



# FOREST DELINEATION USING TERRAIN MODELS

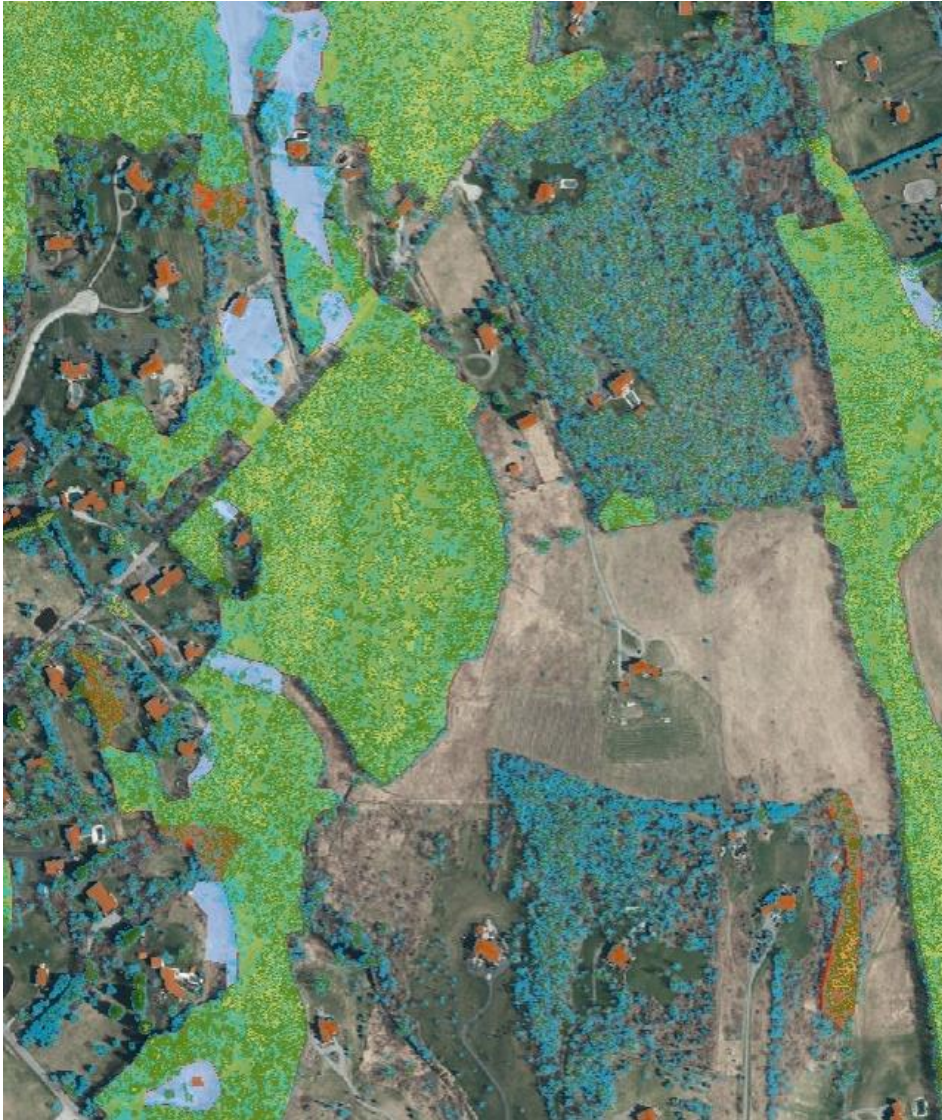
A SEMI-AUTOMATED  
PROCESS FOR  
GREATER ACCURACY  
AND EFFICIENCY

NYGeoCon 2017

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Dutchess County Department of Planning  
and Development



## **OBJECTIVES:**

**Describe methods and efficiencies of delineating a forest, using raster data.**

**Describe methods of combining forests with wetland and water data.**

**Discuss planning decisions that can be made based on the data.**



**Dr. Richard S. Ostfeld**  
Disease Ecologist  
Ph.D., 1985, University of California, Berkeley  
Expertise: disease ecology, Lyme disease, West Nile virus

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## COLLABORATION:

**Cary Institute of Ecosystem Studies  
2005, updated 2017.**

**Dr. Richard Ostfeld's hypothesis:  
More forest edge, more chance of  
Tickborne Illness.**

### Why?

- **Less Biodiversity**
- **Human-Wildlife Interface**

### How?

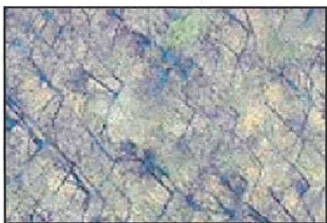
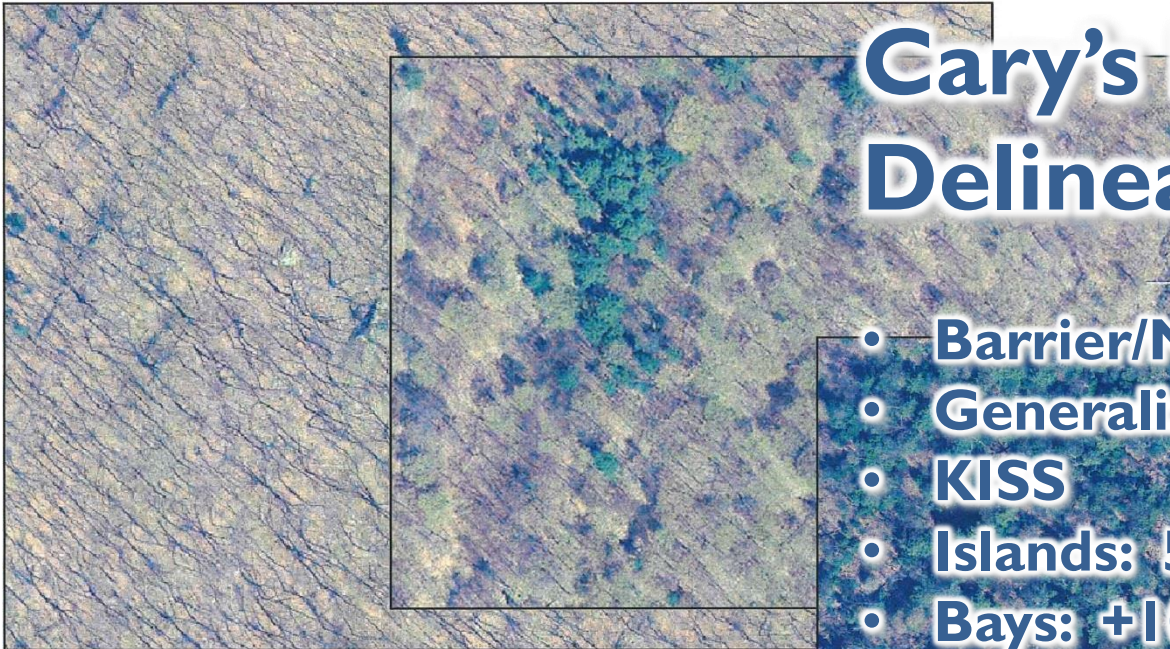
- **Delineate Forests**
- **Metrics for Forests (Edge, etc)**



## What is Forest? Identification of Forested Areas

# Cary's Forest Delineation Rules:

- **Barrier/Not Barrier to wildlife**
- **Generalize (no canopy bubble)**
- **KISS**
- **Islands: 50M a side (include)**
- **Bays: +10 m width (exclude)**
- **L or W of Holes: + 50 m (ex)**
- **No hedgerows (single trees)**
- **Fragments > 1 Tree and + 10 m**



*Note: If you can not easily distinguish tree trunks than it is probably not forest cover.*

Key: Distinguishing the striations of trunks and patterns of a canopy.



### Forest Fragments

# IS Forest



Extensions coming off of the main forest patch that consist of a single tree row should not be included. Only those areas **wider than 1 tree width** should be included. As a result many of these extensions should be cut off.

# IS NOT Forest



This area of urban forest should be included in the forest class.

Although there seem to be separate rows of single trees, due to their close proximity to one another, they should be included in the classification.

These two forest patches should be connected since the 2-lane road is not a barrier.

# IS Forest

### Hedgerows

# IS NOT Forest



Perimeter trees around a property that consist of a single line of trees **should NOT** be included.

A cut off for the forest class should occur at the black line.

