UPDATING THE MINNESOTA NATIONAL WETLAND INVENTORY

An Integrated Approach Using Object-Oriented Image Analysis,

Human Air-Photo Interpretation and Machine Learning

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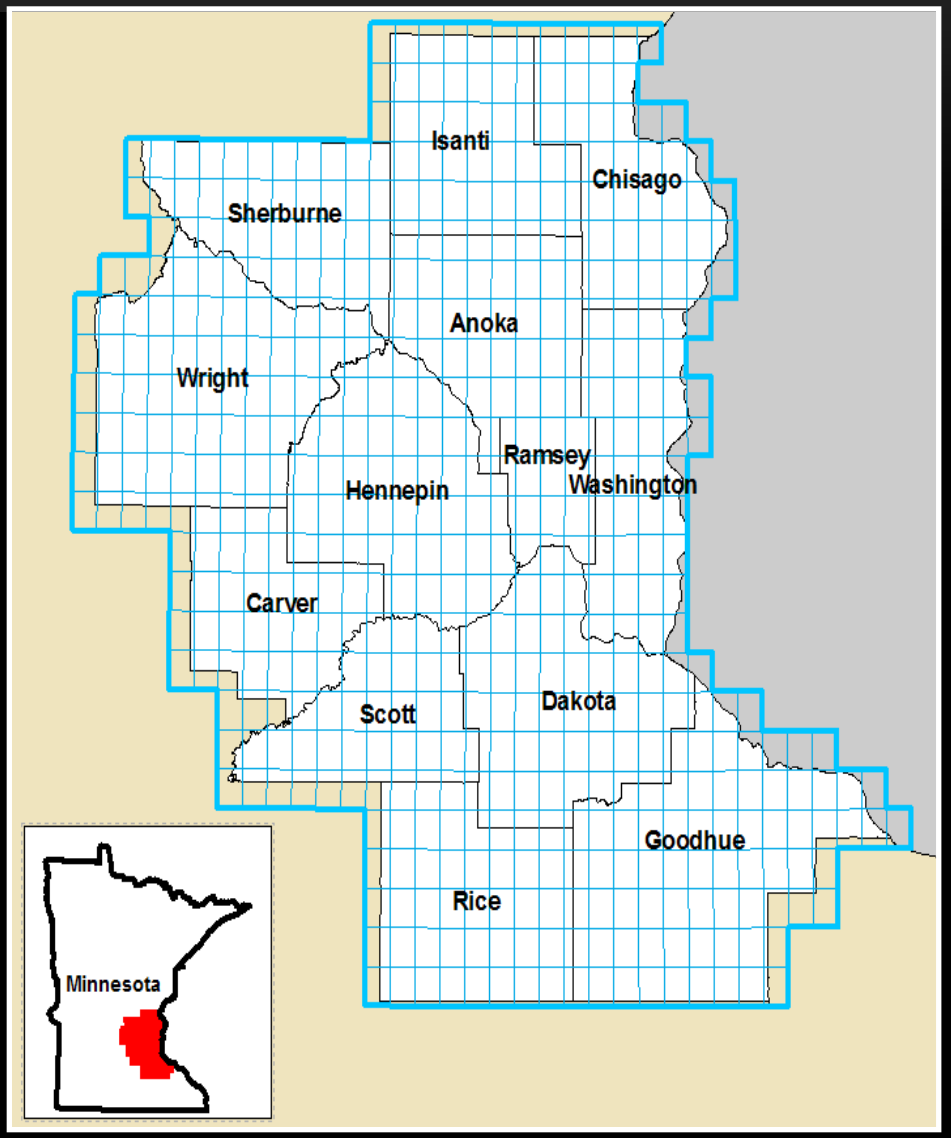
AS RECOMMENDED BY THE LEGISLATIVE-CITIZEN COMMISSION ON MINNESOTA RESOURCES (LCCMR)

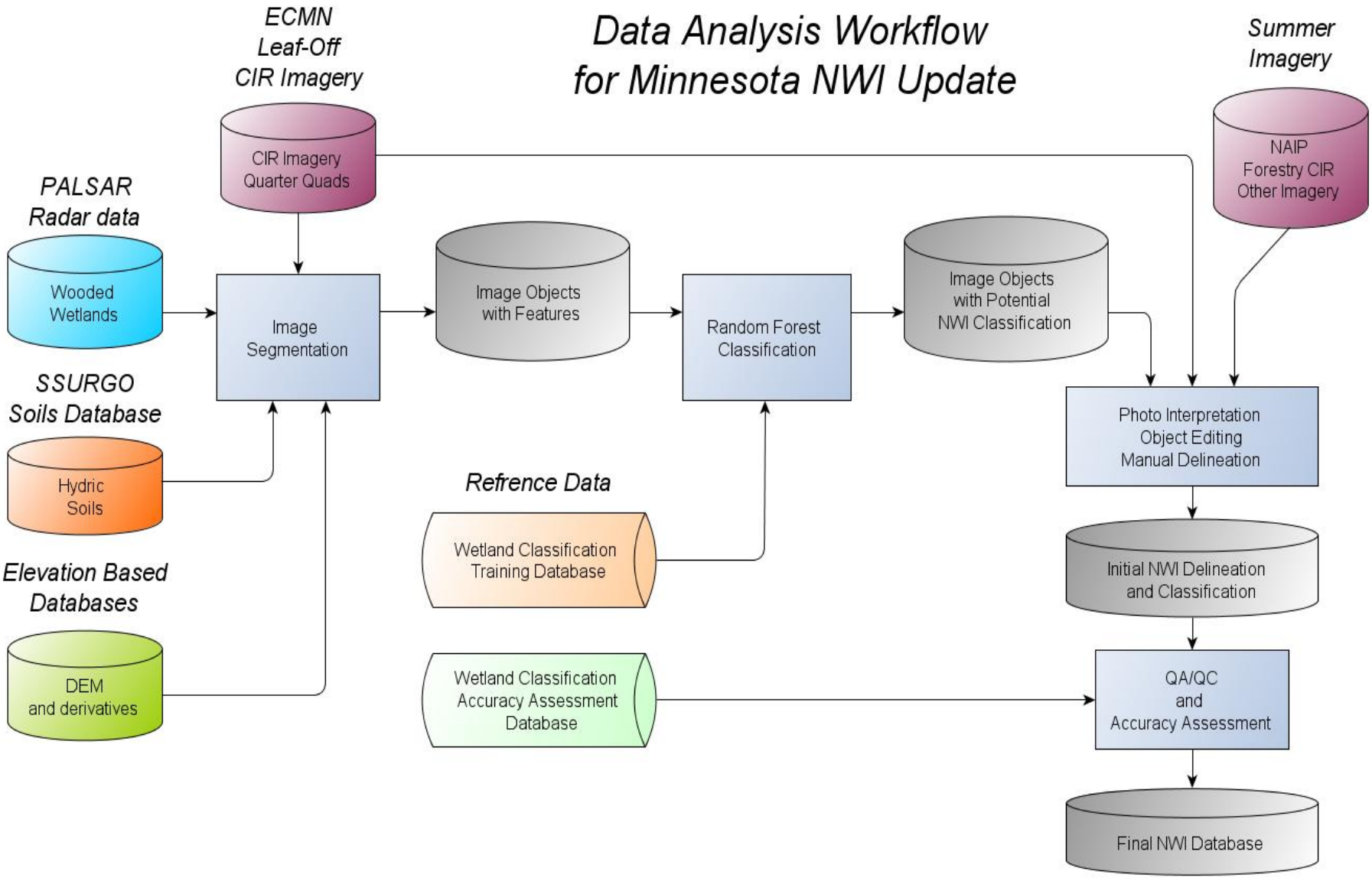
THE TRUST FUND IS A PERMANENT FUND CONSTITUTIONALLY ESTABLISHED BY THE CITIZENS OF MINNESOTA TO ASSIST IN THE *PROTECTION, CONSERVATION, PRESERVATION, AND ENHANCEMENT OF THE STATE'S AIR, WATER, LAND, FISH, WILDLIFE, AND OTHER NATURAL RESOURCES.*

