# Colorado's Wetland Program Plan: Monitoring and Assessment

Association of State Wetland Managers Webinar
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# Colorado Natural Heritage Program

- Non-profit organization based at Colorado State University
- Research unit of the Warner College of Natural Resources, Department of Fish Wildlife and Conservation Biology
- Part of an international network of Heritage programs. NatureServe is umbrella over network.
- Provide scientific information and tools needed to help guide effective conservation action in Colorado.

Colorado State University

Natural Heritage Program COLORADO

NatureServe

# EPA's Four Core Elements in Colorado

Wetland Regulation / Section 404
**Army Corps of Engineers / EPA / Colo Dept of Transp**

Wetland Restoration / Conservation
**Colo Parks & Wildlife / USFWS / Land Trusts / Non-Profits / Local Gov'ts**

Water Quality Standards for Wetlands / Section 401
**Colo Dept of Public Health and Environment**

Inventory, Monitoring & Assessment
**Colorado Natural Heritage Program / Colorado State University**

- Wetland mapping / wetland profiles
- Targeted inventories of high quality / biologically significant wetlands
- Basinwide wetland condition assessments
- Wetland tools and resources (field guide, website, field methods, databases

More info on Core Elements: http://water.epa.gov/grants_funding/wetlands/cefintro.cfm

# Monitoring and Assessment Partners

| Core Element/ Partners | Projects / Benefits |
| --- | --- |
| Wetland Restoration / Conservation **Colo Parks & Wildlife / USFWS / Land Trusts / Non-Profits / Local Gov'ts** | River Basin Scale Wetland Profile, Condition Assessment, and Habitat Evaluations **Prioritization of Wetland Restoration Funding** |
| Wetland Regulation / Section 404 **Army Corps of Engineers / EPA / Colo Dept of Transp** | Developing the Watershed Approach to Wetland Mitigation **Mitigation Decision Making and Review Criteria** |
| Water Quality Standards for Wetlands / Section 401 **Colo Dept of Public Health and Environment** | 2012 Integrated Water Quality Monitoring and Assessment Report **Wetlands Section** |

# CPW Wetland Wildlife Conservation Program

Statement of Purpose:

*To conserve wetland and riparian habitats and their ecological functions for the benefit of wildlife.*

History and Overview:

- Voluntary, incentive based program
- Supports wetland protection, restoration and enhancement through annual competitive grants
- Began with 1997 with $4.4M from state lottery
- Continues with additional lottery and CPW funding
- Annual grants ~$1.5M, augmented by NAWCA, etc.

More info on CPW's Wetlands Program: http://wildlife.state.co.us/LandWater/WetlandsProgram/Pages/WetlandsHome.aspx

# Program Goals and Funding Priorities

Program Goals:

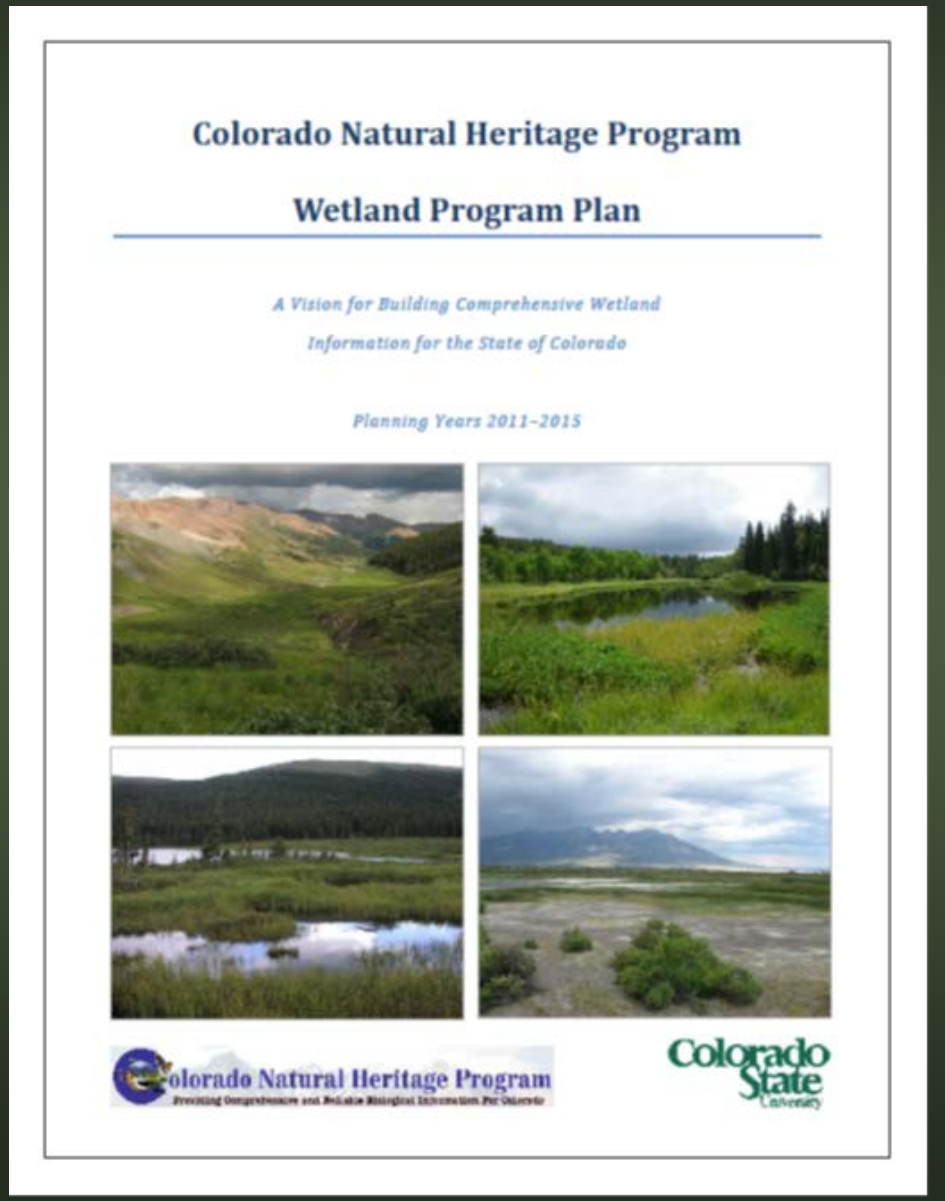
- Improve the status of declining or at-risk species (12 birds, 5 fish, 3 mammals, 5 herps)
- Improve the distribution and abundance of ducks and opportunities for waterfowl hunting (8 ducks)

Funding Priorities:

- In the past, projects selected based on opportunities presented by community groups, not a focused assessment of needs.
- Current goal to use M&A data to guide project selection and funding priorities.

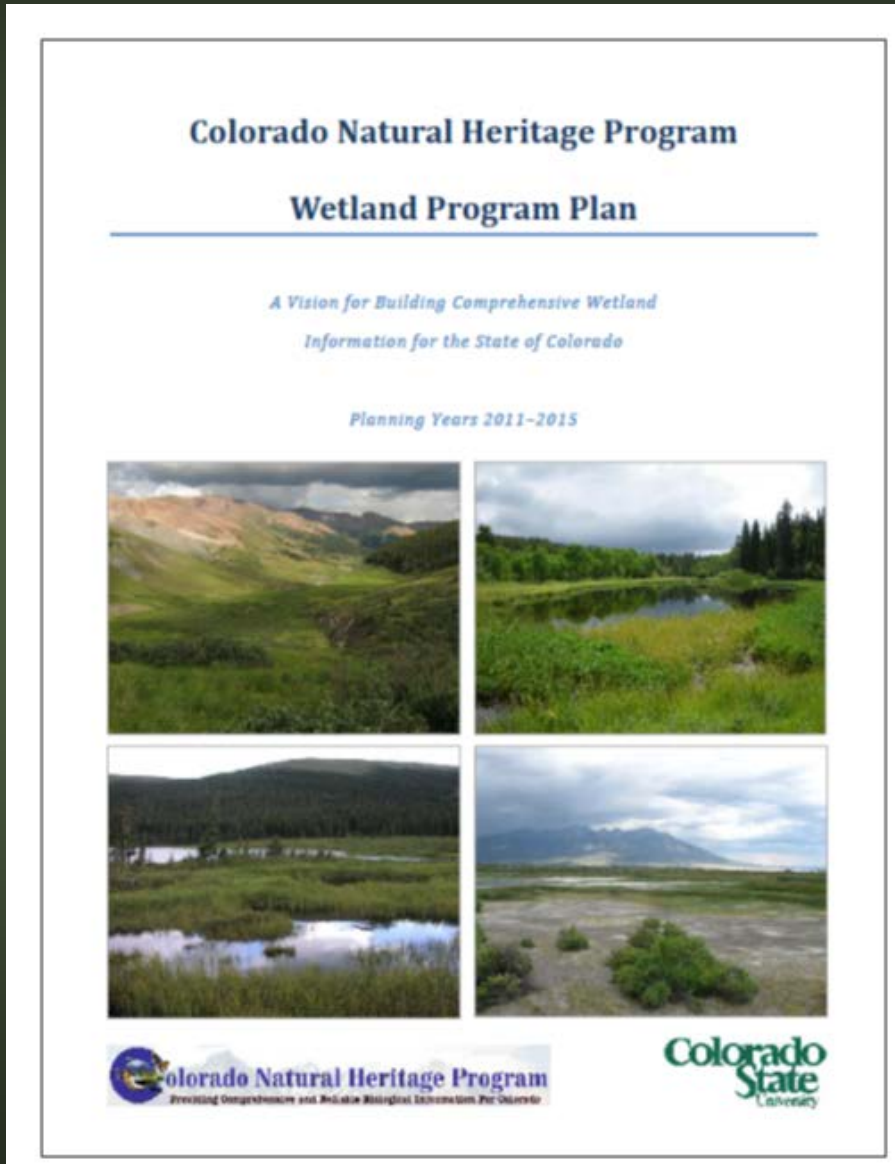
# WPP Background and Development

- CNHP primary recipient of EPA WPDG funds in Colorado over past 15+ years
- All projects have been in partnership with a state or local gov't agency
- EPA's call for WPPs came at same time CNHP and CPW were developing M&A strategy for wetland restoration priorities
- Overall WPP describes all of CNHP's wetland work, written to articulate a vision for our work and partnerships
- M&A components come largely from work with CPW
- WPP written by CNHP alone, but focuses on partnerships