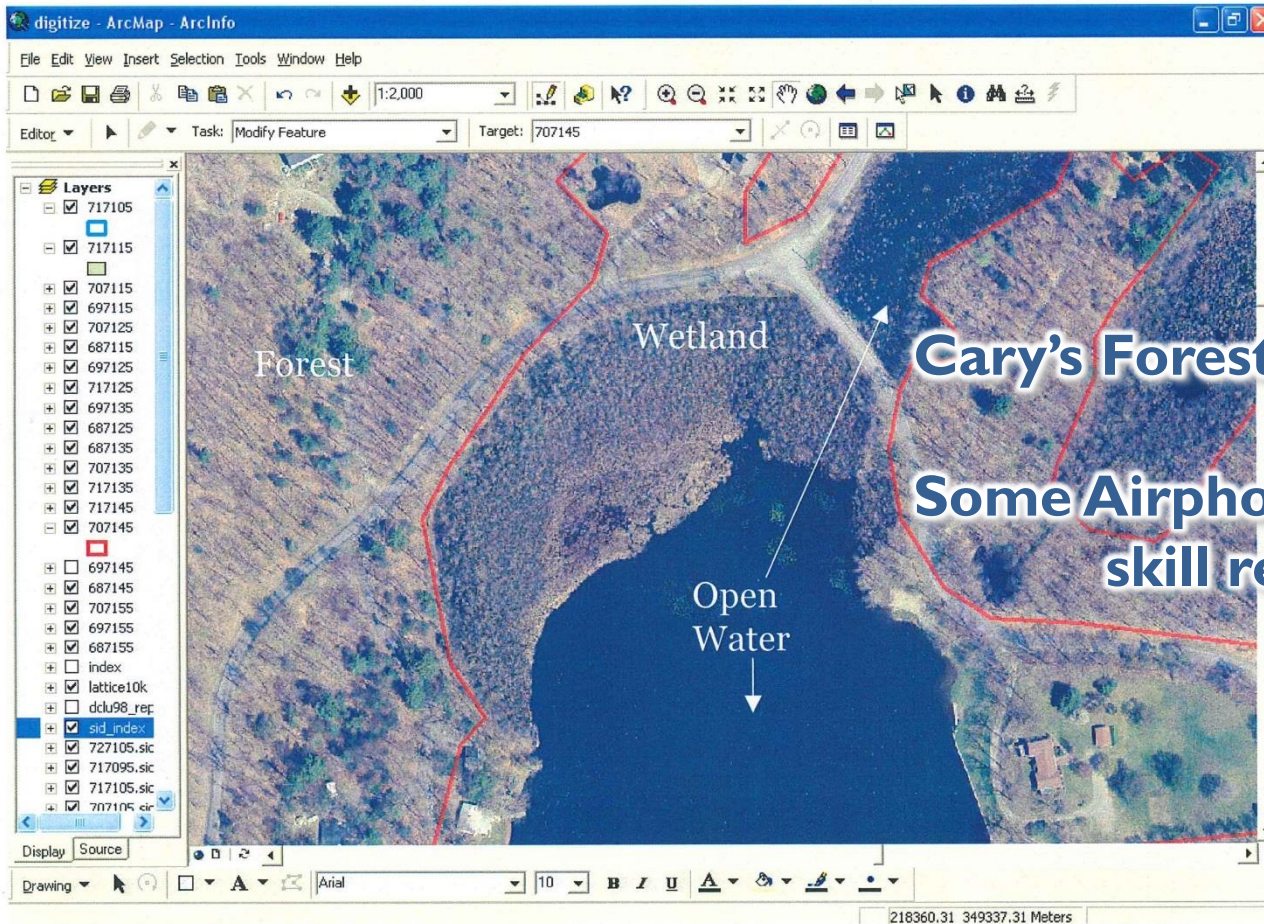
# IS Forest



**Single rows** of trees (hedgerows) should **NOT** be included in forest class unless the hedgerow is greater than one tree width.



# Wetland Community Identification –Texture & Association



Texture of wetlands and the association with open water.



