



# A Landscape Level Approach to Wetland Functional Assessment

Wetland Mapping & Functional Assessment  
Canadian River Watershed  
New Mexico

GeoSpatialServices

 Saint Mary's  
University  
OF MINNESOTA

November, 2013



# EPA 3 Level Technical Approach

	Products/Applications
<p><b>Level 1 - Landscape Assessment:</b> Use GIS and remote sensing to gain a landscape view of watershed and wetland condition. Typical assessment indicators include wetland coverage (NWI), land use and land cover</p>	<ul style="list-style-type: none"> <li>•Targeting restoration and monitoring</li> <li>•Landscape condition assessment</li> <li>•Status and trends</li> <li>•Integrated reporting CWA 305(b)/303(d)</li> </ul>
<p><b>Level 2 – Rapid Wetland Assessment:</b> Evaluate the general condition of individual wetlands using relatively simple field indicators. Assessment is often based on the characterization of stressors know to limit wetland functions e.g., road crossings, tile drainage, ditching.</p>	<ul style="list-style-type: none"> <li>•401/404 permit decisions</li> <li>•Integrated reporting</li> <li>•Watershed planning</li> <li>•Implementation monitoring of restoration projects, including nonpoint source BMPs, and Farm Bill programs</li> </ul>
<p><b>Level 3 – Intensive Site Assessment</b> Produce quantitative data with known certainty of wetland condition within an assessment area, used to refine rapid wetland assessment methods and diagnose the causes of wetland degradation. Assessment is typically accomplished using indices of biological integrity or hydrogeomorphic function.</p>	<ul style="list-style-type: none"> <li>•WQS development, including use designation</li> <li>• Integrated reporting</li> <li>•Compensatory mitigation performance standards</li> <li>•Verify levels 1 and 2 methods</li> </ul>



# Level 1 - Landscape Level Wetland Mapping & Assessment

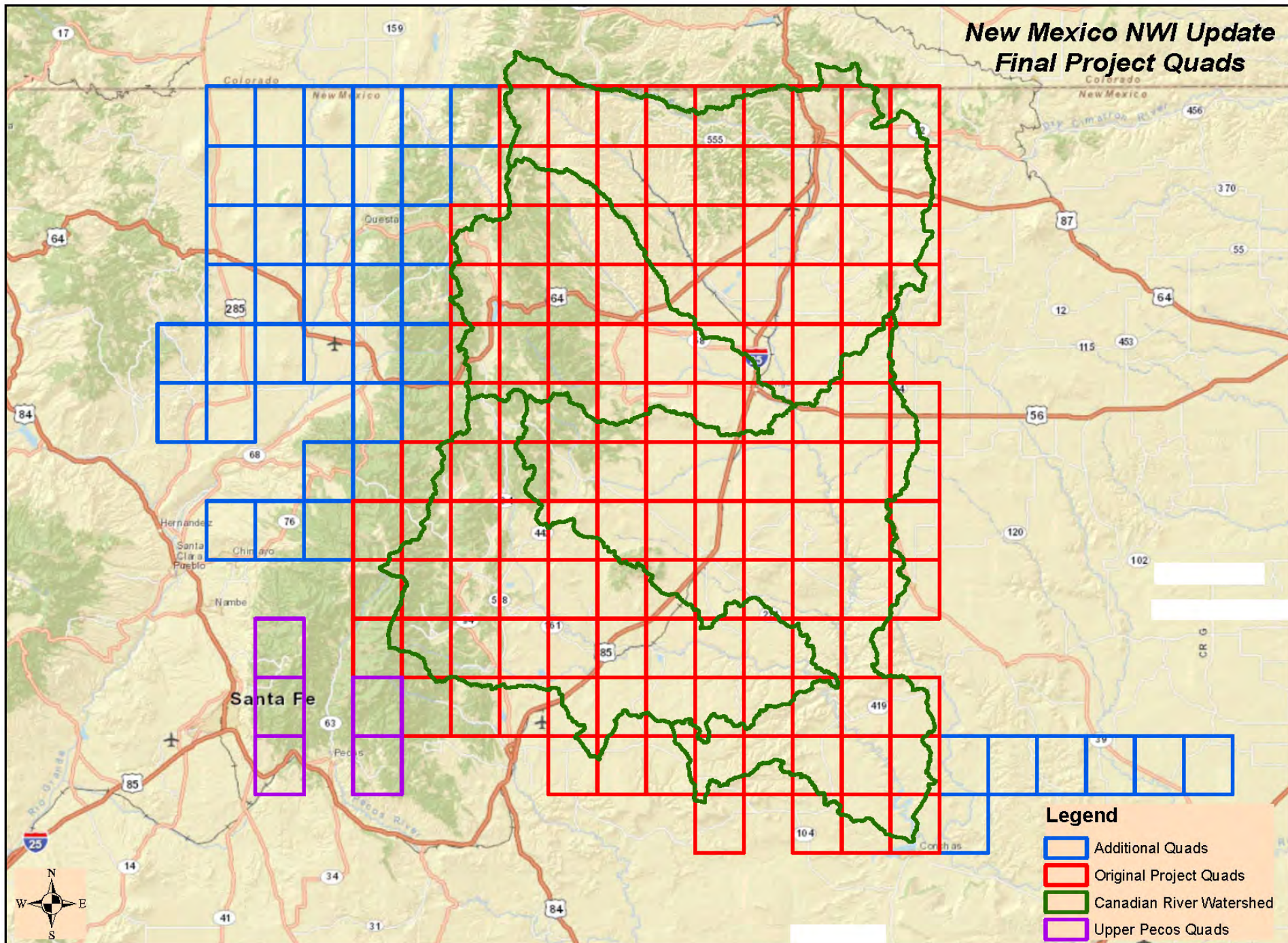
## Project Objectives:

Use remote sensing, image interpretation techniques, collateral GIS data, and best professional judgment to:

- Map or update the wetland landscape profile of a project study area (soil, hydrology, vegetation)
- Extend traditional wetland mapping to include “interpretable” hydrogeomorphic metrics
- Correlate wetland types and characteristics to wetland function on the landscape
- map and document additional wetland characteristics to provide continuity between Level 1 and Level 2