EAST CENTRAL MN NWI UPDATE PHASE II

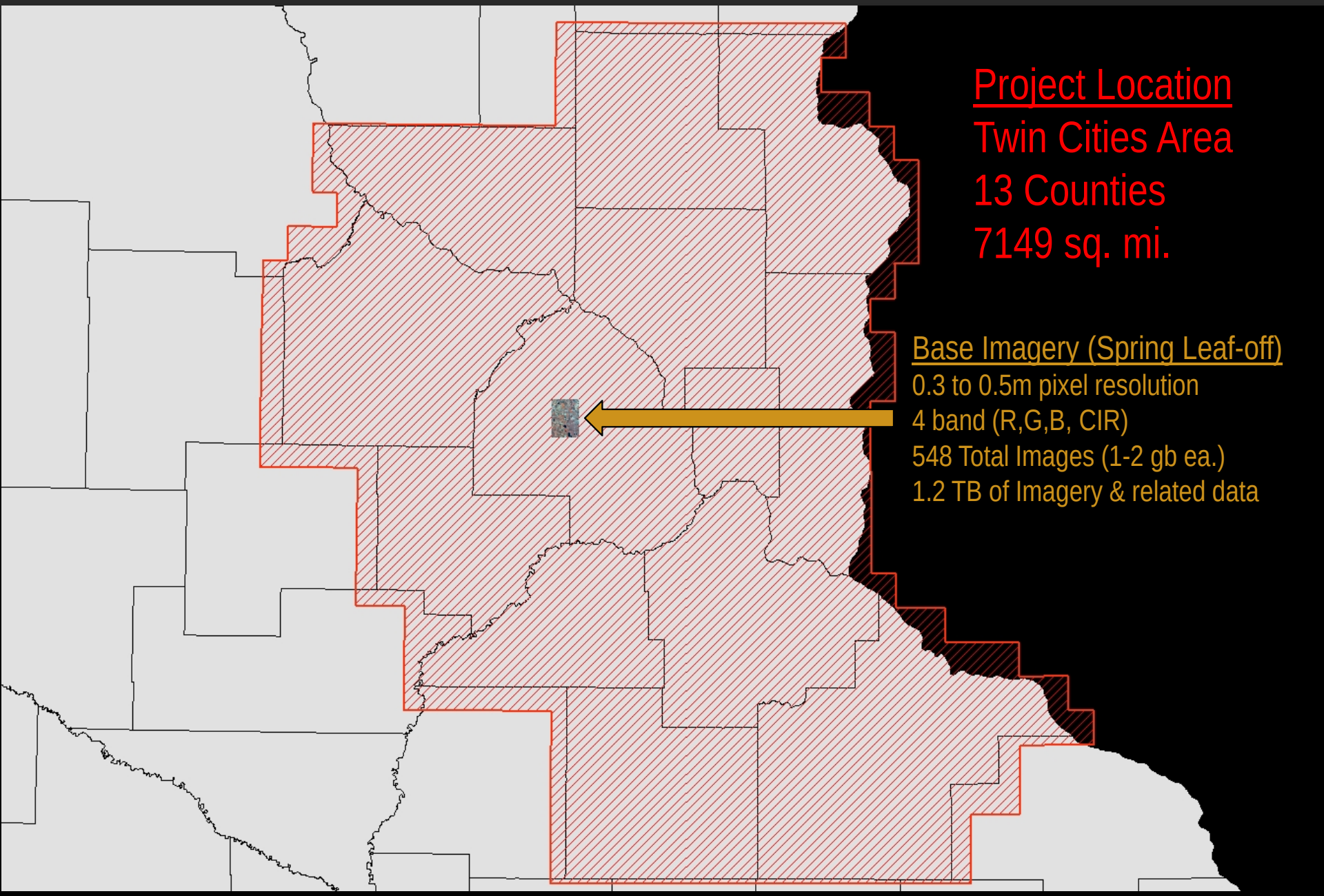
- MN NWI update program was initiated in 2008 by MN DNR
- Funding provided by: The Minnesota Environment and Natural Resources Trust Fund
- Production mapping for East Central Region (Phase II) began in 2010
- Expected completion of the state in 2019 (5 project phases)
- Project specifications called for integration of digital image analysis and traditional photo-interpretation
  - Human Photo Interpretation (PI)
  - Object Based Image Analysis
  - Seamless integration of LiDAR, RADAR, SSURGO, field reference data.