**COMPARISON:**

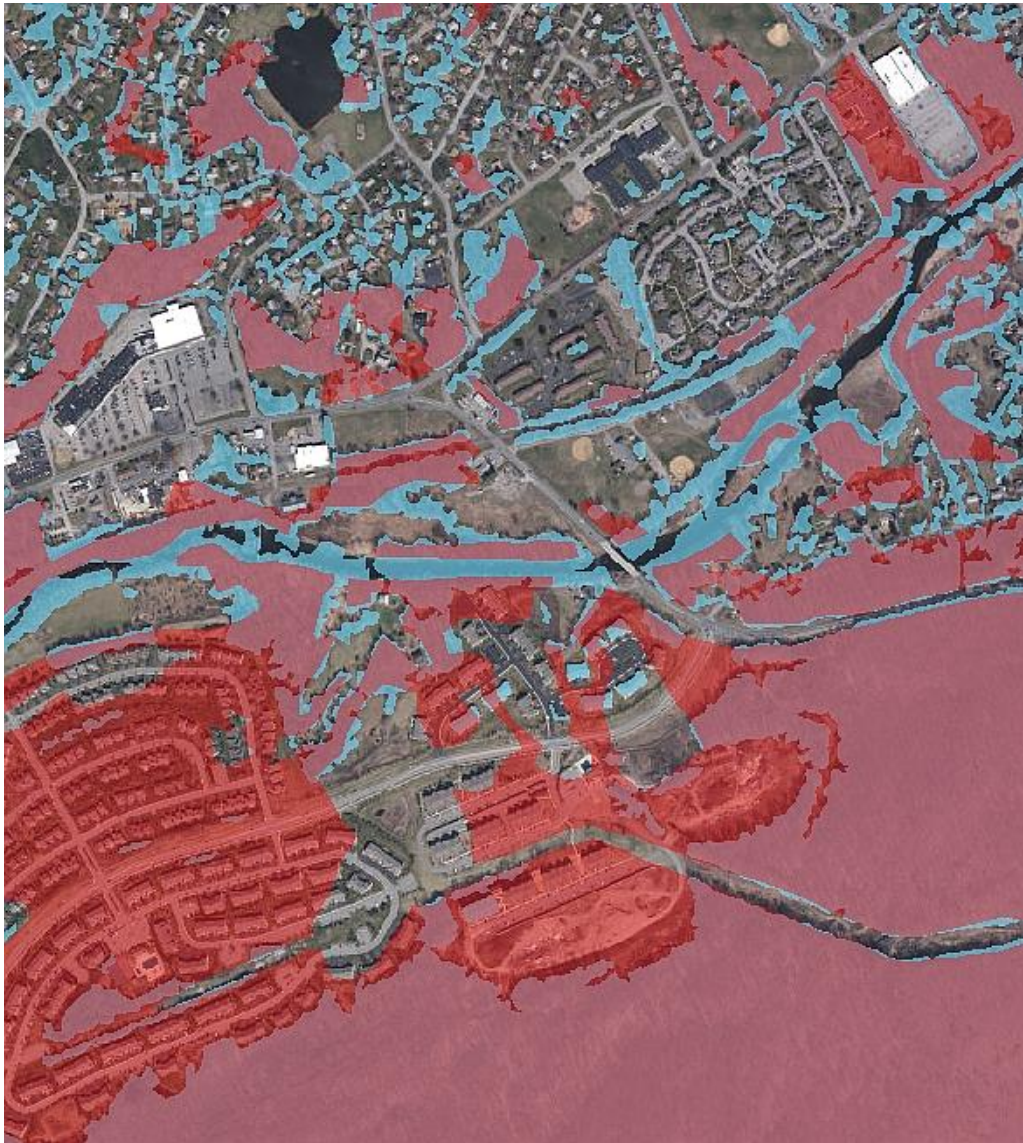
**2000 Photos / Forests**



**COMPARISON:**

**2014 Photos / Forests**

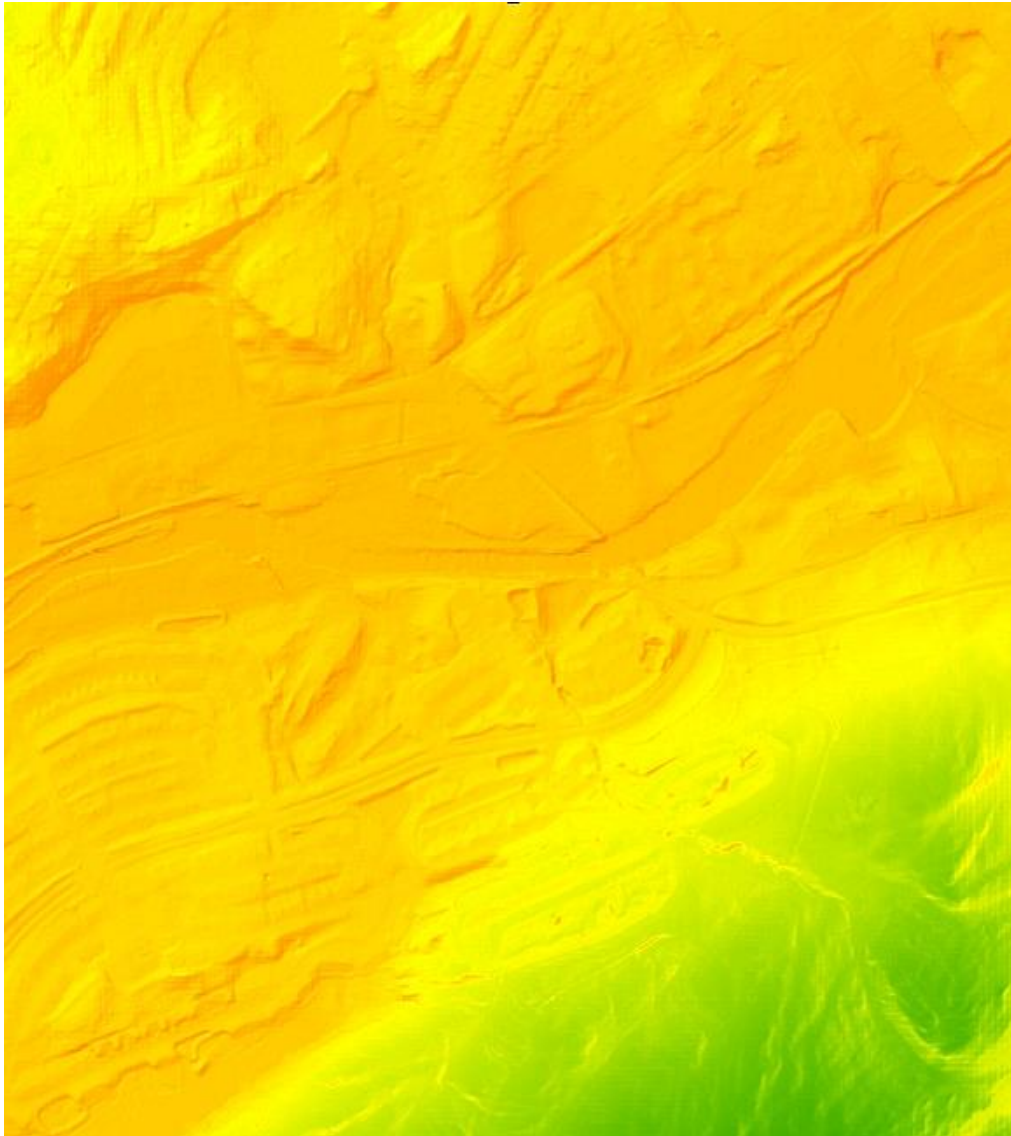




**COMPARISON:**

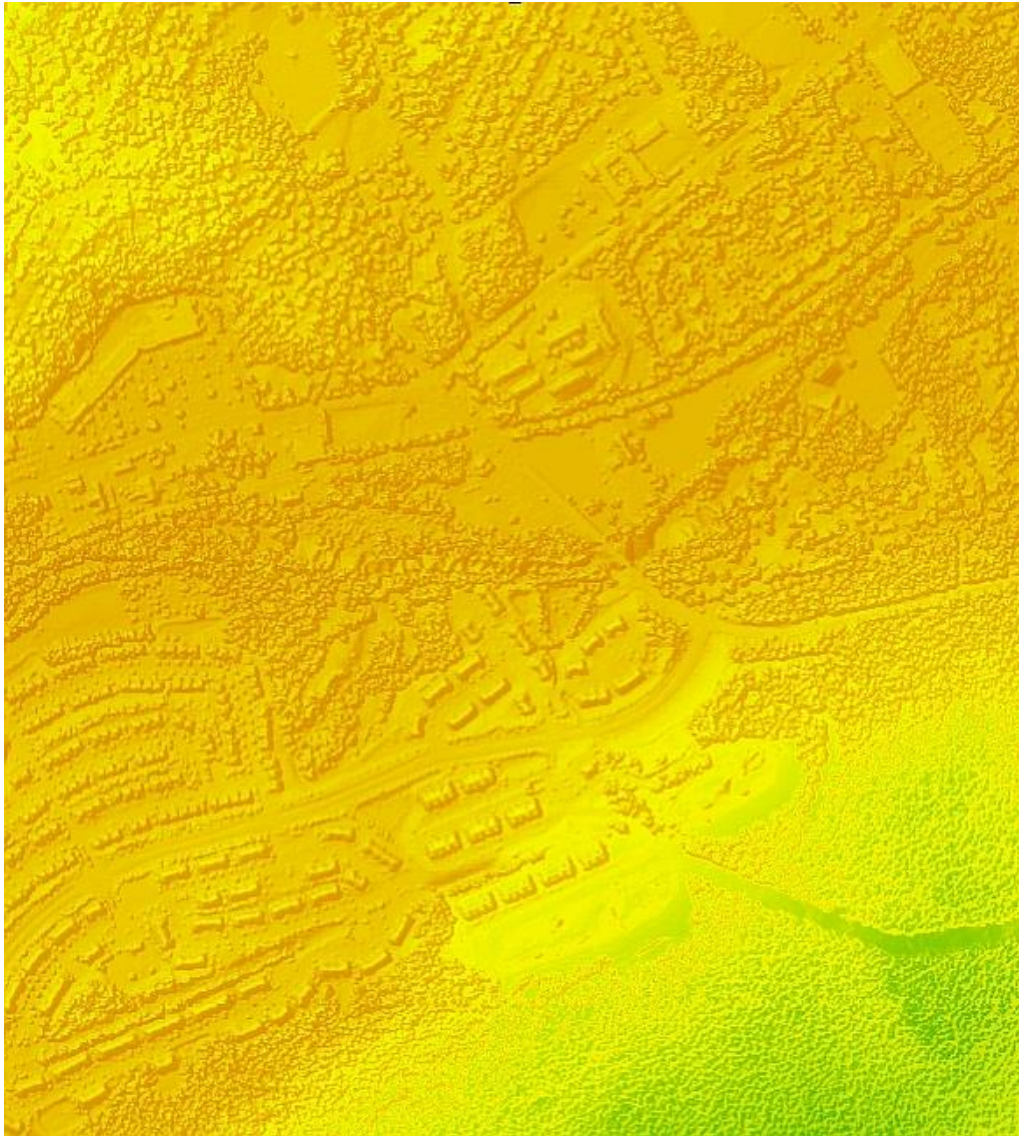
**Comparison Forests**

**OUR METHODS....**



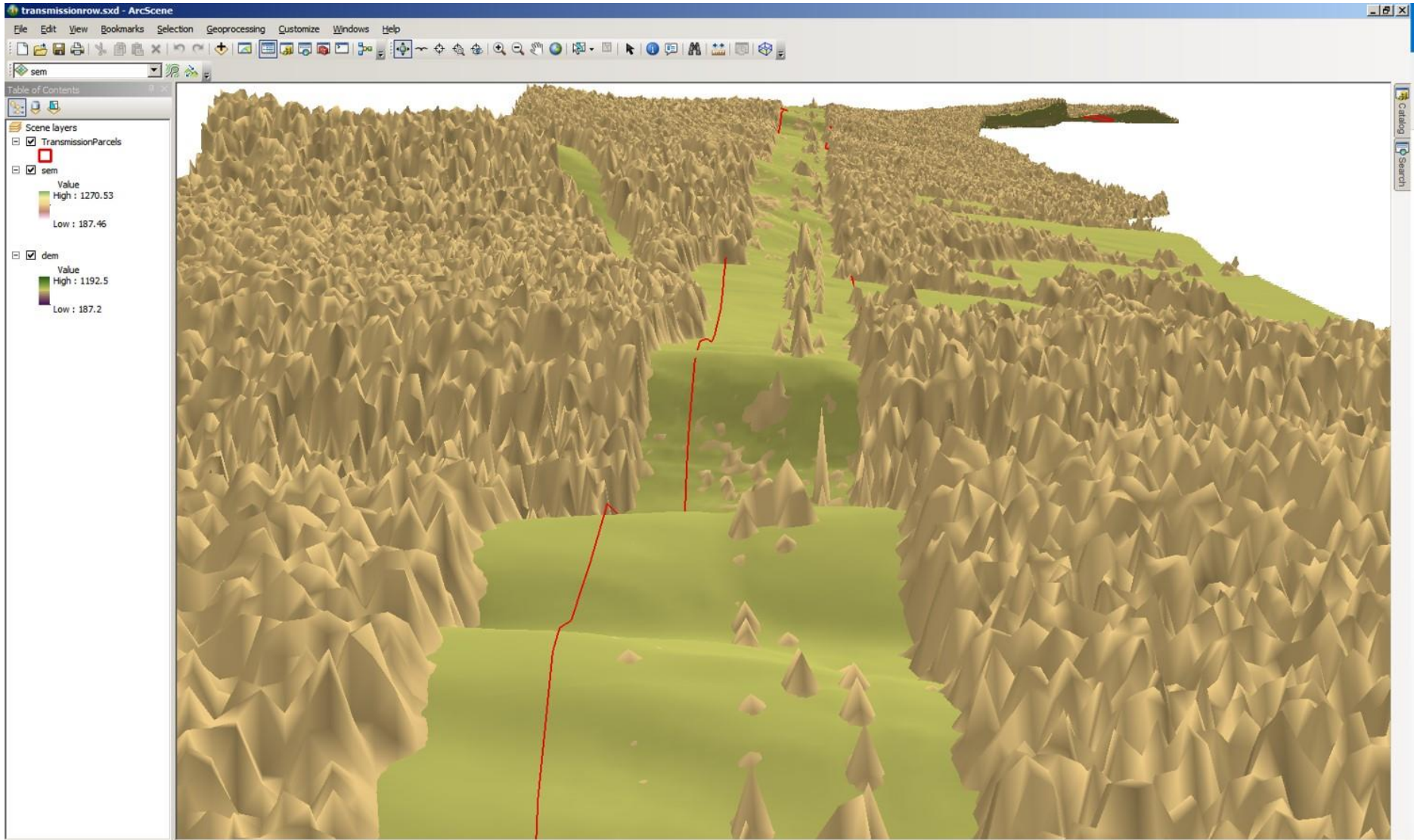
**COMPARISON:**

**DEM**



**COMPARISON:**

**SEM**





Untitled - ArcMap

File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help

1 in = 250 ft

Representations

Table Of Contents

Layers

gis

GIS

### Aspect

Input raster

Output raster

**Aspect**

Derives aspect from a raster surface. The aspect identifies the downslope direction of the maximum rate of change in value from each cell to its neighbors.