# New Mexico NWI Update Final Project Quads



# Northeastern New Mexico Study Area Description

- Watersheds (HUC 8): Upper Canadian, Upper Rio Grande, Upper Pecos Rivers
- Total Area: 9100 sq. miles or 5.7 M acres
- Counties: Colfax, Mora, San Miguel, Taos, Rio Arriba and Santa Fe
- Previous Wetland Mapping: None, limited site specific NWI
- Major Ecoregions: Montane forests, foothill shrub lands, tableland shrub and grasslands, high plains



# Major Steps of Project

- Map and classify present-day wetlands:
  - NWI Cowardin classification
  - FGDC National Wetland Mapping Std
  - Map and classify adjacent riparian areas
  - project imagery 2009 NAIP
  - numerous collateral data layers
- Add hydrogeomorphic characteristics to wetlands:
  - LLWW interpretation and classification
- Develop functional correlation table:
  - utilize local wetland professionals – “bpj”
  - establish wetland functions to be assessed
  - correlate wetland descriptors to functions



# National Wetland Inventory

- Based on Cowardin (1976) and endorsed by FGDC Federal Wetland Mapping Standard
- Dominant Life Forms (e.g. forested, emergent)
- Subclasses (e.g. Persistent, Non-persistent)
- Water Regimes (generally, e.g. Wet Soil Palustrine)
- Special Modifiers (certain, e.g. farmed, beaver, excavated etc.)



# Mapping and Classification Systems

- National Wetland Inventory (NWI)  
Cowardin (1976)
- System for Mapping Western Riparian Areas  
Dick/USFWS (2009)
- Landscape Position, Landform, Waterbody Type, Water Flow Path (LLWW)  
Tiner (2011)
- Crosswalk to Hydrogeomorphic Classification for Wetlands (HGM)  
Brinson (1993)





# Riparian Classification

- **System** is a single unit category - riparian vegetation (Rp).
- **Subsystem** defines two categories reflecting the water source for the riparian area - lotic (1) and lentic (2).
- **Class** describes the dominant life form of riparian vegetation. Classes are: forested (FO), scrub/shrub (SS), and emergent (EM)
- **Subclass** further describes the Class as either dead (5), deciduous (6), evergreen (7), or mixed deciduous/evergreen (8).
- **Dominance Type** refers to vegetative species within the mapping unit, e.g. cottonwood (CW).
- **Rp1FO6CW** is interpreted as:

System: **Rp** - Riparian

Subsystem: **1** - Lotic

Class: **FO** - Forested

Subclass: **6** - Deciduous

Dominance: **CW** - Cottonwood



# NM Project Imagery and Collateral Data

## Interpretation Challenges

- Limited resources for image acquisition
- Chose to move forward with existing NAIP imagery
- True color, mid summer, leaf on, drought conditions. Not an ideal image source for wetland interpretation
- Ideally would have been spring, leaf off, normal precipitation color infra-red
- Forced reliance on collateral data





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Maxwell Wildlife Refuge  
2009 NAIP



9/8/2005

Image NMRGIS  
Image © 2012 DigitalGlobe

Google earth

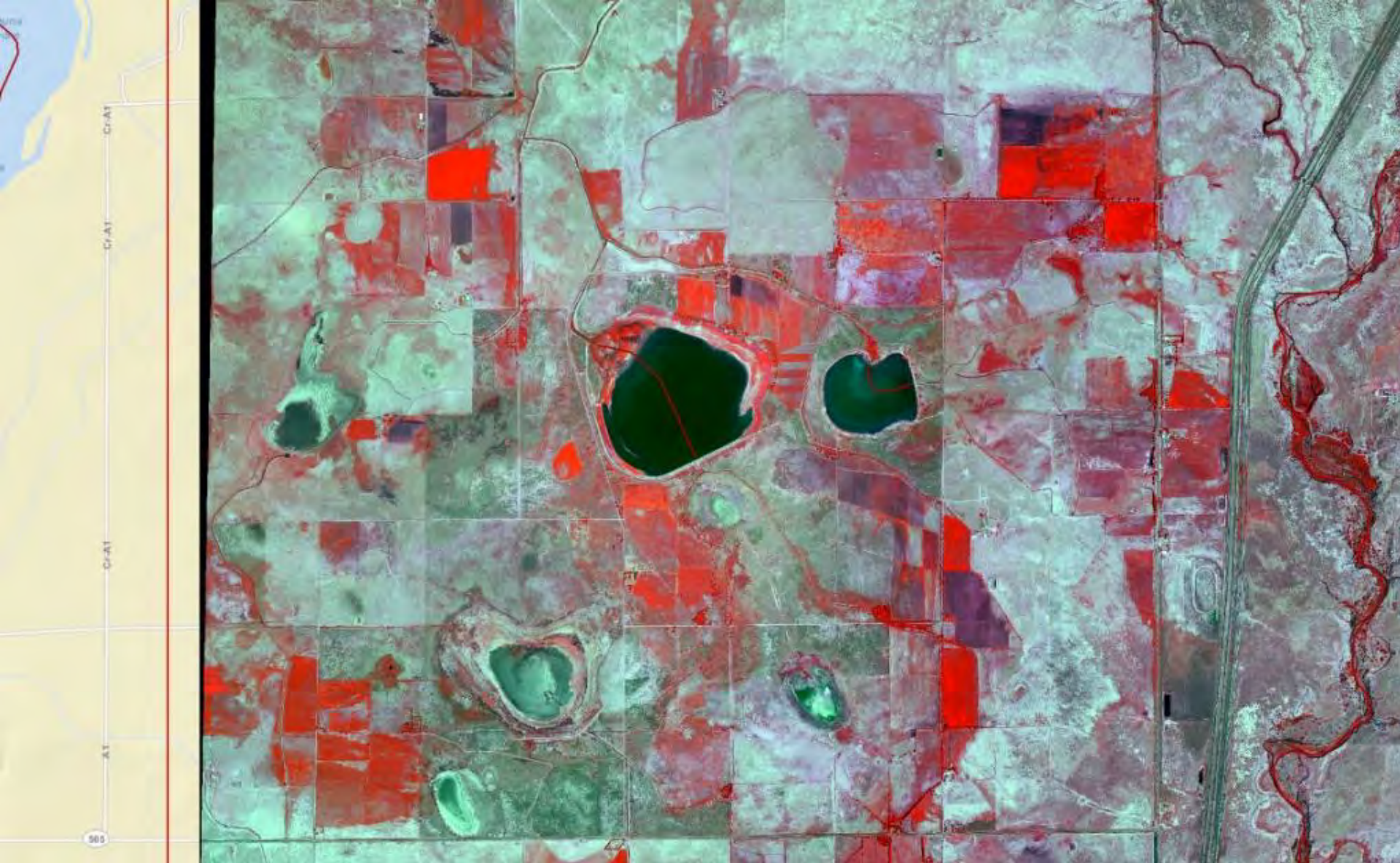
Imagery Date: 9/8/2005 1997

36°34'20.74" N 104°34'59.18" W elev 6020 ft

Eye alt 39514 ft

# Maxwell Wildlife Refuge 2005 – 2009 Imagery





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Maxwell Wildlife Refuge  
2009 NAIP CIR

