



U.S. Fish & Wildlife Service

WETLAND MAPPING & CLASSIFICATION

National Wetlands Inventory
Southwest Region



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Program Vision

The National Wetlands Inventory (NWI) provides scientifically-based information on the location, status, extent, characteristics, and functions of wetlands and related habitats to promote the understanding and conservation of these resources.



Bosque del Apache NWR



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Program Mission

The NWI program supports National and Service policies and initiatives to further conservation of the Nation's wetlands and related habitats by;

1. Producing, maintaining, and providing current and historical geospatial wetland data and information for the Nation.
2. Analyzing and reporting on status and trends where wetlands and related habitats are vulnerable to change, loss or degradation, either man made or natural.
3. Promoting sound decision making and policy formation, through the development and dissemination of wetlands data and information through a variety of media.



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NWI: A National Program, Setting Standards

The National Wetlands Inventory was established in 1974.

In 1986 The Emergency Wetlands Resources Act (P.L. 99-645) directed the USFWS to complete mapping of the Conterminous United States and Alaska.

The Cowardin Classification System used by the USFWS to describe wetland habitats is now the National Standard for any federally-based wetland mapping.

The Presidential; Office of Management and Budget (OMB) Circular A-16 states the USFWS is responsible for maintaining the wetlands data layer of the National Spatial Data Infrastructure (NSDI).



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Program History

1970's: Wetlands photo interpretation done on 1:120,000 and 1:80,000 B&W aerial photography. Wetlands coded out to *Class* only. Wetland delineations manually rectified to USGS topo base with Zoom Transfer Scope.

1980's: Wetlands photo interpretation done on 1:58,000 and 1:40,000 CIR aerial photography. Wetlands coded to full extent of class system. Transfer rectification still done manually. Status and Trends work begins. Large-scale production of NWI maps ensues.

1990's: Various scales and types of aerial photos are used as project areas become more focused, due to budget cuts and loss of primary contractor. Large-scale vectorization of NWI maps begins. Early attempts at digital map creation take place.

2000's: "Pen & ink" era of NWI map creation ends. All data is created digitally, in a head's-up or Digital Transfer Scope environment. NWI partners with USGS to create a Wetlands Master Geodatabase and web interface. National data standards are created for all digital NWI data.

2010's: The onset of contributed and "scalable" data lead to near total completion of national wetlands dataset. EPA State and Tribal wetland programs account for much the this data inflow. Look for "NWI 2.0".



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Data Limitations

The Service's objective of mapping wetlands and deepwater habitats is to produce reconnaissance level information on the location, type and size of these resources. The maps are prepared from the analysis of high altitude imagery. Wetlands are identified based on vegetation, visible hydrology and geography. A margin of error is inherent in the use of imagery; thus, detailed on-the-ground inspection of any particular site may result in revision of the wetland boundaries or classification established through image analysis.

Precautions - Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that used in this inventory. There is no attempt, in either the design or products of this inventory, to define the limits of proprietary jurisdiction of any Federal, state, or local government or to establish the geographical scope of the regulatory programs of government agencies. Persons intending to engage in activities involving modifications within or adjacent to wetland areas should seek the advice of appropriate federal, state, or local agencies concerning specified agency regulatory programs and proprietary jurisdictions that may affect such activities.



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What is a Wetland?

The Service uses the Cowardin *et al.* (1979) definition of a wetland; **Classification of Wetlands and Deepwater Habitats of the United States** (FWS/OBS – 79/31 December 1979). This definition is the Federal standard for classifying and mapping wetlands as determined by the Federal Geographic Data Committee. It is a two-part definition as indicated below:

Wetlands are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

For purposes of this classification wetlands must have one or more of the following three attributes: 1) at least periodically, the land supports predominantly hydrophytes; 2) the substrate is predominantly undrained hydric soil; and 3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.



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Are Wetlands Important?

- **Maintain Natural Fish/Wildlife Habitat**
- **Flood Control/Retention**
- **Promote Nutrient Transformation**
- **Carbon Sequestration**
- **Stream Bank Maintenance**
- **Water Quality**
- **Aquifer Recharge (other areas)**
- **Education/Recreation**

One part of a bigger picture of ecosystem health...
relating directly to human health.



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Why Map Wetlands?

Create a current spatial inventory of wetland habitats;

- Location
- Area
- Structure and Composition

Set a baseline for trend studies, future and past;

- Human Development
- Climate Change/Natural Variations
- Restoration & Re-establishment



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Why Map Wetlands?



Wetlands
Hydrography
Land Cover
Elevation
Jurisdiction
Etc...

One tool, in the toolbox of data and information systems to aid in making sound, scientific decisions.



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Mapping Wetlands... The NWI Way!





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Mapping/Data Collection Process

Classification:

Wetland features classified using Cowardin Classification System

Identification:

Wetlands are identified and interpreted from digital aerial imagery

- Vegetation
- Hydrology
- Soils

Digitization:

Wetland features created in a heads-up digital environment

-
- *Field surveys performed before/after to verify mapped wetlands*
 - *Data quality control and assurance procedures are integrated into all steps.*



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Mapping/Data Collection Process: Classification

Cowardin Classification System for Mapping Wetlands

Hierarchal (L1UBHh)

System (L)

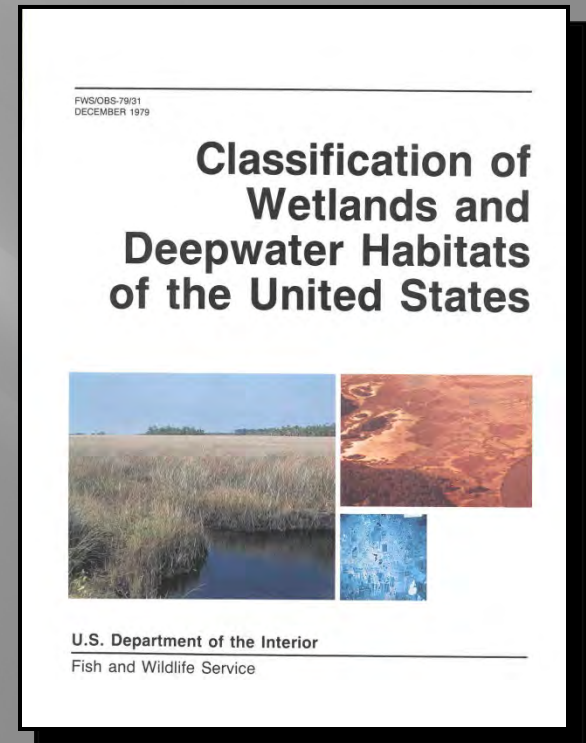
Subsystem (1)

Class (UB)

Subclass (-)

Water Regime (H)

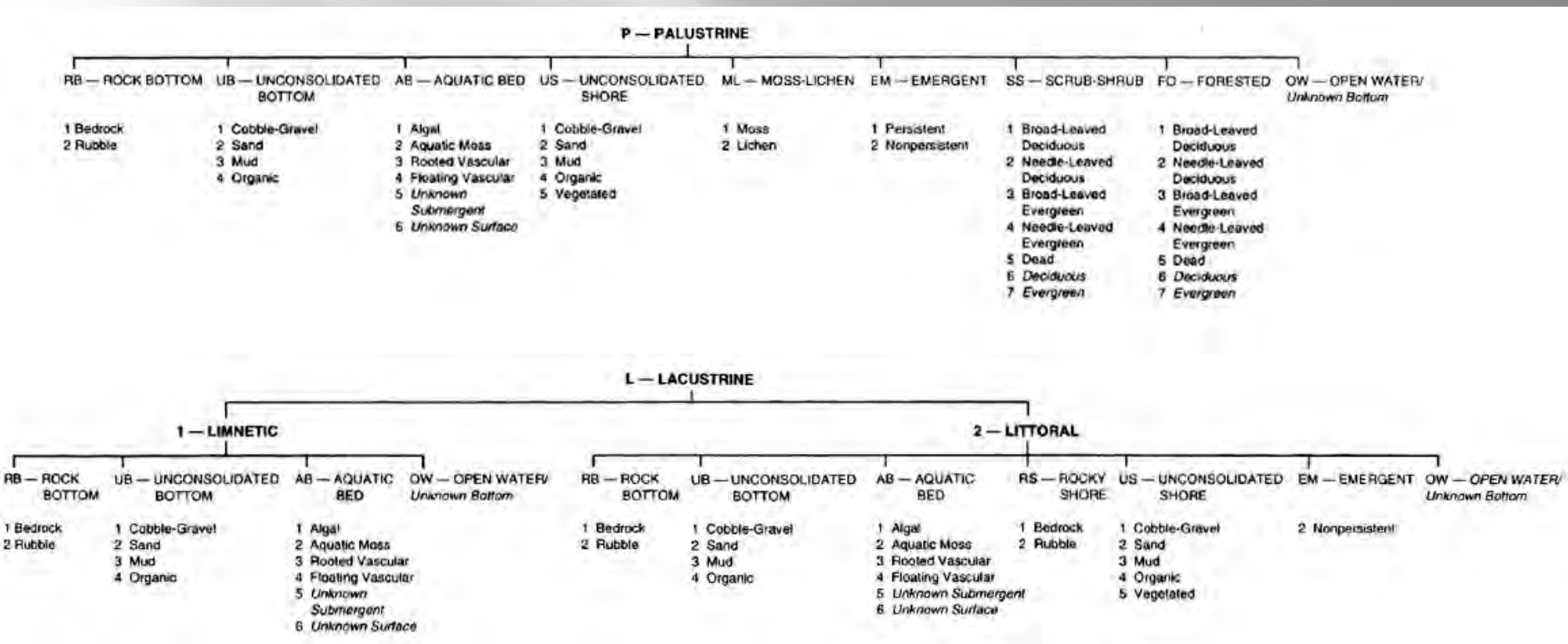
Special Modifiers (h)