Aspect can be thought of as the slope direction. The values of the output raster will be the compass direction of the aspect.

### Area Solar Radiation

Input raster

Output global radiation raster

**Area Solar Radiation**

Derives incoming solar radiation from a raster surface.

### Raster Calculator

Map Algebra expression

Layers and variables

- GIS\_Raster.DCGIS.SEM\_5ft
- GIS\_Raster.DCGIS.DEM\_5ft

7	8	9	/	==	!=	&
4	5	6	*	>	>=	
1	2	3	-	<	<=	^
0	.	+	(	)	~	

Conditional

- Con
- Pick
- SetNull

Math

- Abs

"GIS\_Raster.DCGIS.SEM\_5ft" - "GIS\_Raster.DCGIS.DEM\_5ft"

Output raster

C:\Users\jwills\Documents\ArcGIS\Default.gdb\rastercalc

OK Cancel Environments... << Hide Help Tool Help

### Map Algebra expression

The Map Algebra expression you want to run.

The expression is composed by specifying the inputs, values, operators, and tools to use. You can type in the expression directly or use the buttons and controls to help you create it.

- The Layers and variables list identifies the datasets available to use in the Map Algebra expression.
- The buttons are used to enter numerical values and operators into the expression. The ( and ) buttons can be used to apply parentheses to the expression.
- A list of commonly used tools is provided for you.

### ArcToolbox

- Geocoding Tools
- Geostatistical Analyst Tools
- Linear Referencing Tools
- Multidimension Tools
- Network Analyst Tools
- Parcel Fabric Tools
- Schematics Tools
- Server Tools
- Space Time Pattern Mining Tools
- Spatial Analyst Tools
  - Conditional
  - Density
  - Distance
  - Extraction
  - Generalization
  - Groundwater
  - Hydrology
  - Interpolation
  - Local
  - Map Algebra
    - Raster Calculator
  - Math
    - Multivariate
  - Neighborhood
  - Overlay
  - Raster Creation
  - Reclass
  - Segmentation and Classification
  - Solar Radiation
    - Area Solar Radiation
    - Points Solar Radiation
    - Solar Radiation Graphics
  - Surface
    - Aspect
    - Contour
    - Contour List
    - Contour with Barriers
    - Curvature
    - Cut Fill
    - Hillshade
    - Observer Points
    - Slope
    - Viewshed
    - Viewshed 2
    - Visibility
  - Zonal
- Spatial Statistics Tools
- Tracking Analyst Tools