# NM Collateral Data Sources

- USGS 1:24,000 DRG
- USGS NHD streams and waterbodies
- NRCS SURRGO Soils Data
- NAIP Imagery 2001, 2005, 2009 CIR
- Google Earth imagery time slider tool
- SWQB Stream Data (cold water, warm water, fish species)
- USGS 30m and 10m National Elevation Dataset
- USFS Springs and Seeps database



# NM Pre and Post Mapping Field Validation



Validation of image signatures



Confirmation of landscape position  
and other hydrogeomorphic metrics





# LLWW

Based on Tiner (2011)

\*similar to older hydrogeomorphic classification  
(Brinson 1993)

Landscape Position - relationship between a  
wetland and an adjacent waterbody or not

Landform - shape or physical form  
(island, basin, floodplain, etc.)

Water Flow Path - directional flow of water  
(outflow, inflow, isolated, etc.)

Water Body Type – lake, pond, river, stream



# Landscape Position

LLWW continued

Lotic – in or along rivers and streams and in floodplains

Lentic – in or along lakes

Terrene – completely surrounded by upland or nearly so; not flooded by river or streams



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# Lentic

LLWW continued



# Lotic

LLWW continued



# Terrene

LLWW continued



# Landforms

LLWW continued

- Slope
- Island
- Fringe
- Floodplain (basin, flat)
- Interfluve (basin, flat)
- Basin
- Flat



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# Basin (BA) Landform





# Flats (FL) Landform



# Slope (SL) Landform



# Floodplain (FL) Landform



# Water Flow Paths

LLWW continued

- Bidirectional (BI)
- Inflow (IN)
- Isolated (IS)
- Throughflow (TH)
- Outflow (OU)



# Bidirectional (BI) Waterflow Path



# Inflow (IN) Waterflow Path



# Isolated (IS) Waterflow Path



# Outflow (OU) Waterflow Path





# Throughflow (TH) Waterflow Path



# Waterbody Types

## River (RV)

- low, middle, high gradient
- dammed

## Stream (ST)

- low, middle, high gradient
- artificial

## Lake (RV)

- natural
- dammed

## Pond (PD)

- natural, dammed, excavated, beaver, other artificial



# Waterbody Types

LLWW continued

- River and Stream Gradients (low)
- Lakes (natural, reservoir)
- Ponds (e.g. natural, beaver, farm, residential)



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# LLWW Interpretation and Coding

During NWI mapping also consider and add LLWW codes:

Example (next slides, highlighted polygon):

NWI: **PSS5C**

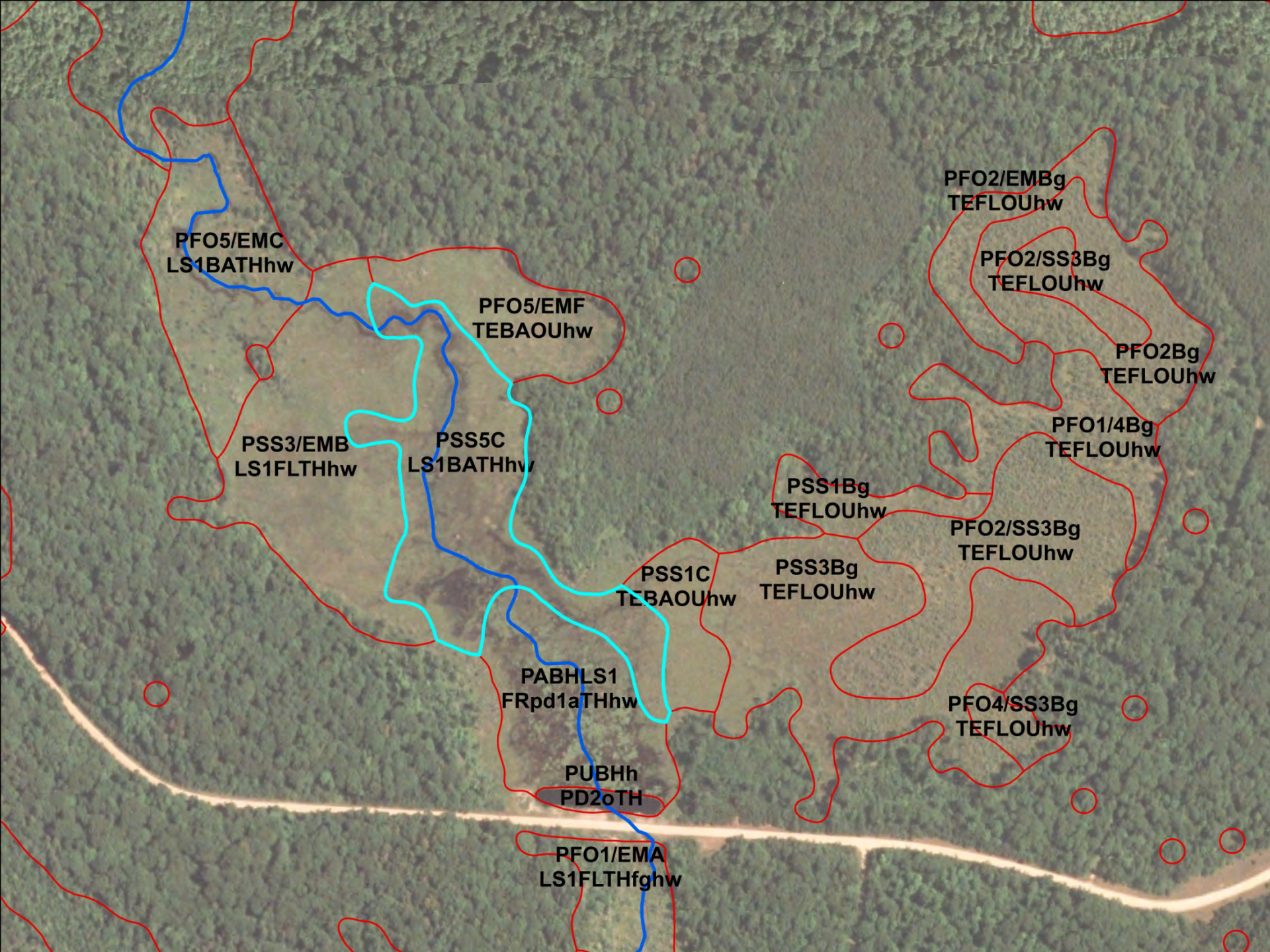
*Paulustrine, scrub shrub - dead, seasonally flooded)*

