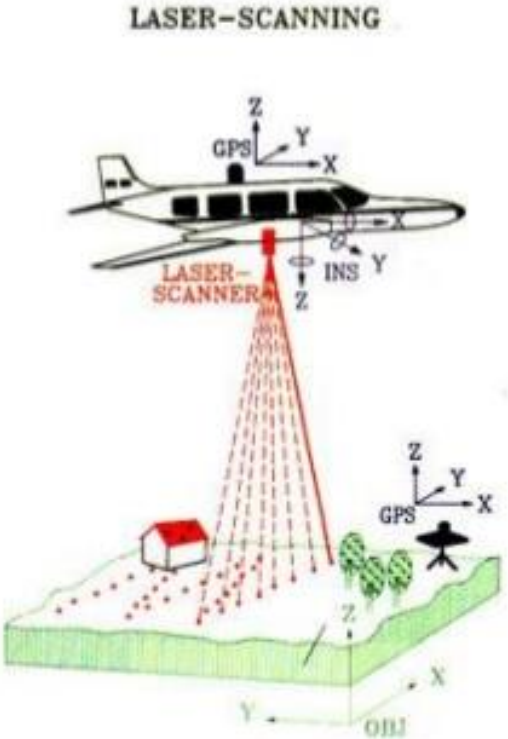
# Wisconsin Elevation Mapping: Statewide Completion of Lidar, Development of Hydro-enforced Products and Planning for Future Needs

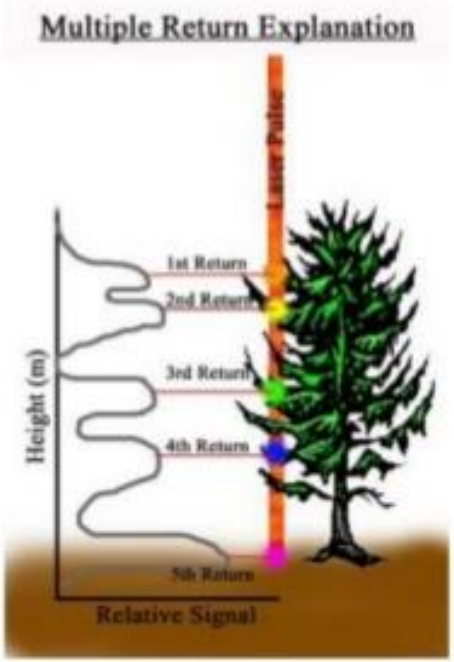
WAFSCM Fall Conference
November 8, 2018

Jim Giglierano
Wisconsin DOA - WLIP - GIO

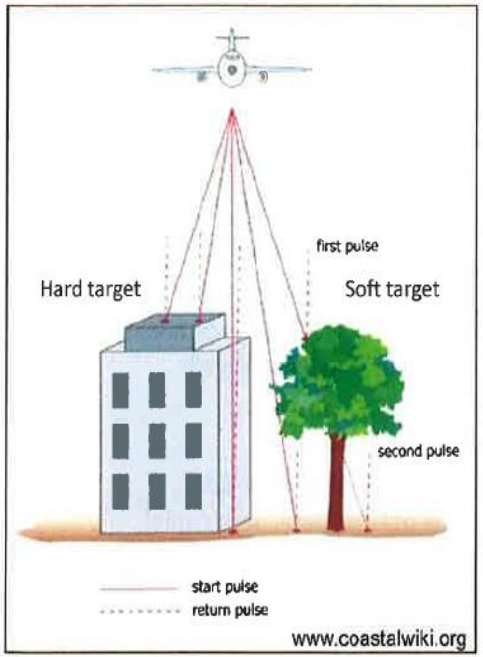
# What is LIDAR?

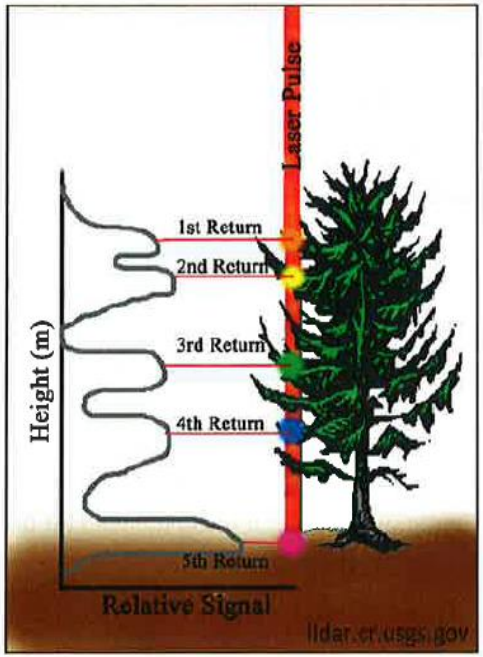
**LI**ght **D**etection **A**nd **R**anging