CNHP's WPP and all other wetland report available on our website: http://www.cnhp.colostate.edu/download/reports.aspx

# CNHP's Wetland Program Plan




## Plan Mission Statement

*To empower public and private partners by providing science-based information on the types, extent, location, condition, and biodiversity significance of Colorado's native wetland ecosystems.*

## Guiding Questions:

- What kinds of wetlands occur in Colorado?
- How many acres of wetlands exist in Colorado and where are they located?
- What is the condition of Colorado's wetlands?
- Which of Colorado's wetlands are most significant?

## Strategic Directions

1. *Wetland Types:* Classification and identification
2. *Extent and Location:* Digital wetland mapping
3. *Wetland Condition:* Protocol development
4. *Wetland Condition:* Probabilistic assessments
5. *Biodiversity Significance:* Natural heritage inventories and conservation planning
6. *Empowering Public and Private Partners:* Using data for conservation and management

## Extent and Location: Comprehensive Digital Wetland Mapping

CNHP will work with the U.S. Fish and Wildlife Service's National Wetland Inventory (NWI) Program and numerous funding partners to create a comprehensive digital map of wetlands for the state of Colorado by 2015. CNHP will be recognized as the best source of digital wetland data and will help determine the *extent and location* of wetlands across the state.

*Action items*

- **Compile Known Sources of Digital Wetland Data:** Digital wetland mapping from the NWI Program exists for a small portion of Colorado. Though NWI mapping is the recognized national standard, the lack of digital NWI data necessitates that alternative digital wetland mapping be used to estimate the extent and location of wetlands across the state. Several projects undertaken by various agencies and organization have involved mapping wetlands and/or riparian areas in Colorado, though each effort has targeted a different portion of the resources and followed different methods. Though a 2007 EPA Region 8 WPDG (*Statewide Strategies for Colorado Wetlands:* Assistance ID #CD-97874301), CNHP is currently compiling all major known sources of digital wetland data. In addition to NWI data, these sources include riparian mapping from the Colorado Division of Wildlife, potential playa mapping from Rocky Mountain Bird Observatory, potential fen mapping from several National Forests, and wetland mapping from two counties. These data will be used to estimate the extent and location of Colorado's wetlands.

  *Timeframe:* The compilation of wetland data is underway and nearly complete. All major data sources will be compiled and initial estimates of wetland acreage will be calculated by April 2011.

- **Convert Existing NWI Paper Maps to Digital Data:** All of Colorado was mapped by NWI in the early years of the program, between the late 1970s and the early 1980s. Though the mapping exists, it was all created as paper maps and not as digital data. In today's electronic era where Geographic Information Systems (GIS) are the norm, paper maps are not as useful. Acreages cannot be calculated and analyses cannot be conducted based on the paper maps. However, delineating brand new NWI maps is time consuming and expensive and many rural areas of the state have not experienced extensive change in wetland acreage since the paper maps were created.

  Starting in 2008, CNHP developed a process to convert the existing NWI paper maps into digital data using Definiens eCognition® image recognition software. In only two years, CNHP has more than doubled the amount of digital NWI data available from less than 10% of the state to nearly 20%. Current contracts will again double that figure to more than 40% mapped. This work has been supported by funding from numerous partners and is slated to continue for several years in the future.

  *Timeframe:* Conversion of existing NWI maps to digital data is underway through several separate projects. The overall goal is to convert all paper maps to digital data by 2015. This will be completed in several steps, some currently funded and others proposed. Separate projects planned or proposed between 2011-2015 are listed below by geographic region:

  - Yampa River Basin: 90 quads will be delineated in 2011 with funding from the BLM.
  - Routt National Forest: 45 quads will be delineated in 2011 with funding from the U.S. Forest Service.
  - White River National Forest: 123 quads will be delineated in 2011 with funding from the U.S. Forest Service.
  - Lower South Platte River Basin: 204 quads will be delineated in 2011–2012 with funding from EPA Region 8.





  - Jefferson County: 16 quads will be delineated in 2011–2012 with funding from EPA Region 8.
  - East-Central Colorado: 130 quads are proposed for digitizing, contingent upon funding from the U.S. Highway Administration's Transportation Research Board.
  - All future grant proposals for river basin-scale wetland condition assessment projects and county surveys of biologically significant wetlands will include digitizing wetland maps. The specific areas will depend on opportunities that arise each year (see the following strategic directions on wetland condition assessments and county surveys).

- **Delineate New NWI Maps for Select Areas:** Converting the original paper maps to digital data is effective for many areas in Colorado. However, certain regions have experienced rapid land use changes since the maps were produced. This is especially true along the rapidly urbanizing Front Range corridor. For those areas where the original maps no longer represent the extent and location of wetlands, CNHP will seek opportunities to delineate new NWI maps. Through a 2009 EPA Region 8 WPDG (*Mitigation in the Watershed Context:* Assistance ID #CD-97847001) and supplemental funding form a local organization, CNHP is currently creating new NWI maps for 36 quads along the northern Front Range. These new maps are based on 2009 color infra-red imagery and follow the Federal Geographic Data Commission's National Wetland Mapping Standards. As opportunities arise, additional areas will be selected for new delineation.

  *Timeframe:* The newly delineated NWI maps for the northern Front Range will be submitted to the NWI program by April 2011. CNHP will seek additional opportunities to create new NWI maps with a goal of creating new NWI maps for 5–10% of the state by 2015.

- **Develop an Interactive Online Wetland Mapping Tool:** In order to make all of the newly compiled and created digital wetland mapping available to the wetland community, CNHP will work with GIS Specialists at CDOW to create an interactive online mapping tool for wetlands. This tool will display all compiled and generated wetland polygons along with background aerial imagery, topographic maps, and shaded relief. In addition, the tool will show land ownership, river basin and ecoregion boundaries, and will summarize all of CNHP's information related to wetlands of high biodiversity significance.

  *Timeframe:* The interactive online wetland mapping tool is funded by a 2007 EPA Region 8 WPDG (*Statewide Strategies for Colorado Wetlands:* Assistance ID #CD-97874301). The tool is currently under development and the first iteration will be complete by April 2011.

- **Monitor Change in Wetland Area Over Time:** A comprehensive digital map of wetlands in Colorado will be a significant accomplishment for the state. However, the NWI maps are a snapshot of wetland acreage in a given year. In order to fully understand whether we are gaining or losing wetland acres, it is important to monitor the change over time. This can only be done by re-mapping certain sections of the state at repeated intervals. Once we have digital wetland mapping for a majority of the state, CNHP will pursue opportunities to re-map select areas to estimate trends. This could be accomplished by re-mapping a small portion of the state (1–5%) each year. The particular areas could be selected using a random sample approach to ensure distribution across the state.

  *Timeframe:* This action item is a proposed goal for which we will seek grant funding. The target timeframe for this action item is to secure funding starting in 2014 in order to begin re-mapping areas in 2015. Ideally, we would seek funding that could continue over several years to monitor change over time.

## Wetland Condition Assessment Protocols

CNHP will continue to refine wetland condition assessment protocols developed over the past 5 years and will promote their use to public and private entities conducting wetland condition assessments. These protocols follow both the EPA's Level 1-2-3 framework[1] and Ecological Integrity Assessment (EIA) framework of the NatureServe Network.[2]

*Action items*

- **Develop a Landscape Integrity Model for Wetlands (Level 1):** Within the EPA Level 1-2-3 framework, Level 1 assessment tools rely on geospatial data, such as GIS layers and remote sensing. As part of a 2007 EPA Region 8 WPDG (*Statewide Strategies for Colorado Wetlands:* Assistance ID #CD-97874301), CNHP is developing a coarse assessment of wetland stressors based on numerous statewide GIS layers. The resulting GIS model will be a first draft towards a rigorous Level 1 assessment tool. In the future, we will test the outputs from this model with field data collected through wetland assessments across the state and refine the model inputs and formula to better reflect condition on the ground. This may be carried out through a standalone project or may be incorporated as an element of future condition assessment projects. A robust Level 1 tool could be used by many of our wetland partners for predicting the condition of wetlands in areas of the state where field-based assessments have not been conducted.

  *Timeframe:* The initial development of the Landscape Integrity Model for Wetlands is being carried out as part of a funded project. The draft model will be finalized by April 2011. This initial model will need refinement in future years and we will seek funding for refinement as either a standalone project or as a component of future wetland condition assessment projects. We will seek funding by or before 2013 to develop a refined version of the Level 1 tool by 2015.