NWI UPDATE MAPPING PROCESS



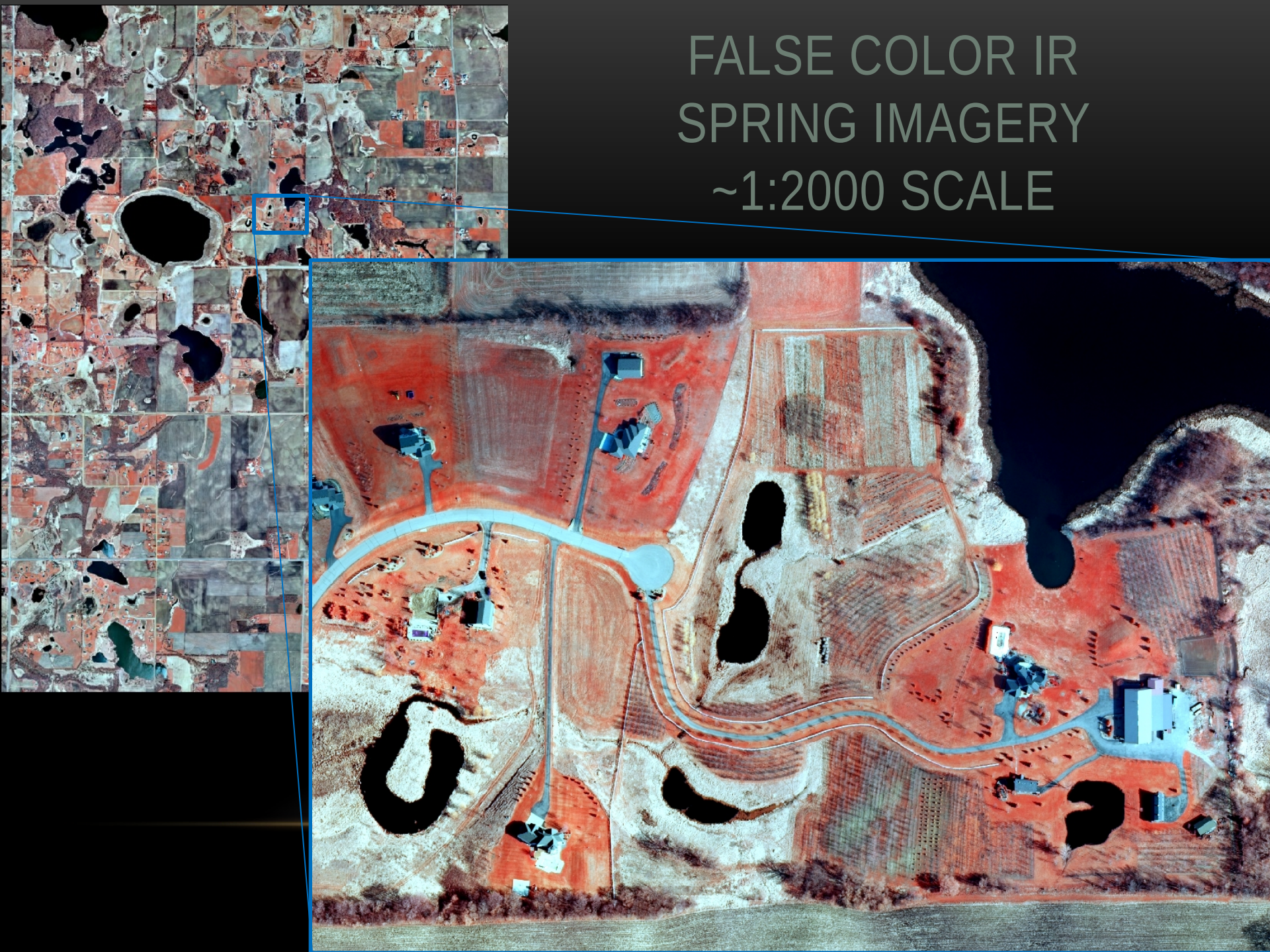
MINNESOTA NWI UPDATE PHASE II PROJECT



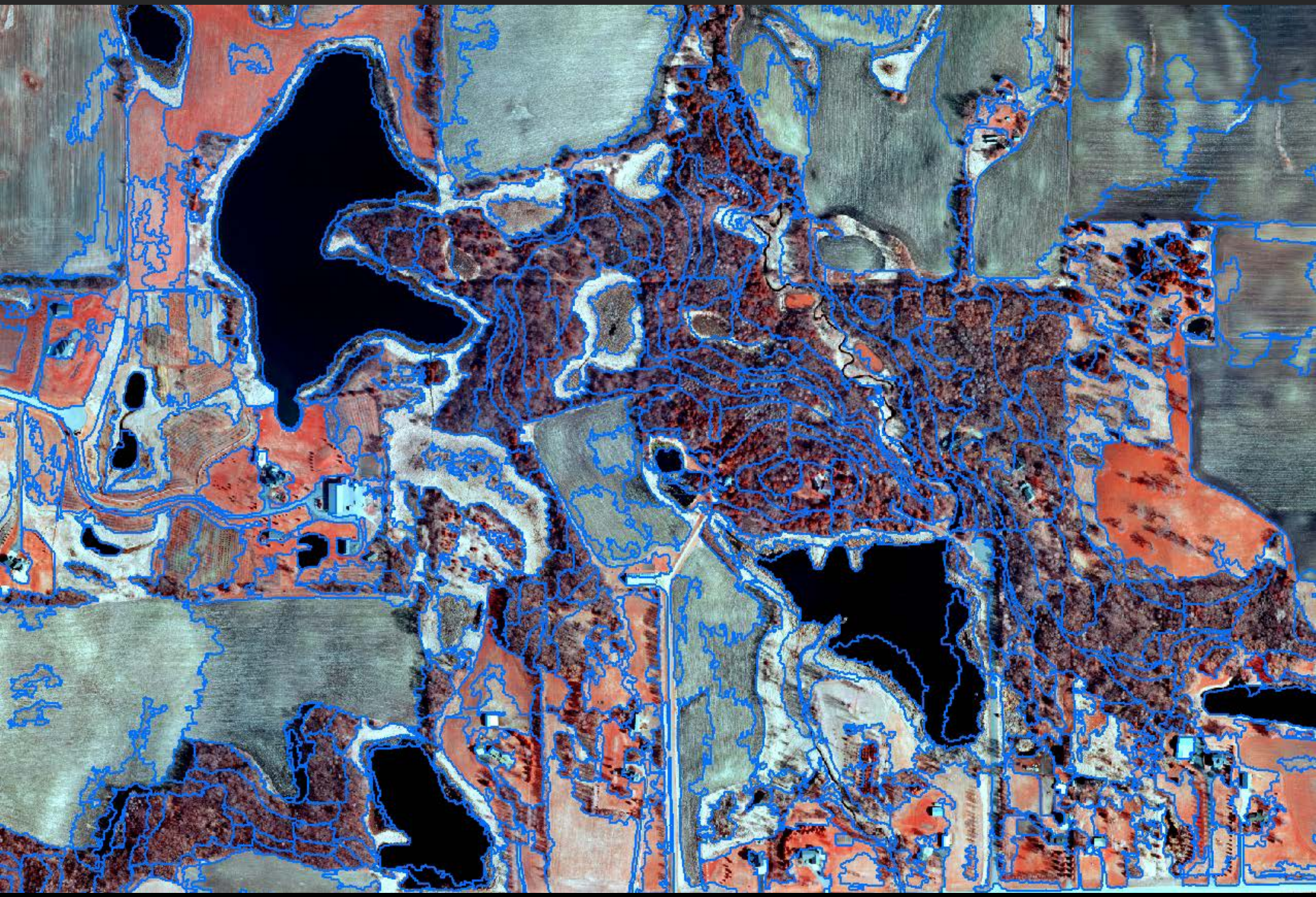
Project Location
Twin Cities Area
13 Counties
7149 sq. mi.