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Mapping/Data Collection Process: Classification Cowardin Classification System for Mapping Wetlands

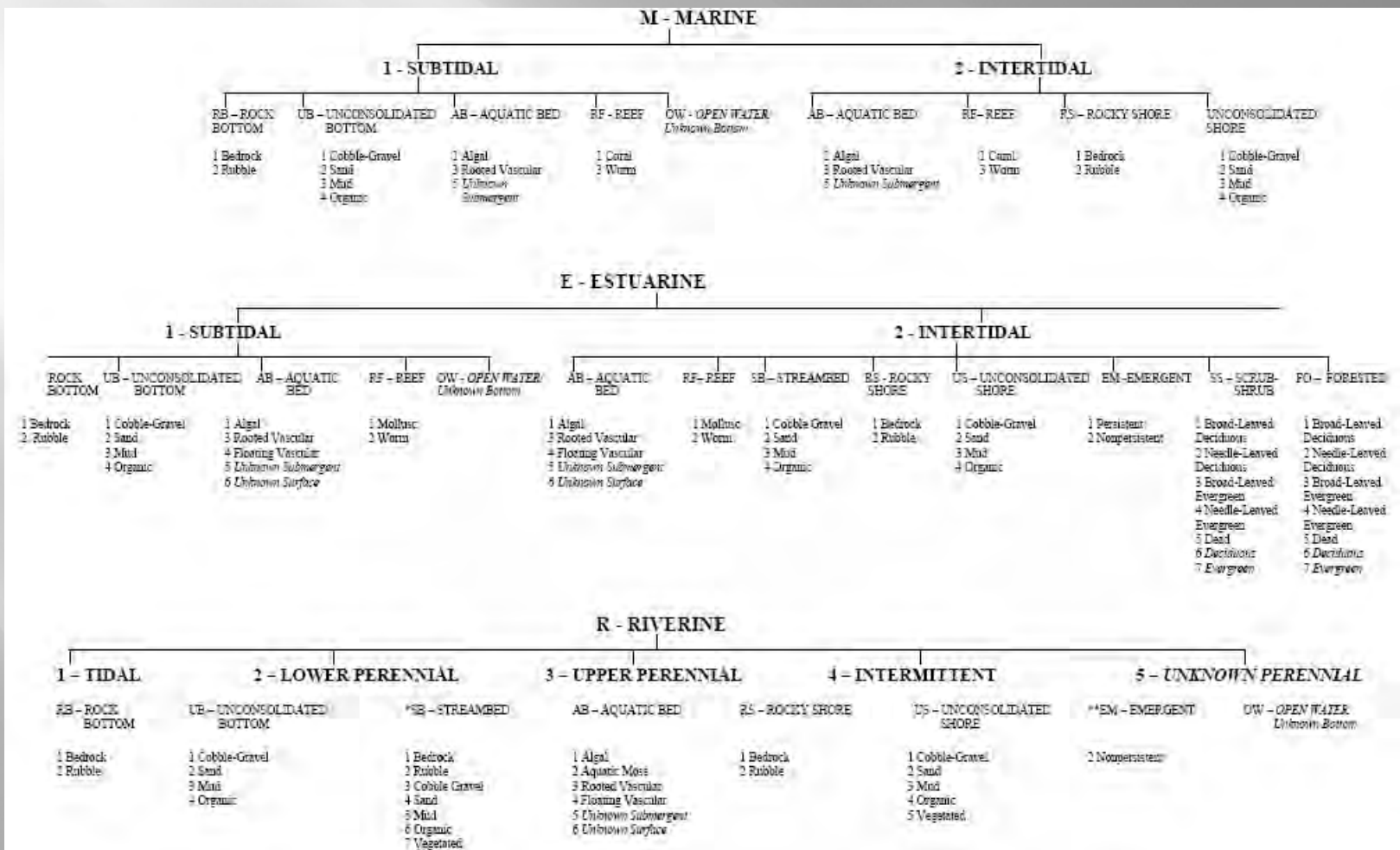




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Mapping/Data Collection Process: Classification

Cowardin Classification System for Mapping Wetlands





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Mapping/Data Collection Process: Classification

Examples of Cowardin Class System

SYSTEM

SUBSYSTEM

CLASS

R-RIVERINE (rivers, streams, washes, arroyos, etc...)

2-LOWER PERENNIAL (low gradient)

3-UPPER PERENNIAL (high gradient)

4-INTERMITTENT (flows part of year)

RB-Rock Bottom

UB-Unconsolidated Bottom

AB-Aquatic Bed

SB-Streambed

RS-Rocky Shore

US-Unconsolidated Shore

SYSTEM

SUBSYSTEM

CLASS

P-PALUSTRINE (marshes, swamps, ponds, bottomlands, wet prairies, etc...)

(None)

RB-Rock Bottom

UB-Unconsolidated Bottom

US-Unconsolidated Shore

AB-Aquatic Bed

EM-Emergent (sedges, grasses, etc...)

SS-Scrub/Shrub

FO-Forested



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Mapping/Data Collection Process: Classification Examples of Cowardin Class System, Cont.

CLASS

SUBCLASS

SS-Scrub/Shrub and **FO**-Forested

- 1 Broad-leaved Deciduous (ex. willow, cottonwood)
- 2 Needle-leaved Deciduous (ex. Salt cedar)
- 3 Broad-leaved Evergreen
- 4 Needle-leaved Evergreen
- 5 Dead
- 6 *Deciduous*
- 7 *Evergreen*

MODIFIERS

WATER REGIME

- A Temporarily Flooded
- B Saturated
- C Seasonally Flooded
- E Seasonally Flooded/Saturated
- F Semi-permanently Flooded
- H Permanently Flooded
- J Intermittently Flooded
- K Artificially Flooded