- **Refine Rapid Wetland Assessment Protocols (Level 2):** Within EPA's Level 1-2-3 framework, Level 2 tools can be completed in the field within a few hours using simple, qualitative or semi-quantitative indicators. Ecological Integrity Assessment (EIA) methods developed NatureServe and member program can be used as Level 2 protocols and include metrics from four different attribute classes: landscape context, biotic condition, abiotic condition, and size. In 2006, CNHP created draft EIA protocols for several wetland types in Colorado with funding from the EPA and CDOW. Draft reports are available in the 2006 section of our reports page (http://www.cnhp.colostate.edu/download/reports.asp). One of these draft protocols (Subalpine-Montane Riparian Shrublands) was tested in 2007 and a report describing the results is available under the 2009 section of the same reports page.

  The EIA protocols have since been used in two basinwide wetland assessments (Rio Grande Headwaters and North Platte River Basin, see next strategic direction for more information). Through each project, the methods have been refined to ensure that they are intuitive, consistently applied, and adequately capture the range of condition of Colorado wetlands. To date, however, these protocols have only been tested in the Southern Rocky Mountain Ecoregion of the state. Starting in 2011, with funding from a 2010 EPA Region 8 WPDG (*Lower South Platte Wetland Profile:* Assistance Agreement in process), CNHP will begin a 3-year project using these and other tools to assess the condition of wetlands in the High Plains Ecoregion. Through that project and others in the future, CNHP will continue to improve the Level 2 EIA protocols.

[1] For more information on EPA's Level 1-2-3 framework, see http://www.epa.gov/owow/wetlands/pdf/techfram.pdf
[2] For more informaiton on NatureServe's EIA framework, see: http://www.natureserve.org/publications/EPA-Wetland-Mitigation.jsp





## Probabilistic Wetland Condition Assessments

CNHP will conduct probabilistic assessments of wetland condition for all river basins at the 6-digit hydrologic unit code (HUC) level by 2020. Beyond 2020, these assessments could be repeated at 10 year intervals to monitor change over time. CNHP will also participate in national assessments of wetland condition.

*Action items*

- **Conduct Basin by Basin Wetland Condition Assessments:** The EPA strongly recommends that each state monitor its aquatic resources, including wetlands, using a probabilistic random sample design to make statistically valid statements about the condition of those resources. In 2008, using the condition assessment tools described above, CNHP began a series of river basin scale wetland condition assessment projects. The first was a pilot wetland condition assessment in the Rio Grande Headwaters River Basin and was supported by a 2007 EPA Region 8 WPDG (*Statewide Strategies for Colorado Wetlands:* Assistance ID #CD-97874301). The second project was conducted in the North Platte River Basin and was supported by a 2008 EPA Region 8 WPDG (*Basinwide Wetland Profile of the North Platte River Basin:* Assistance ID #CD-97854101). Data analysis is still underway for both projects. The third project will be conducted in the Lower South Platte River Basin and will be supported by a 2010 EPA Region 8 WPDG (*Lower South Platte Wetland Profile:* Assistance Agreement in process).

  CNHP plans to implement a rotating basin survey strategy, by starting a new river basin study every one to two years depending on resource availability. We intend to conduct one survey in every HUC 6 river basin by 2020. In some instances, smaller HUC 6 basins will be combined with neighboring basins. In other cases, the largest HUC 6 basins will be divided in two. We will select the river basins to study depending on interest of partner agencies. Based on the two surveys already conducted, we have begun to standardize both the study design and field protocols. More detailed information is available in the Quality Assurance Project Plans (QAPPs) developed for both studies.

  *Timeframe:* This action item is ongoing and will continue for many years into the future. The initial pilot study of the Rio Grande Headwaters River Basin involved three years of data collection and the final report will be available in April 2011. The North Platte River Basin project will be completed in December 2011. The Lower South Platte River Basin project was recently awarded and will be carried out between 2011 and 2013. Funding for additional basins will be sought in subsequent years.

- **Conduct Sampling for the National Wetland Condition Assessment:** In the early 2000s, the EPA began the National Aquatic Resource Surveys to assess the condition of the nation's aquatic resources. In 2011, EPA and the states will carry out the nation's first assessment of wetland condition across the entire country. CNHP has been involved in the development of field protocols for this survey and has served on several working groups to support it. In 2011, CNHP will conduct the field sampling for this project in both Colorado and neighboring Wyoming. CNHP will also remain engaged with the National EPA Wetlands Team as they analyze the field data and prepare the report. This survey is schedule to be conducted every 5 years. CNHP will continue to be the organization responsible for carrying out the field work in Colorado and will also conduct sampling in Wyoming until a Wyoming-based partner is identified.

  *Timeframe:* Sampling for the first National Wetland Condition Assessment will be carried out in 2011. Subsequent surveys will be carried out every 5 years; CNHP will seek funding to participate in future surveys.

# Overview of Monitoring and Assessment

## Major Objectives:

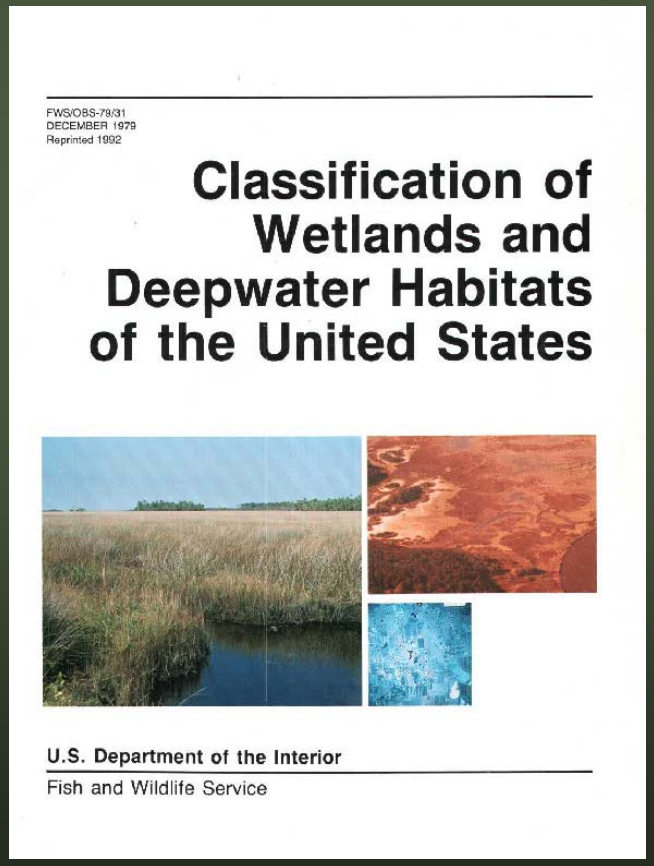
1. Expand digital wetland mapping
   - Convert existing NWI paper maps to digital data
   - Create new, updated NWI maps for priority areas
2. Develop and refine condition assessment protocols
   - Level 1, 2, 3 framework
3. Conduct probabilistic wetland condition assessments
   - Assess the condition of wetlands in each major river basin across the state (n = 10)
   - Participate in EPA's National Wetland Condition Assessments (NWCA)

## Progress to Date:

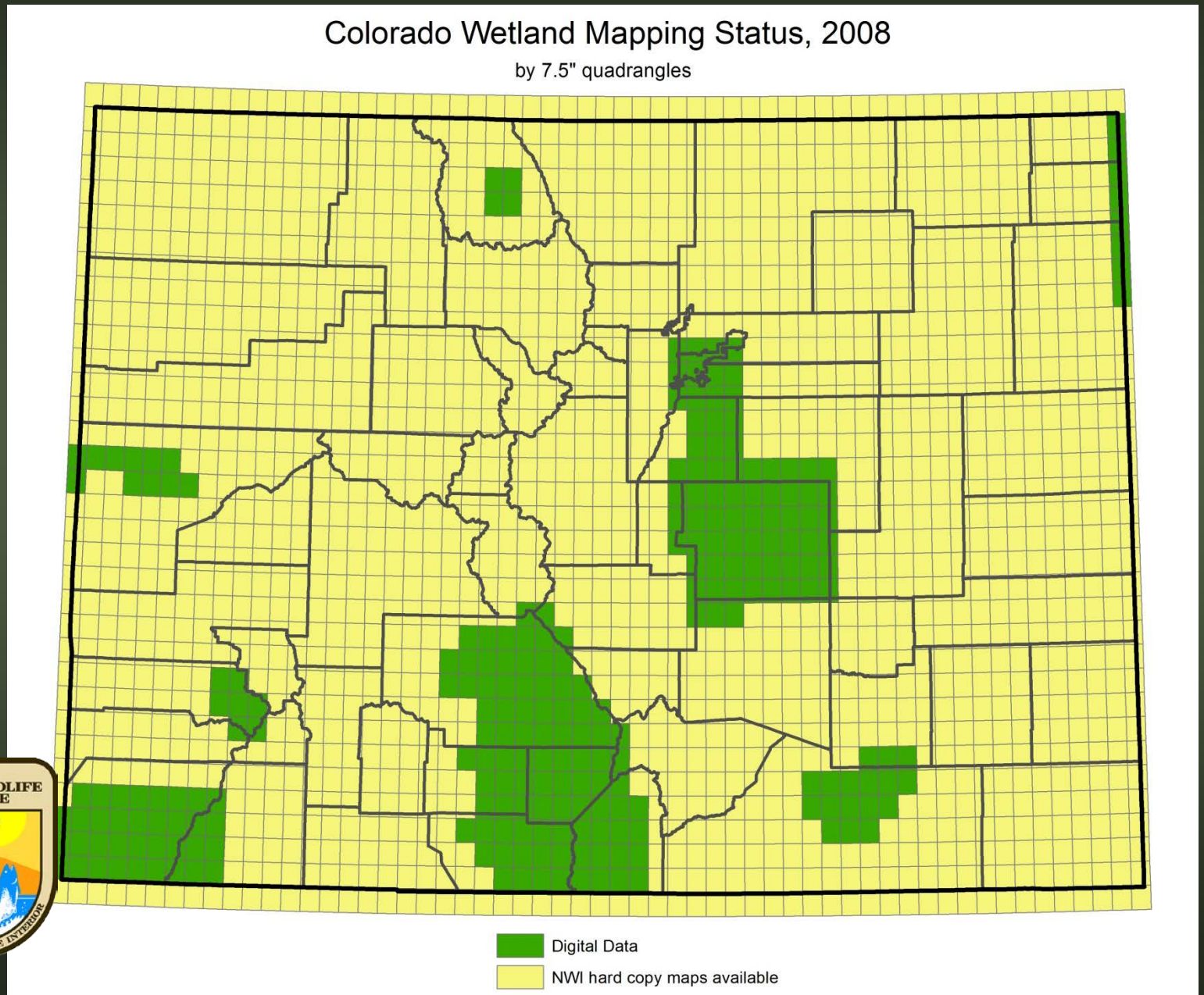
- Significant progress on digital wetland mapping
- Refinement of wetland assessment tools
- Two basin-wide assessments complete, one underway in 2012, and one planed for 2014
- Conducted NWCA Sampling in Colorado and Wyoming