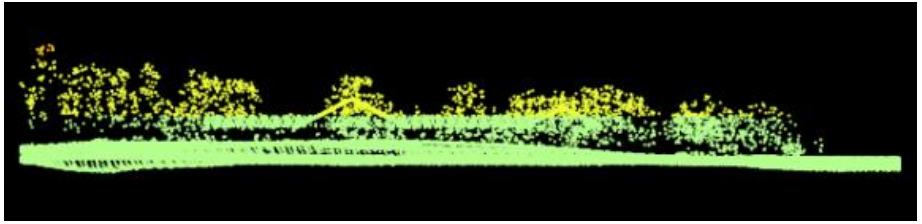



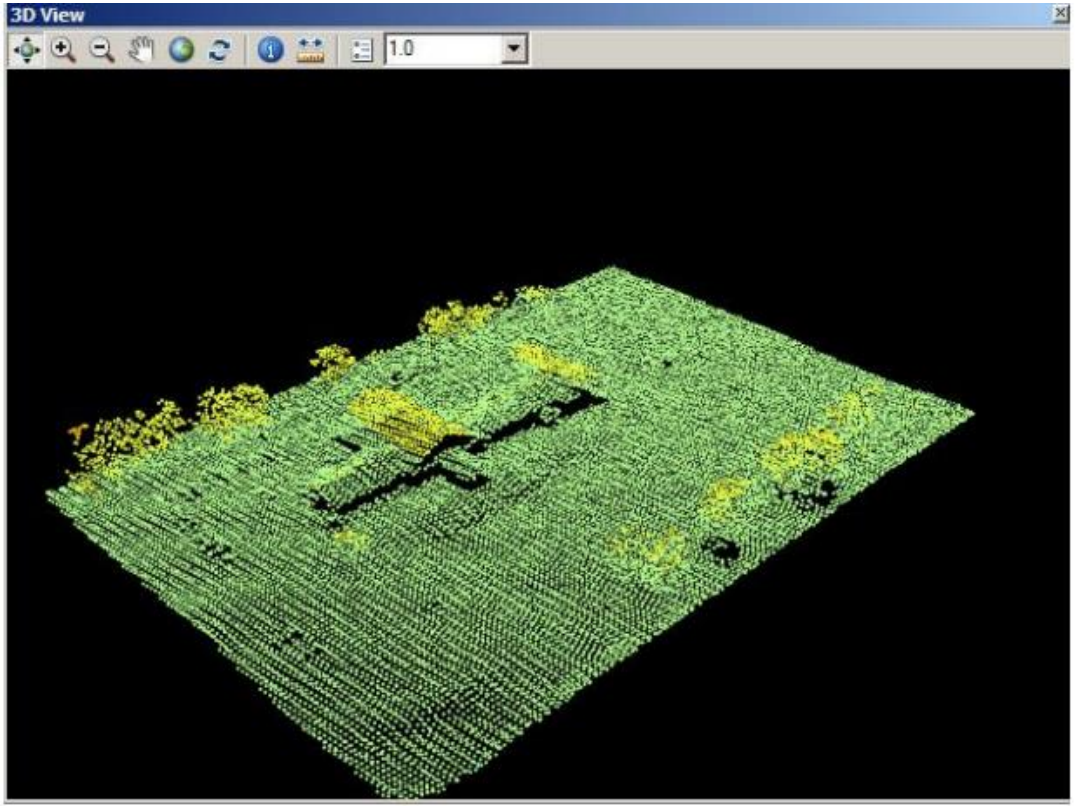
# Different Targets = Different Returns



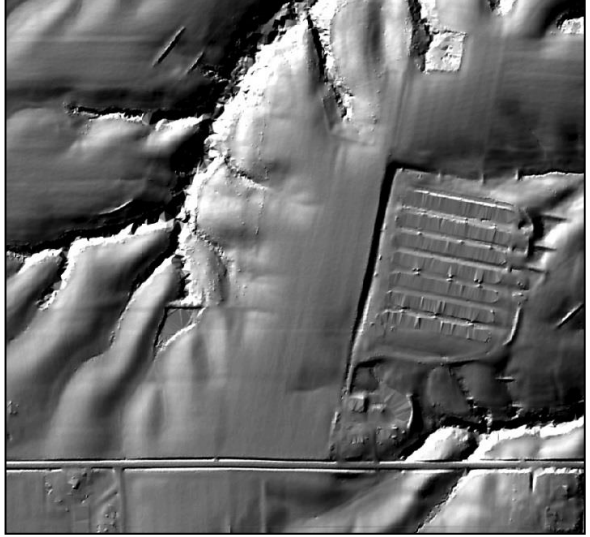



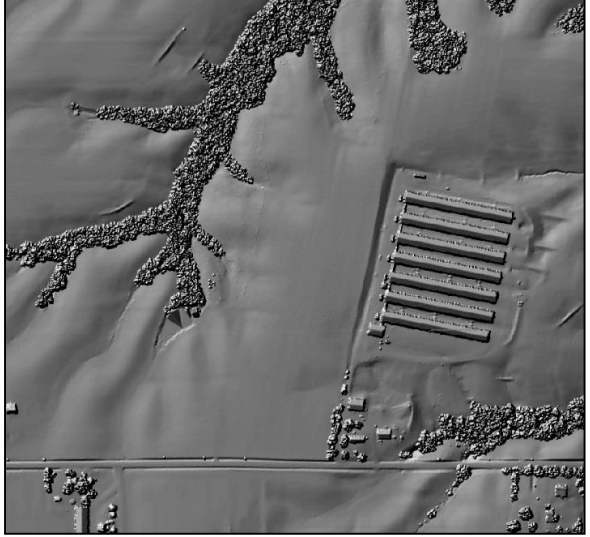

# 2D and 3D Viewing Lidar Point Cloud



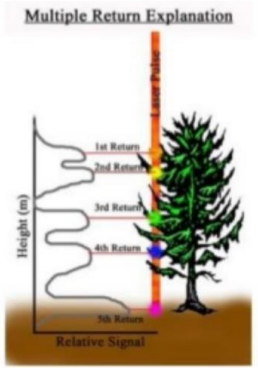


Bare Earth

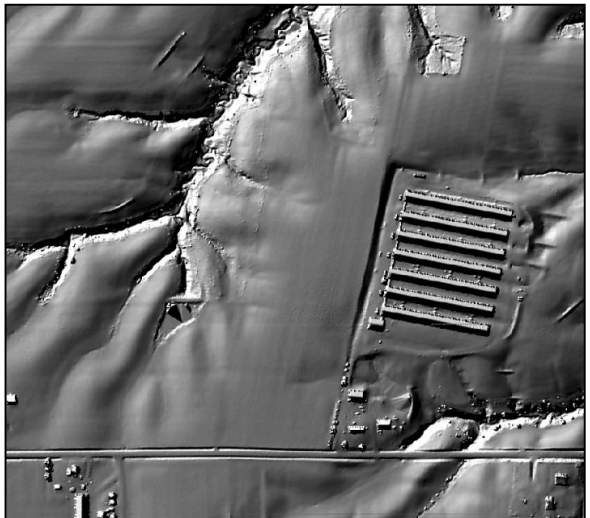




First Return



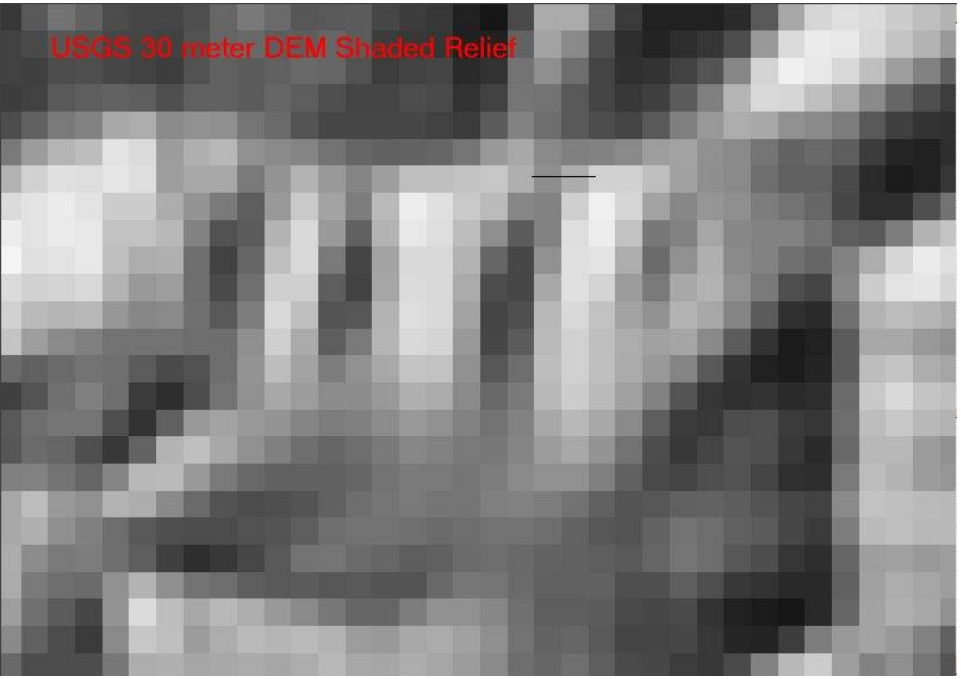

Last Return

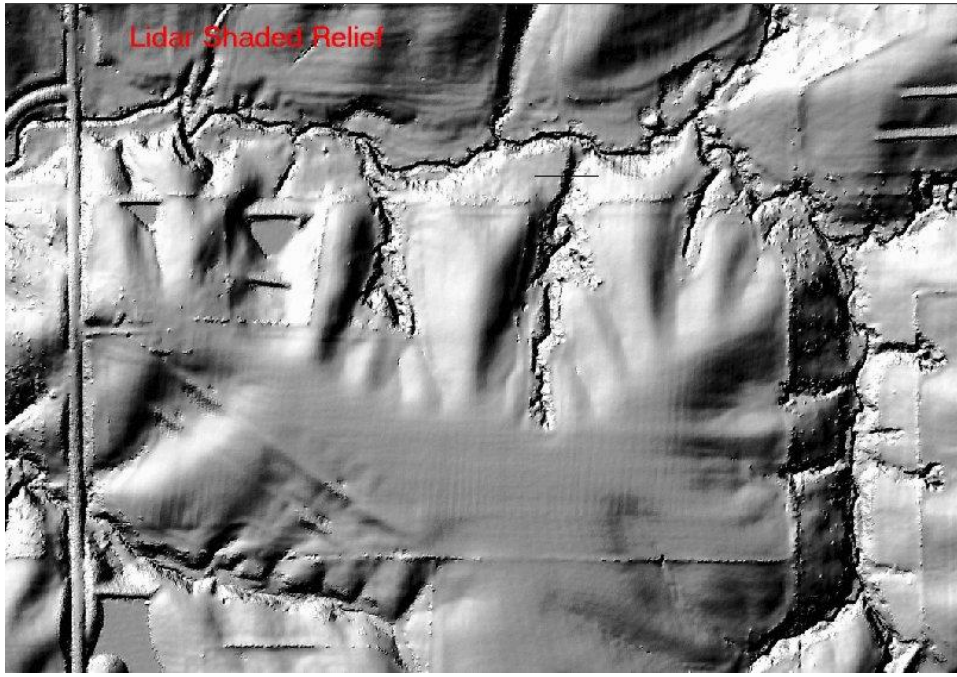


Intensity

# *Lidar Products*

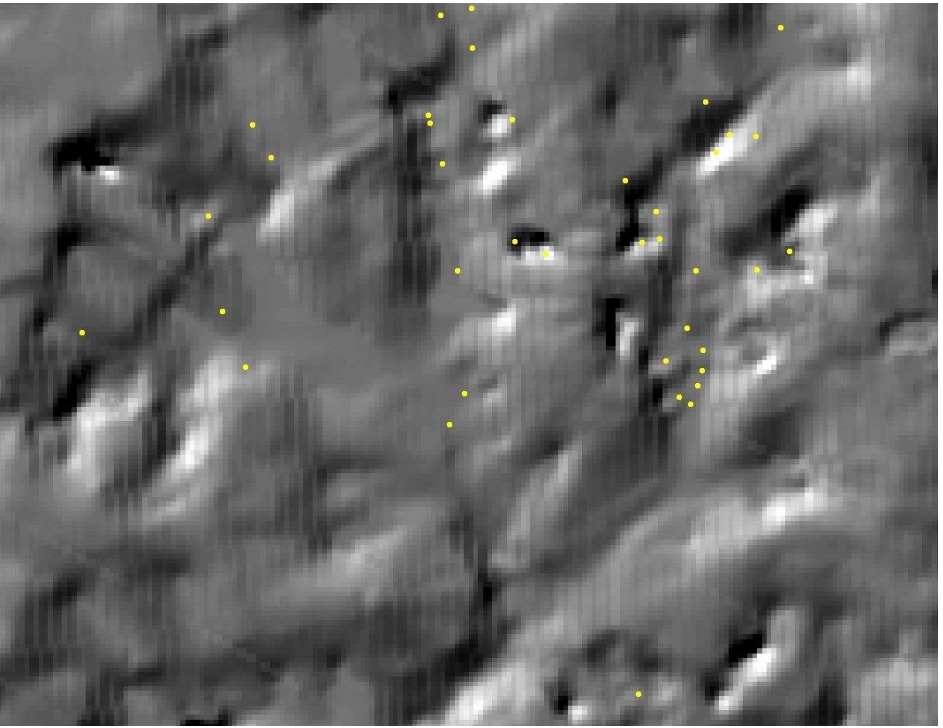
This is your brain on NED…..
(old USGS topo product)

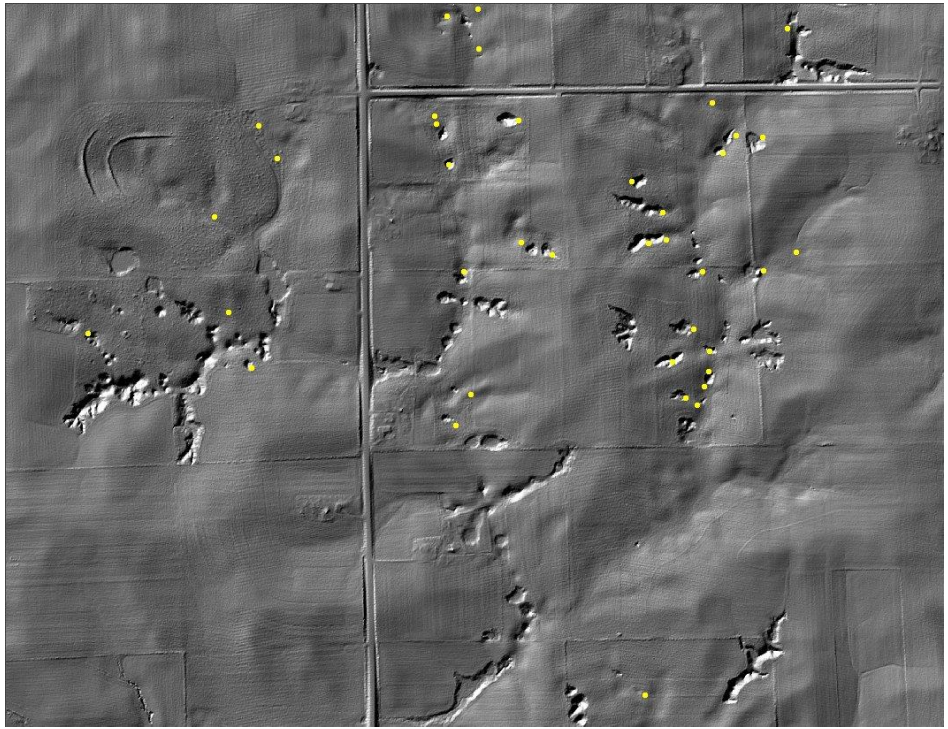



This is your brain on Lidar….!