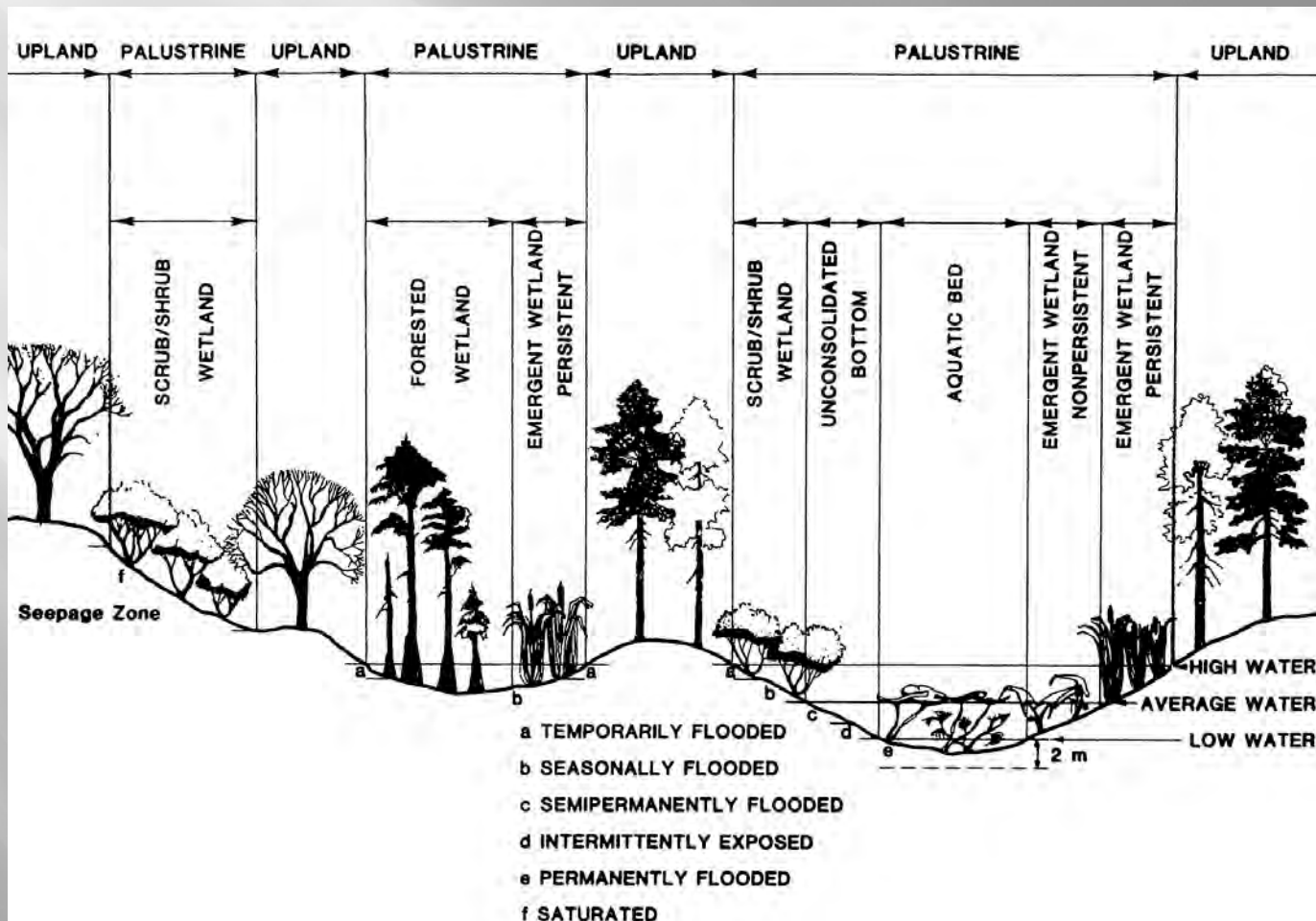
SPECIAL MODIFIERS

- b Beaver
- d Partially drained/Ditched
- f Farmed
- h Diked/Impounded
- x Excavated



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Mapping/Data Collection Process: Classification Generalized Wetland Structure, Relating to Classification





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Mapping/Data Collection Process: Identification & Digitization

Digital aerial imagery (publicly available) is used as a base for all wetland mapping.

In order to assure wetlands are accurately interpreted and identified, ancillary datasets are used to derive needed information;

- Hydrology/Topology (NHD, DRG's, LiDAR)
- Soils (SSURGO)

Field surveys are conducted, before and after, the mapping process to verify wetland type and classification.

Wetland features are digitized using Esri, inc. ArcGIS, Geodatabase format. Polygonal and linear shapes are used to define wetland areas.



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True color aerial image.



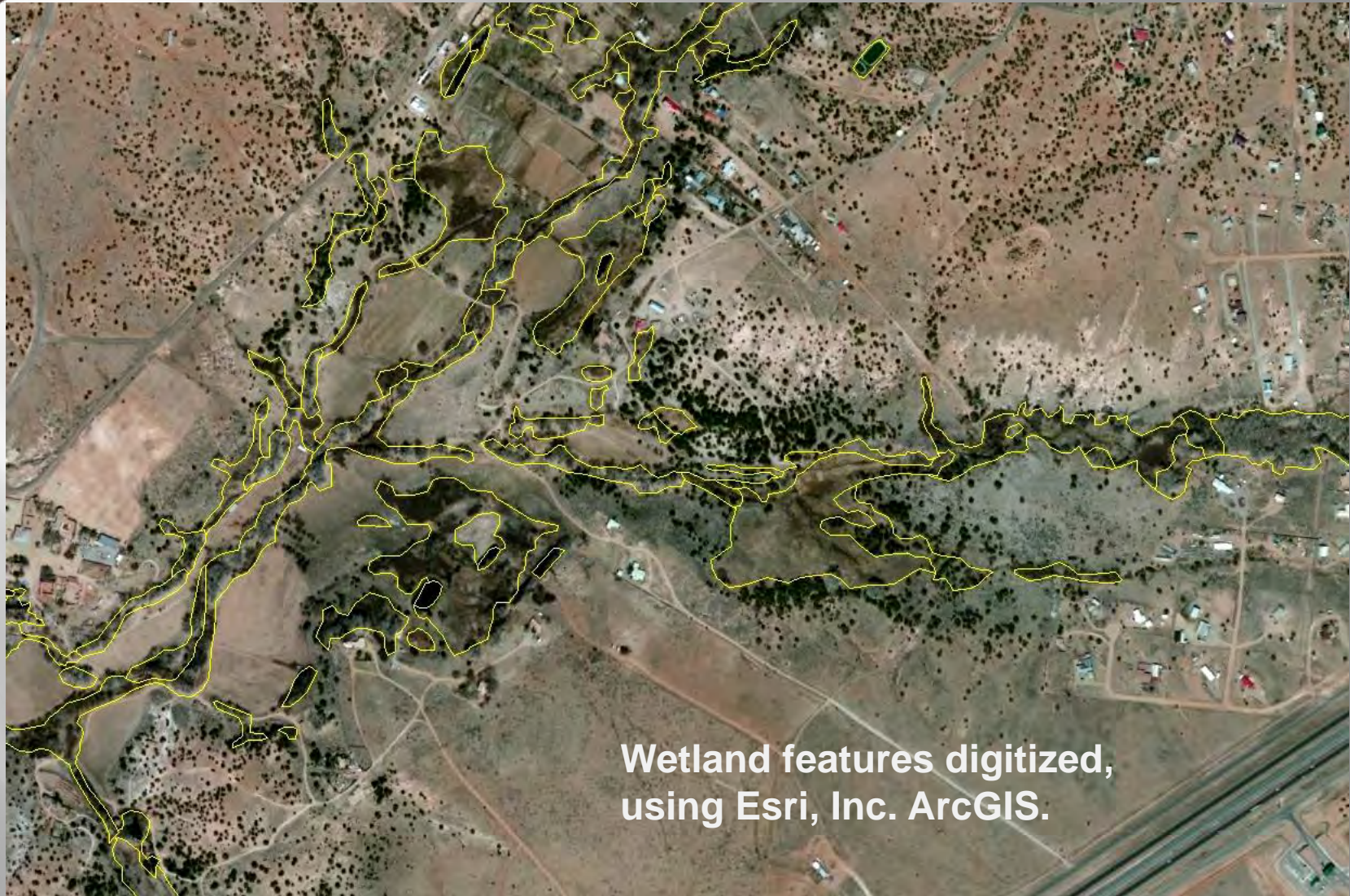
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Field surveys are conducted to verify photo signatures.