# Digital Wetland Mapping in Colorado

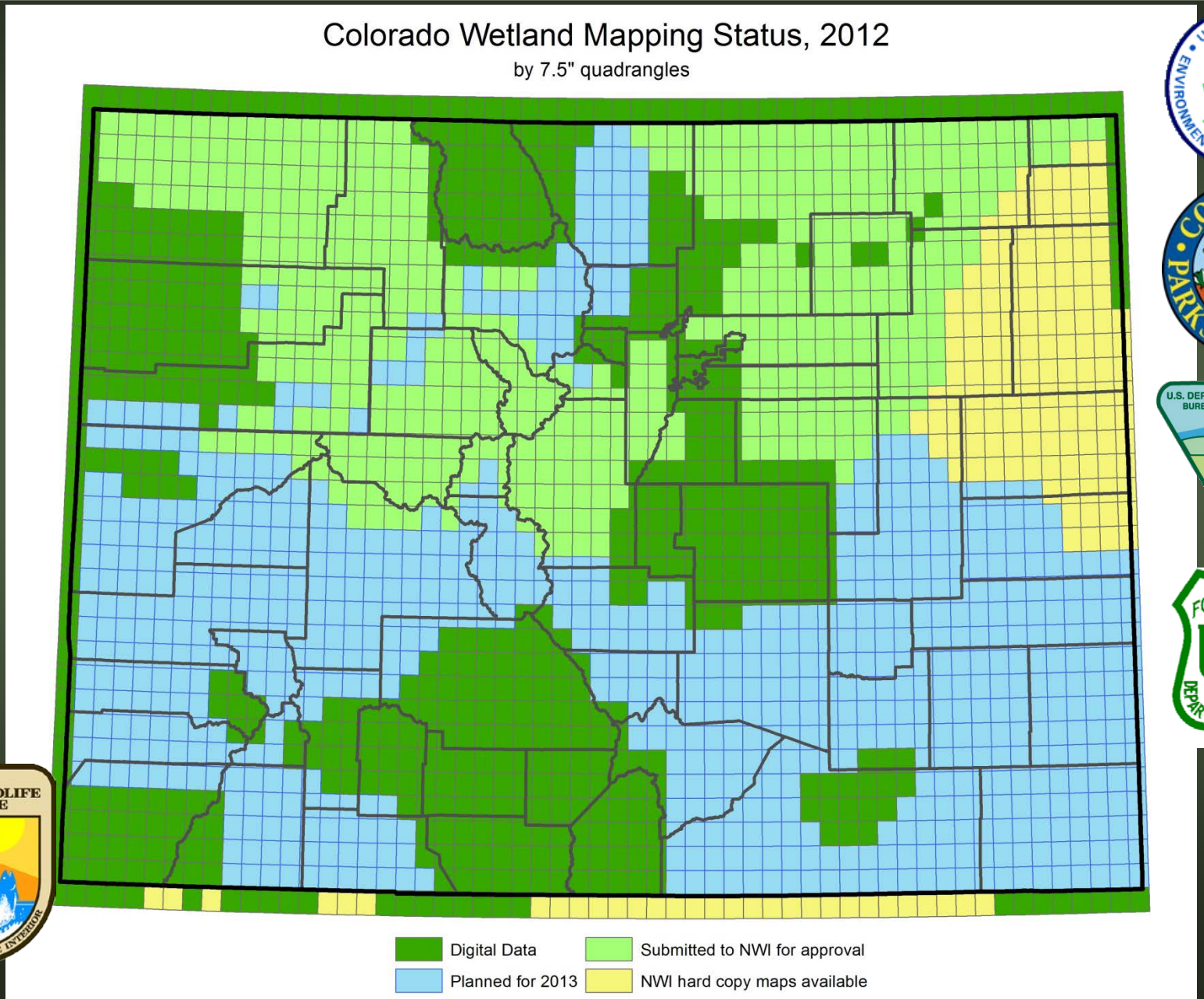
- U.S. Fish and Wildlife Service, National Wetland Inventory
- All of Colorado mapped in 1970s and 80s on paper
- As of 2008, very little available digitally
- Out of date mapping in urban areas

# Digital Wetland Mapping in Colorado



# Digital Wetland Mapping in Colorado



# Level 1-2-3 Wetland Assessment Methods

## Level 1

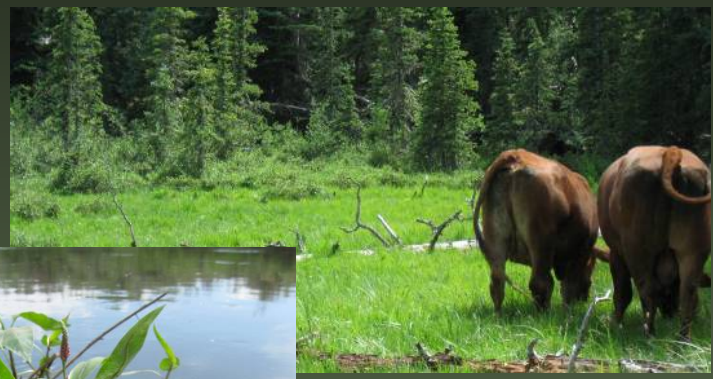
- Statewide Wetlands Landscape Integrity Model (LIM)

## Level 2

- Ecological Integrity Assessment (EIA) rapid assessment

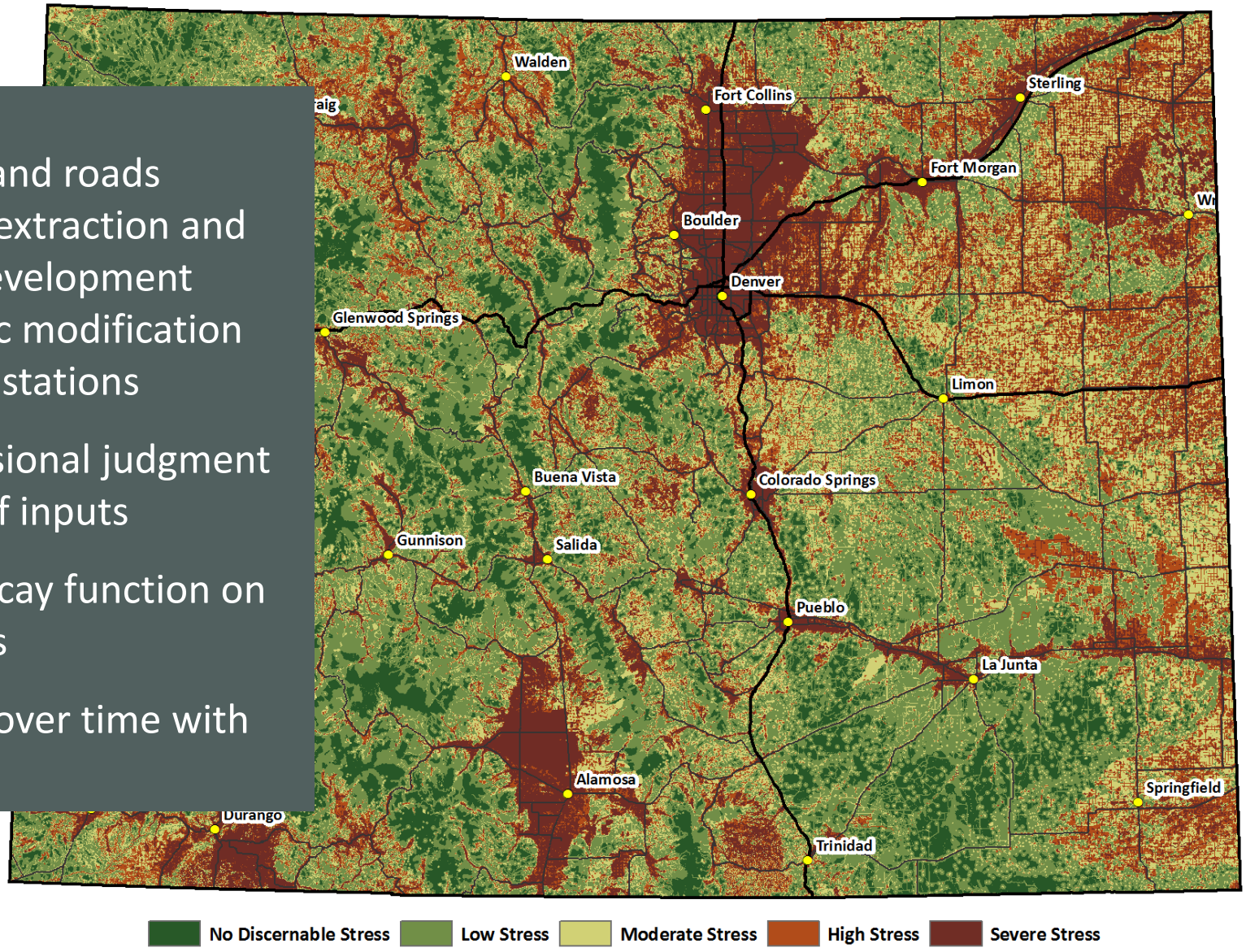
## Level 3

- Floristic Quality Assessment (FQA)
- Vegetation Index of Biotic Condition (VIBI) models for selected wetland types