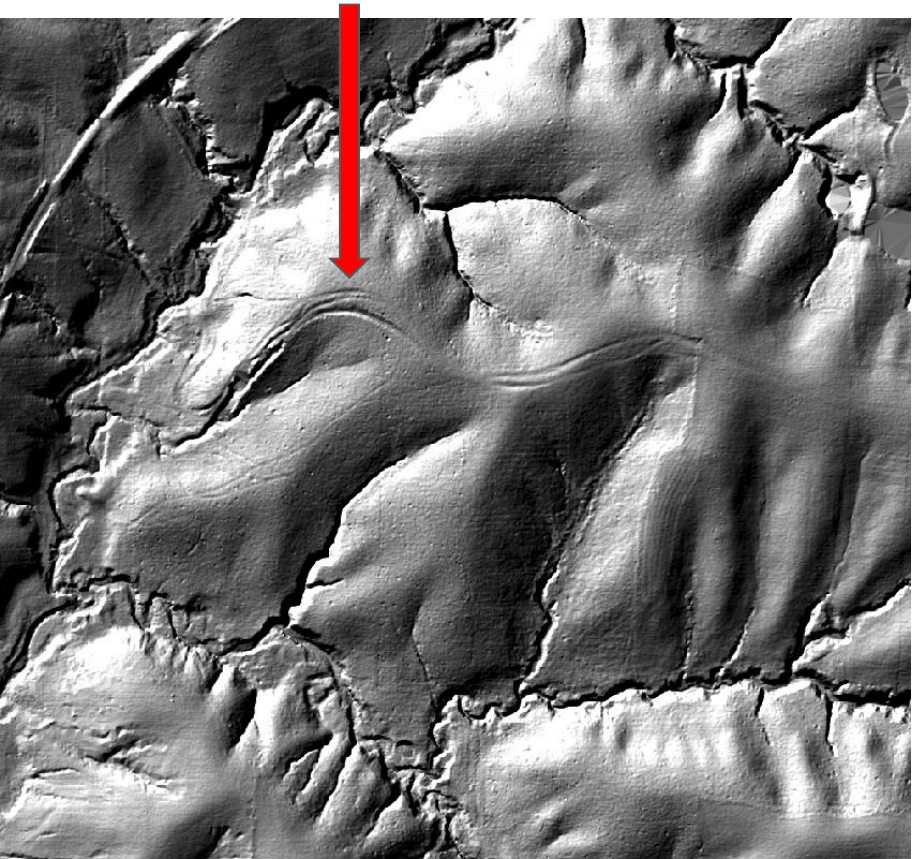
# Sinkhole Mapping with Lidar

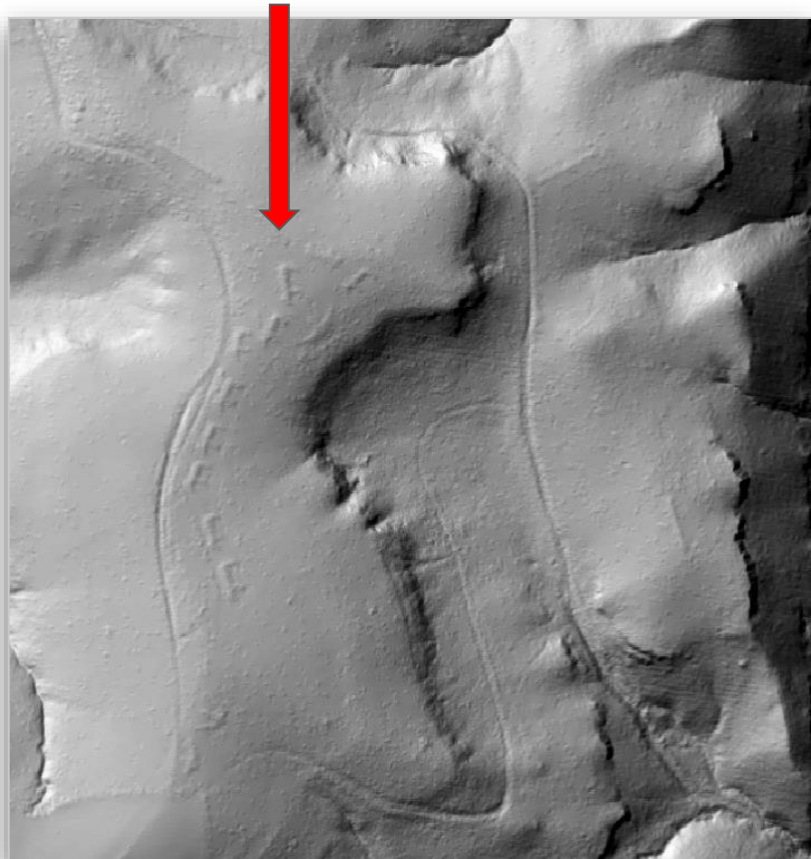




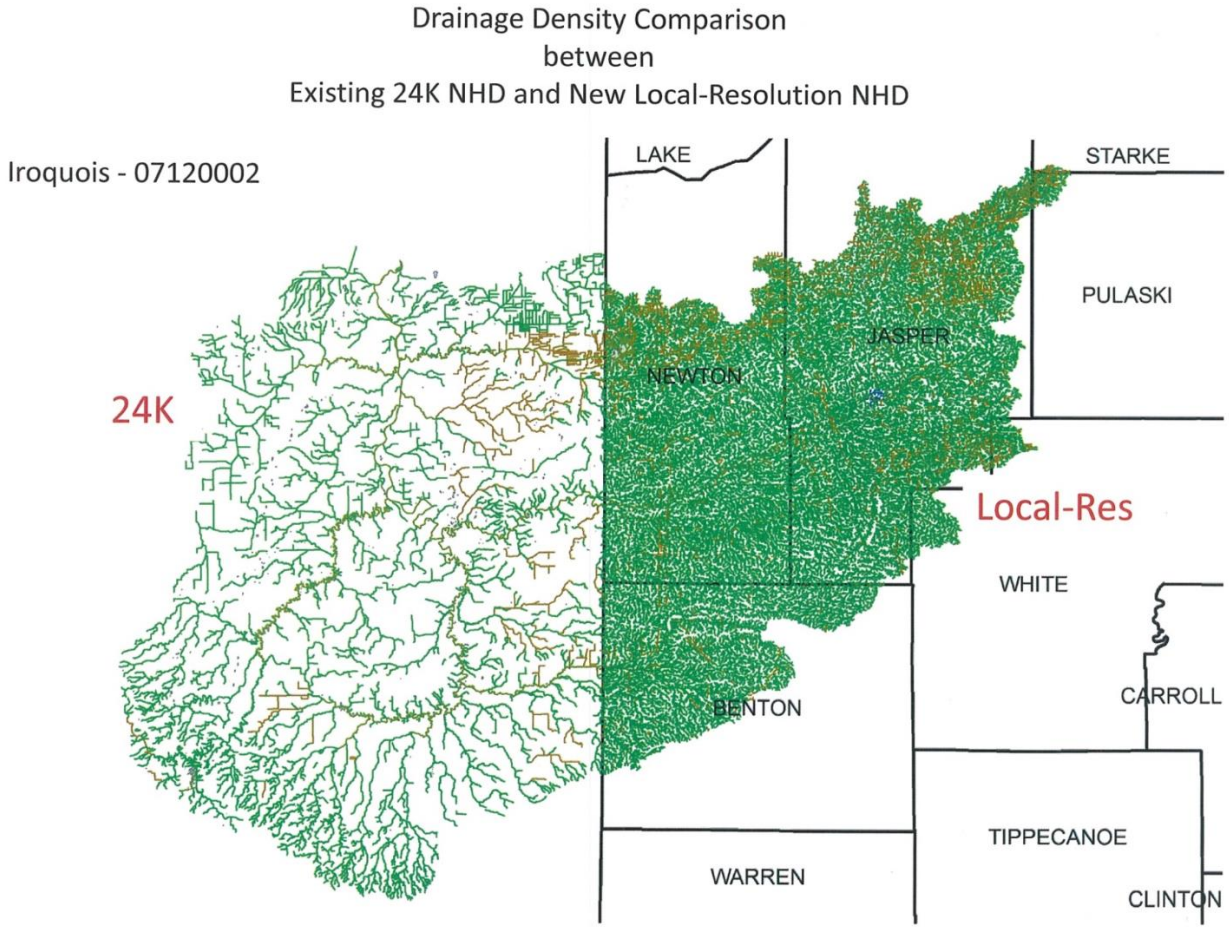
Yellow dots are depression features from soil survey point data

# Archaeological Sites - Mormon Trail remnants and Effigy Mounds

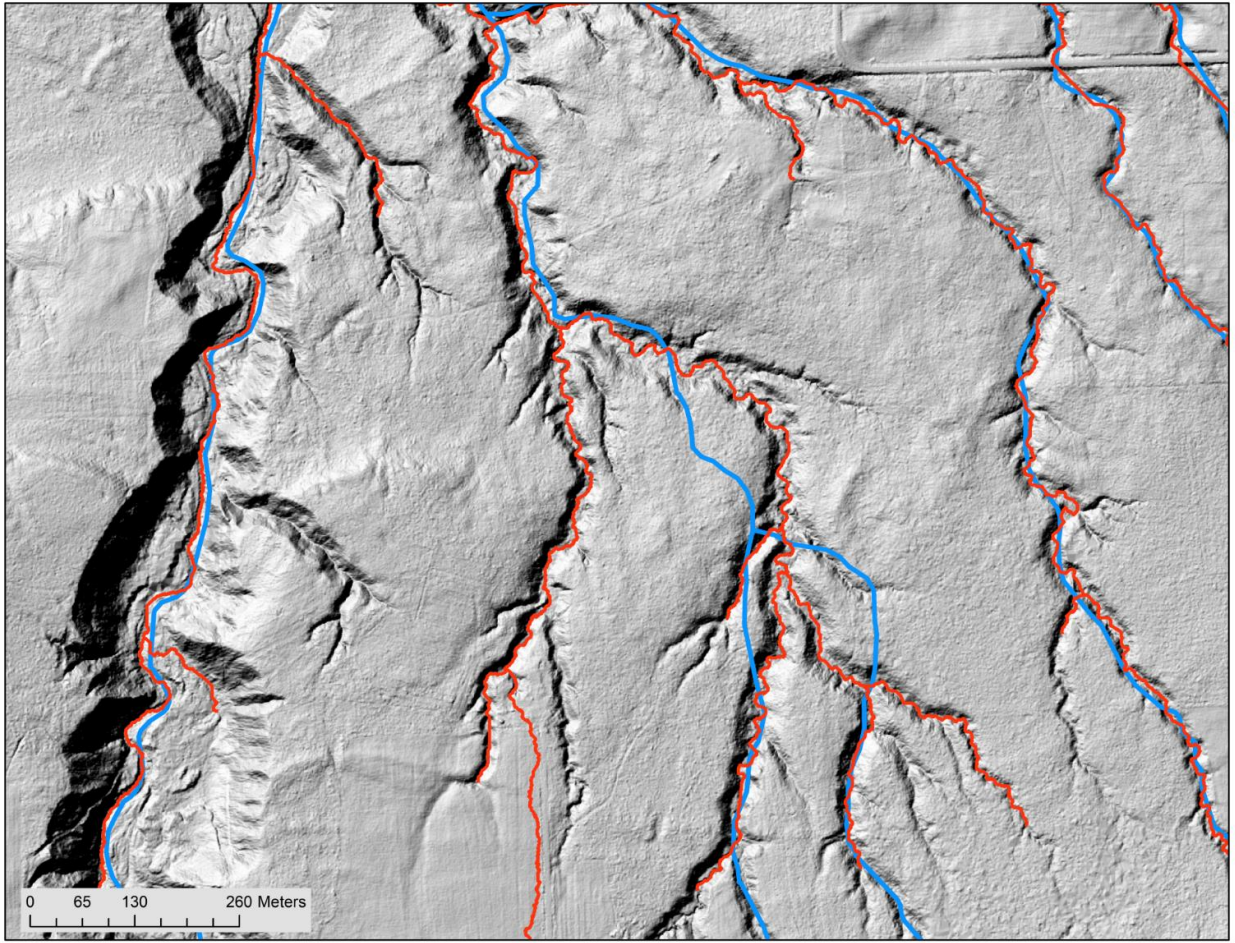




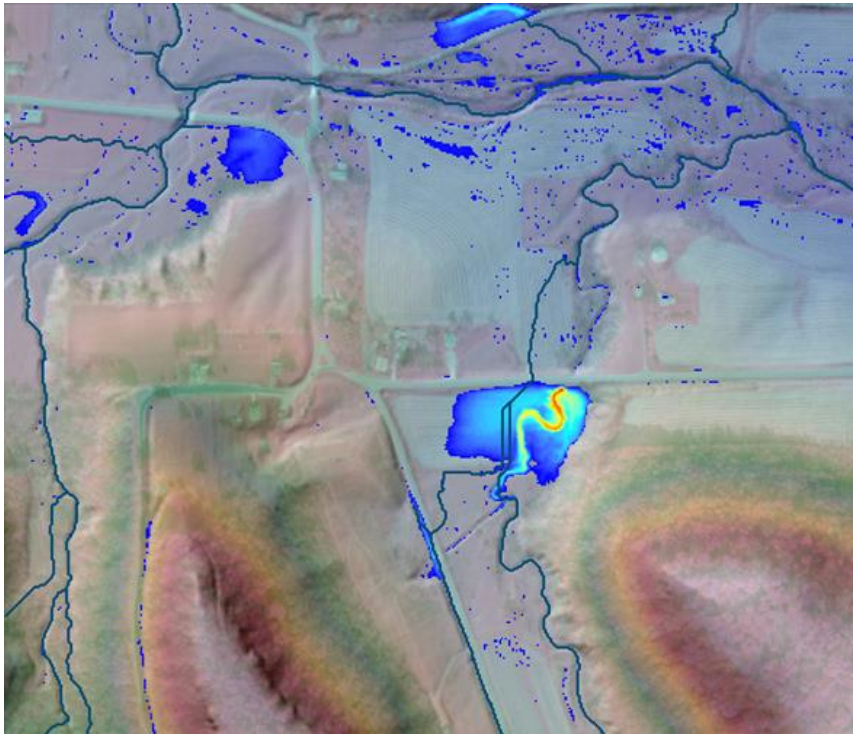
# Local resolution hydrology derived from Lidar



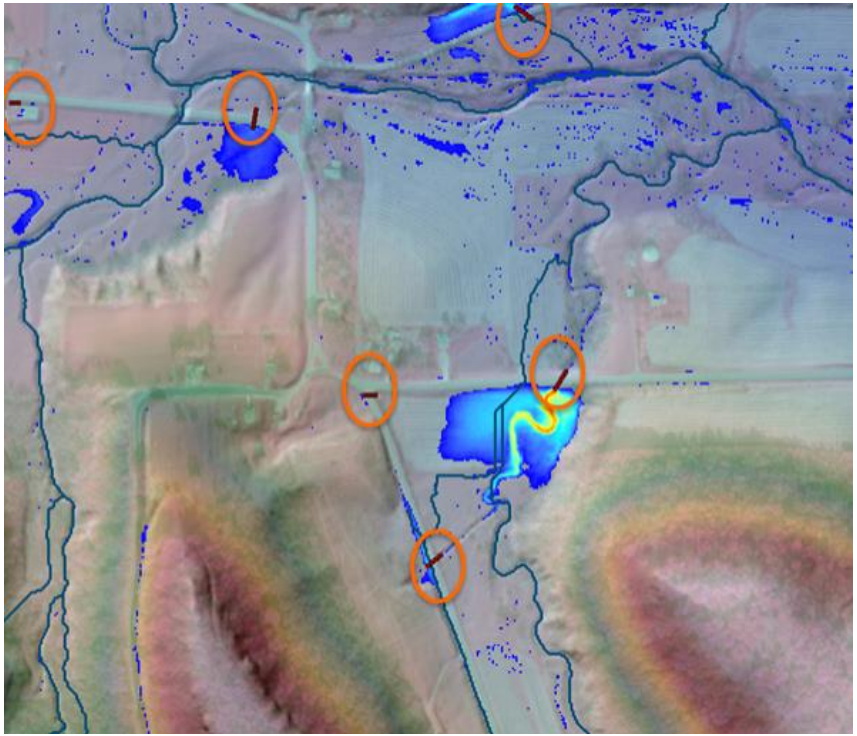
# Ashland Co Lidar BLUE = WDNR 24k hydro RED = LiDAR-derived lines



# Creating basic hydro layers from lidar



Using ACPF tools to identify sinks and depressions - initial flow lines delineated



Creating “cut-lines” to enforce drainage through artificial impediments - culverts

# Mapping Farmed Wetlands

1) Locate depressions by subtracting the original DEM from a “filled” DEM
2) Create outlines of depressions >10cm
3) Center points of depressions
4) Create flowpath network
5) Create connection network
6) Create “basin order”
7) Create basin catchments