707624.961 1105631.49 Feet

Notes Comments

33%

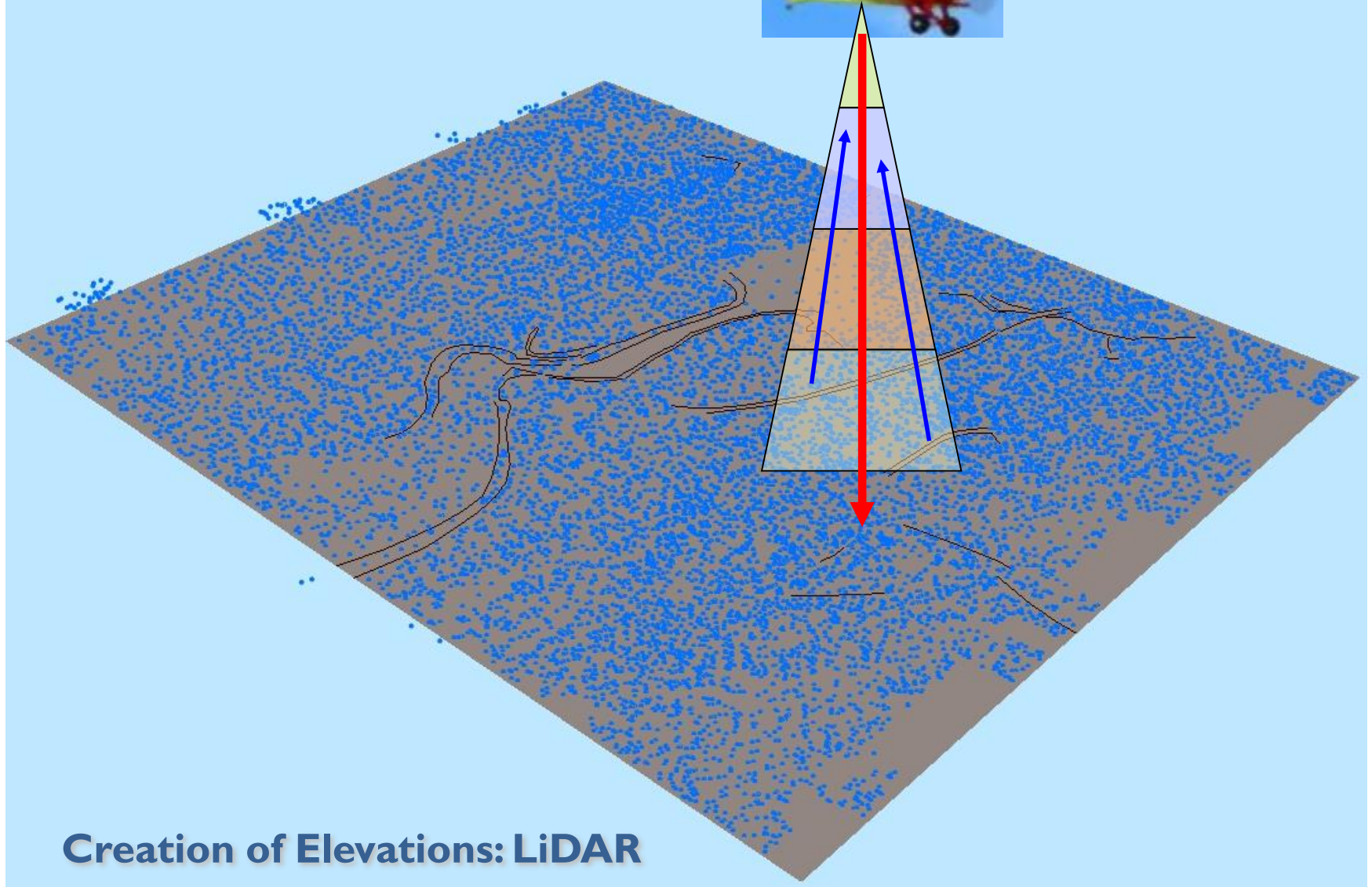


## A little bit about LiDAR

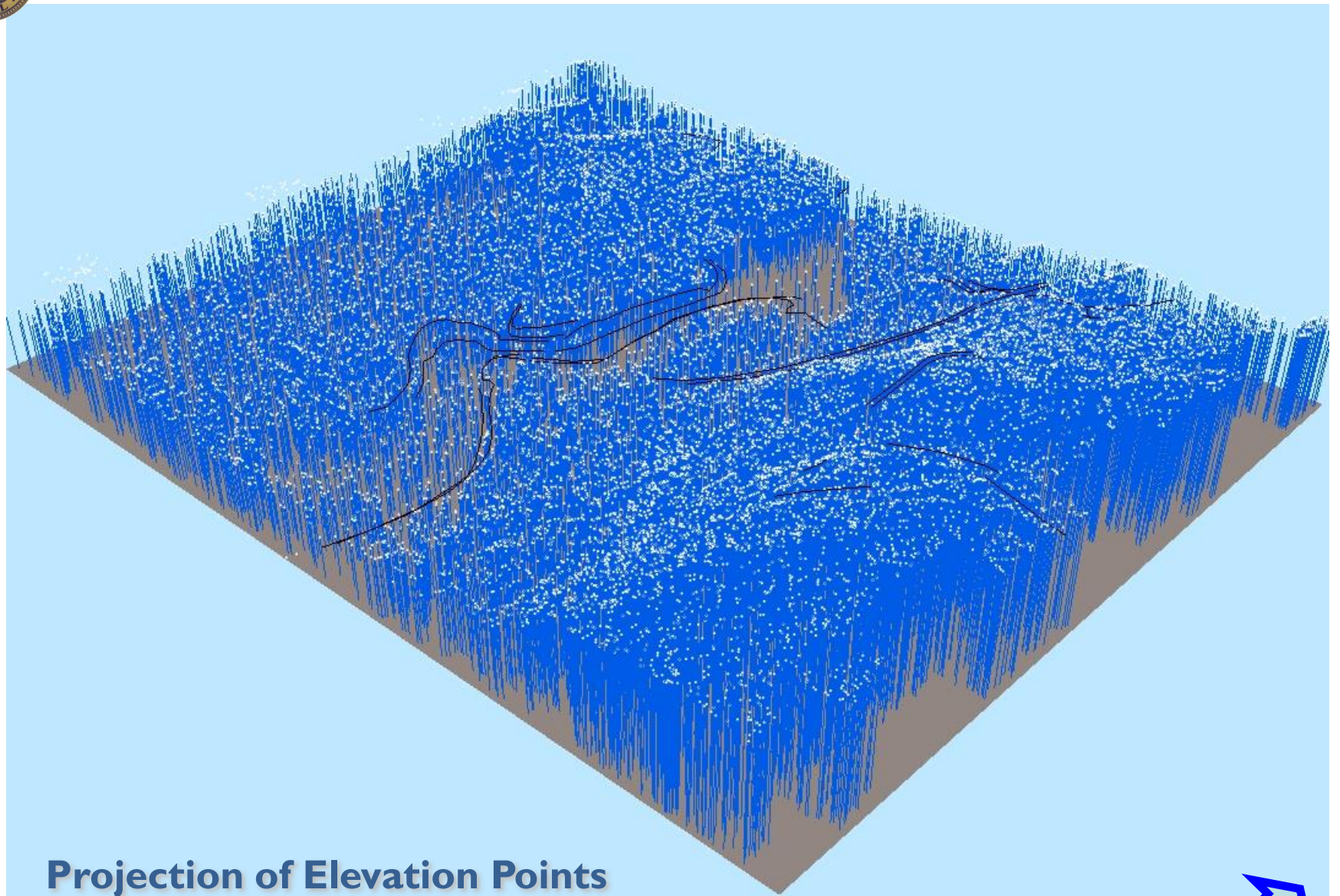


**Photo in Oblique View**





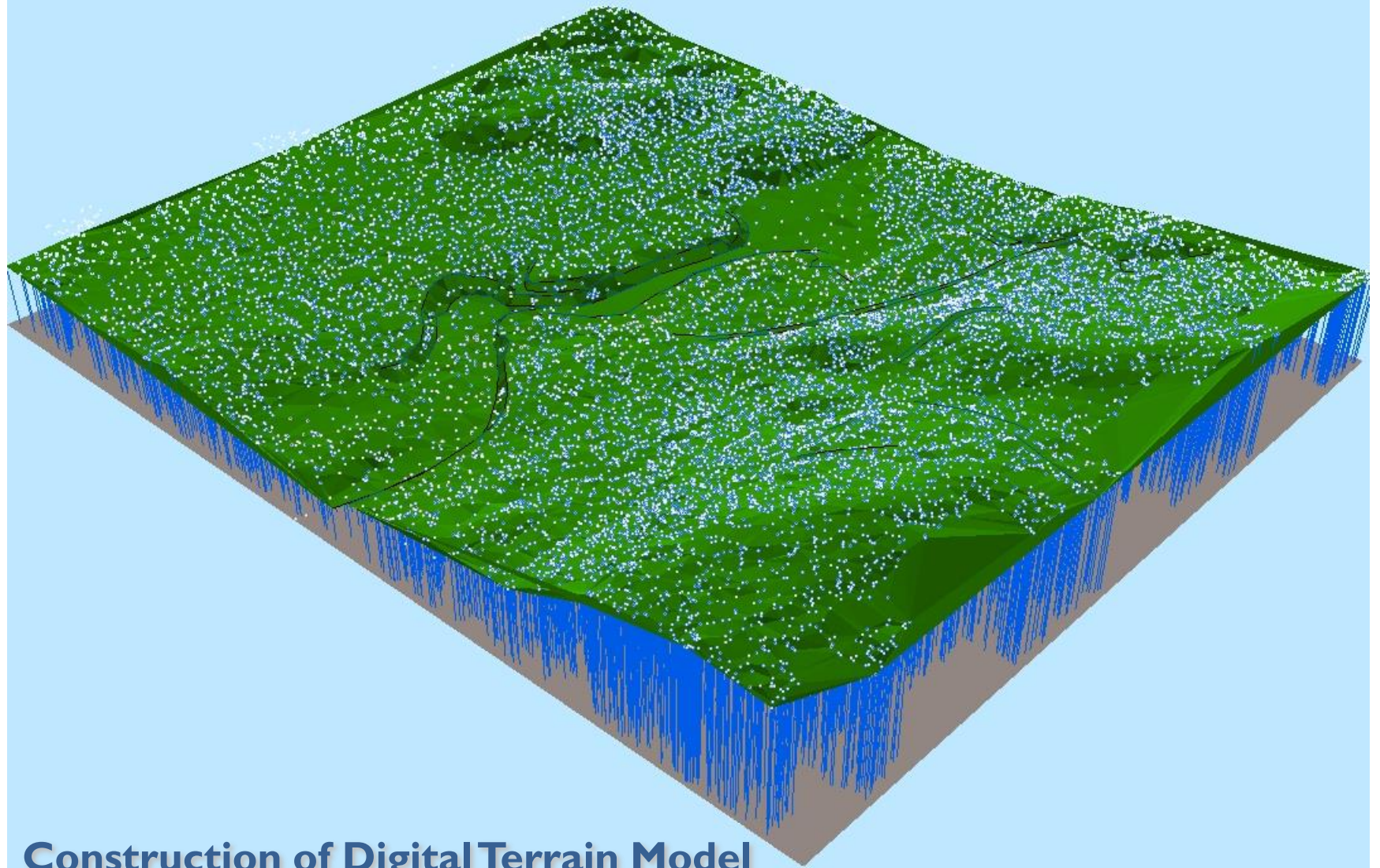
**Creation of Elevations: LiDAR**



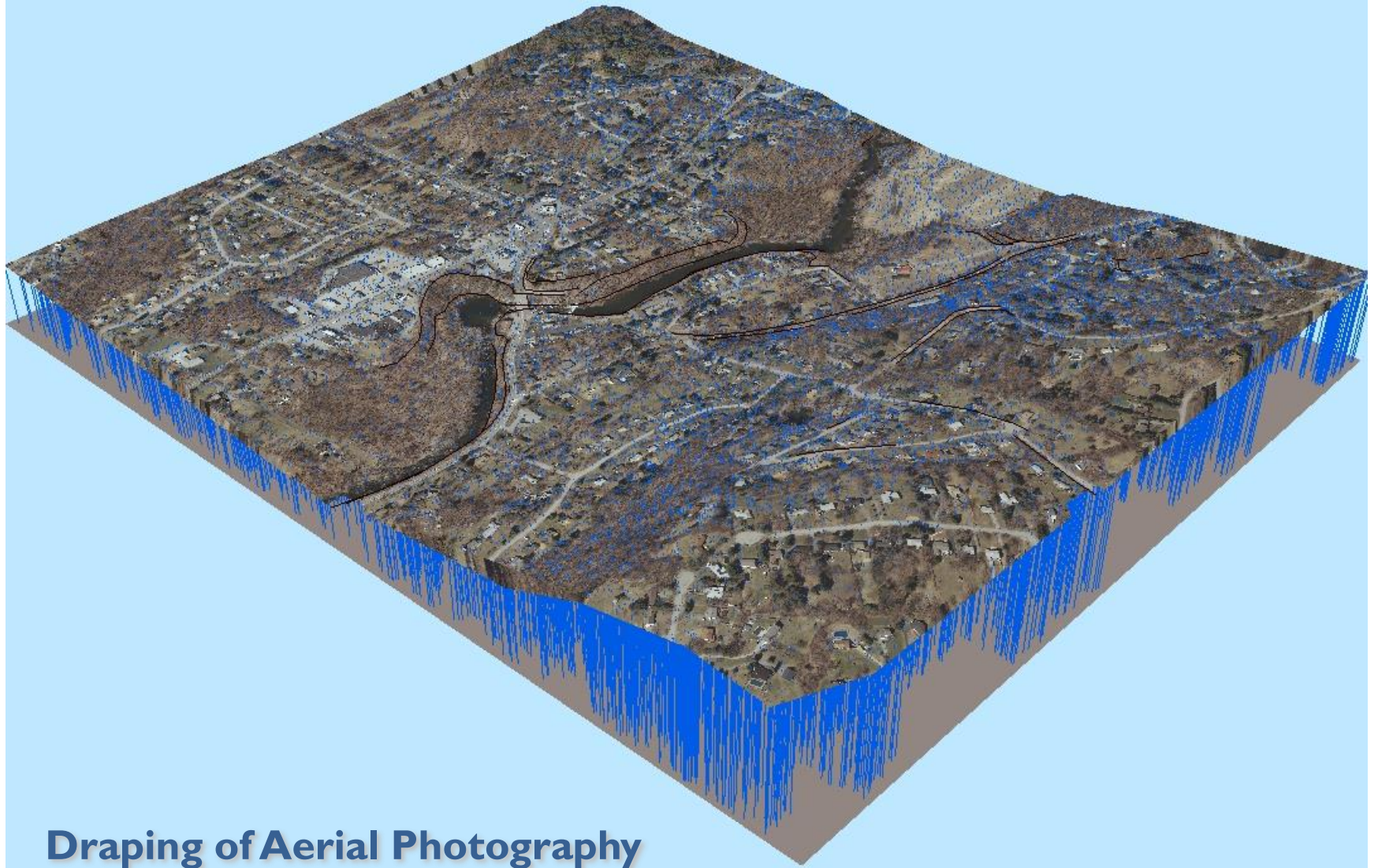
**Projection of Elevation Points**



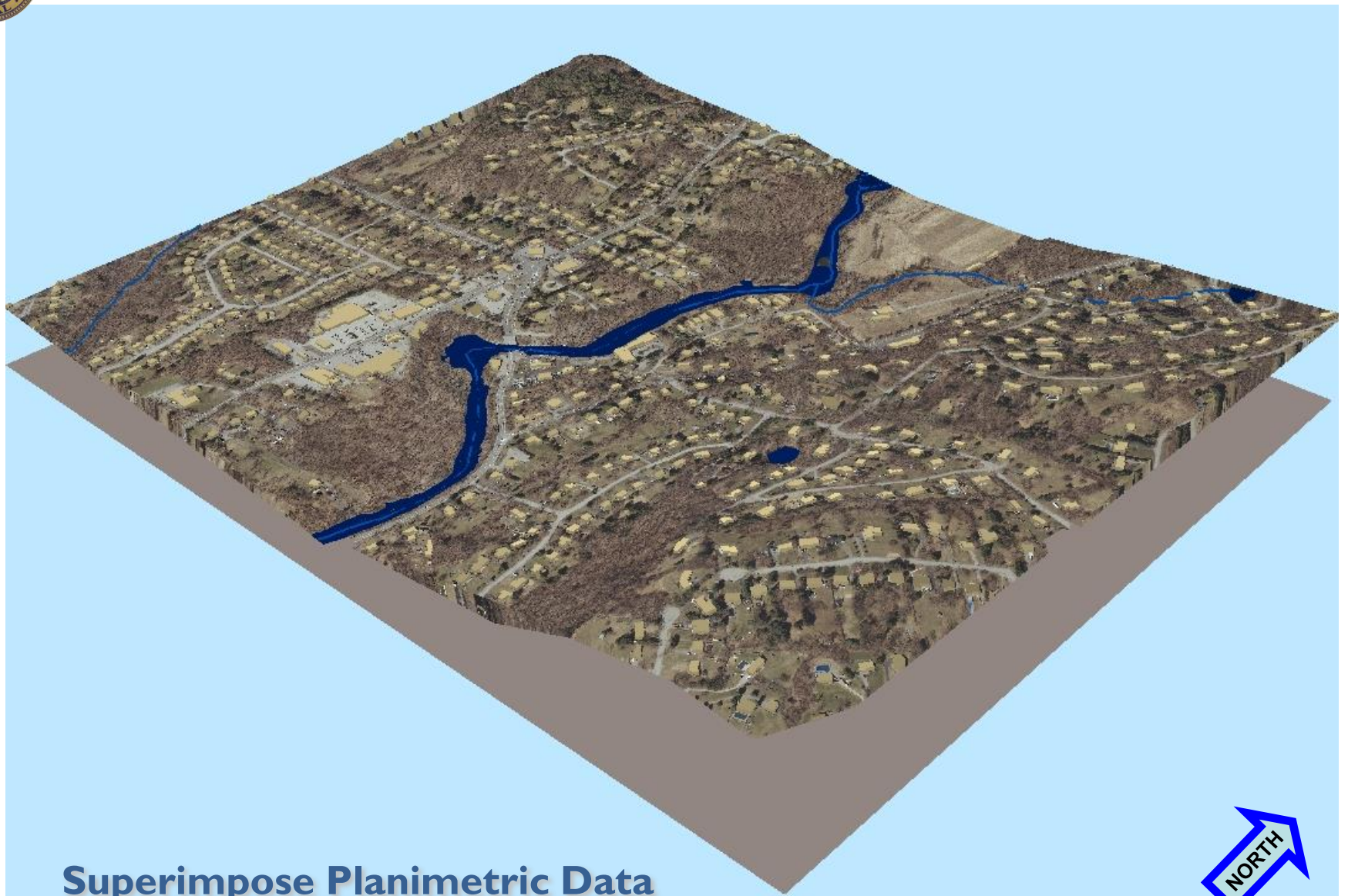