# Level 1: Landscape Integrity Model

- GIS Inputs:
  - land use and roads
  - resource extraction and energy development
  - hydrologic modification
  - weed infestations
- Best professional judgment weighting of inputs
- Distance decay function on many inputs
- Calibration over time with field data



# Level 2: Ecological Integrity Assessment (EIA)

| ECOLOGICAL CATEGORIES | KEY ECOLOGICAL ATTRIBUTES | INDICATORS & METRICS (mix of quantitative and qualitative) |
|---|---|---|
| Landscape Context | Landscape Composition | landscape fragmentation (all wetlands)<br>riparian corridor continuity (riverine wetlands) |
| | Buffer Index | buffer extent, buffer width, buffer condition |
| Biotic Condition | Community Composition | native plant cover, noxious weed cover, aggressive native cover, mean C |
| | Community Structure | woody species regeneration, litter accumulation, structural complexity |
| Hydrologic Condition | Hydrological Regime | water source, hydrologic connectivity, alteration to hydroperiod (all wetlands)<br>bank stability, beaver activity (riverine wetlands) |
| Physiochemical Condition | Chemical /Physical Processes | soil surface disturbance, water quality |

# Level 3: Floristic Quality Assessment (FQA)

## Coefficient of Conservatism (C-Value)

**0** = non-native, introduced species

**1-3** = native but more commonly found in non-natural areas

**4-6** = equally found in natural and non-natural areas

**7-9** = obligate to natural areas but can sustain some habitat degradation

**10** = obligate to high-quality natural areas (relatively unaltered from pre-European settlement conditions)

## Colorado C-values assigned to entire flora by a panel of experts

***Helianthus annuus***

***C-value = 1***

***Carex utriculata***

***C-value = 5***

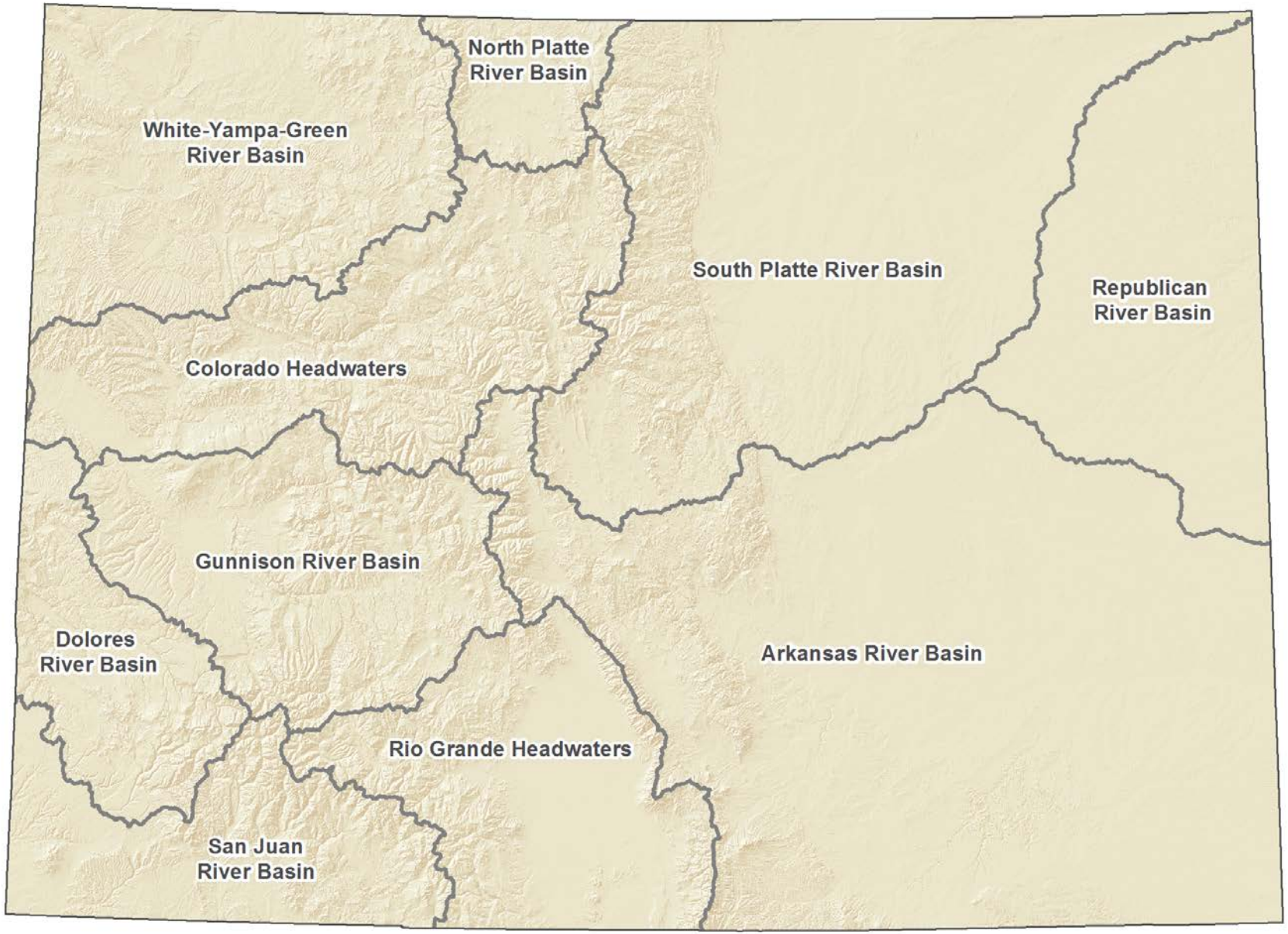
***Cypripedium parviflorum***

***C-value = 9***

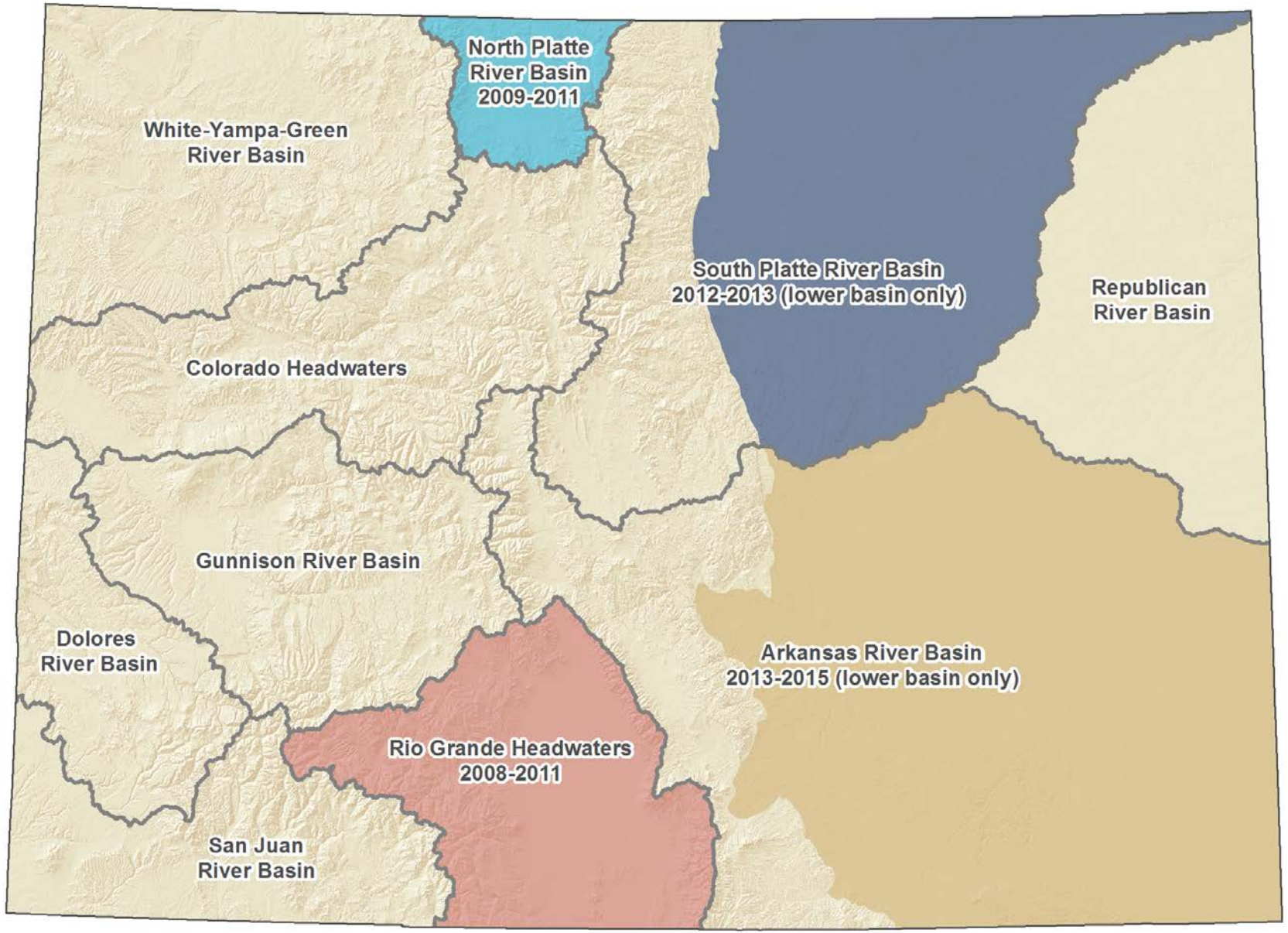
# Level 3: Vegetation Index of Biotic Integrity