LLWW: **LS1BATHhw**

*Lotic Stream low gradient, Basin, Through-flow, headwaters*







# Functional Correlations

How well do they perform each function?

- Each polygon is ranked high or moderate based on the characteristics identified in NWI+
- Use existing correlation tables developed by Best Professional Judgment (BPJ) and modify for the Arid West

Fizzell (2011), Miller et al. (2012), Richtman (2012)

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# LLWW Codes to Wetland Functions

## Functions for New Mexico Assessment:

- 1. Surface Water Detention;
- 2. Streamflow Maintenance;
- 3. Groundwater Recharge;
- 4. Carbon Sequestration;
- 5. Nutrient Transformation;
- 6. Carbon Sequestration;
- 7. Bank and Shoreline Stabilization;
- 8. Fish Habitat;
- 9. Aquatic Invertebrate Habitat;
- 10. Waterfowl and Water Bird Habitat;
- 11. Other Wildlife Habitat; and,
- 12. Unique, Uncommon, or Highly Diverse Wetland Plant Communities





# Functions and Values Schema



- Requires wetlands classified in Cowardin (NWI) System
- NWI Water Regimes correlate to LLWW Landforms
- NWI System and Classes correlate to Waterbody Type
- Requires accurate spatial wetland data

# Surface Water Detention or Stream-flow Maintenance

## Highly Functional

- Vegetated wetlands along streams, rivers, lakes, and islands
- Isolated wetlands with inlet and outlet

## Moderately Functional

- Isolated or outflow vegetated wetlands
- Wetlands adjacent to lakes not already included in High



# Carbon Sequestration

## Highly Functional

- Dominated by floating aquatics (e.g. lillies)
- Non-persistent emergents (e.g. wild rice)
- Wetlands with organic soils (P\_\_\_\_\_g)  
(Teleconference with Ralph Tiner)

## Moderately Functional

- Saturated, Temporarily Flooded or Seasonally Flooded Wetlands with mineral soils



# Fish Habitat

## Highly Functional

- Wetlands with throughflow lakes, rivers, and streams

## Moderately Functional

- Throughflow ponds
- Scrub/shrub and forested wetland along trout streams



# Waterfowl Habitat

## Highly Functional

- Vegetated shallow lakes and ponds
- Wooded wetland along rivers and streams

## Moderately Functional

- Natural ponds and excavated open water in wetland
- Emergent wetlands adjacent to open water



# Other Wildlife Habitat

## Highly Functional

- Wetland complexes larger than 20 acres
- Wetlands 10 to 20 acres with two or more plant communities

## Moderately Functional

- All vegetated wetland



# National Wetland Inventory Wetlands (NWI) - City of Mora

**Wetland Identification**

**Polygons**

- Small Lakes
- Palustrine Aquatic Beds
- Palustrine Emergent
- Palustrine Forested
- Palustrine Unconsolidated
- Palustrine Scrub Shrub

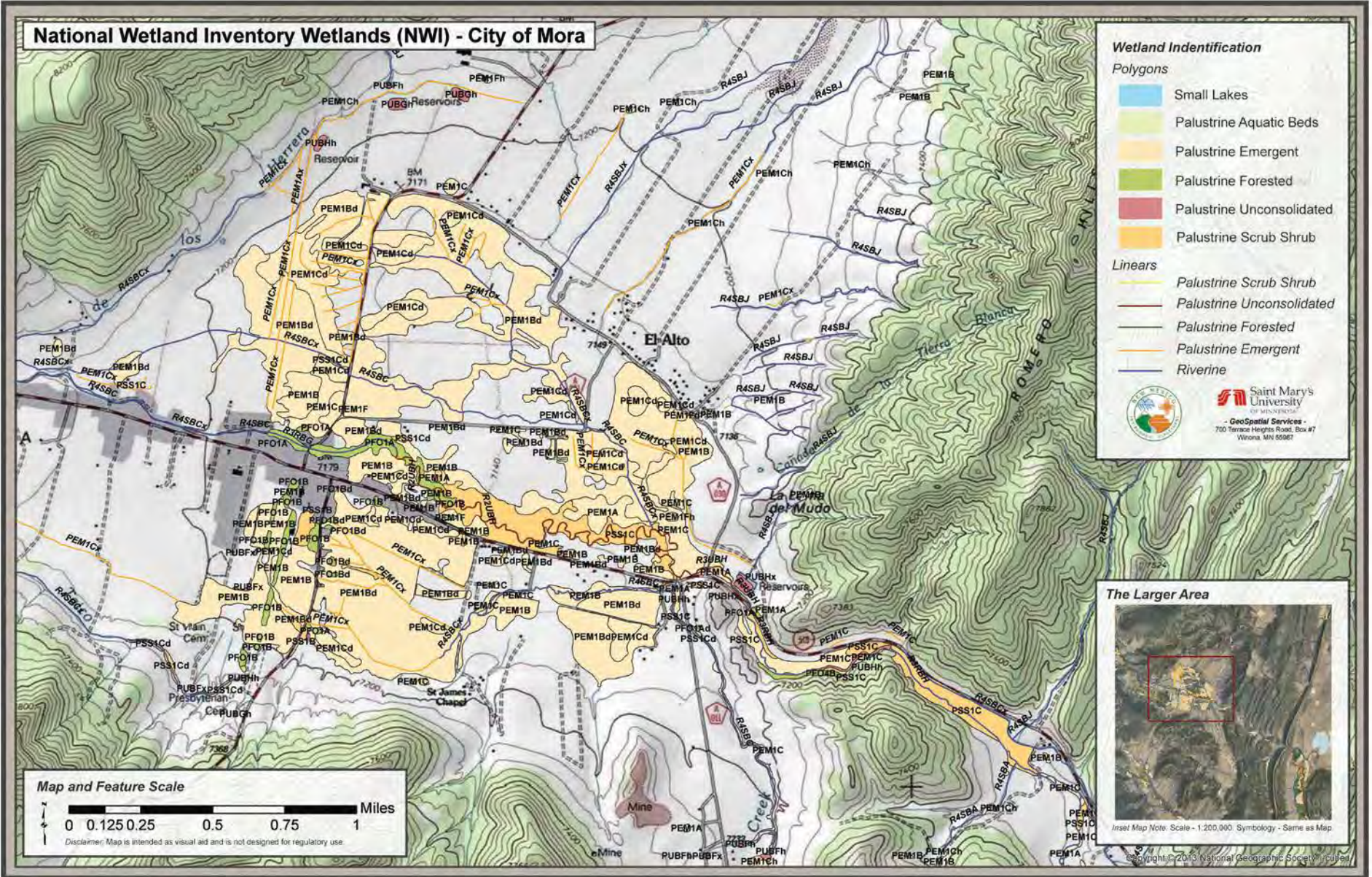
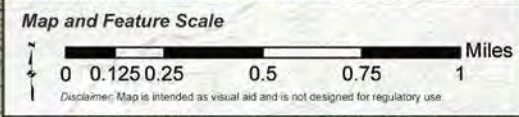
**Linears**