**Construction of Digital Terrain Model**



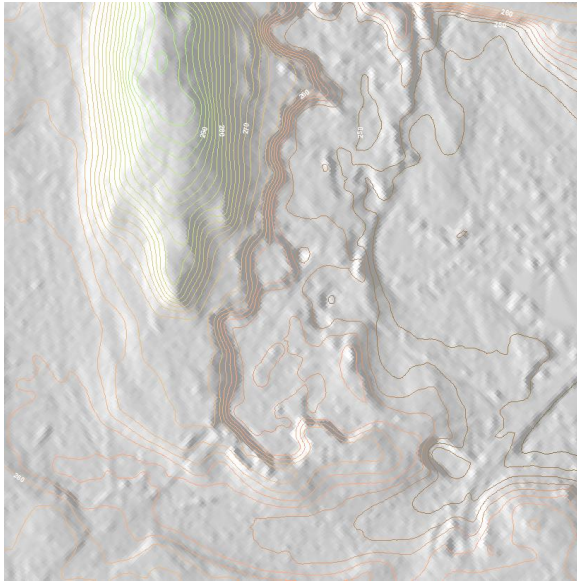
**Draping of Aerial Photography**



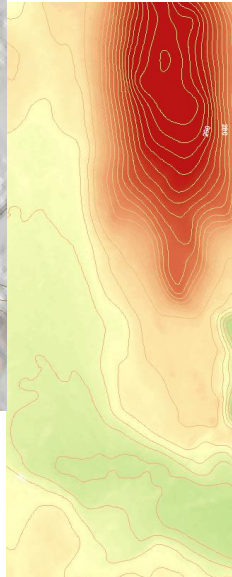
**Superimpose Planimetric Data**







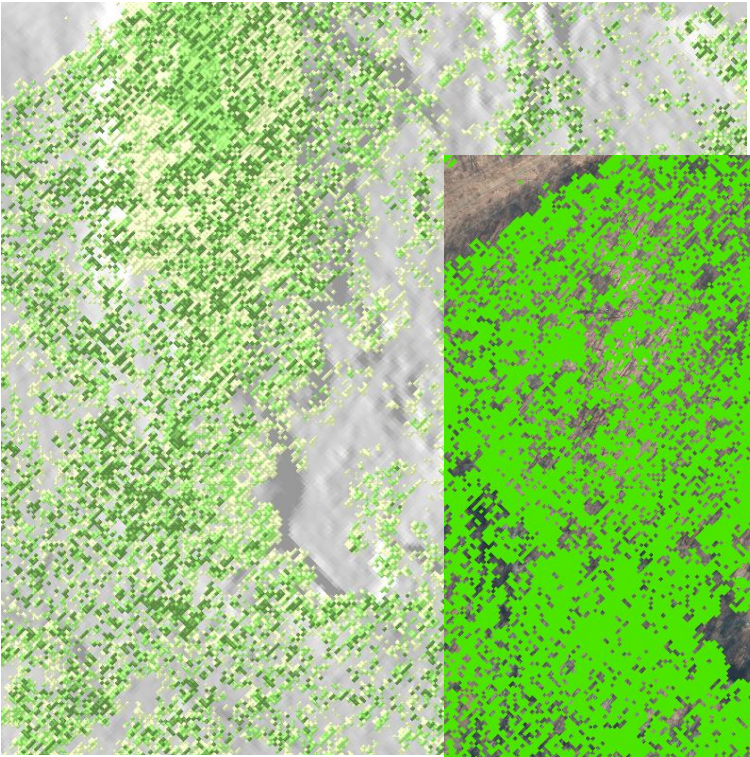
**2014 Bare-earth  
Hillshade**



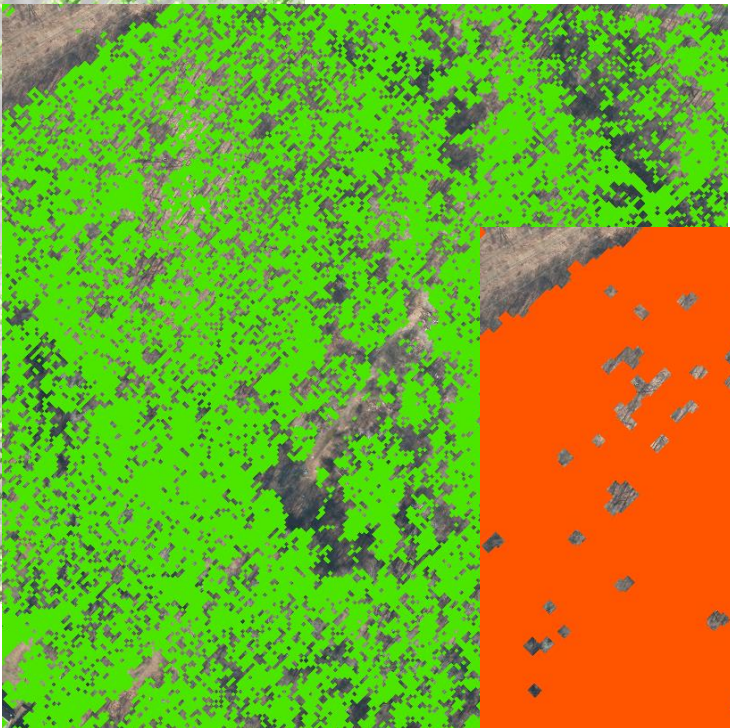
**2014 Bare**



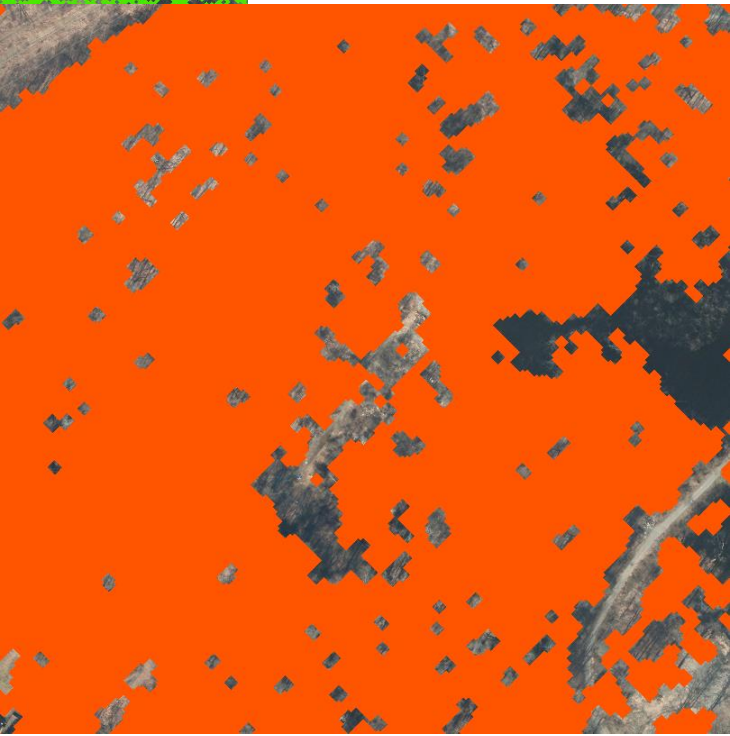
- **Method relies on heights**