# Tile Mapping of Farmed Wetlands

Central Iowa - The Des Moines Lobe - Wright County

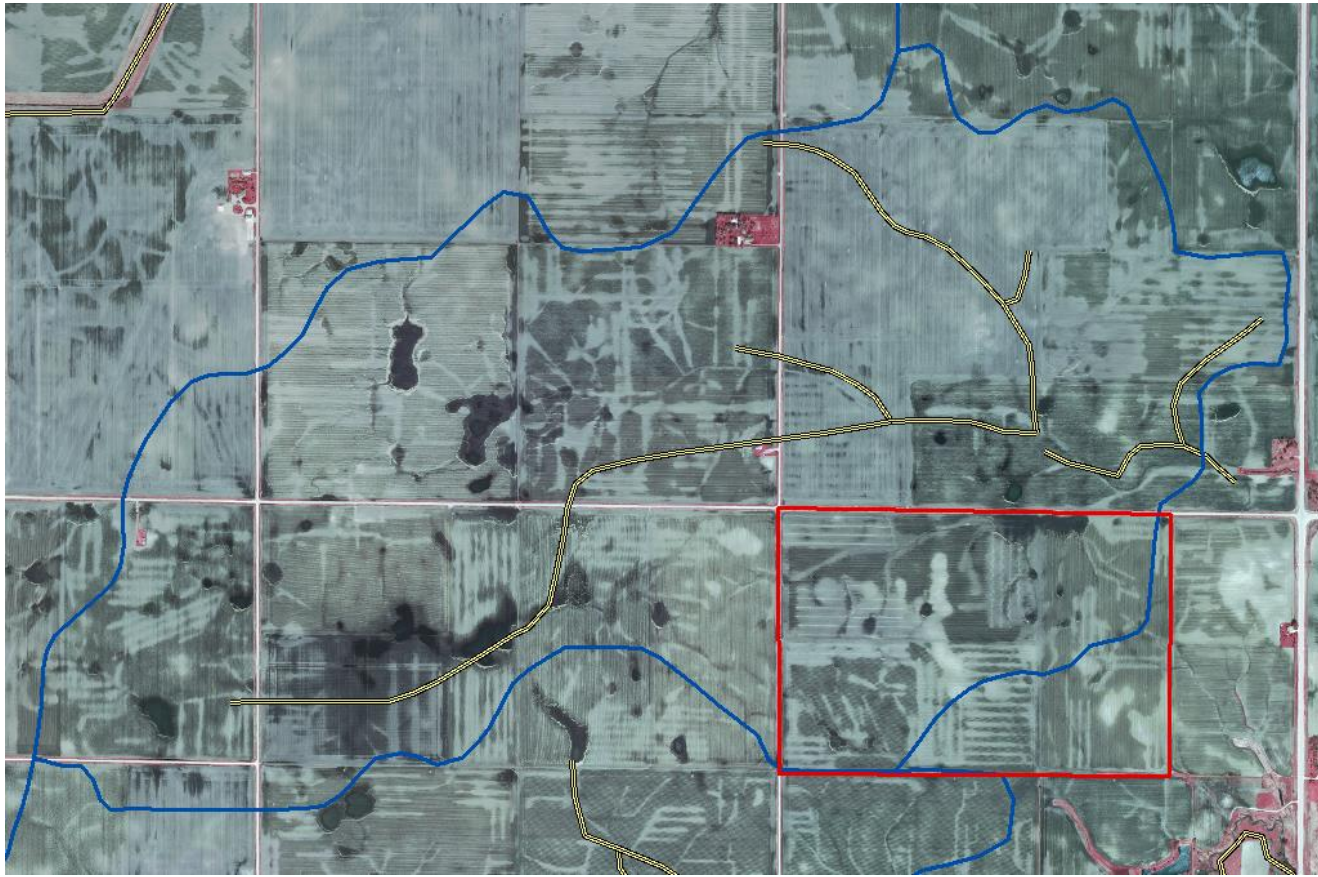
Airphoto from April 2007

Drainage District 160 - dark blue outline

District Tile Mains - yellow lines

Private tiles visible after 4-7” total rainfall in a 10 day period

Soil profile above tiles drain first, producing lighter tone



# Tile Mapping of Farmed Wetlands

Close up of section from previous slide

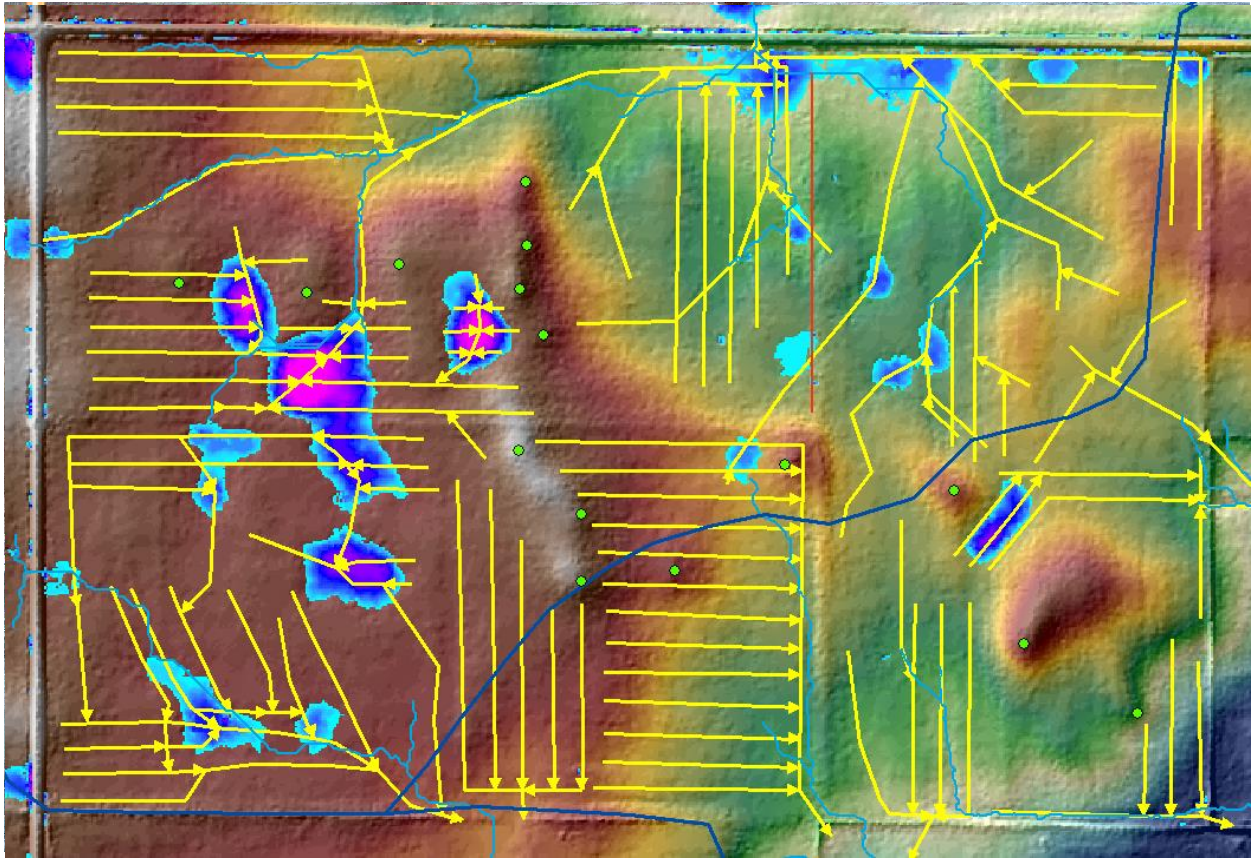
Drainage District boundary - dark blue

Concentrated flow lines - light blue

Topographic high points - green dots (not related to tiles)

Filled depressions

Mapped tiles - yellow arrows



# *Uses of Lidar Derived Products*

- **Replacement of ground elevation surveys for planning and design work on engineering and construction projects**
- **Mapping and photo-interpretation**
- **Modeling and analysis**

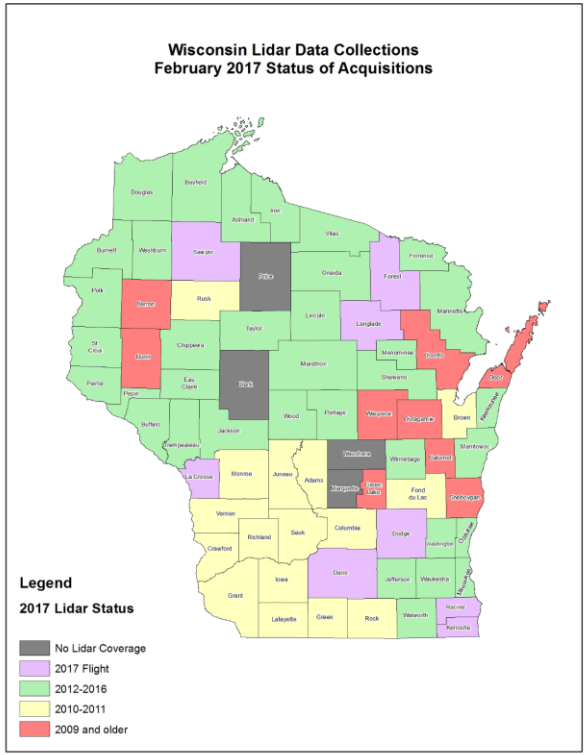
# Wisconsin Lidar General Priorities

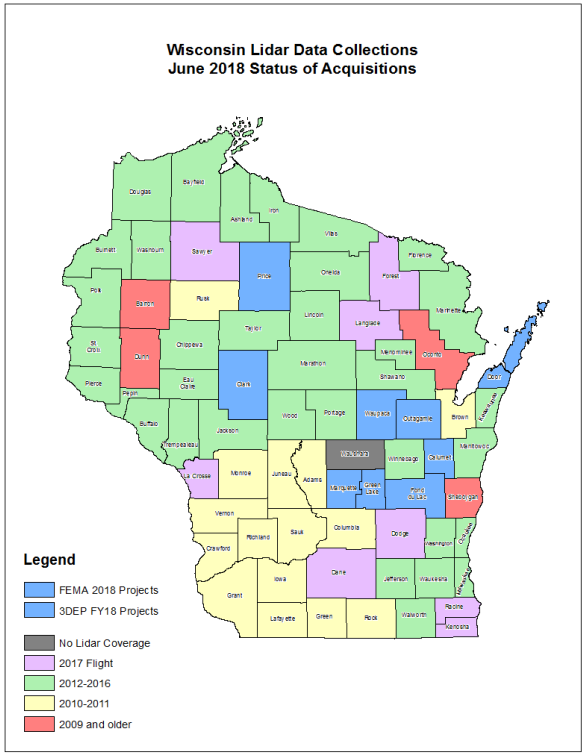
- Complete lidar coverage of state using all available funding options
- Update older, lower resolution lidar data sets
- Increase public access to lidar data
- Increase usability of lidar products
- Increase lidar user knowledge
- Plan for the future

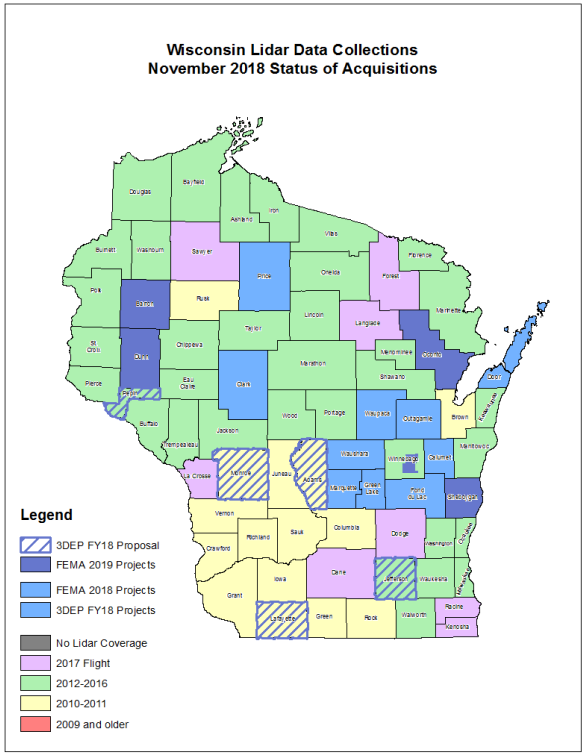
# Wisconsin Lidar General Priorities

- Complete lidar coverage of state using all available funding options ***- first time coverage available summer 2019***
- Update older, lower resolution lidar data sets
- Increase public access to lidar data
- Increase usability of lidar products
- Increase lidar user knowledge
- Plan for the future