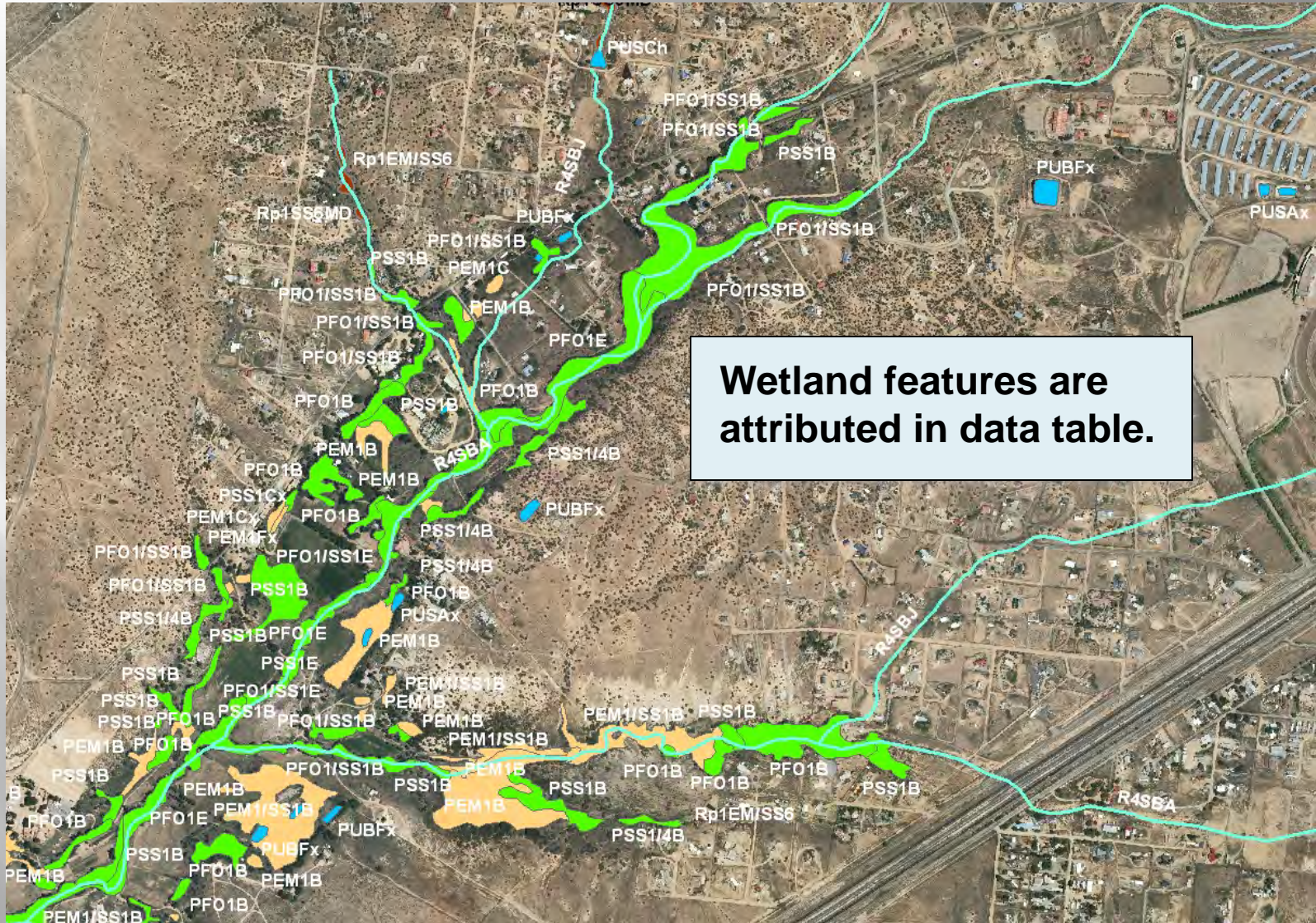
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**Wetland features digitized,
using Esri, Inc. ArcGIS.**

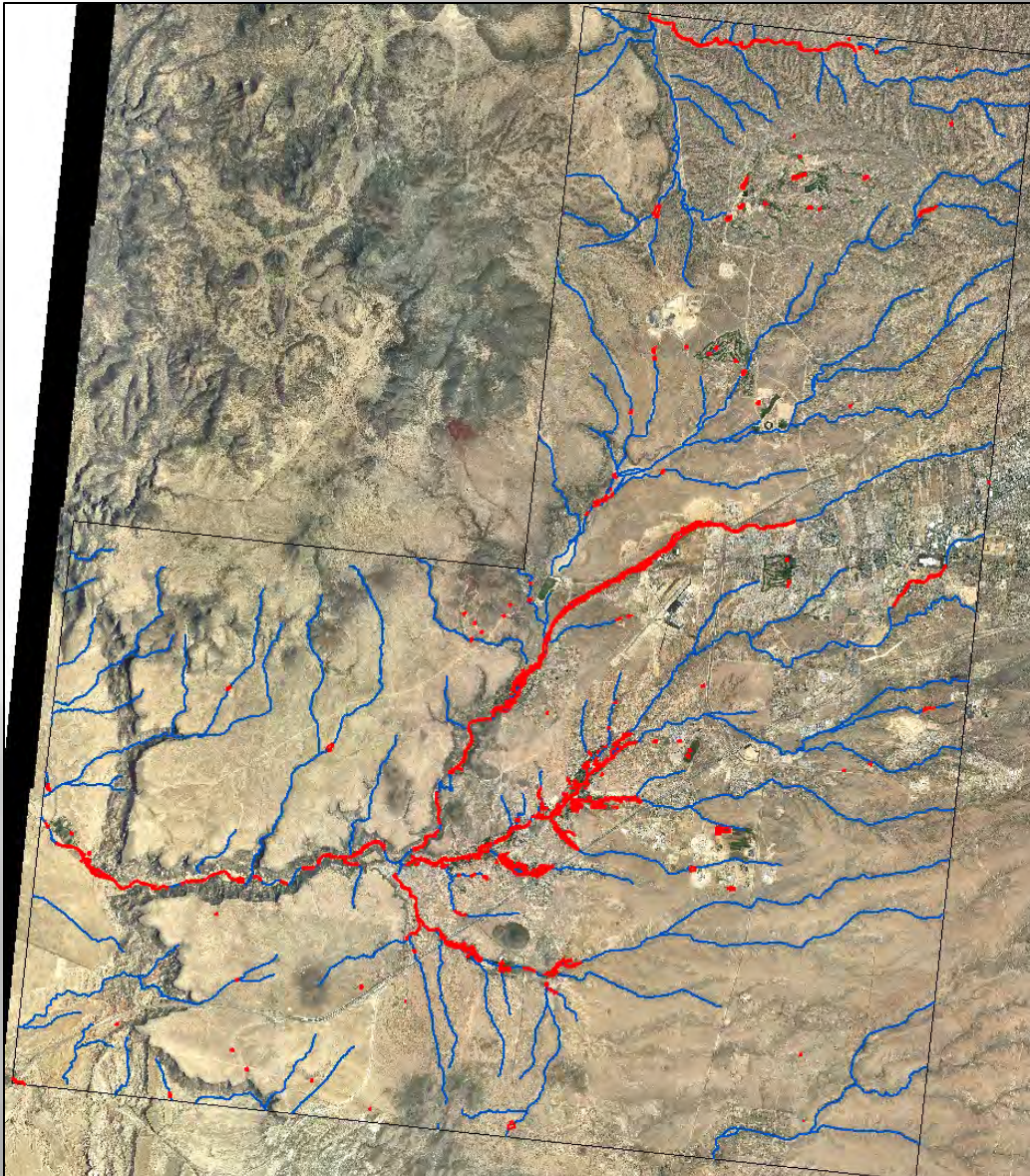


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Overview of wetland geospatial data (polygon and linear features).



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Describing Wetland Habitats

<u>Wetland Code</u>	<u>Generalized Wetland Habitat Type</u>	<u>Basic Hydrology</u>	<u>Flooding Duration</u>	<u>Man-Impact</u>
PEM1/SS1E	Freshwater Emergent/Shrub Wetland	Groundwater & Surface Flooding	Saturated & Seasonal/Drainage	
PEM1/SS1J	Freshwater Emergent/Shrub Wetland	Surface Flooding	Intermittent	
PEM1Ah	Freshwater Emergent Wetland	Surface Flooding	Temporary	
PEM1B	Freshwater Emergent Wetland	Groundwater	Saturated/Slope	
PEM1Cx	Freshwater Emergent Wetland	Surface Flooding	Seasonal	Excavated
PEM1E	Freshwater Emergent Wetland	Groundwater & Surface Flooding	Saturated & Seasonal/Drainage	
PEM1Eh	Freshwater Emergent Wetland	Groundwater & Surface Flooding	Saturated & Seasonal/Drainage	Impounded
PEM1J	Freshwater Emergent Wetland	Surface Flooding	Intermittent	
PEM1Jh	Freshwater Emergent Wetland	Surface Flooding	Intermittent	Impounded
PFO1/4B	Freshwater Forested Wetland	Groundwater	Saturated/Slope	
PFO1/EM1B	Freshwater Forested/Shrub Wetland	Groundwater	Saturated/Slope	
PFO1/SS1E	Freshwater Forested/Shrub Wetland	Groundwater & Surface Flooding	Saturated & Seasonal/Drainage	
PFO1/SS2C	Freshwater Forested/Shrub Wetland	Surface Flooding	Seasonal	
PFO1B	Freshwater Forested/Shrub Wetland	Groundwater	Saturated/Slope	
PFO1E	Freshwater Forested/Shrub Wetland	Groundwater & Surface Flooding	Saturated & Seasonal/Drainage	
PFO1J	Freshwater Forested/Shrub Wetland	Surface Flooding	Intermittent	
PSS1/2C	Freshwater Forested/Shrub Wetland	Surface Flooding	Seasonal	
PSS1/4B	Freshwater Forested/Shrub Wetland	Groundwater	Saturated/Slope	
PSS1B	Freshwater Forested/Shrub Wetland	Groundwater	Saturated/Slope	
PSS1Cx	Freshwater Forested/Shrub Wetland	Surface Flooding	Seasonal	Excavated
PSS1E	Freshwater Forested/Shrub Wetland	Groundwater & Surface Flooding	Saturated & Seasonal/Drainage	
PUBHh	Freshwater Pond	Surface Flooding	Permanent	Impounded
PUBHx	Freshwater Pond	Surface Flooding	Permanent	Excavated
PUBKx	Freshwater Pond	Surface Flooding	Artificial	Excavated
PUSCx	Freshwater Pond	Surface Flooding	Seasonal	Excavated
PUSJh	Freshwater Pond	Surface Flooding	Intermittent	Impounded
R2UBH	Riverine	Surface Flooding	Permanent	
R4SBA	Riverine	Surface Flooding	Temporary	
R4SBC	Riverine	Surface Flooding	Seasonal	
R4SBJ	Riverine	Surface Flooding	Intermittent	