| Metrics | Riparian Shrubland VIBI | Fen VIBI | Wet Meadow VIBI |
|---|---|---|---|
| Mean C (native) | X | X | |
| cw FQI | | | X |
| % Intolerant species | X | X | |
| Intolerant species richness | | | X |
| % Tolerant species | X | X | |
| % Non-native species | X | X | |
| Total cover native species | | X | X |
| Invasive species richness | X | | |
| Total cover perennial species | | | X |
| % Native perennial species | X | | |
| Native perennial species richness | | | X |
| % Native forb species | | | X |
| % Hydrophytes | X | | |
| Total cover hydrophytes | | X | X |
| Mean wetland indicator | X | | |
| *Carex* species richness | X | | |
| Relative cover *Poaceae* | | | X |
| Total cover bryophytes | | X | |
| Total cover litter | | X | |
| Total cover bare ground | | X | X |

# River Basin Scale Wetland Assessments

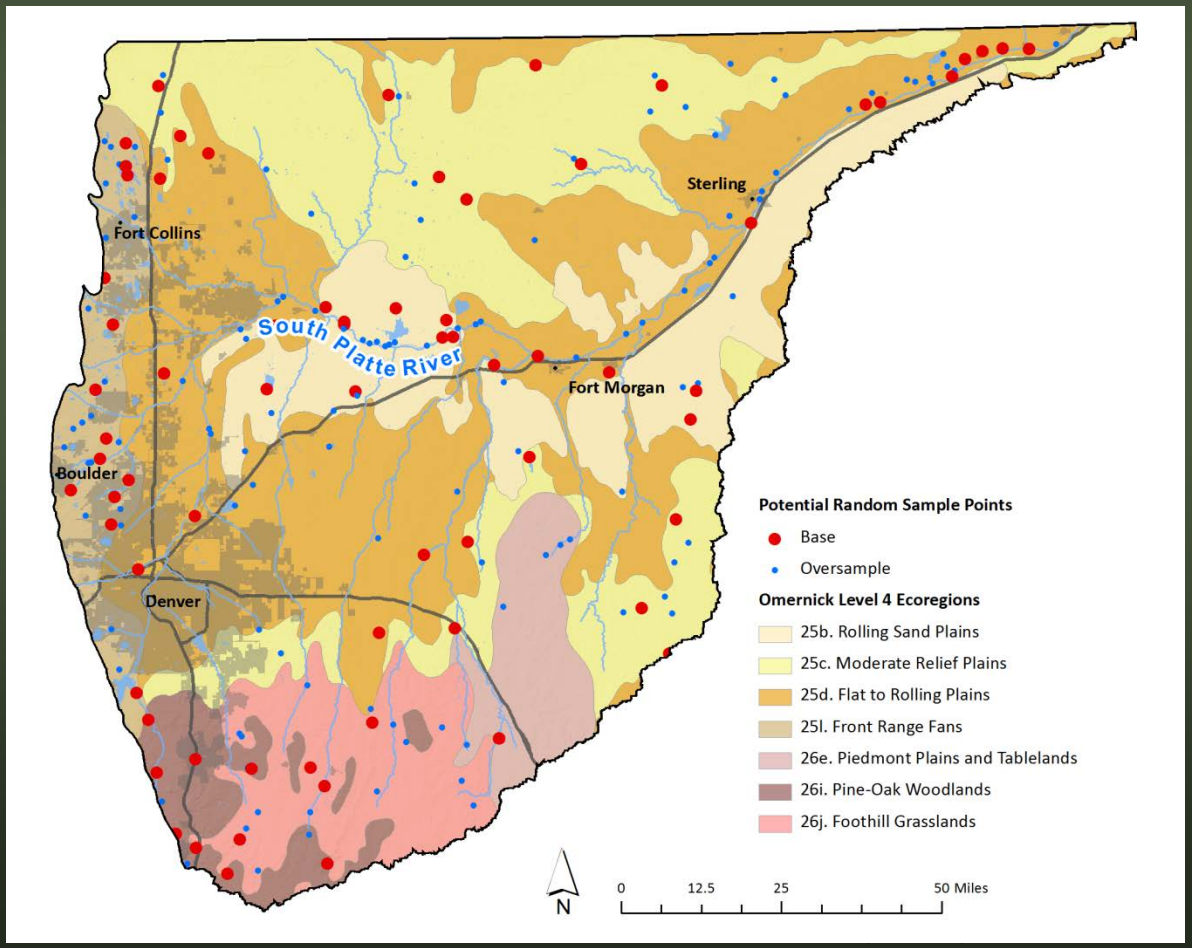


# River Basin Scale Wetland Assessments



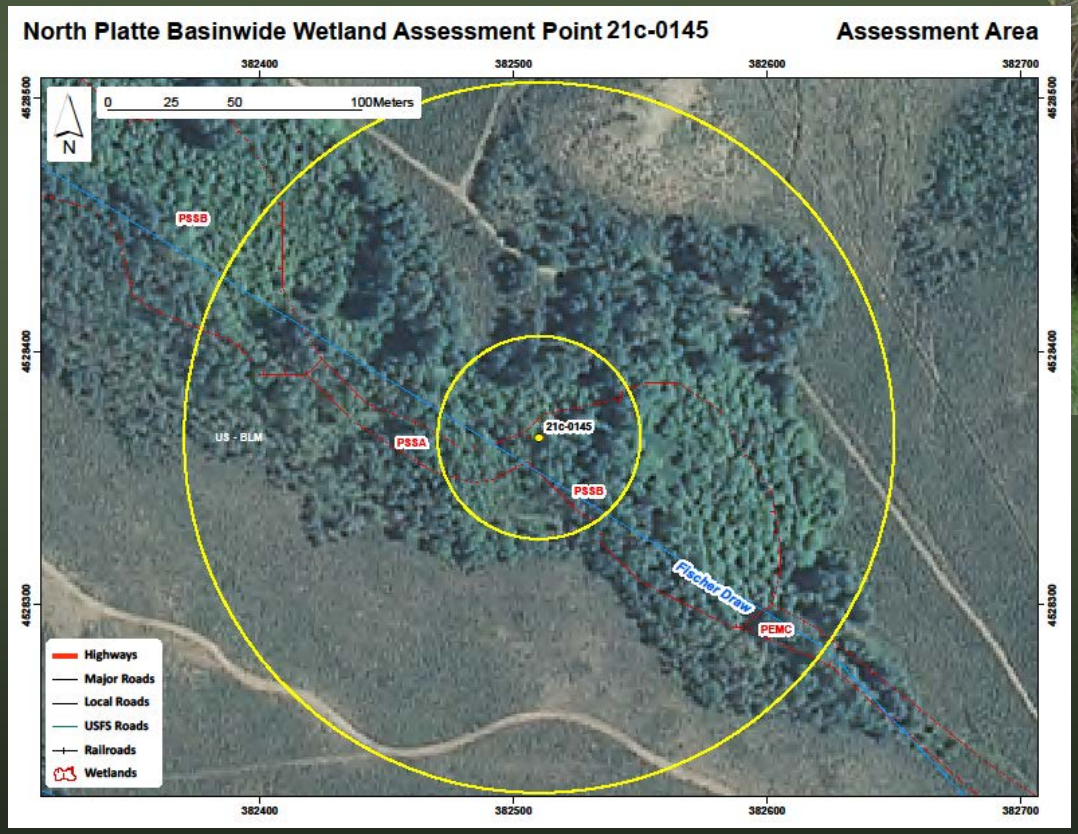
# Probabilistic Survey Designs

- Target points distributed across wetland area in each basin
- Stratified by ecoregions to enforce spread
- Selected using GRTS in R or RRQRR in ArcGIS
- Allow for estimates of condition across each basin