- Palustrine Scrub Shrub
- Palustrine Unconsolidated
- Palustrine Forested
- Palustrine Emergent
- Riverine

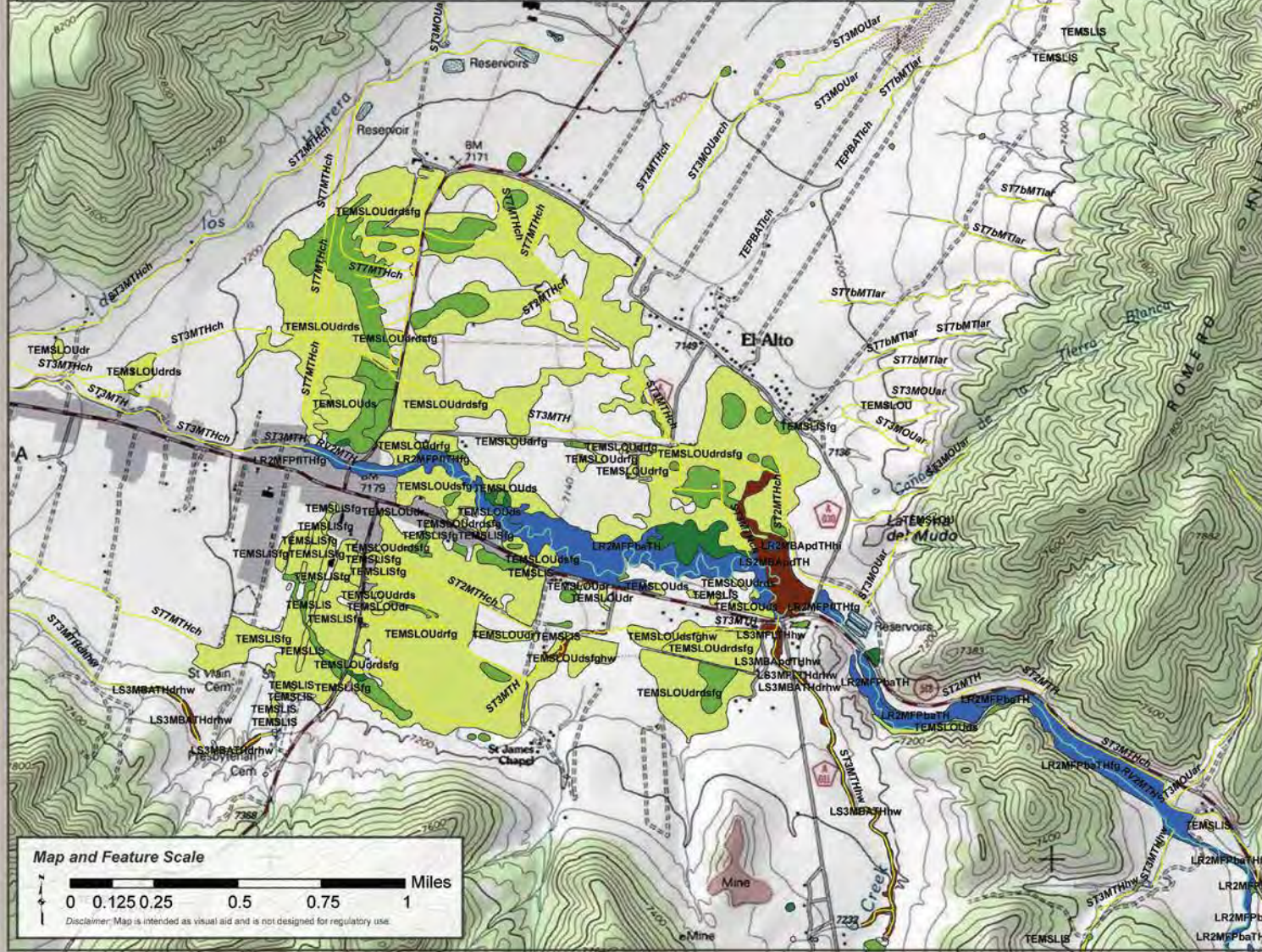




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# Landscape Position, Landform, Water Flow Path, Waterbody (LLWW) - City of Mora