Base Imagery (Spring Leaf-off)
0.3 to 0.5m pixel resolution
4 band (R,G,B, CIR)
548 Total Images (1-2 gb ea.)
1.2 TB of Imagery & related data

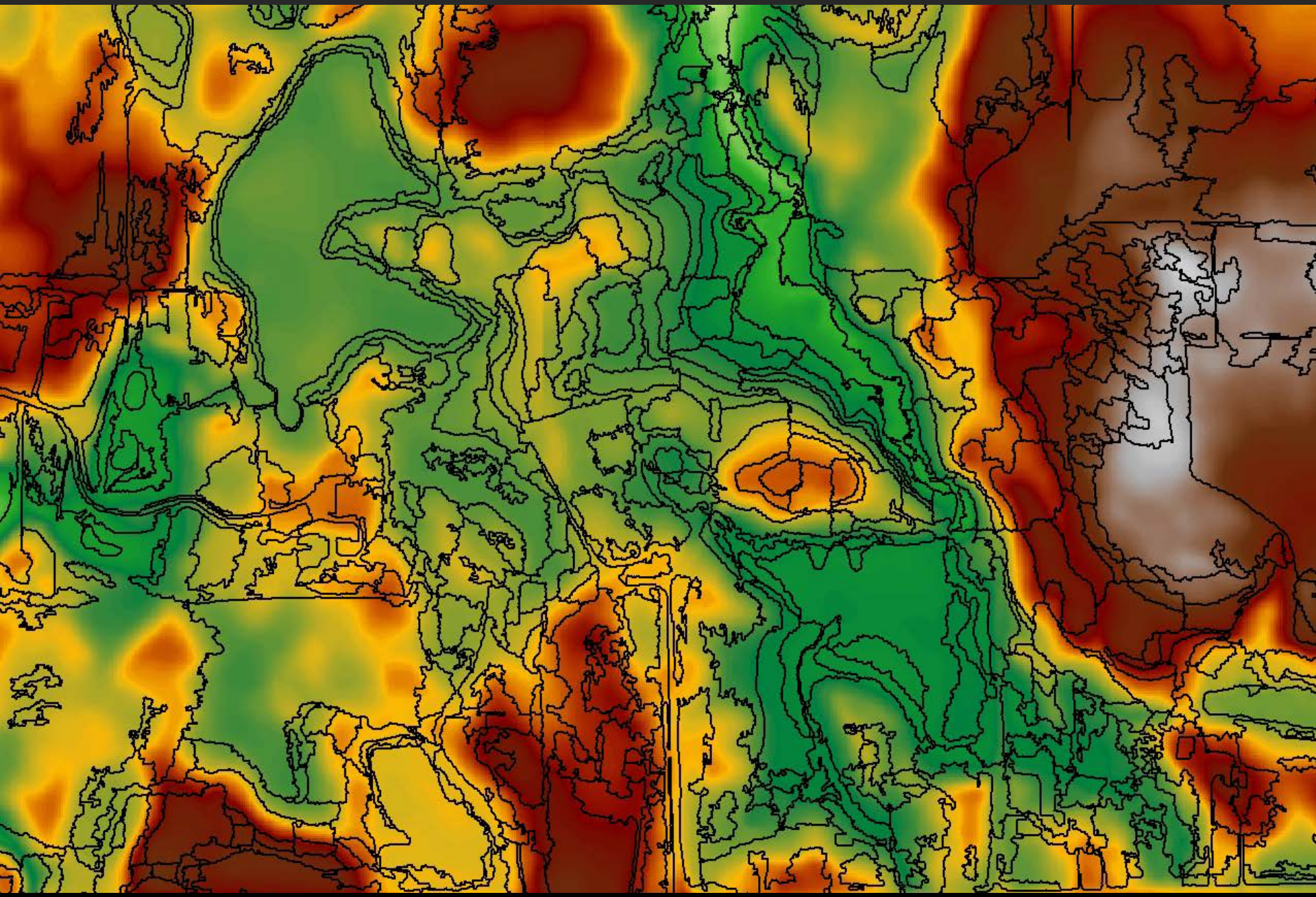
FALSE COLOR IR SPRING IMAGERY ~1:2000 SCALE