# Completing Lidar Coverage Statewide And Updating Older Datasets



# Wisconsin Lidar General Priorities

- Complete lidar coverage of state using all available funding options
- Update older, lower resolution lidar data sets ***- ongoing process, national goal to be completed by 2023***
- Increase public access to lidar data
- Increase usability of lidar products
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# Comparison of Lidar Quality Levels (QL)

| Quality Level | Source | Vertical Accuracy RMSEz | Nominal Pulse Spacing (NPS) | Nominal Pulse Density (NPD) | DEM Post Spacing |
|---|---|---|---|---|---|
| QL1 | Lidar | 10 cm | 0.35 m | 8 points/sq. meter | 0.5 meter |
| QL2 | Lidar | 10 cm | 0.7 m | 2 points/sq. meter | 1 meter |
| QL3 | Lidar | 20 cm | 1.4 m | 0.5 points/sq. meter | 2 meters |
| QL4 | Imagery | 139 cm | N/A | N/A | 5 meters |
| QL5 | Ifsar | 185 cm | N/A | N/A | 5 meters |

QL2 Vertical Accuracy = 3.94 inches  NPS = 2.3 feet  NPD = .19 pts/sq. foot

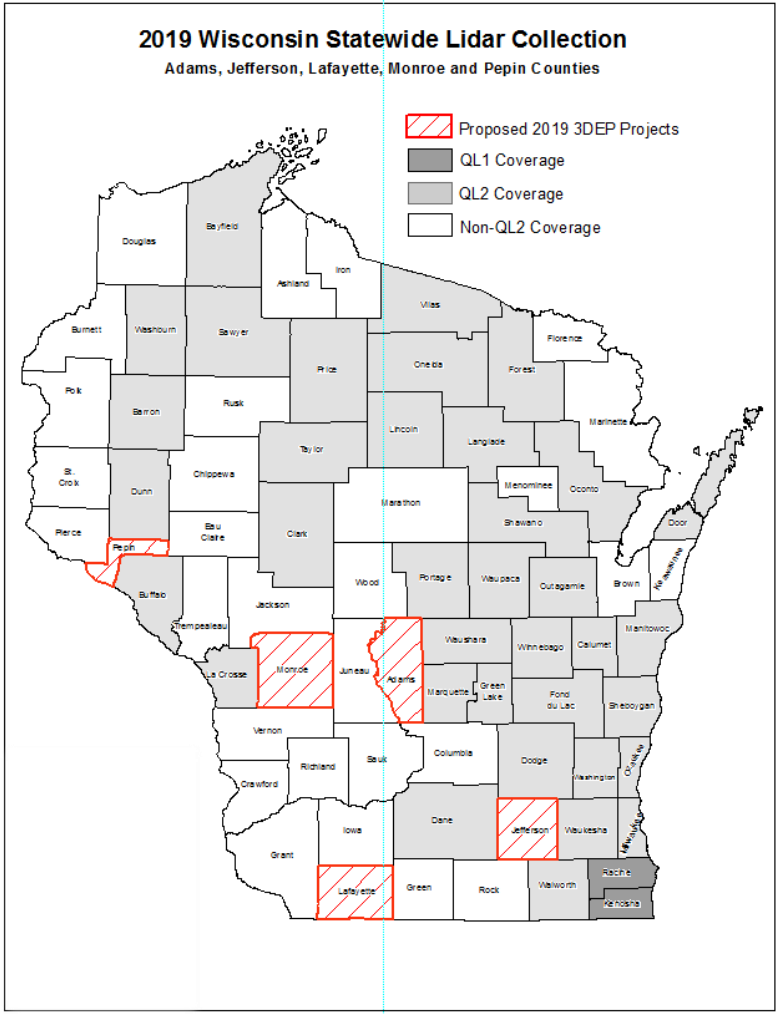
**QL2 Lidar can be used to create accurate 1’ contours**

# Lidar Quality Improvements

3DEP goal is to cover US with QL2 by 2023

Wisconsin after 2019 FEMA and 3DEP flights will have 38 QL2 or QL1

About half done, 34 counties (white areas on the map) are still eligible for 3DEP funding



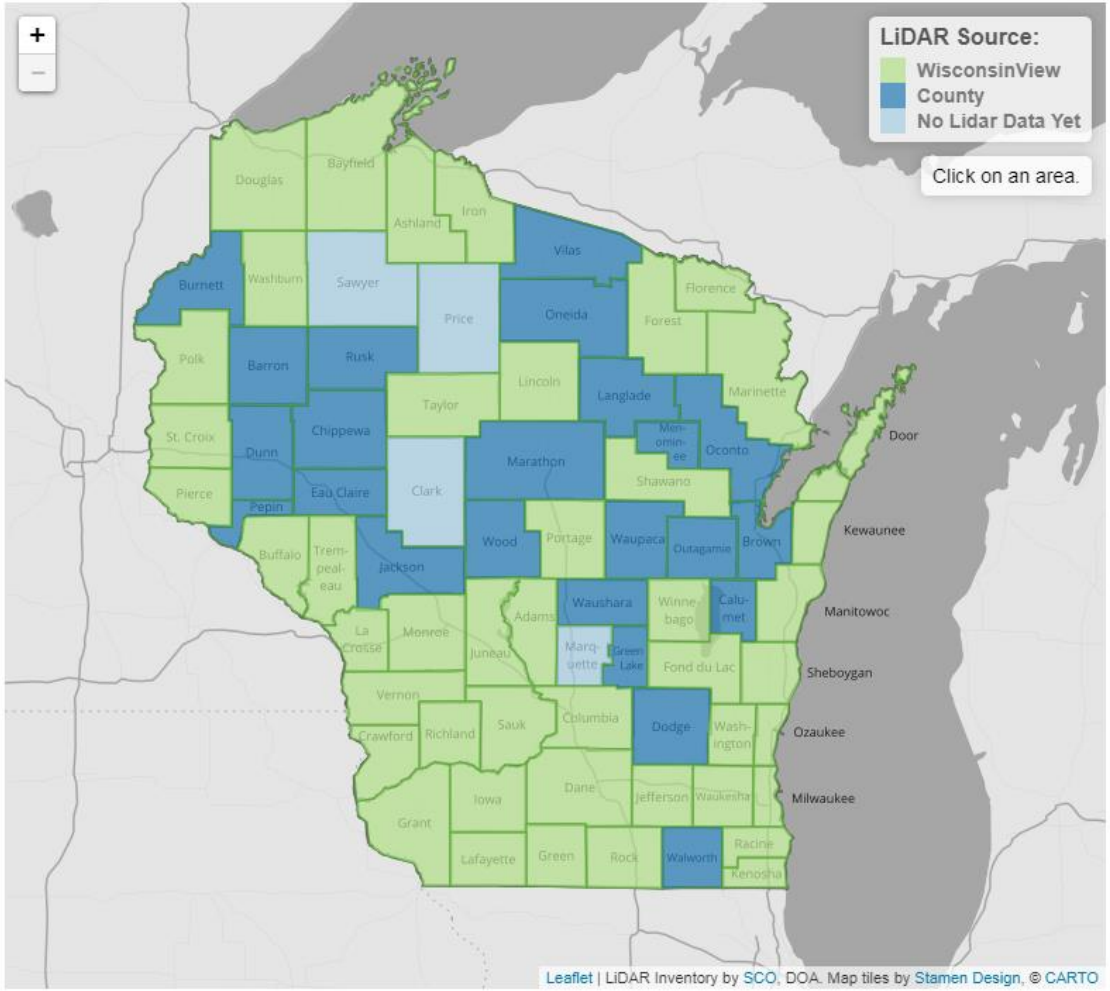
# Wisconsin Lidar General Priorities

- Complete lidar coverage of state using all available funding options
- Update older, lower resolution lidar data sets
- Increase public access to lidar data ***- June 2018 rebuilding WisconsinView Lidar and Imagery archive***
- Increase usability of lidar products
- Increase lidar user knowledge
- Plan for the future

# Increase Lidar Accessibility

Upgrade WisconsinView Remote Sensing Data Archive

- Funding from Wisconsin Coastal Management Program
- Increased download space to 100TB - compress LAS files?
- New download interface?
- Tiled web services?
- Develop commonly needed derived products - WTM grids, hillshades, contours, etc.



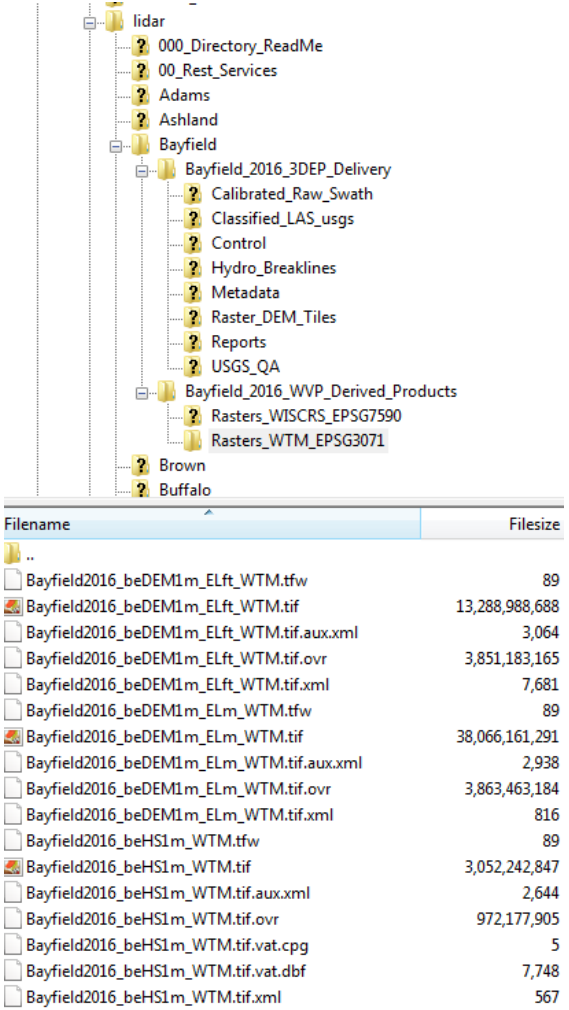
# WisconsinView

Encourages ftp downloading using ftp client software like FileZilla

County data collections - LAS, break lines, DEMs, control, metadata, contours if available

Derivative products - WTM or UTM DEMs, reprocessed LAS

ftp://ftp.ssec.wisc.edu/pub/wisconsinview/lidar/



# Wisconsin Lidar General Priorities

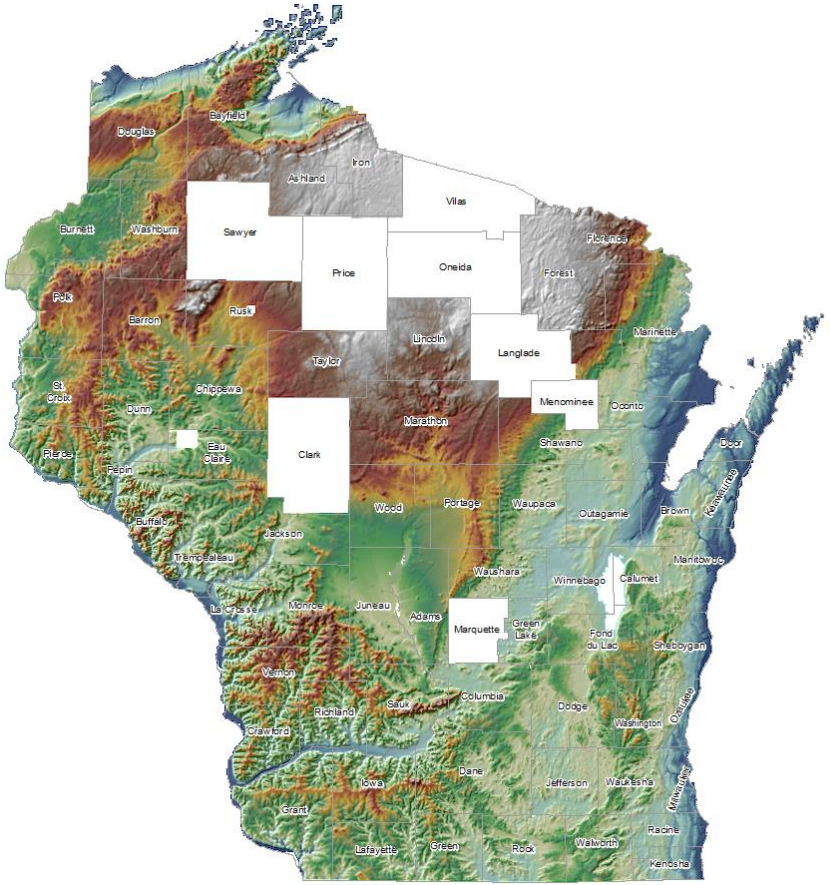
- Complete lidar coverage of state using all available funding options
- Update older, lower resolution lidar data sets
- Increase public access to lidar data
- Increase usability of lidar products ***- development of streaming web services since 2017 by DNR***
- Increase lidar user knowledge
- Plan for the future