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Wetland Examples;

Emergent & scrub-shrub wetland
(PEM1F & PSS1C).



Intermittent streambed with forested
wetland (R4SBJ & PFO1J).



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Wetland Examples;

Impounded pond, with adjacent emergent Wetlands (PUBHh & PEM1Fh).



Emergent wetland, former river channel (PEM1F).



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Types of NWI Wetlands Data

Standard Wetlands Digital Data (Vector)

- Meets FGDC National Standards
- Photo interpreted, detailed mapping (0.1 acre)

Scanned Raster (from hardcopies)

- Scanned from original map mylar or photo overlay
- Rough geo-referencing
- Labels, leader lines, corner tic marks included

Hardcopy Only (1:24,000 scale)

Scalable Mapping

Landscape-level approach (small scale)

“Generalized” wetlands mapping

Truncated class system

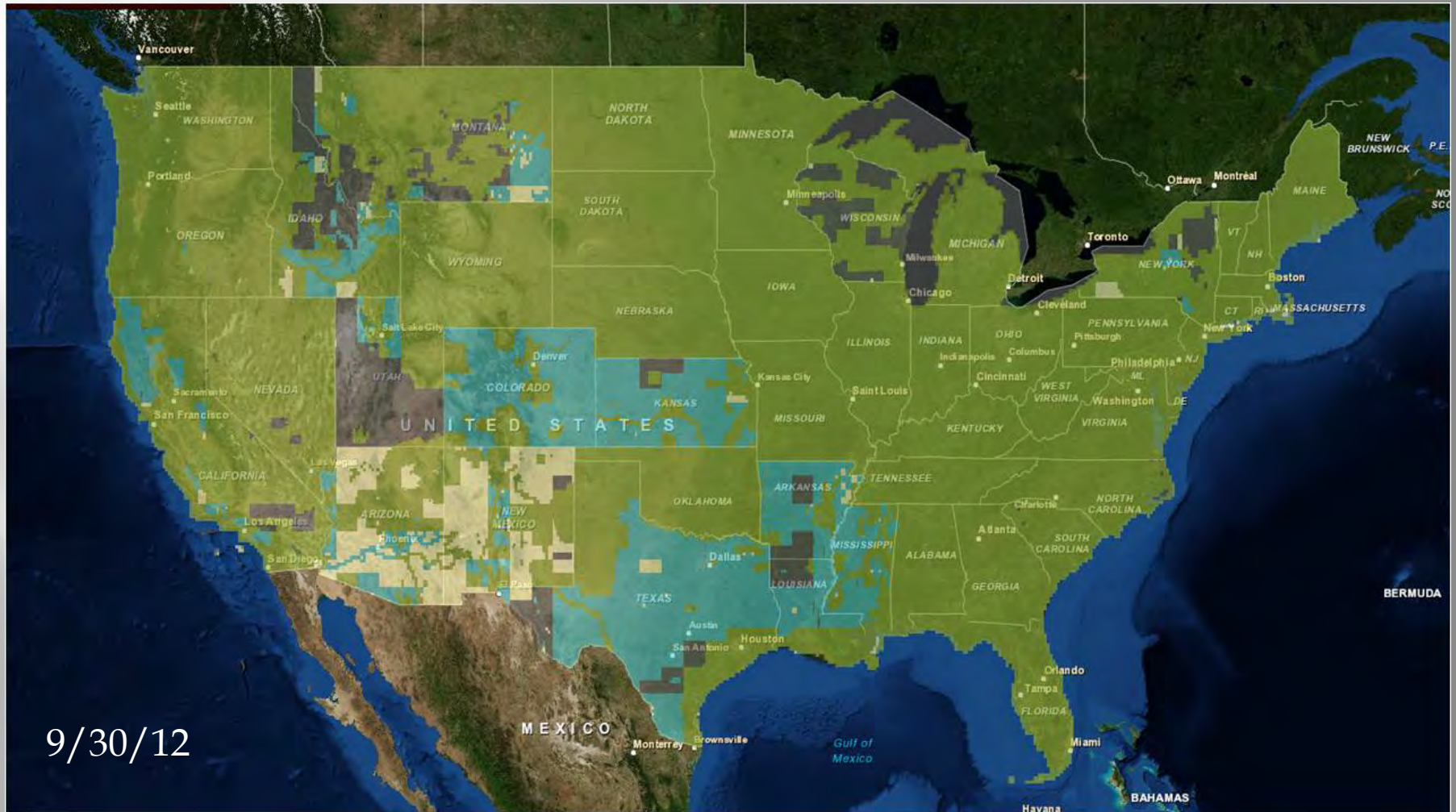
Assembled from various data sources

May not meet National Map Standards



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Types of NWI Wetlands Data





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Scalable and Contributed Wetlands Data: “Filling in the Gaps”

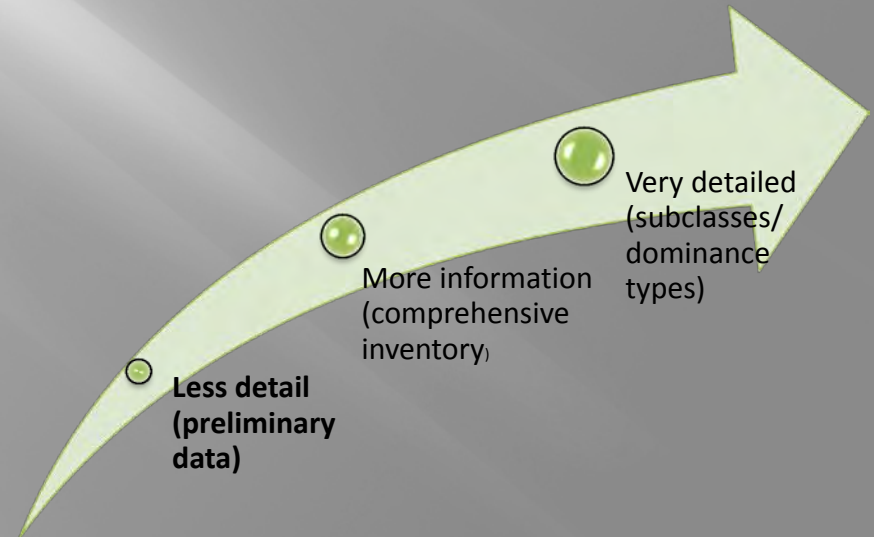
Issues currently being faced by NWI/USFWS:

- Reduced Budgets
- Reduced Manpower
- Shifting Priorities
- Wetland Data Gaps
- Need for Landscape-level Data (LCC Support)
- Need to Cover Large Areas... Quickly!



Scalable Wetlands Data: “Filling in the Gaps”

Scalable maps are considered an interim product and may include map information at different scales, classification level(s), or resolution that are capable of being easily expanded or upgraded.