# Field Methods (EIA, FQA, VIBI)

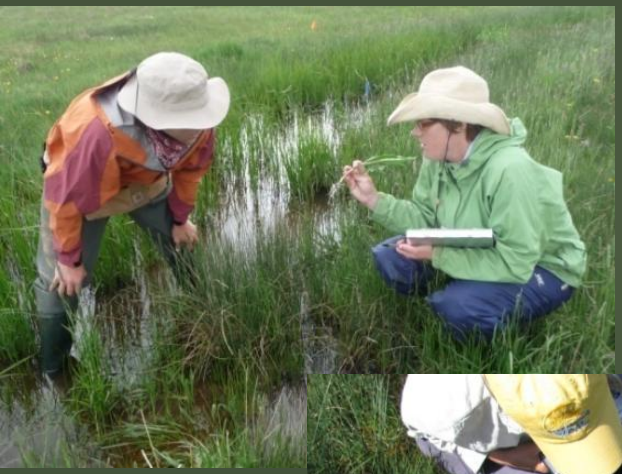
- For every target, survey 0.5 hectare (~1.2 acres) around the point
- Classify the wetland area by multiple classification systems
- Identify land uses within the wetland and surrounding area
- Photographs of the site

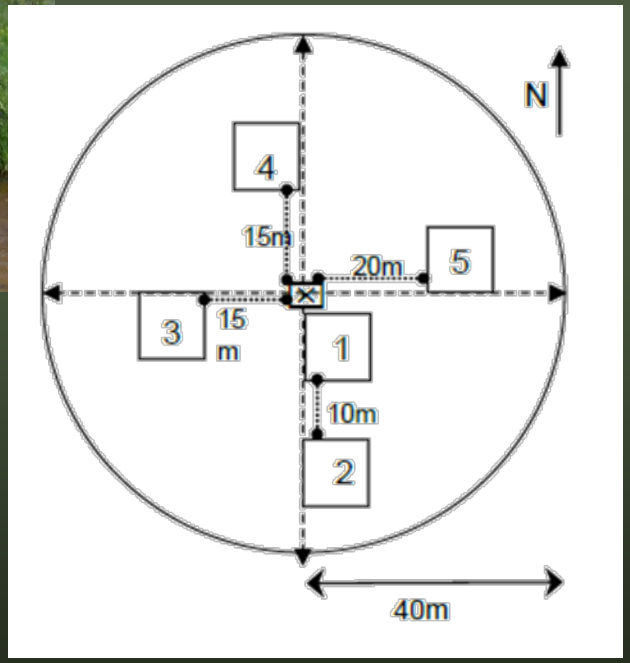




# Field Methods (EIA, FQA, VIBI)

- Detailed vegetation data collection based on EPA's NWCA[1] methods
- Soil profile descriptions for 2-4 soil pits
- Identification of water sources and modifications to natural hydrology
- Documentation of wildlife habitat and human disturbance






More info on EPA's NWCA and field protocols: http://water.epa.gov/type/wetlands/assessment/survey/index.cfm

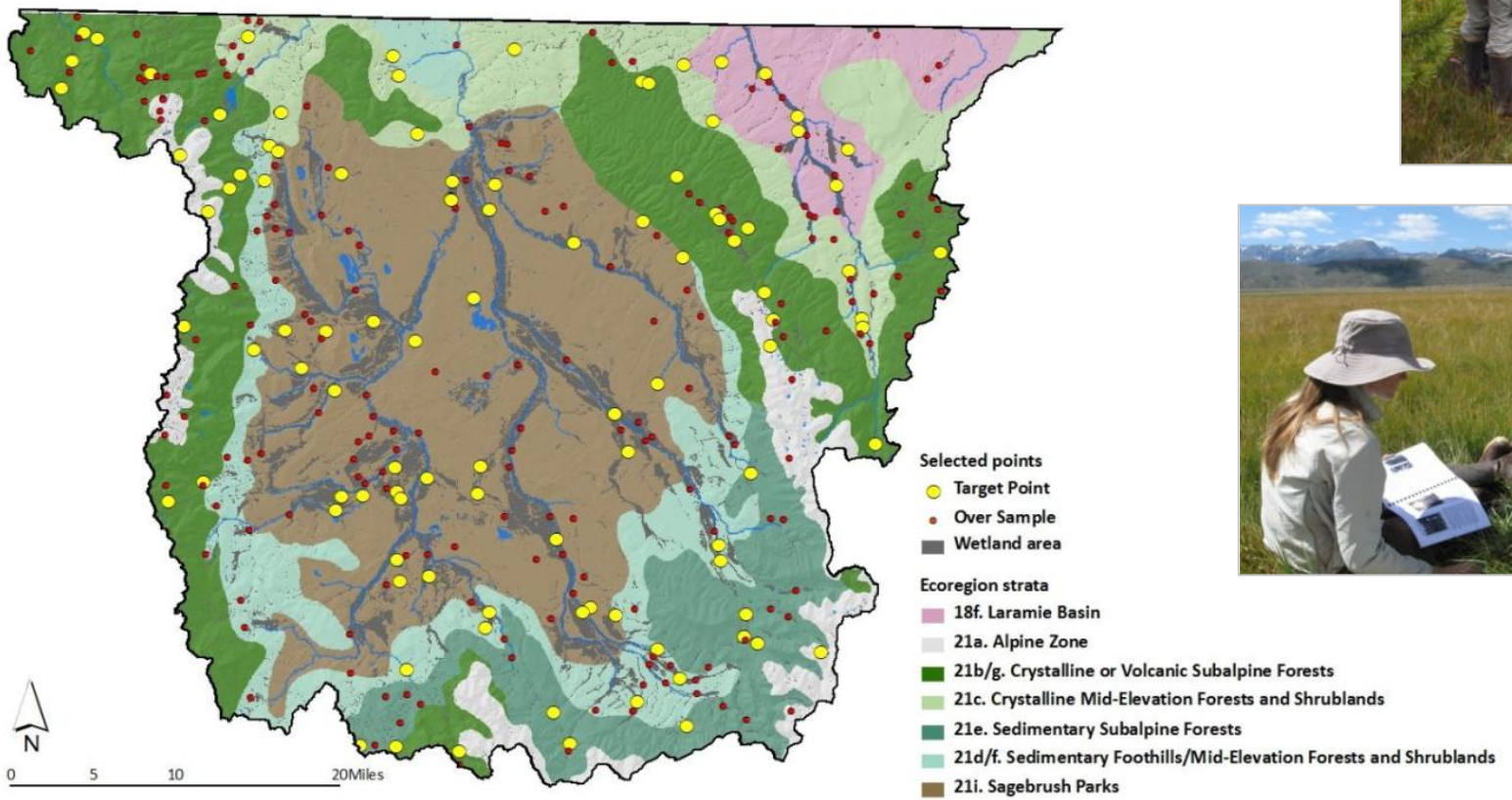
# Uses of Monitoring and Assessment Data

| Core Element/ Partners | Projects / Benefits |
| --- | --- |
| Wetland Restoration / Conservation **Colo Parks & Wildlife / USFWS / Land Trusts / Non-Profits / Local Gov'ts** | River Basin Scale Wetland Profile, Condition Assessment, and Habitat Evaluations **Prioritization of Wetland Restoration Funding** |
| Wetland Regulation / Section 404 **Army Corps of Engineers / EPA / Colo Dept of Transp** | Developing the Watershed Approach to Wetland Mitigation **Mitigation Decision Making and Review Criteria** |
| Water Quality Standards for Wetlands / Section 401 **Colo Dept of Public Health and Environment** | 2012 Integrated Water Quality Monitoring and Assessment Report **Wetlands Section** |

# Wetland Restoration & Conservation

## Colorado Parks and Wildlife

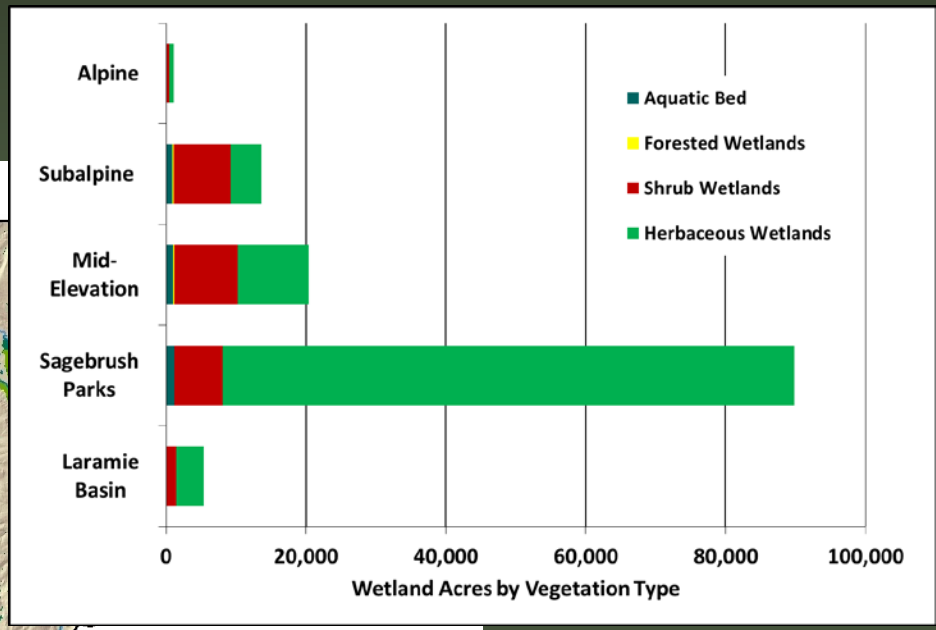
- Wetlands Wildlife Conservation Program
- Use data from river basin scale wetland condition assessments to prioritize grant funding