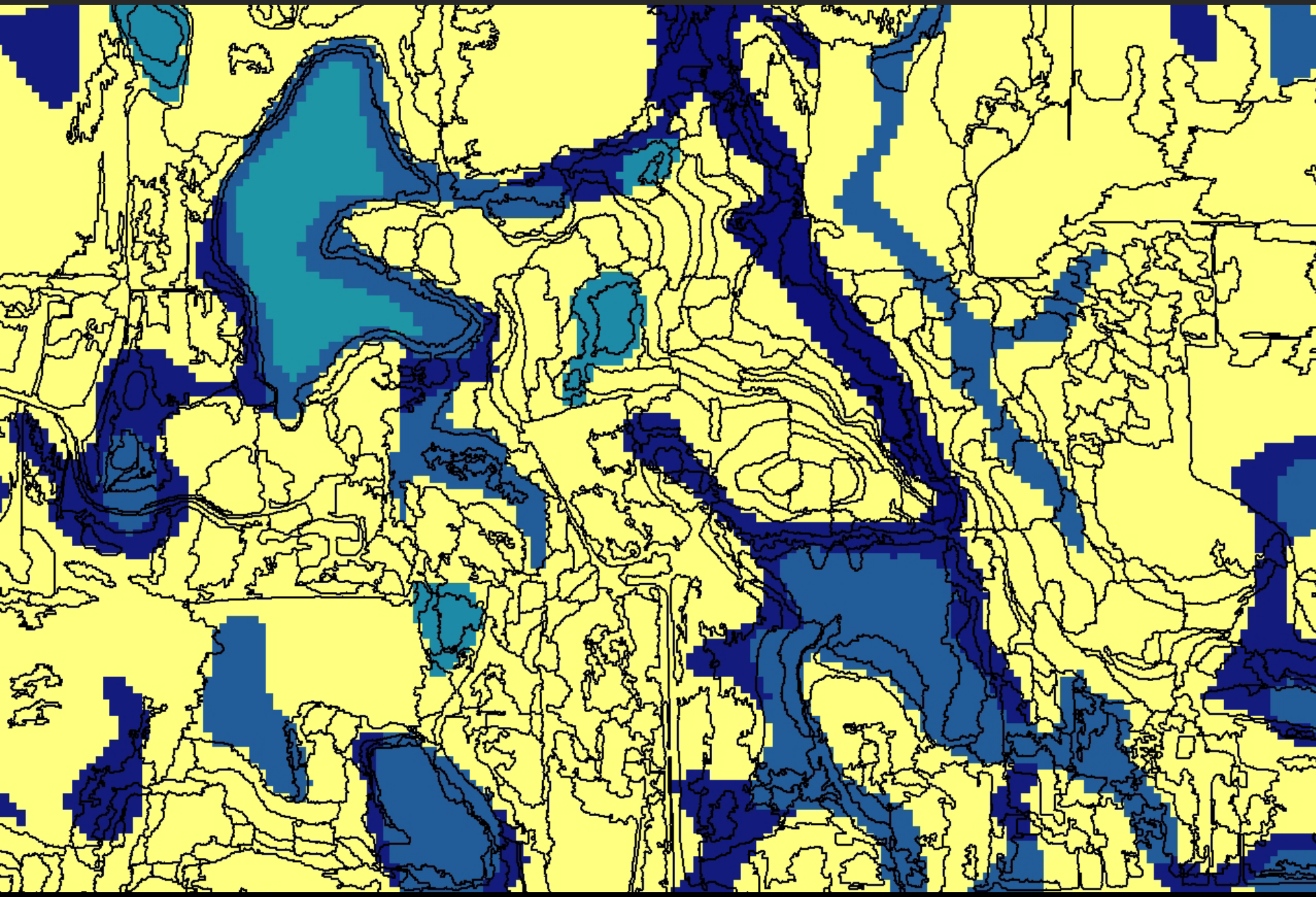
SPRING IMAGERY AT 1:5000 SCALE



LIDAR DERIVED DEM

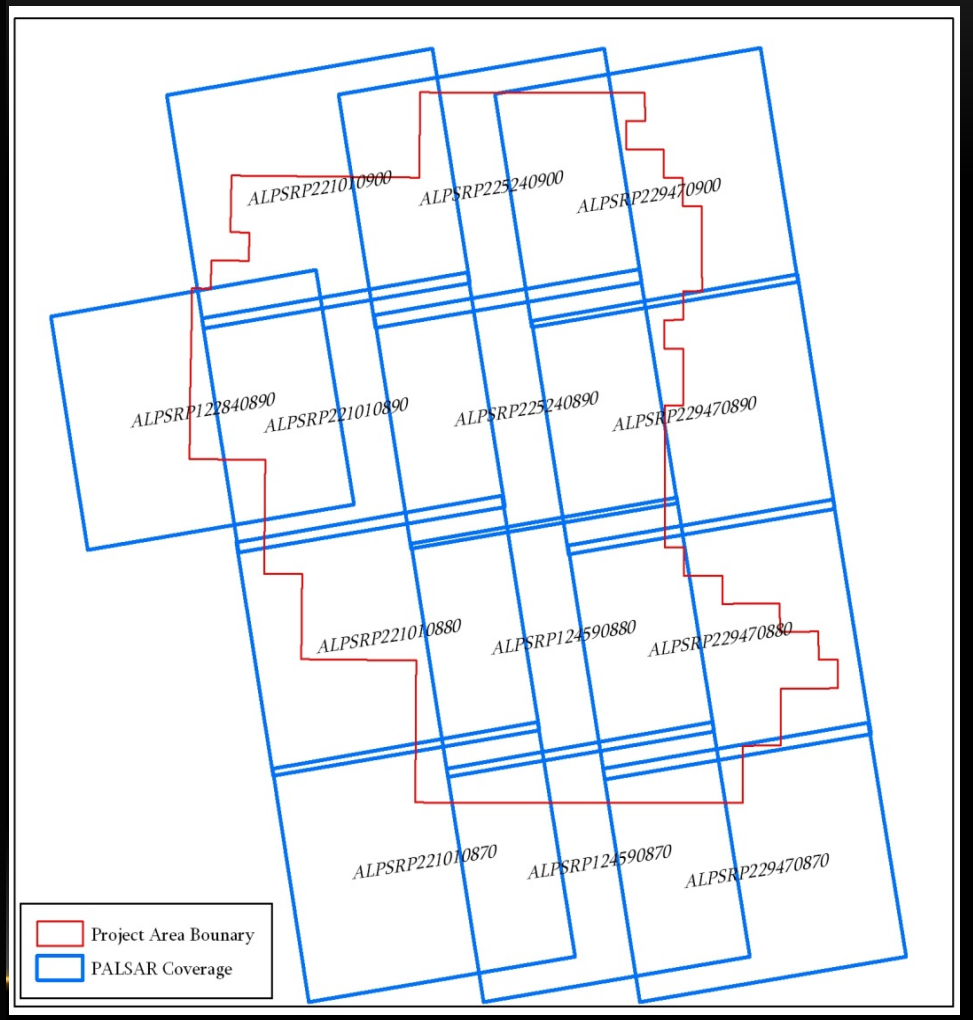


SSURGO HYDRIC SOILS



ALOS PALSAR SATELLITE RADAR

- PALSAR archival data provided by the Alaska Satellite Facility
- PALSAR processing done by Ducks Unlimited Inc.
  - Speckle reduction
  - Unsupervised clustering
  - Manual identification of clusters associated with wooded wetlands (trees + surface water = double bounce)
  - These clusters also were also associated with parking lots (cars + pavement = double bounce)
  - OBIA context information is used to constrain application of PALSAR to forested areas