# Increase Usability of Lidar Datasets

**Collaboration between DNR, UW, DOA, and NRCS**

- Collect public domain lidar DEMs, LAS and other files, organize and store on WisconsinView
- Creating a “statewide” mosaic of 2-3 meter DEMs and shaded relief
- ESRI Image Server for lidar web services - DNR BTS

https://dnrmaps.wi.gov/arcgis_image/rest/services/DW_Image/EN_DEM_from_LiDAR/ImageServer



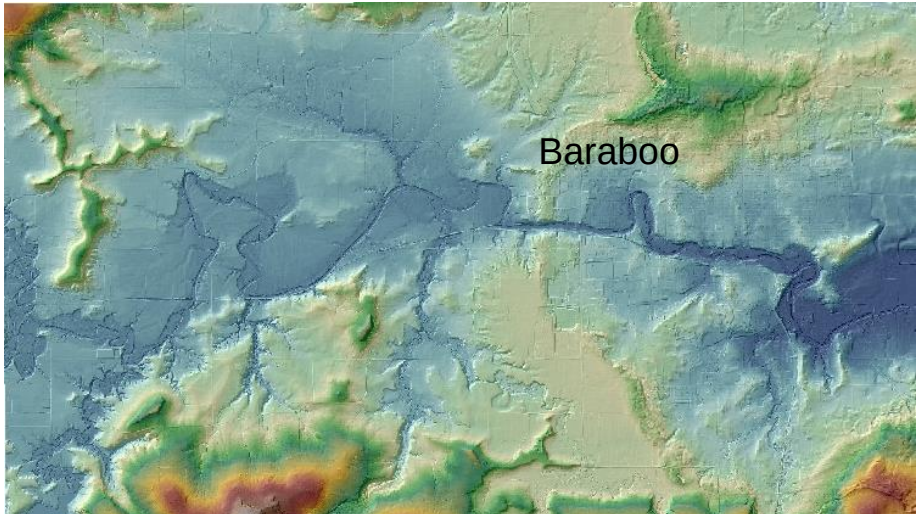
# Wisconsin Lidar General Priorities

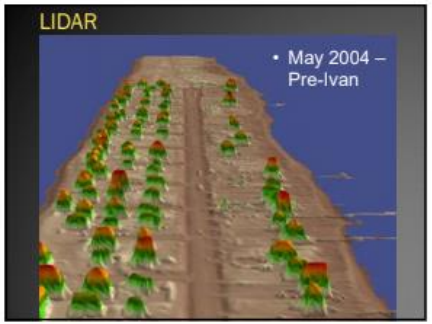
- Complete lidar coverage of state using all available funding options
- Update older, lower resolution lidar data sets
- Increase public access to lidar data
- Increase usability of lidar products
- Increase lidar user knowledge ***- training since 2017 and peer to peer collaboration opportunities***
- Plan for the future

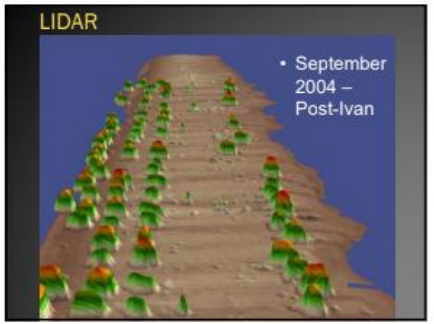
# Increase User Knowledge of Lidar Datasets

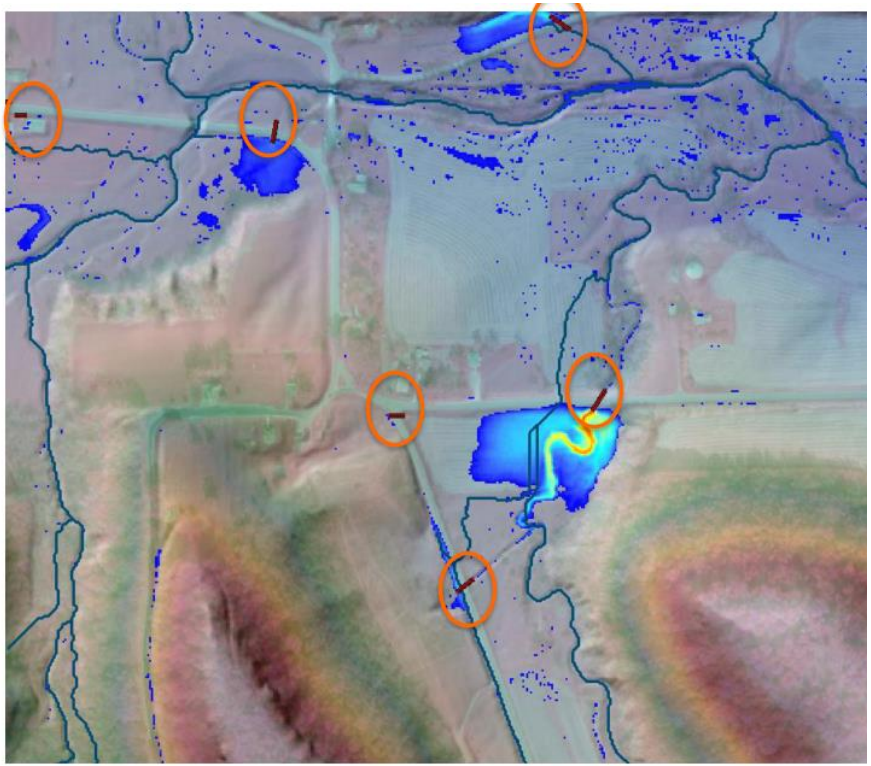
## Basics of Lidar Workshop

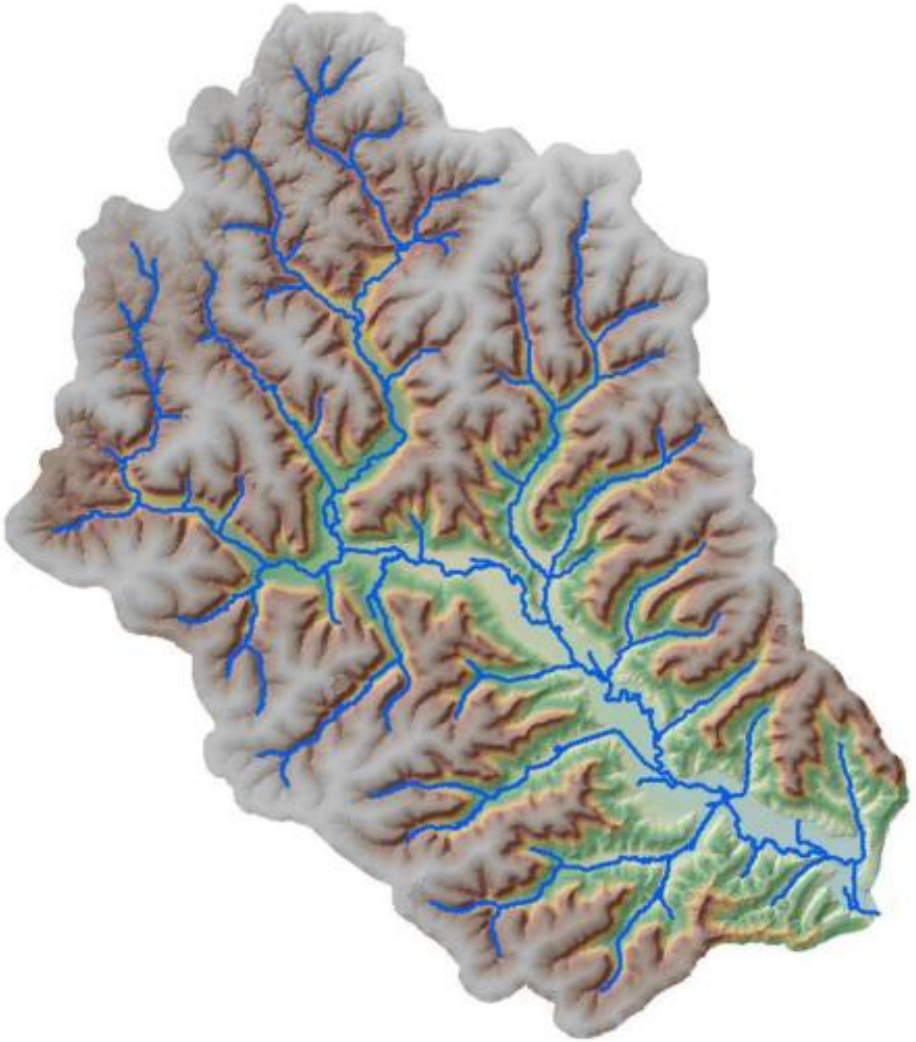
**Collaboration between UW SCO, University of Minnesota, and DOA**

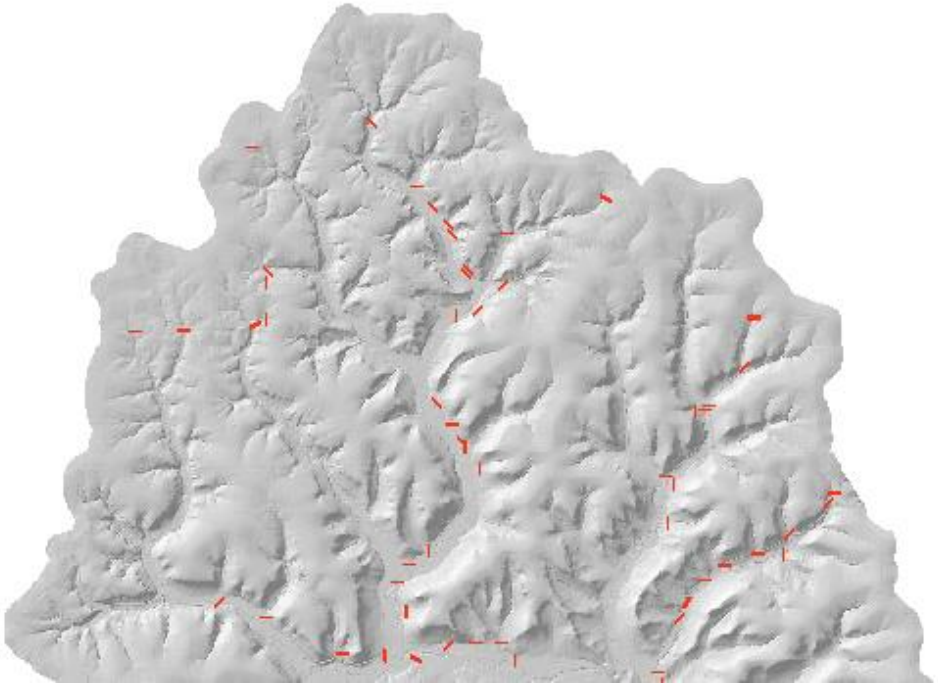


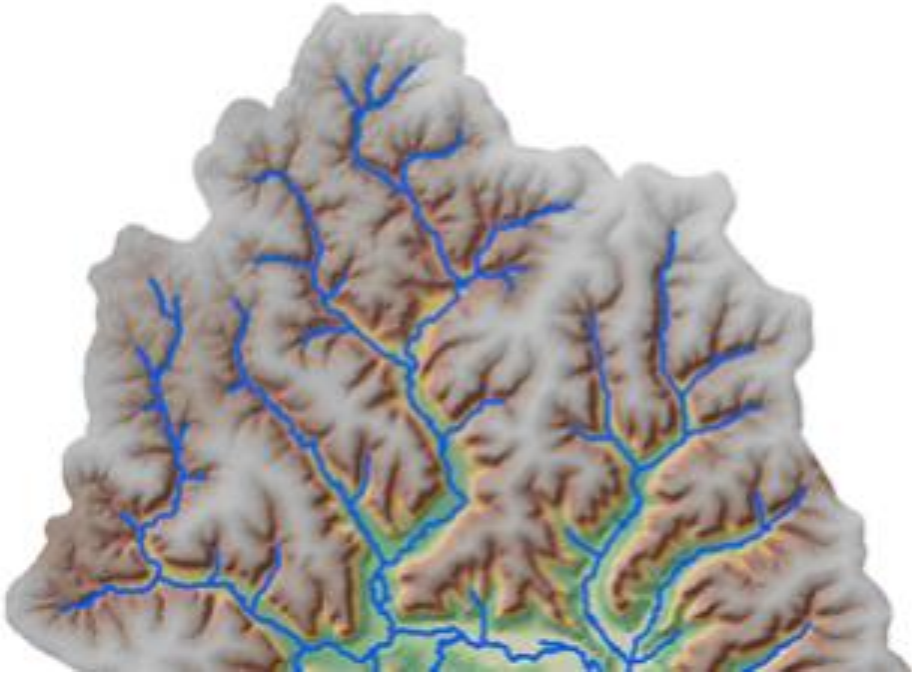


SCO Lidar Workshop - using ACPF tool to delineate stream networks and small catchments