Scalable to ‘fill-in’ data gaps
provide less detailed information



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Scalable Wetlands Data: “Filling in the Gaps”

Source(s) Information (utilizing existing databases)

- Hydrography
- Topology
- Other topographic map information
- Available imagery with limited analysis

Classification attributes

Herbaceous wetland (emergent)

Woody wetland (forested/shrub)

Ponds

Impounded

Lakes (lacustrine)

Reservoirs (impounded)

Rivers

Lower perennial

Unknown perennial

Intermittent stream bed

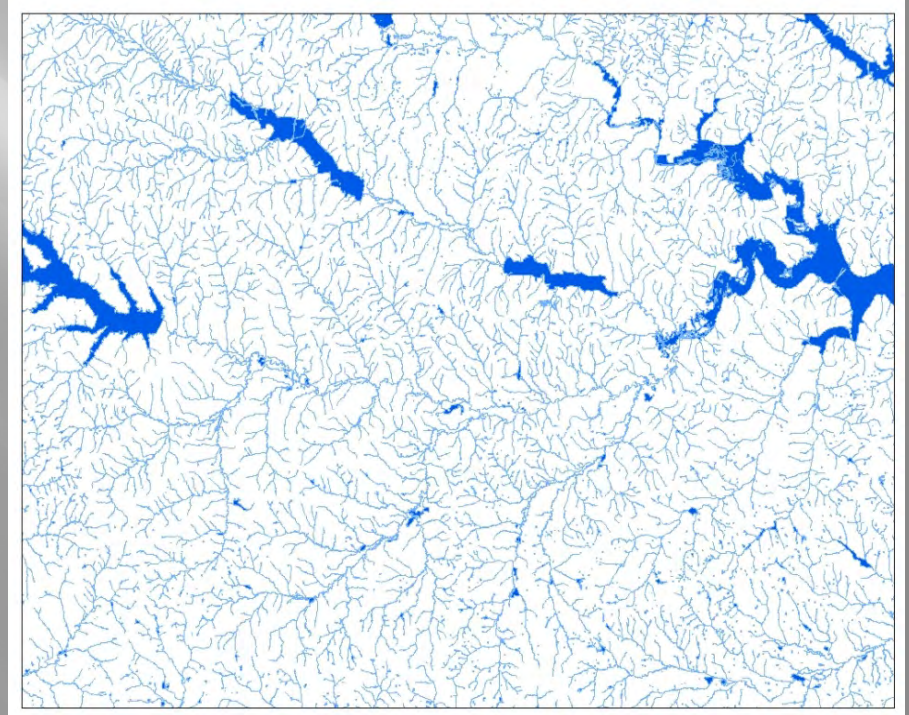


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Scalable Wetlands Data: “Filling in the Gaps”

Linear hydrology features buffered to create polygons and attributed to Cowardin classification.

Geospatial model creates topologically correct polygon feature class. This process is automated as an ArcGIS model.





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Contributed Wetlands Data: “Filling in the Gaps”

Wetlands Data Produced/Funded from Outside Sources:

States (NM, AZ, WI, FL, NY, etc...)

Tribal (Navajo Nation, etc...)

Universities (Texas Tech)

NGO's (Duck's Unlimited)

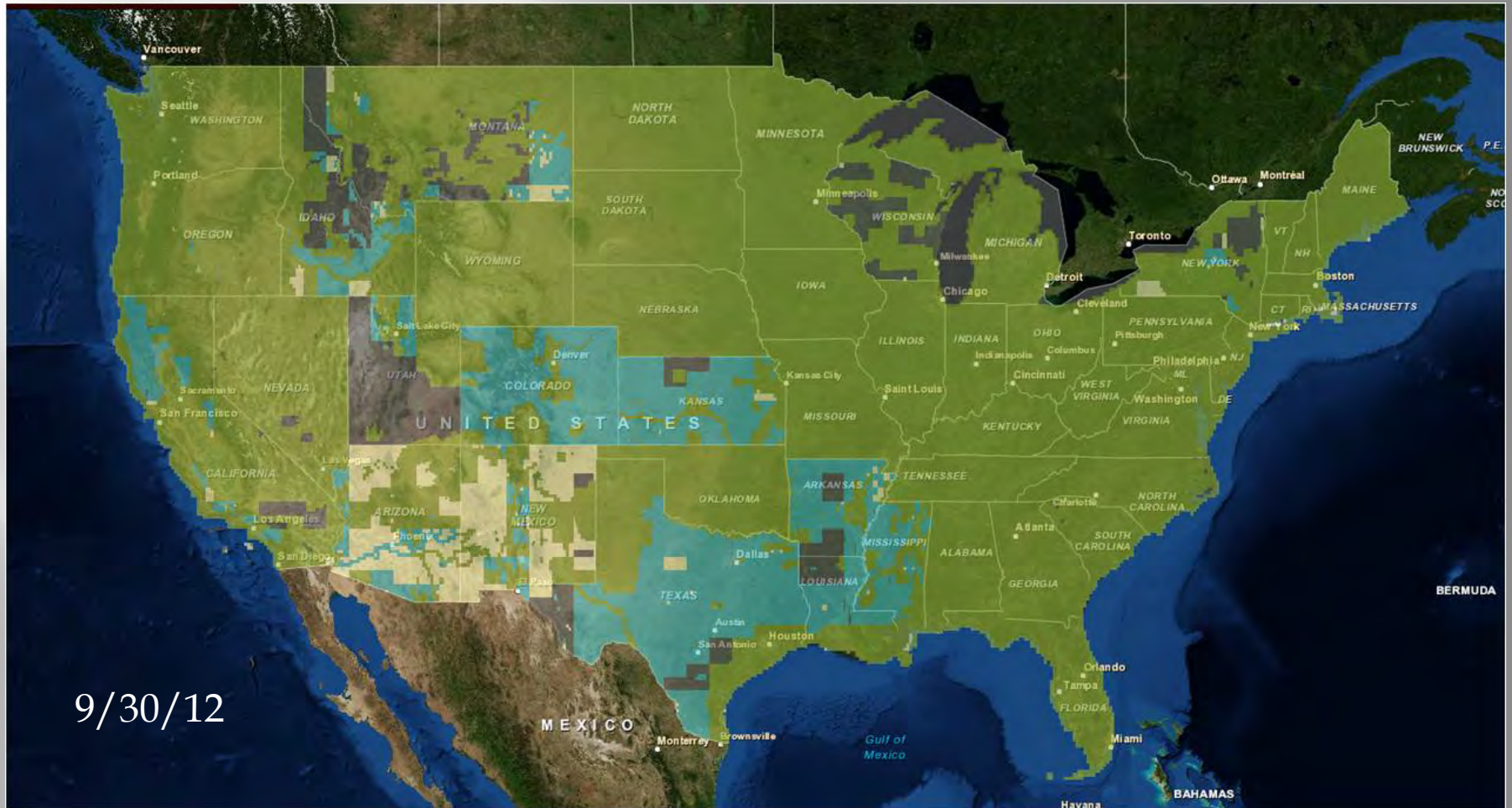
Some State and Tribal projects were EPA-Funded.

Partnering w/ NWI/USFWS to meet National Wetland Mapping Standards.



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Scalable and Contributed Wetlands Data: “Filling in the Gaps”





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Scalable and Contributed Wetlands Data: “Filling in the Gaps”



9/30/13



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SWI: Surface Waters & Wetlands Inventory: NWI 2.0

- Single composite database of landscape-level NWI wetland and surface water/hydrography data
- Assembled at a State-scale
- Seamless data layer, within and across state boundaries
- Complete ecological descriptions/Cowardin classification maintained
- Constructed for geospatial analysis/modeling
- Traceable water flow paths



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SWI: Surface Waters & Wetlands Inventory: NWI 2.0

The screenshot shows a web application interface for the Surface Waters and Wetlands Inventory (SWI) Beta Version. The main map area displays a satellite-style basemap of the United States with several regions highlighted in green and grey. The green areas represent digital mapping status, while the grey areas represent non-digital mapping status. The interface includes a search bar at the top right, a "Basemap" button, and a legend titled "Explanation" on the right side. The legend indicates that green represents "Digital" and grey represents "Non-Digital". The bottom of the map shows the coordinates "Lat: 35.7465, Lng: -100.9424" and a source attribution: "Source: Esri, DigitalGlobe, GeoEye, Earthstar USA, USGS, AEX, Getmapp...".