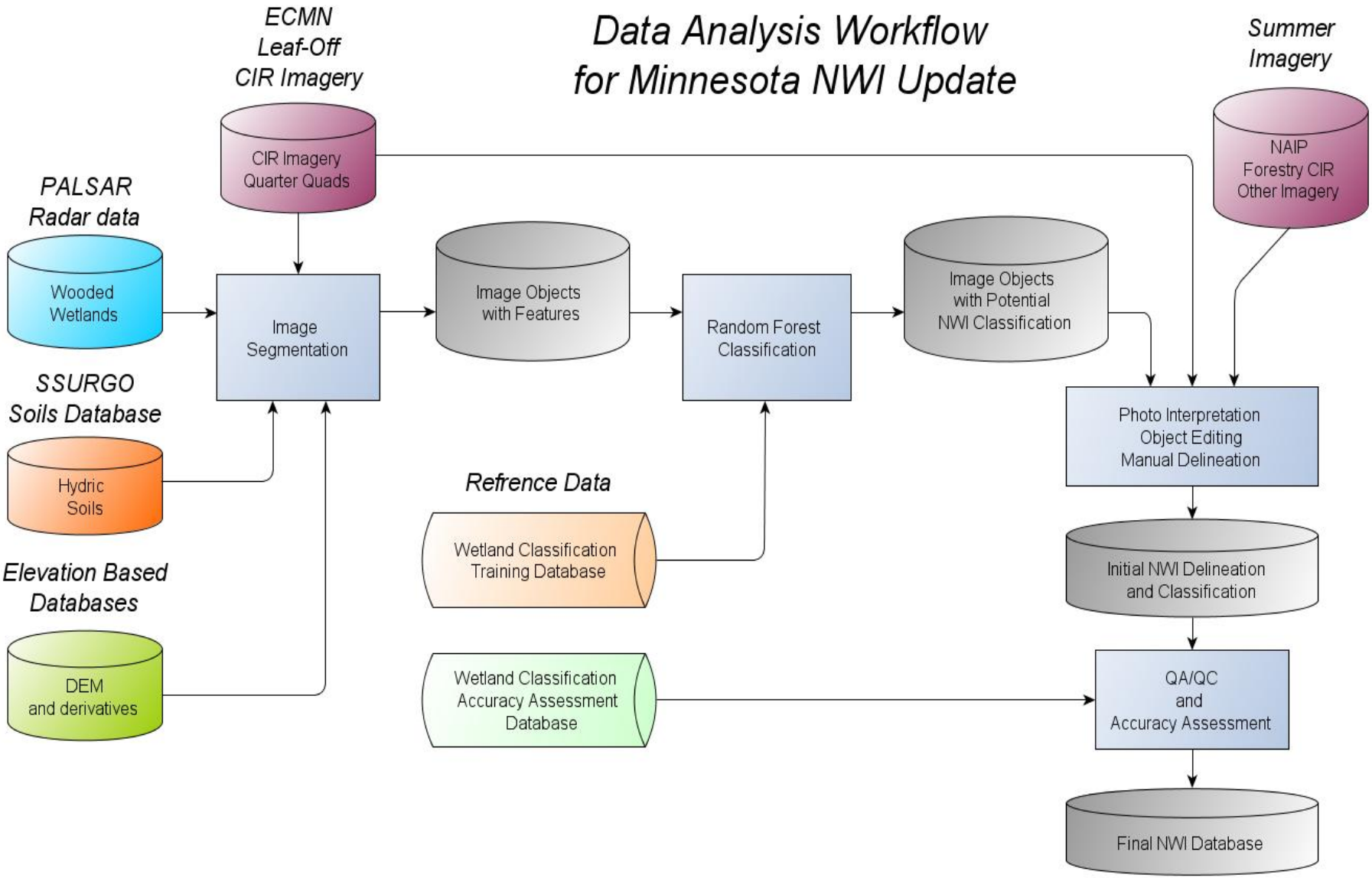


PALSAR WOODED WETLANDS

FIELD DATA COLLECTION

- Field data collection for classification reference
  - 1,346 polygons in total were selected for field verification
  - Used to create photo guide for training PI team
  - Used to train RandomForest algorithm
- Field data collection for accuracy assessment
  - Independent data collection by the University of Minnesota
  - Production team never sees this dataset