**Wetland Identification**

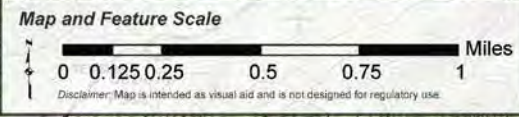
**Polygons**

<b>Lentic Habitats</b>	<b>Lotic River Habitats</b>
Basin	Outflow
Flat	Inflow
<b>Terene Habitats</b>	Throughflow
Sloped	<b>Lotic Stream Habitats</b>
Basin	Throughflow
Flat	Inflow
	Outflow

**Linears**

Lotic River
Lotic Stream
River
Stream
Terene Flat
Terene Basin
Terene Sloped

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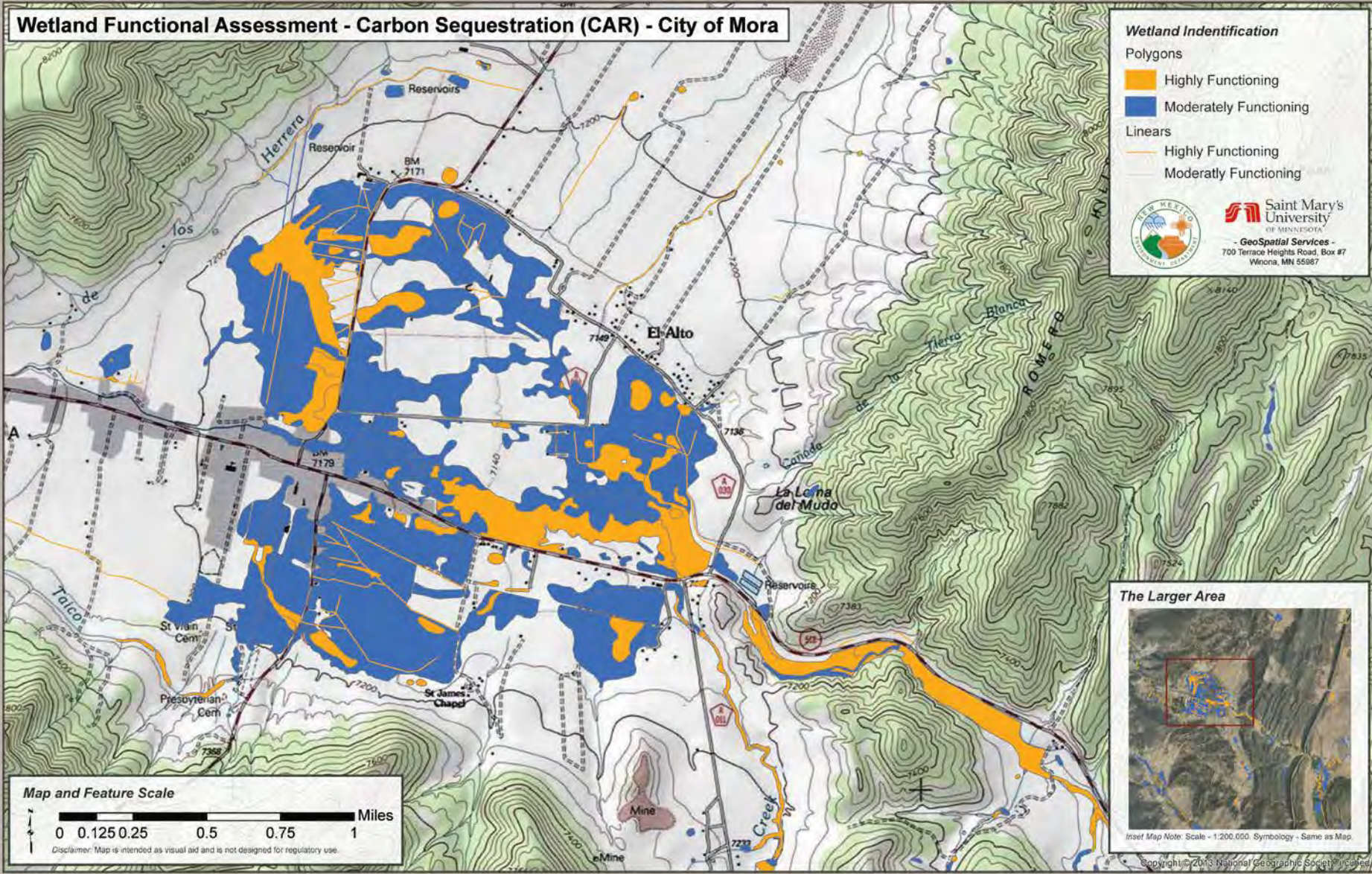
**The Larger Area**

Inset Map Note: Scale - 1:200,000. Symbology - Same as Map.

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# Wetland Functional Assessment - Carbon Sequestration (CAR) - City of Mora



**Wetland Identification**

**Polygons**

- Highly Functioning
- Moderately Functioning

**Linears**

- Highly Functioning
- Moderately Functioning




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**Map and Feature Scale**

0 0.125 0.25 0.5 0.75 1 Miles

Disclaimer: Map is intended as visual aid and is not designed for regulatory use.

**The Larger Area**



Inset Map Note: Scale = 1:200,000. Symbology - Same as Map.