Surface Waters and Wetlands Inventory
Beta Version

Basemap

Available Layers

Explanation

Surface Waters and Wetlands Mapping Status

- Digital
- Non-Digital

Lat: 35.7465, Lng: -100.9424

Source: Esri, DigitalGlobe, GeoEye, Earthstar USA, USGS, AEX, Getmapp...



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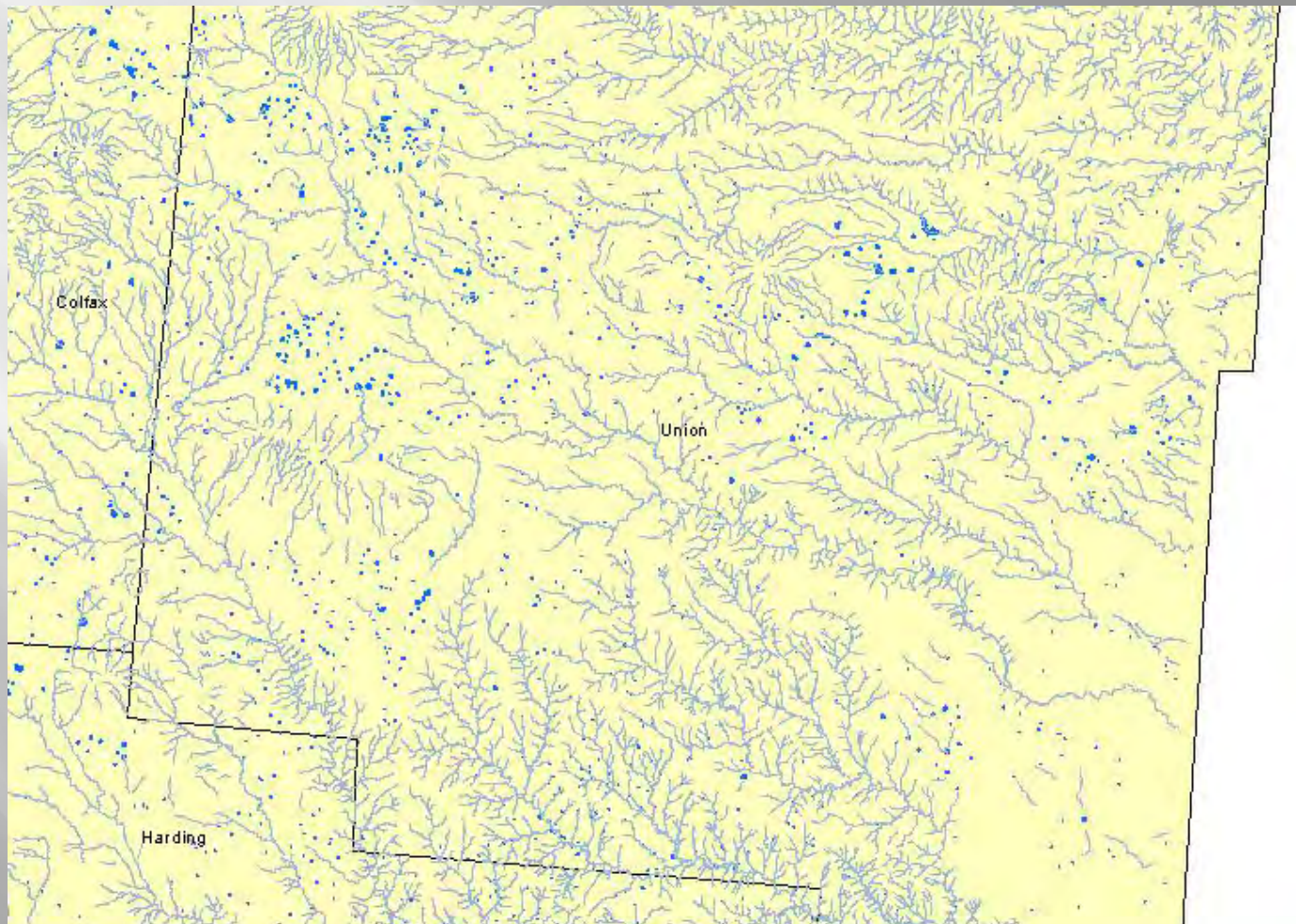
SWI: Surface Waters & Wetlands Inventory: NWI 2.0





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SWI: Surface Waters & Wetlands Inventory: NWI 2.0





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Addition of “Riparian” Data

The term “*riparian*” may be viewed from different perspectives, and has many definitions. In 1997, the western Regions of the Service developed a classification system to identify riparian areas that fell outside of the Cowardin *et al.* (1979) system. Since that time, “**A System for Mapping Riparian Areas in the Western United States**” (USFWS 2009) has also been adopted by the Service and is a national standard for riparian mapping, monitoring and data reporting as determined by the Federal Geographic Data Committee. The definition is indicated below:

Riparian areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways). Riparian areas have one or both of the following characteristics: 1) distinctly different vegetative species than adjacent areas, and 2) species similar to adjacent areas but exhibiting more vigorous or robust growth forms. Riparian areas are usually transitional between wetland and upland.

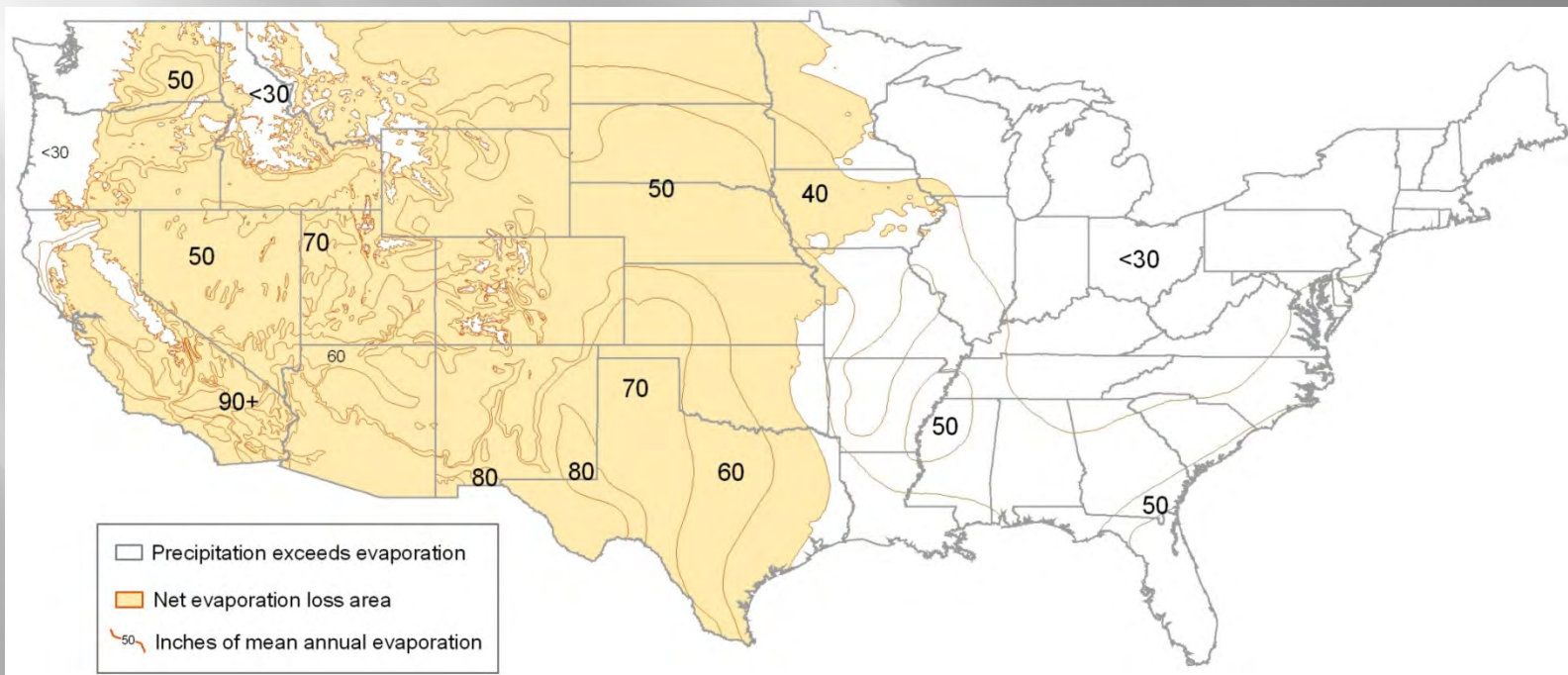


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Applicability of “Riparian” Data

Riparian areas are plant communities contiguous to and affected by surface and subsurface hydrologic features of perennial or intermittent lotic and lentic water bodies (rivers, streams, lakes, or drainage ways).