- **Visual interpretation lessened**
- **No parallax confusion between tree crowns, shadows, and true locations**



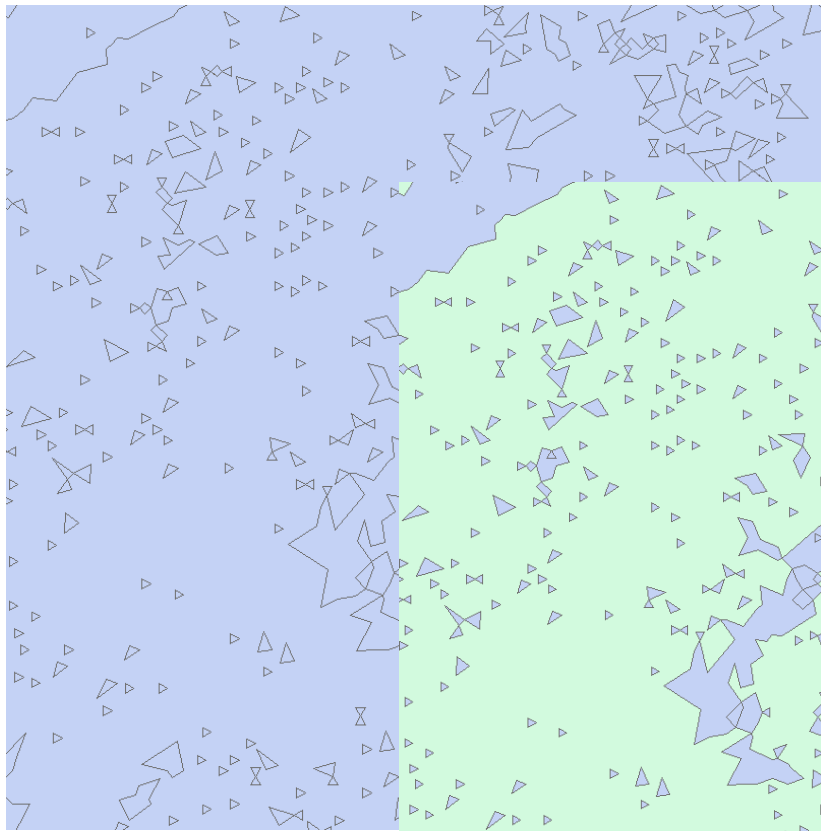
**Subtracted, reclassified (by height) surface**



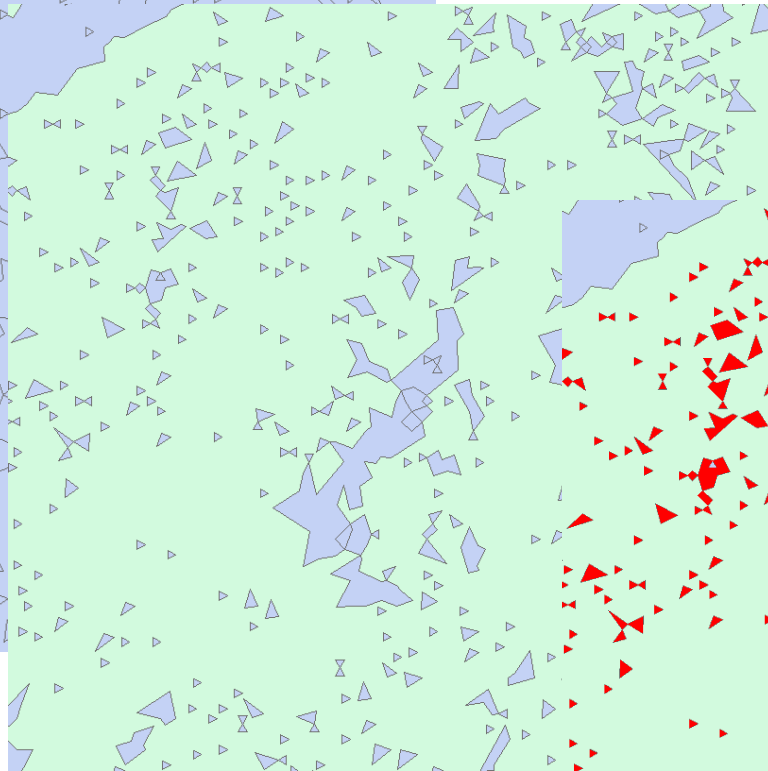
**Aggregated surface  
(all heights above...)**



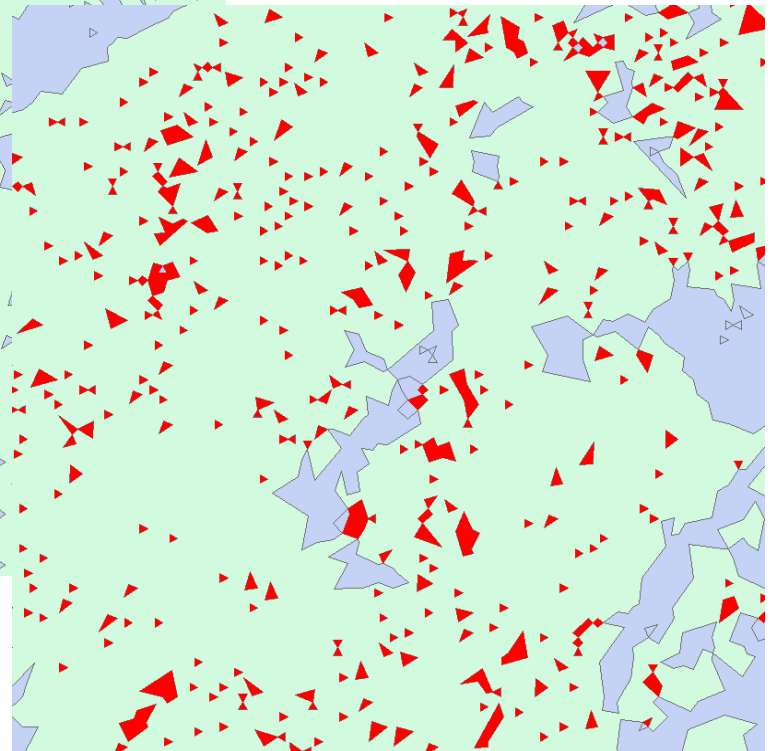
**Tiniest holes healed with  
Boundary Clean Tool**