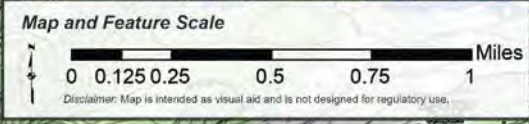
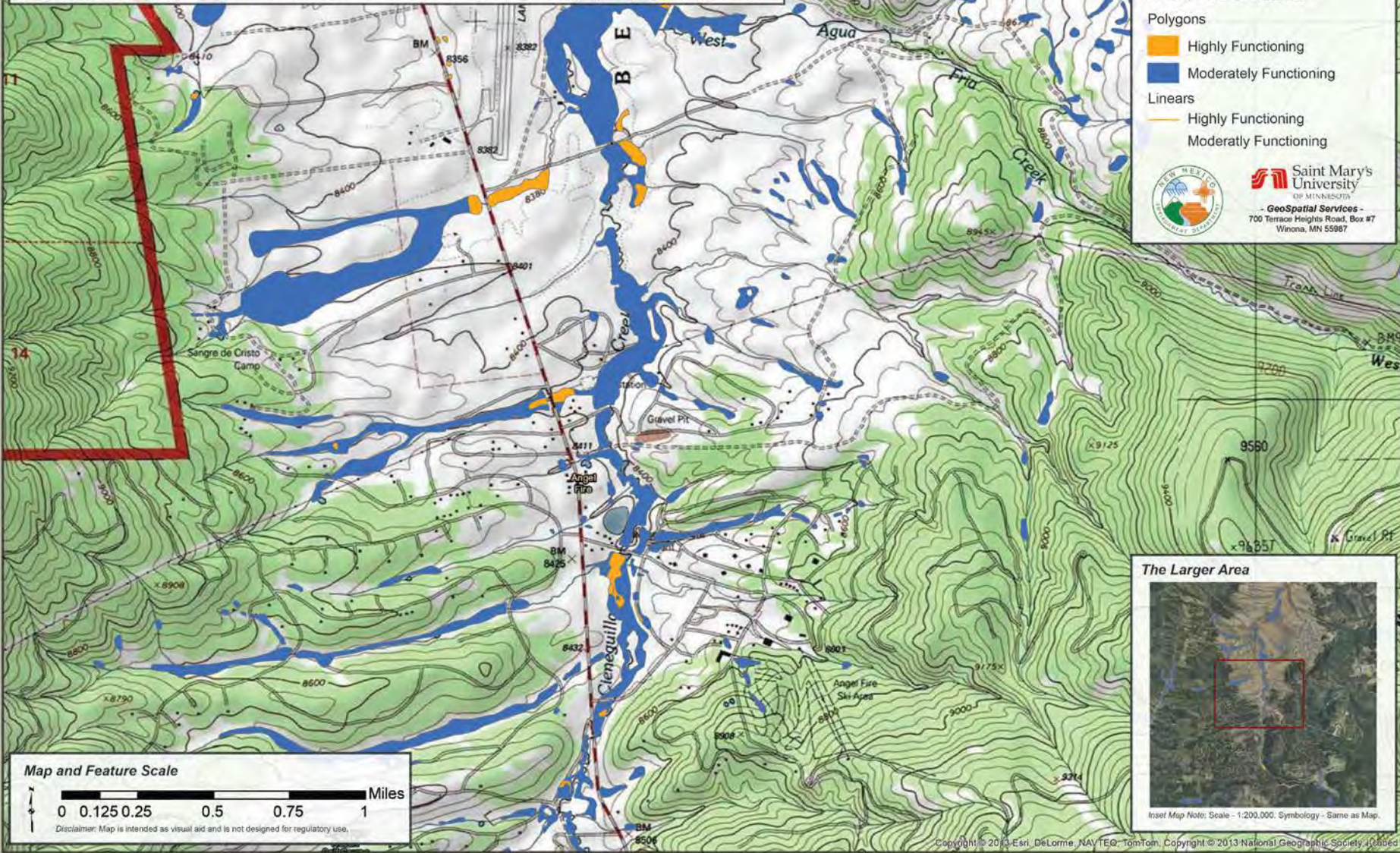
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# Wetland Functional Assessment - Carbon Sequestration (CAR) - Angel Fire

- Wetland Identification**
- Polygons**
- Highly Functioning
  - Moderately Functioning
- Linears**
- Highly Functioning
  - Moderately Functioning



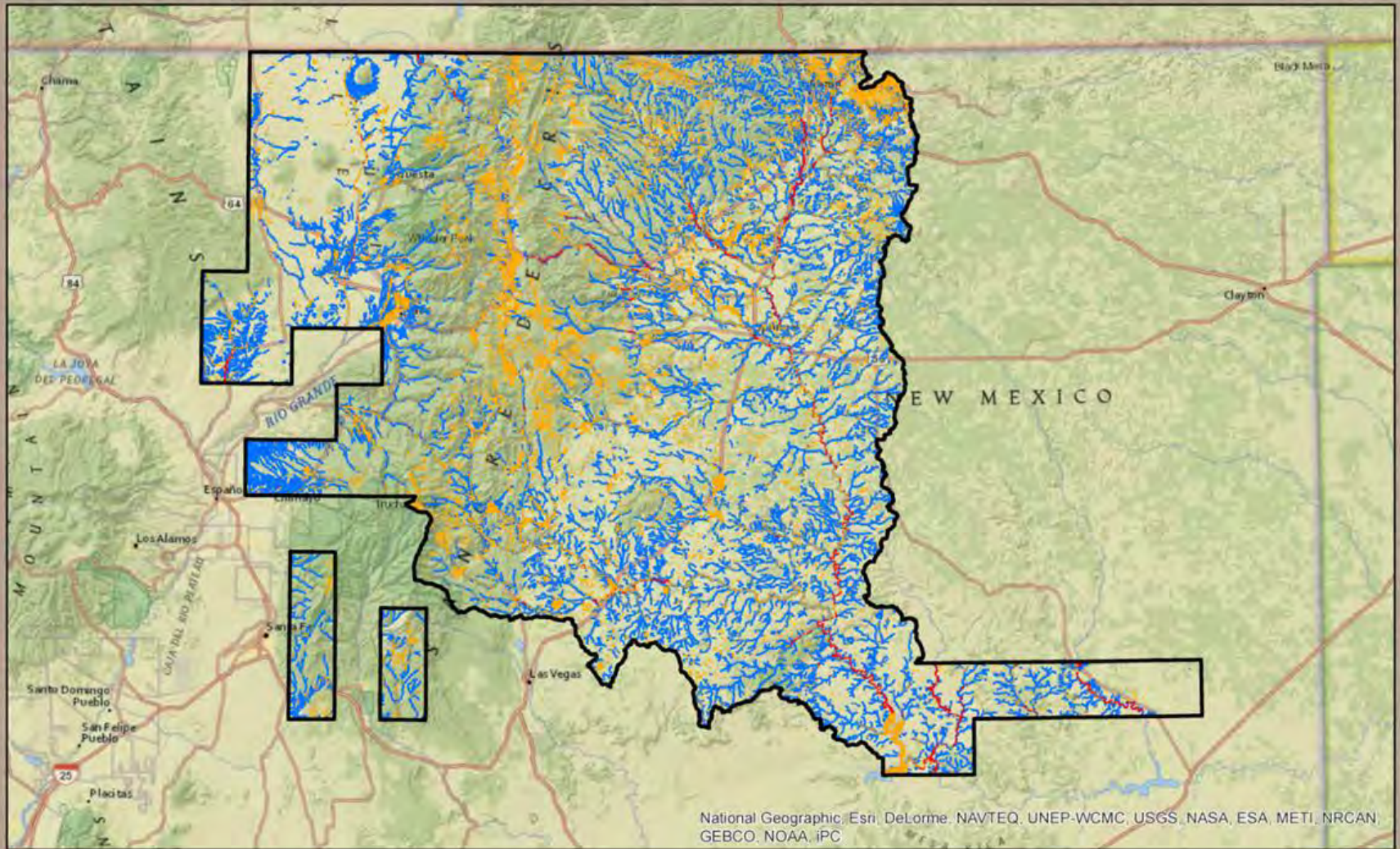
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# Wetland and Deepwater Habitats