Riparian areas are usually transitional between wetland and upland.





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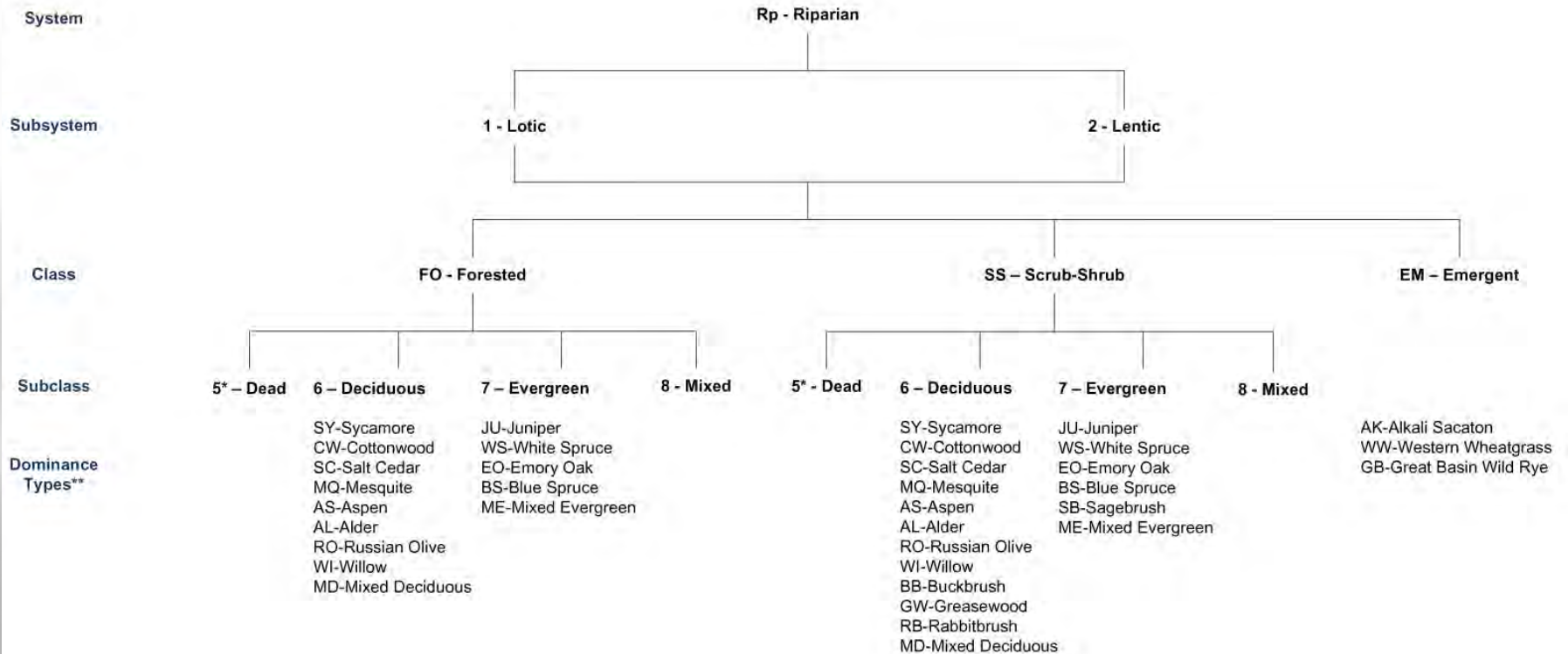
Importance of Riparian Habitats

- Greater than 75 percent of terrestrial wildlife species in the Great Basin region of eastern Oregon, as well as in southeastern Wyoming, are dependent on riparian habitats.
- In Arizona and New Mexico, 80 percent of all vertebrates use riparian areas for at least half their life cycles; more than half of these are totally dependent on riparian areas.
- 60 - 75 percent of Arizona's resident wildlife species depend on riparian areas to sustain their populations, yet these areas occupy less than 0.5 percent of the state's land area.
- Aquatic and fish productivity are directly related to a properly functioning and healthy riparian habitat (Washington Dept. Fish and Wildlife 1995).



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RIPARIAN CLASSIFICATION SYSTEM

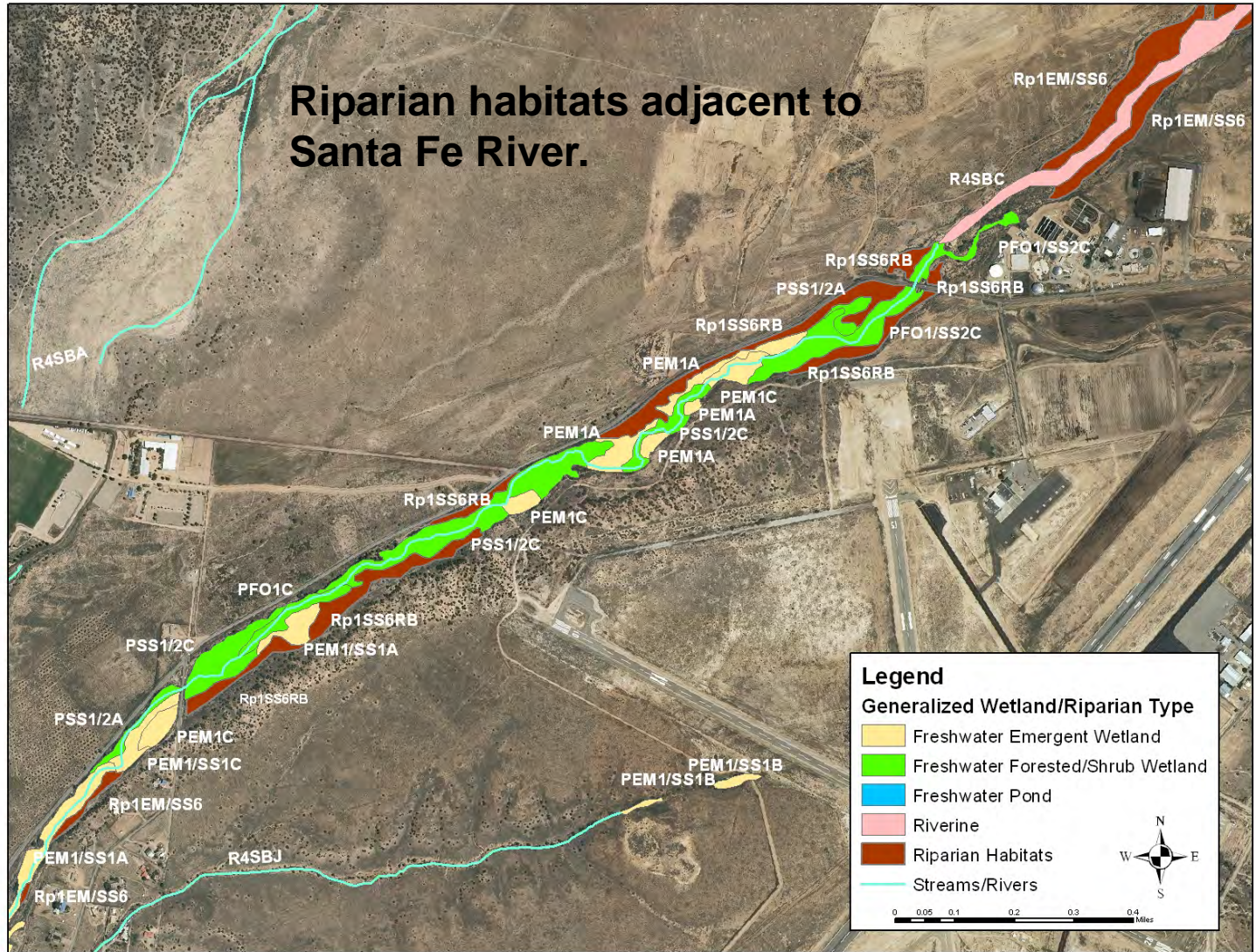


* Any Dominance Type

** Limited to two (2) mixed Dominance Types



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Forested riparian areas associated with, but not flooded by drainage.





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More Information

National Wetlands Inventory Website:

<http://www.fws.gov/wetlands>

Facebook:

<https://www.facebook.com/USFWSWetlands>

Contact

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