**300+ cutlines identified in one HUC12 watershed**

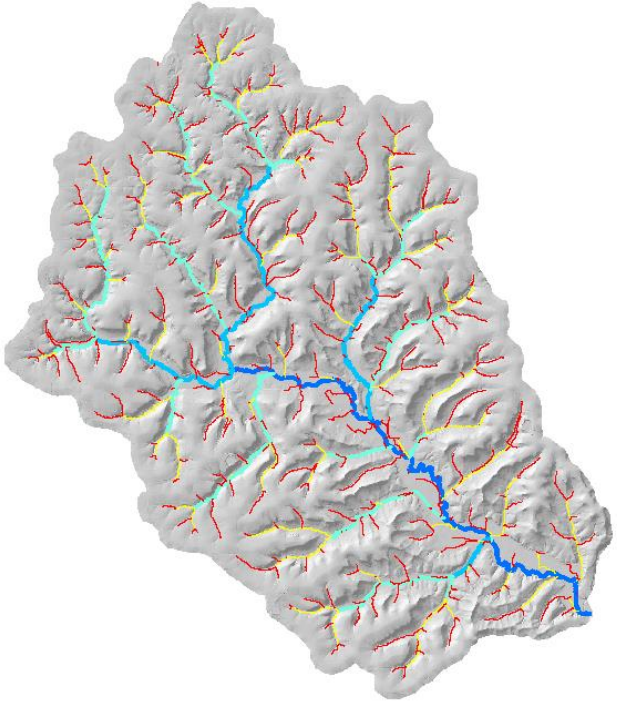
**These are “burned” into the original DEM to create hydrologically connected flow lines**



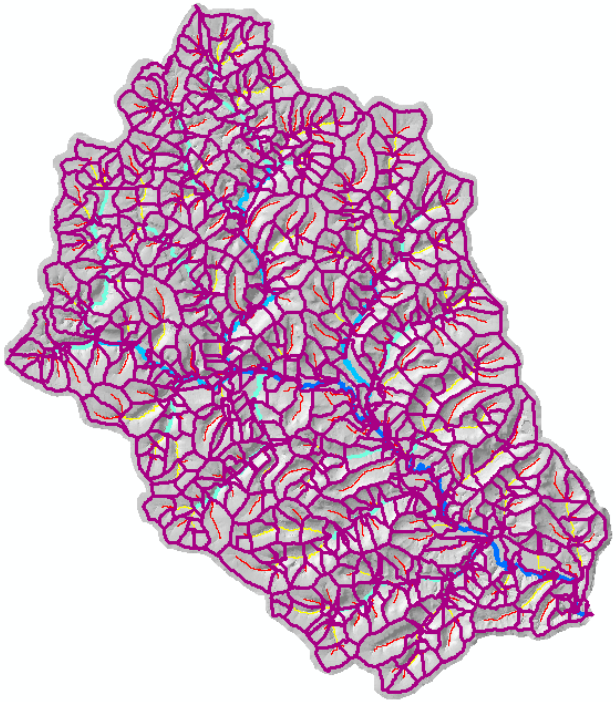


**ACPF derivative products:**

**Stream order and hydro-enforced DEM**



**Sub-catchments**



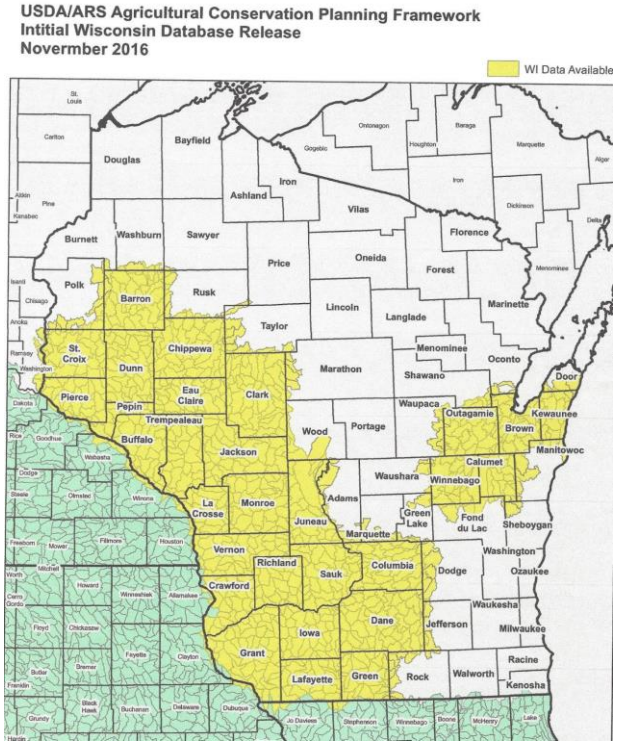
**New HUC12 outline, stream centerlines and basins**

# Increase Usability of Lidar Datasets - Daily Erosion Project and Ag Conservation Practices Framework

**Collaboration between DOA, UW Extension, NRCS/ARS and ISU Dept Agricultural Engineering**

- Collect lidar data from counties
- Create DEMS HUC12 watersheds
- Automated hydro-enforcement
- Used in Daily Erosion Project
- ACPF - watershed planning toolkit

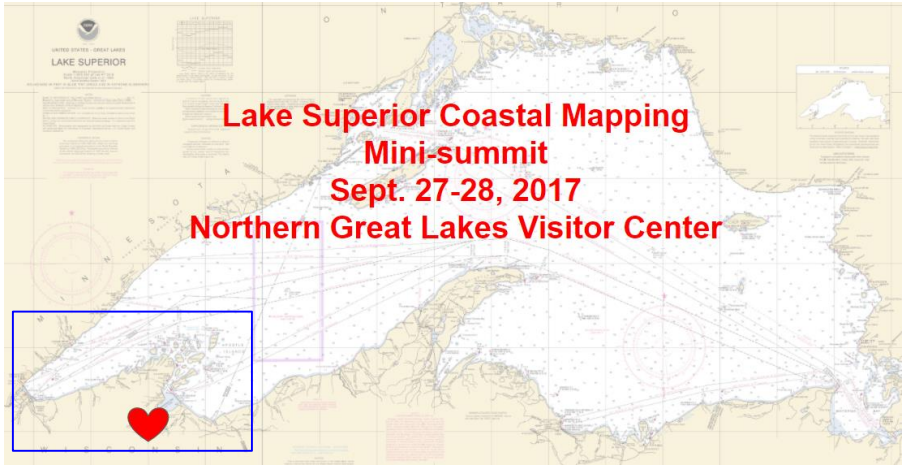
http://northcentralwater.org/acpf/
https://dailyerosion.org/



# Increase User Knowledge Through Collaboration

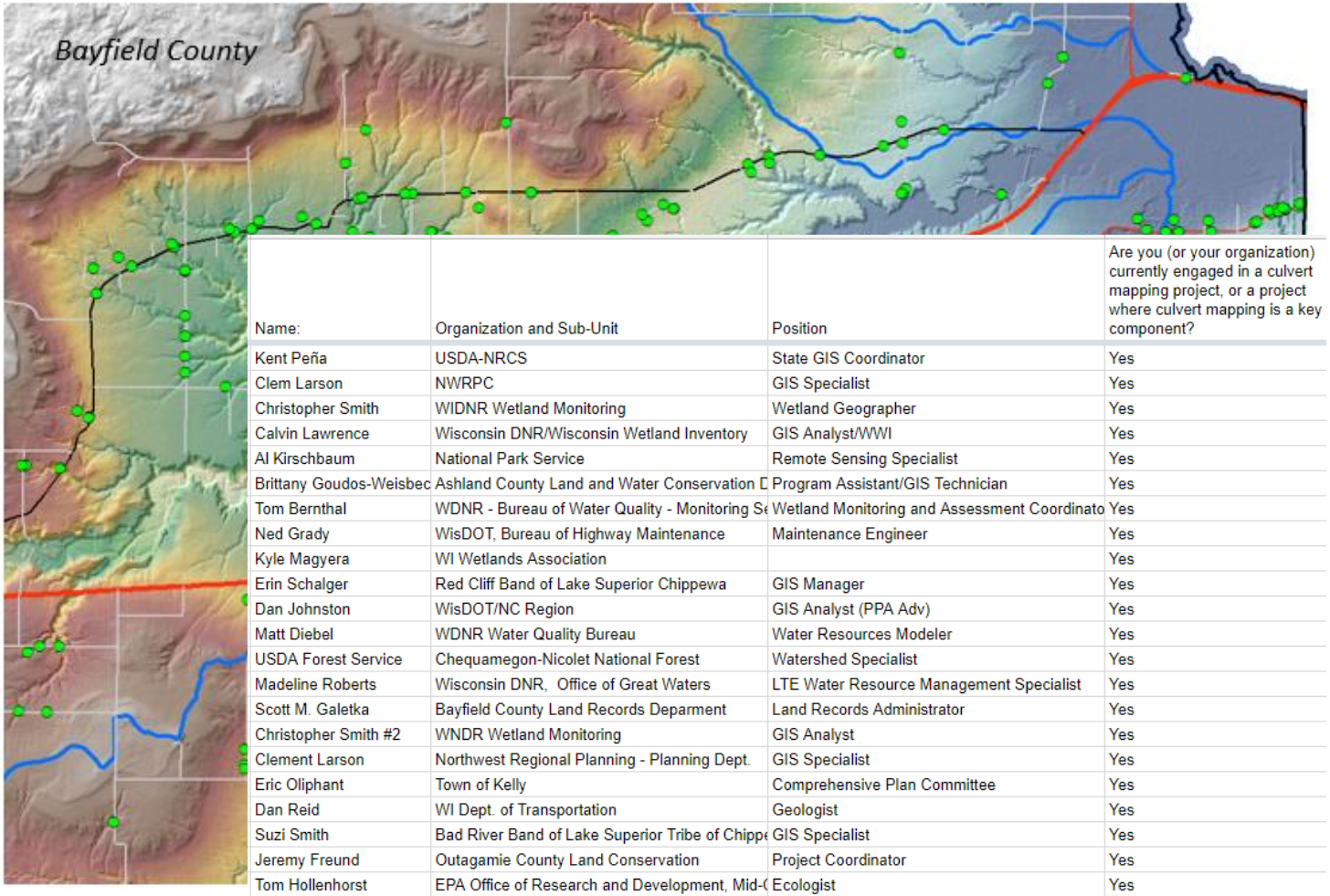
## Coastal Mapping Community of Practice

- Great Lakes Mapping Summit in Chicago, IL
- Lake Superior Coastal Mapping Mini-summit in Ashland, WI
- Who is doing what, where
- Current and future needs
- Identify obstacles
  - Better communication
  - Organizational silos limit collaboration
  - Lack of central data repository
  - Proliferation of data portals
  - Lack of funding
- Identify opportunities for collaboration
  - Culvert inventories for hydro-enforced DEMs
  - Refly lidar - Bad River Watershed flood erosion
  - Increase collection of lake bathymetry
  - Traditional training and learn as you go
  - Community efforts vs traditional silos



**Wisconsin Coastal Management Program**

**Project of Special Merit:** Combining a mapping community of practice with an innovative collaborative cloud-based environment to improve coastal hazard planning and policy development.




| Name: | Organization and Sub-Unit | Position | Are you (or your organization) currently engaged in a culvert mapping project, or a project where culvert mapping is a key component? |
|---|---|---|---|
| Kent Peña | USDA-NRCS | State GIS Coordinator | Yes |
| Clem Larson | NWRPC | GIS Specialist | Yes |
| Christopher Smith | WIDNR Wetland Monitoring | Wetland Geographer | Yes |
| Calvin Lawrence | Wisconsin DNR/Wisconsin Wetland Inventory | GIS Analyst/WWI | Yes |
| Al Kirschbaum | National Park Service | Remote Sensing Specialist | Yes |
| Brittany Goudos-Weisbec | Ashland County Land and Water Conservation D | Program Assistant/GIS Technician | Yes |
| Tom Bernthal | WDNR - Bureau of Water Quality - Monitoring Se | Wetland Monitoring and Assessment Coordinato | Yes |
| Ned Grady | WisDOT, Bureau of Highway Maintenance | Maintenance Engineer | Yes |
| Kyle Magyera | WI Wetlands Association | | Yes |
| Erin Schalger | Red Cliff Band of Lake Superior Chippewa | GIS Manager | Yes |
| Dan Johnston | WisDOT/NC Region | GIS Analyst (PPA Adv) | Yes |
| Matt Diebel | WDNR Water Quality Bureau | Water Resources Modeler | Yes |
| USDA Forest Service | Chequamegon-Nicolet National Forest | Watershed Specialist | Yes |
| Madeline Roberts | Wisconsin DNR, Office of Great Waters | LTE Water Resource Management Specialist | Yes |
| Scott M. Galetka | Bayfield County Land Records Deparment | Land Records Administrator | Yes |
| Christopher Smith #2 | WNDR Wetland Monitoring | GIS Analyst | Yes |
| Clement Larson | Northwest Regional Planning - Planning Dept. | GIS Specialist | Yes |
| Eric Oliphant | Town of Kelly | Comprehensive Plan Committee | Yes |
| Dan Reid | WI Dept. of Transportation | Geologist | Yes |
| Suzi Smith | Bad River Band of Lake Superior Tribe of Chippe | GIS Specialist | Yes |
| Jeremy Freund | Outagamie County Land Conservation | Project Coordinator | Yes |
| Tom Hollenhorst | EPA Office of Research and Development, Mid-( | Ecologist | Yes |

# RiskMap - Lidar LOMAs

### 5.2 Exhibit Requirements for MT-1 Requesters

The applicant requesting that a LOMA determination be evaluated based on LiDAR data must submit a paper map or digital PDF exhibit that displays either: (1) an overlay of the LiDAR contours or (2) an overlay of the LiDAR points both of which must be with an aerial image of the structure/property in question.