**Aggregate forests and holes**



**Separation and non-forest fragments deleted**



**Small fragments identified and merged**



**All height surface (trees and structures)**



**Structure Buffers**



**Subtracted Structure Buffers**

- **Similar method used for Bridges**





**Power Lines:**

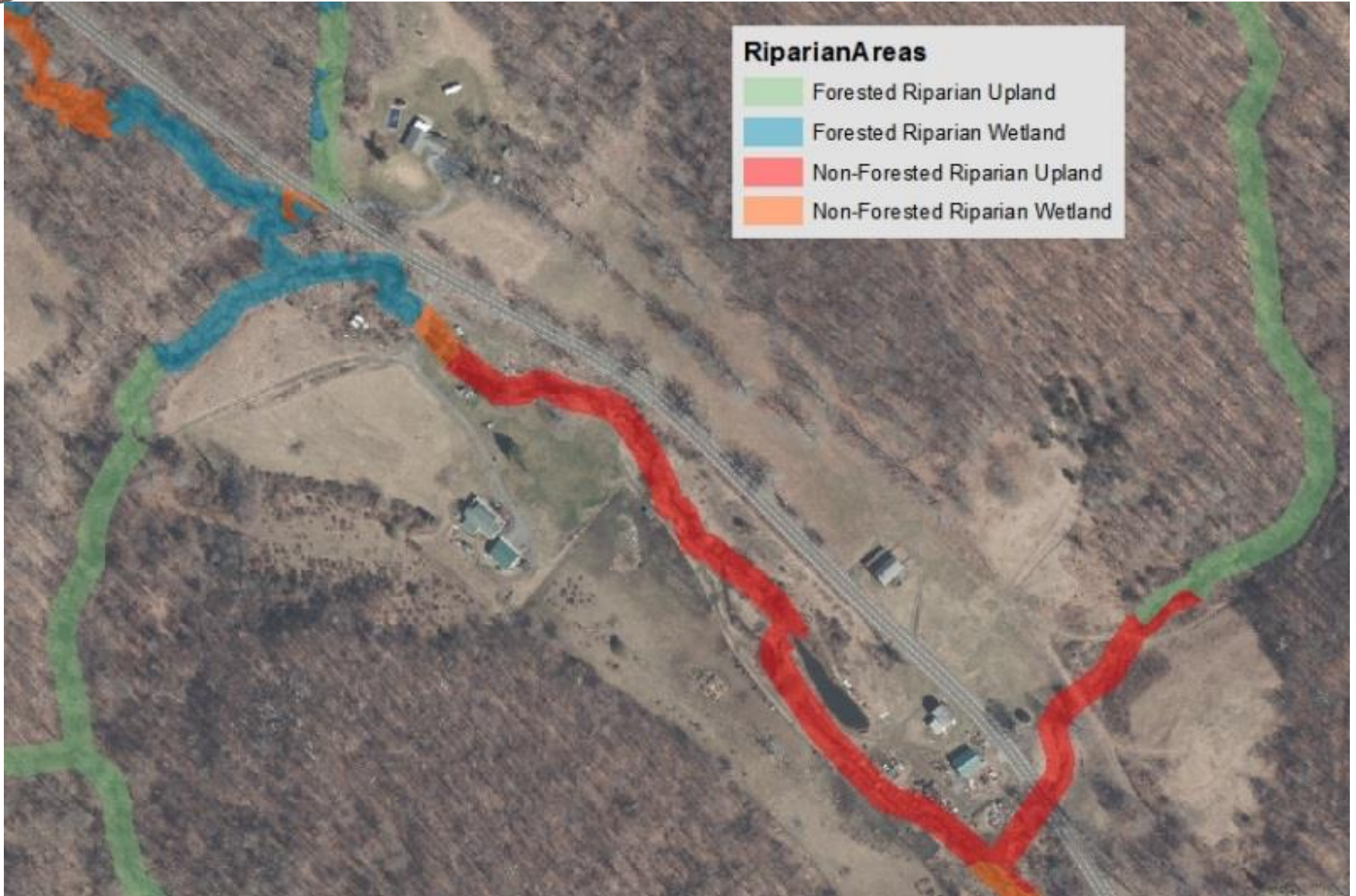
**Elimination using  
Isoperimetric Quotient and  
Area**

**IQ: a measure of “roundness”**

**Value approaching 1=Round  
Value approaching 0= Hot Dog**

**Hot Dog power lines eliminated**

**Because of their area, some  
power lines not eliminated. Also  
could be from vegetation  
growing under lines.**



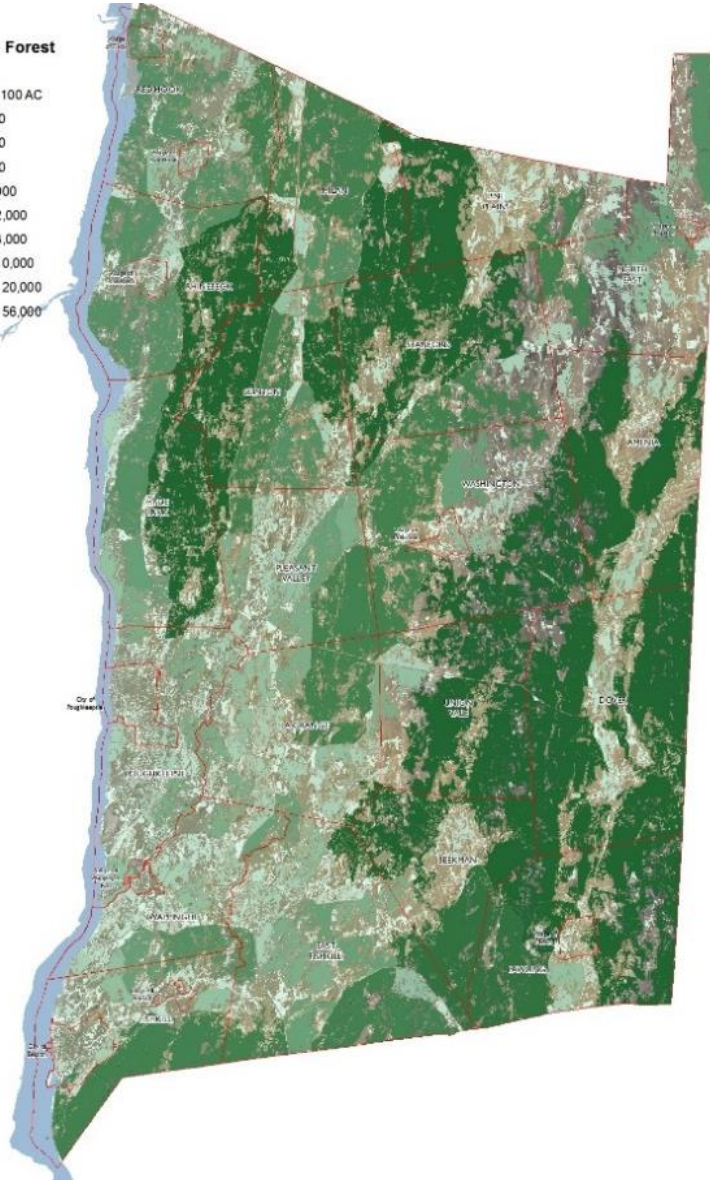
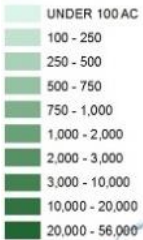
### Riparian Areas

- Forested Riparian Upland
- Forested Riparian Wetland
- Non-Forested Riparian Upland
- Non-Forested Riparian Wetland



## Legend

### Contiguous Forest Acres



# FOREST UPDATE

**Dutchess County is 62% forested:**

**320,132 Acres, or ~500 sq. miles.  
(Dutchess County land area:  
806 sq. miles)**

**2000 Survey: 56% forested  
(not an apples-to-apples comparison)**

**Biologic Diversity: larger forest areas  
'better'. The three largest contiguous  
forest areas are:**

- **55,300 acres (Amenia to Beekman)**
- **25,000 acres (Milan to Hyde Park)**
- **22,400 acres (Dover, Pawling)**

**Thanks!**  
**Robert Wills:**  
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