NWI UPDATE MAPPING PROCESS



SEGMENTATIONS DELIVERED TO INTERPRETERS

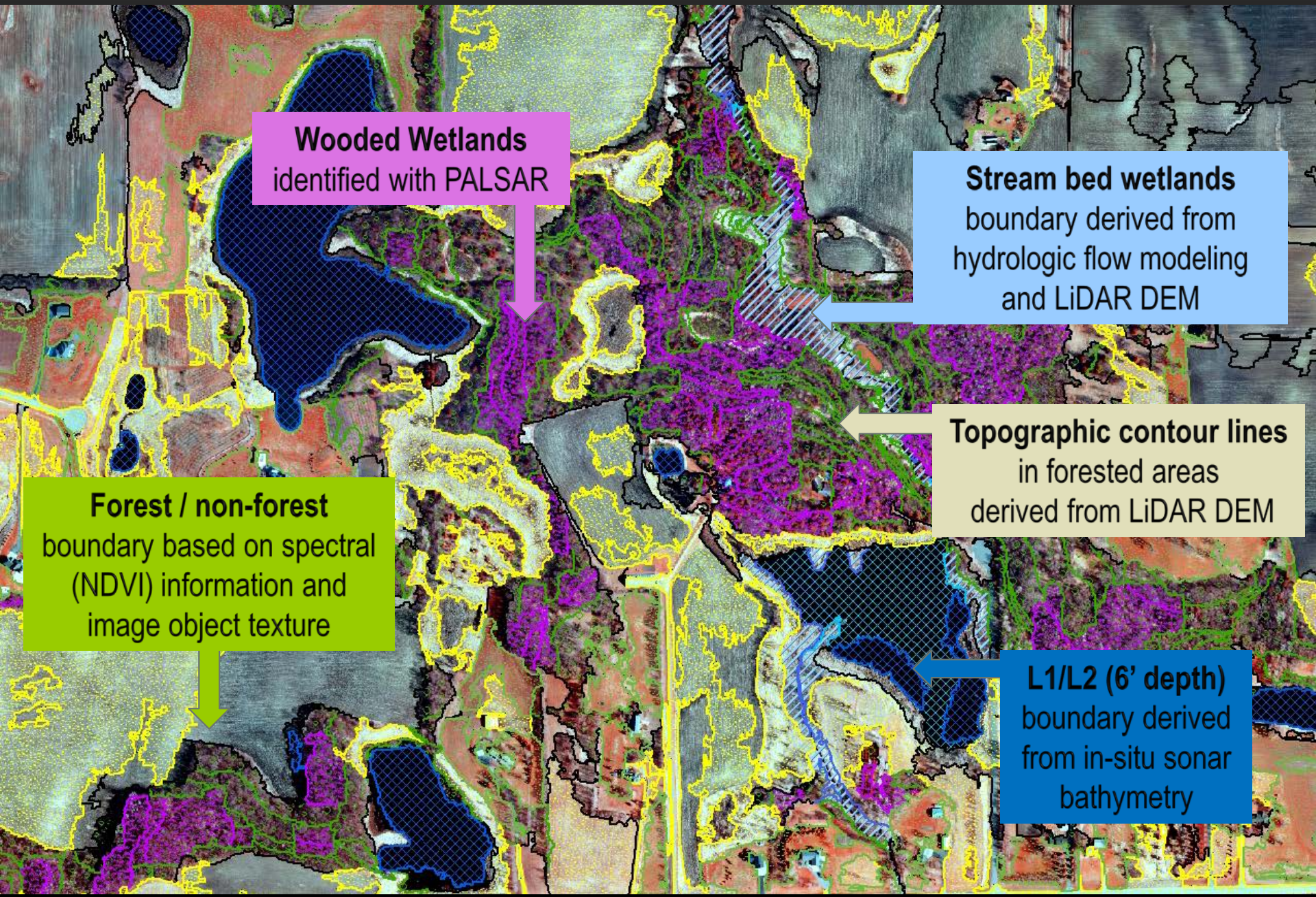


PHOTO INTERPRETATION USING SEGMENTATION

SELECTING VS DIGITIZING

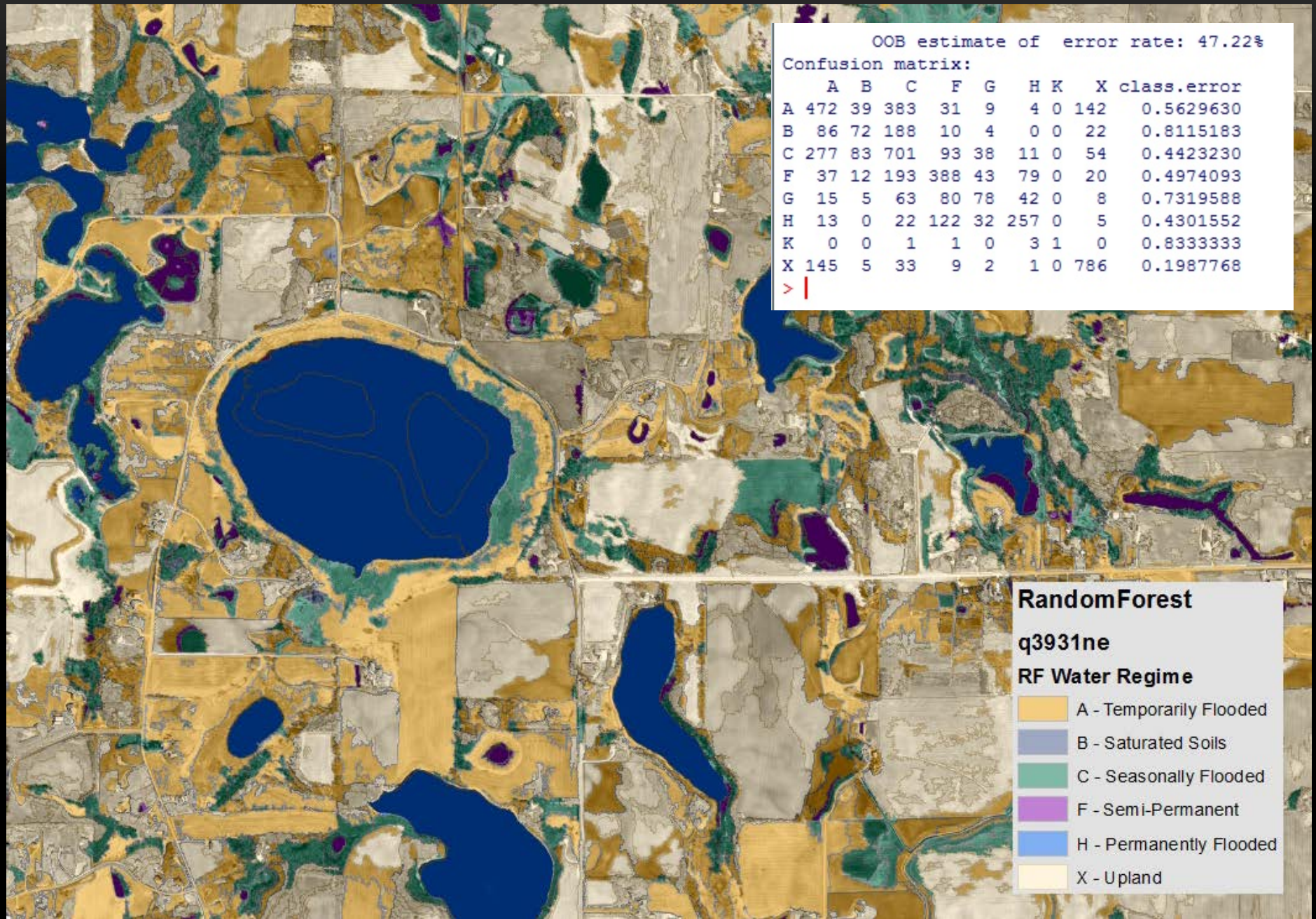
Extracted feature boundary

Time to complete: 6 seconds

Hand drawn boundary

Time to complete: 71 seconds

RANDOM FOREST CLASSIFICATION



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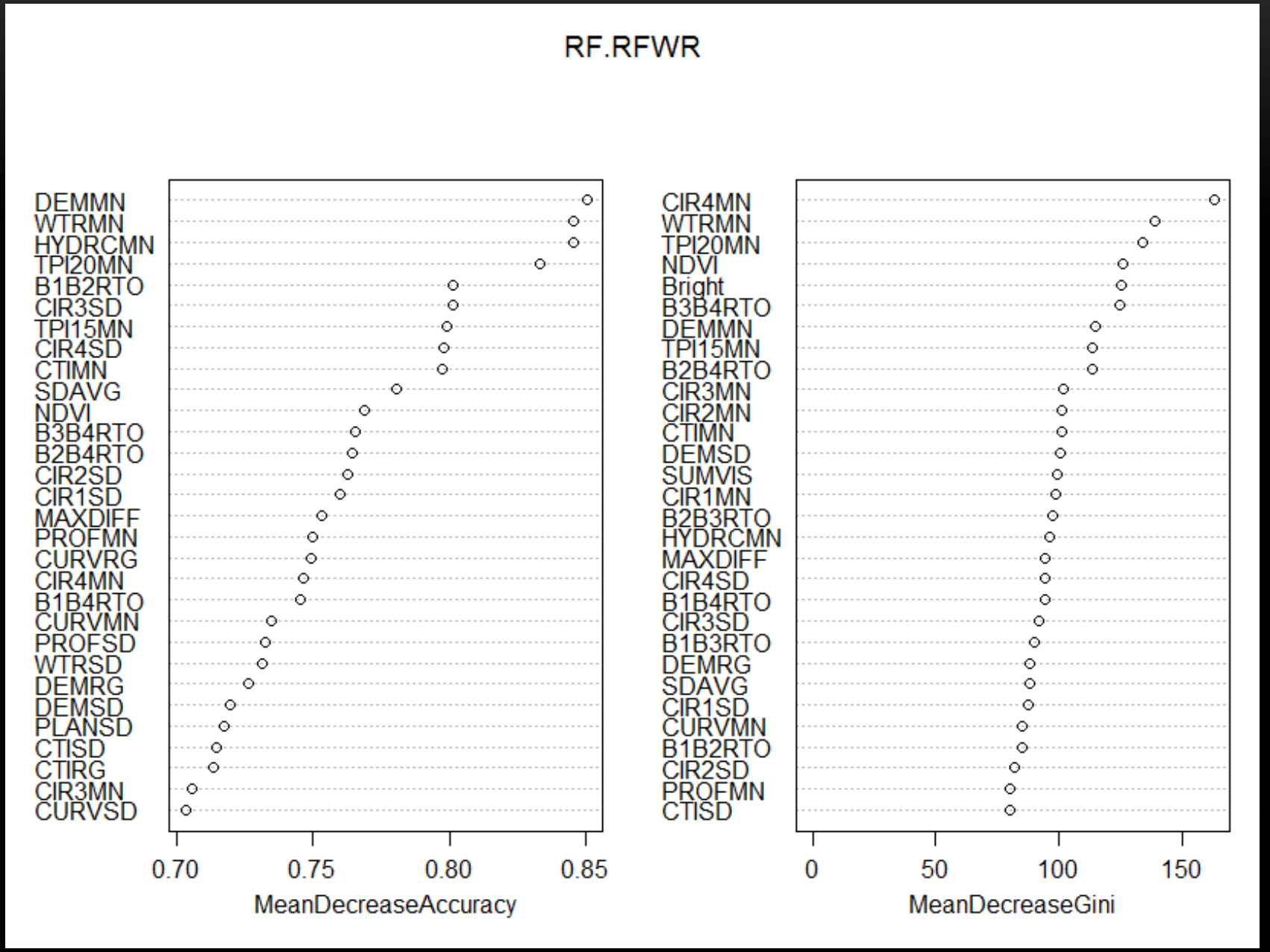
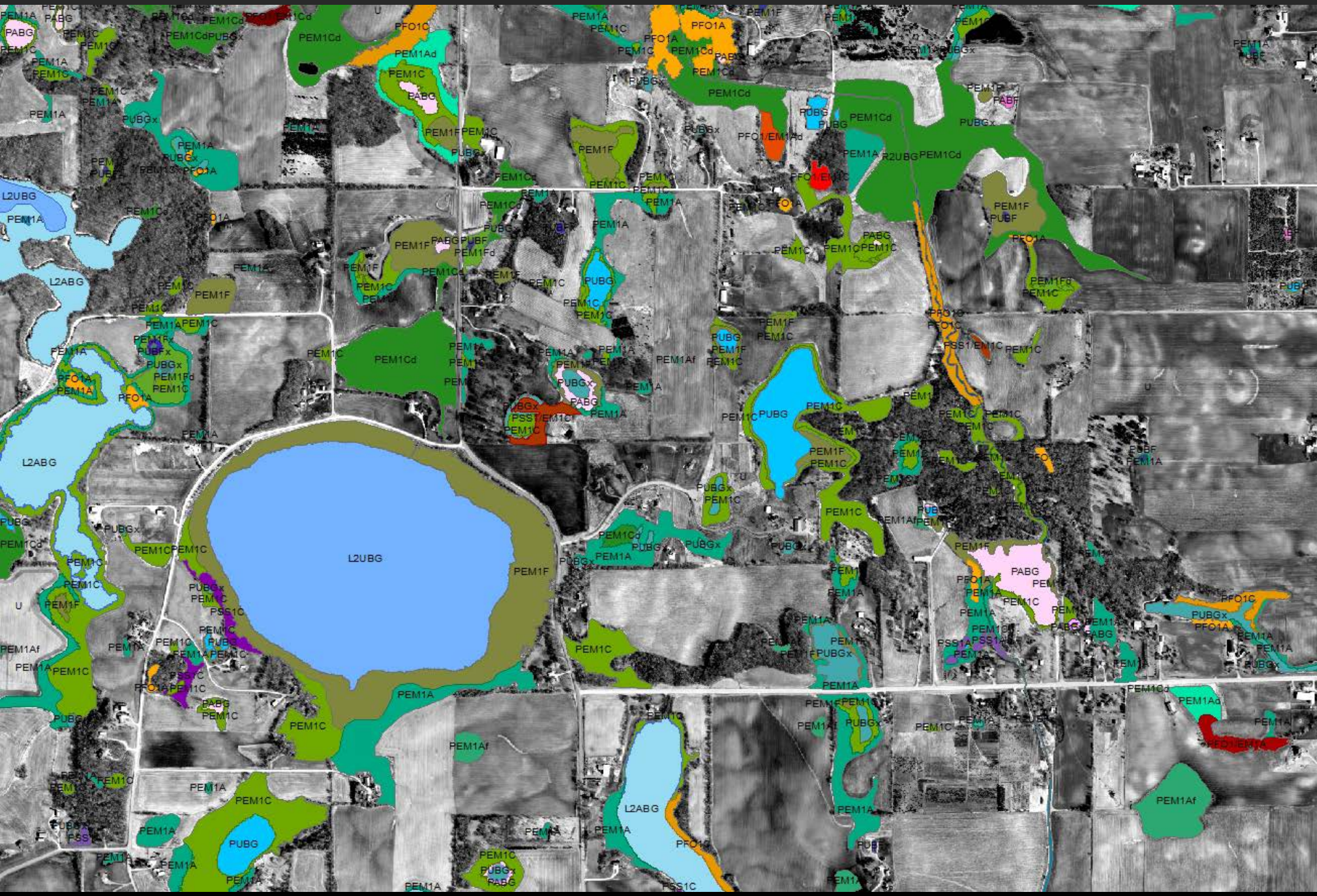


NATIONAL WETLAND INVENTORY



SUCCESSFUL OBIA / HUMAN INTEGRATION:

- Rule #1 – Automated processes do not replace people
  - When difficult decisions need to be made, humans have the advantage in intelligence, judgment, prior experience, subject matter expertise, and in our ability to communicate with each other. A skilled person will beat any affordable program-based alternative
- Rule #2 – Algorithms: not as smart as people, but they don't get bored or tired
  - See Rule #1; When you need to make lots & lots of simple decisions, it is good to engage the services of a computer
- Rule #3 – Humans are not ideally suited for mindless repetitive tasks
  - People get bored when they spend hundreds of hours on a simple task that doesn't require them to exercise their intelligence, judgment, subject matter expertise or the ability to communicate with each other
- Rule #4 – Human time is expensive and computer time is cheap