The exhibit must contain the following data:

- Scale
- North arrow
- Address/Assessor's Parcel Number (APN) for structure/property in question.
- Clearly identified subject of determination At least one street intersection visible on the exhibit, as applicable.
- Name, organization, and contact information of map overlay creator.
- Aerial imagery that correctly represents the footprint of the structure.
- Date the LiDAR was collected.
- Source of the LiDAR data (Federal, State, community, etc.) to include public website address.
- LiDAR accuracy information.
- Location of the data archive or metadata file (must be available for independent verification through a publicly available website or metadata).

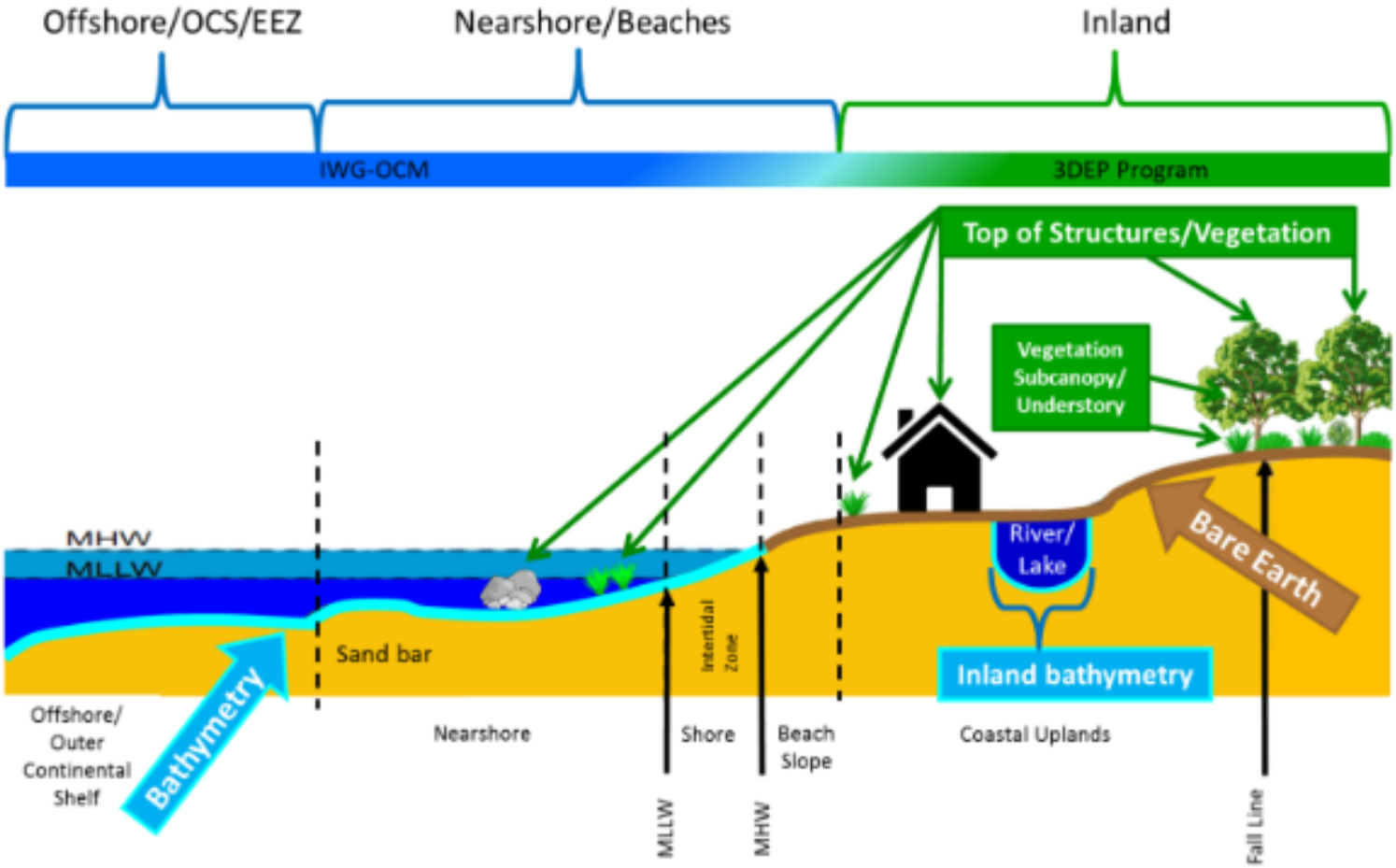
Figure 19: Example – Point Cloud Depiction

# Wisconsin Lidar General Priorities

- Complete lidar coverage of state using all available funding options
- Update older, lower resolution lidar data sets
- Increase public access to lidar data
- Increase usability of lidar products
- Increase lidar user knowledge
- Plan for the future ***- opportunities abound for the WAFSCM community to provide input and guidance!***

3D Nation Study

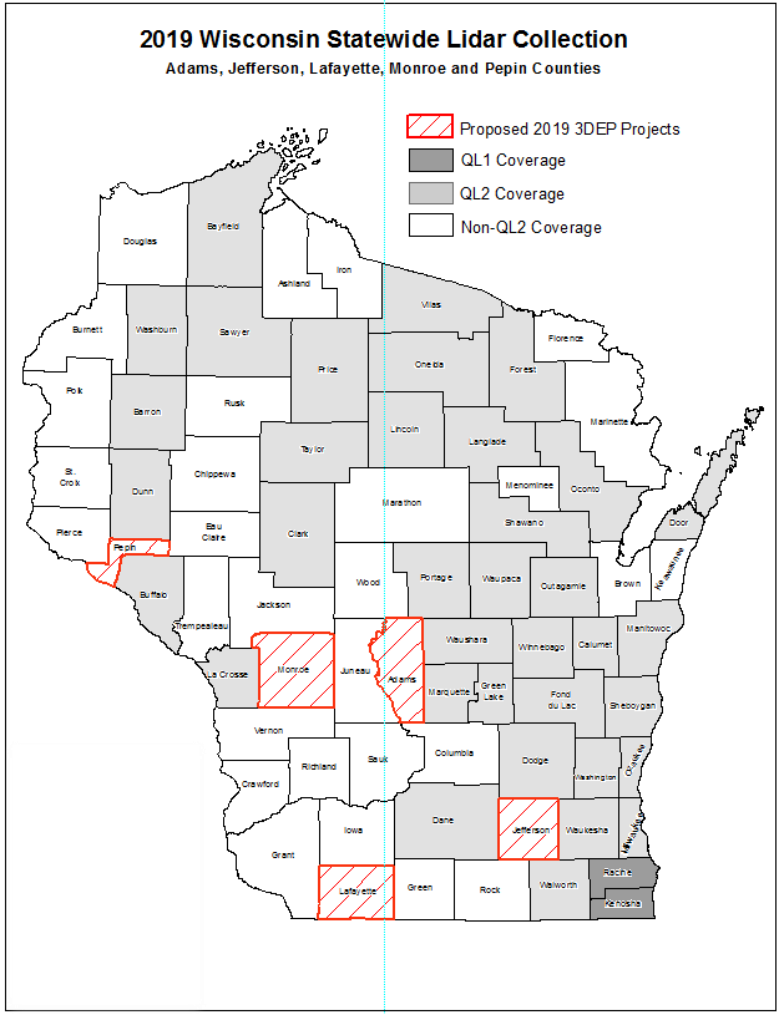
Ongoing




Topographic, coastal, & bathymetric 3D elevation data across a multitude of geographies.

# State Elevation Plan

- Required for FY20 and beyond 3DEP applications
  - How do we complete state by 2023 with QL2 lidar?
  - Are there priority areas for:  local needs, floodplain/inundation mapping, wetland mapping, agricultural conservation planning, dam breach analysis, etc.
  - Are different lidar specs needed: higher resolution (QL1), smaller stream and pond breaklines, LAS classifications, etc.
- What derivative products do we need and how do we fund the systematic development for those?
  - Hydrologic features - streams, waterbodies, culverts, HUC boundaries, etc.
  - Hydro-enforced DEMs needed for modeling
  - Vegetation products
  - Building footprints
- “Other” elevation products - lake and riverine bathymetric data, ordinary high water marks, historic shorelines



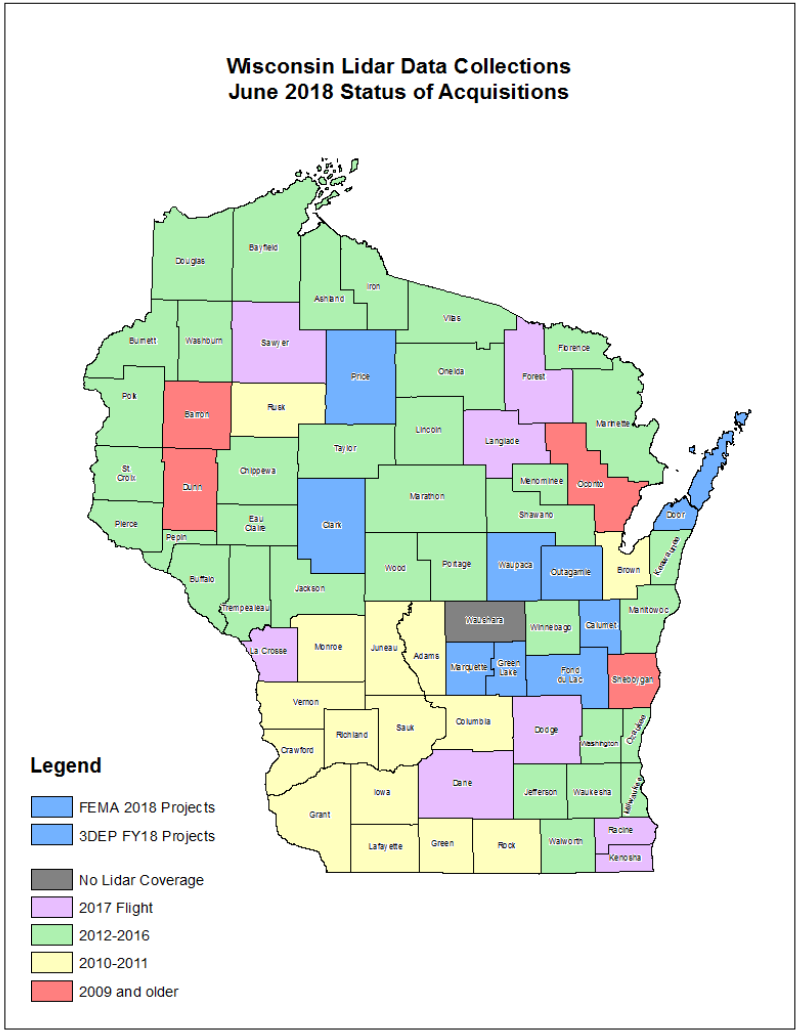
# *Come Celebrate Completion of Statewide Lidar!!*

**All-day Lidar Symposium**

**Wisconsin Land Information Association 2019 Annual Conference**

**Red Lion Hotel Paper Valley, Appleton, WI**

**February 20-22, 2019**



# Questions?

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