Mapping and Classification for Wetland Protection  
Northeastern New Mexico Highlands and Plains



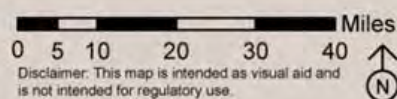
## Map Elements

Categories:

- Wetlands - Polygon
- Wetlands - Linear
- Study Area Boundary
- Riparian Areas

Map Information:

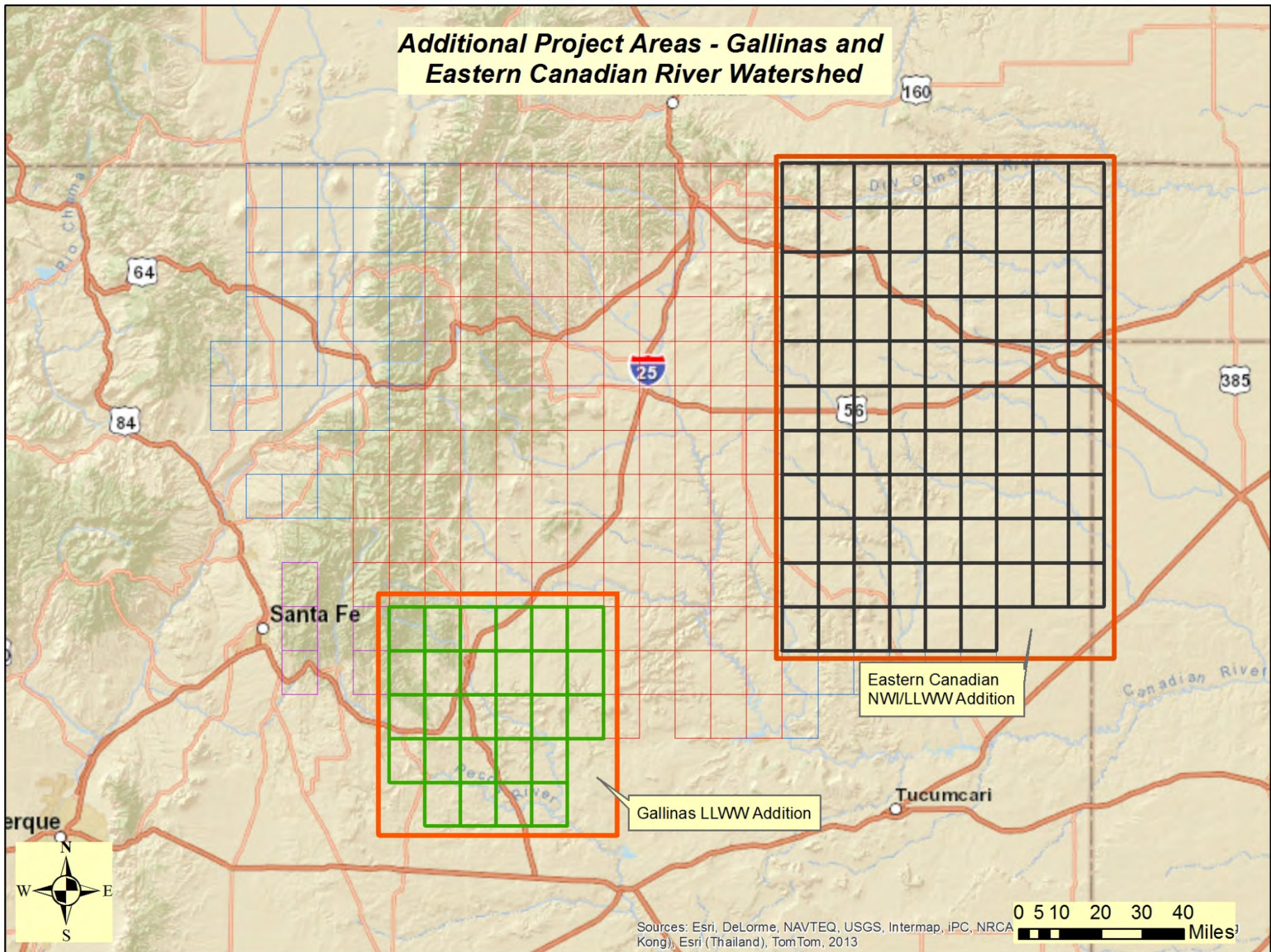
Projection: UTM NAD83 Zone 13N  
Datum: NAD 1983  
Production Date: September 2013



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# Additional Project Areas - Gallinas and Eastern Canadian River Watershed



Eastern Canadian NWI/LLWW Addition

Gallinas LLWW Addition

# Hydrogeomorphic Classification of Wetland Subclasses

- Based on recent document by U.S. Army Corps of Engineers *A Hydrogeomorphic Classification of New Mexico Wetlands*  
Wilder, et al. (2012)
- Developed a model based on vegetation communities by subclass
- First run of model excluded some wetland types
- Continuing to refine model



# Hydrogeomorphic Classifications for future Rapid Assessment Development

- NM Wetlands Program currently has a NM RAM for Mid-Montane Riverine Wetlands
- Lowland Riverine Wetland subclass RAM in development
- Beginning development of RAM for Playa wetlands
- Future planned development of RAM for Springs and Seeps
- Additional wetland subclasses: Headwater/subalpine/alpine riverine subclass; Slope wetlands; Flats; additional subclasses identified from mapping