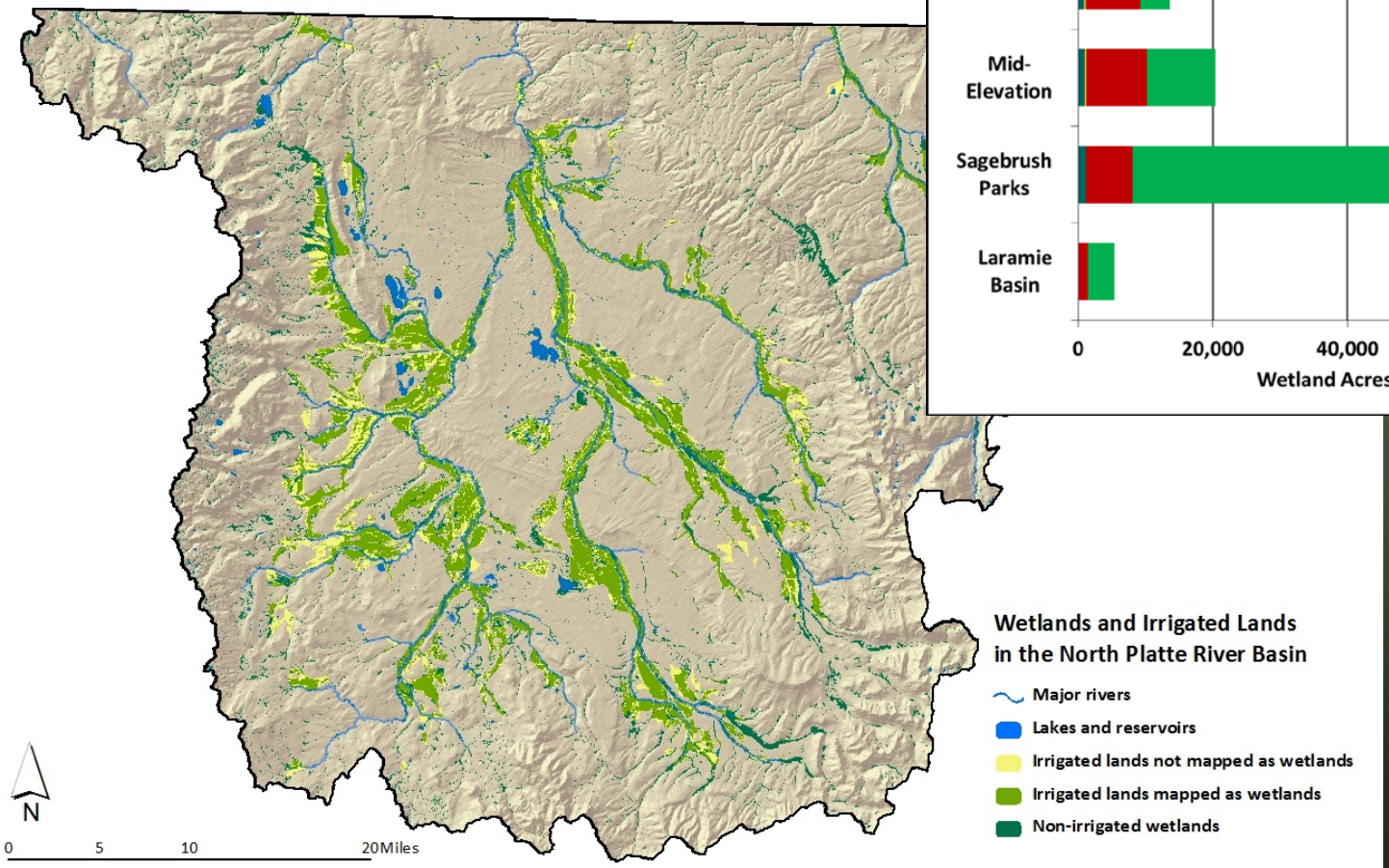


# Wetland Restoration & Conservation

## Colorado Parks and Wildlife

- Extent and distribution of wetland resource
- Quantity of wildlife habitat

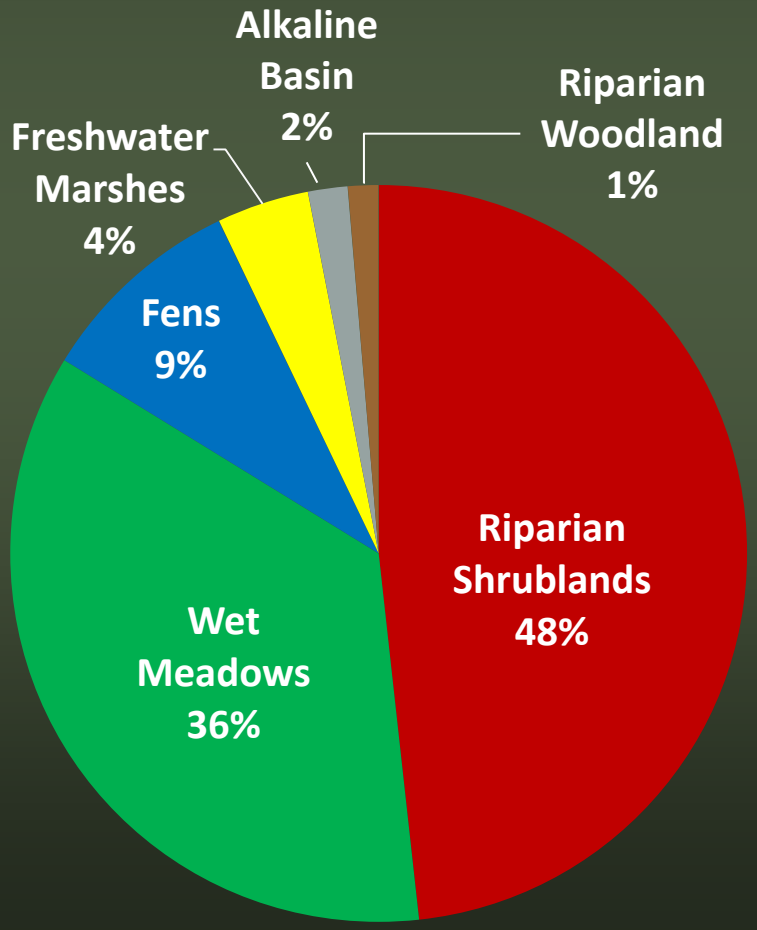


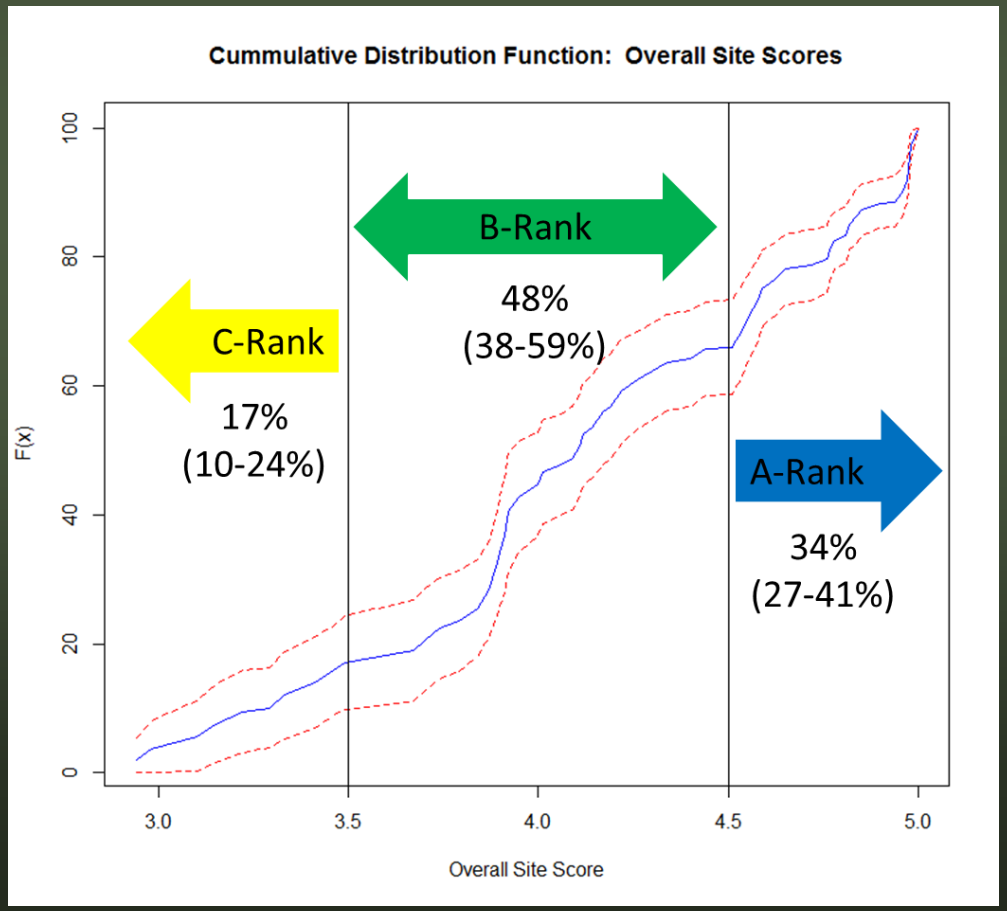



# Wetland Restoration & Conservation

## Colorado Parks and Wildlife

- Estimate of wetland types (more specific than Cowardin)
- Estimate of general wetland condition
- Current study includes even more metrics specific to wildlife habitat



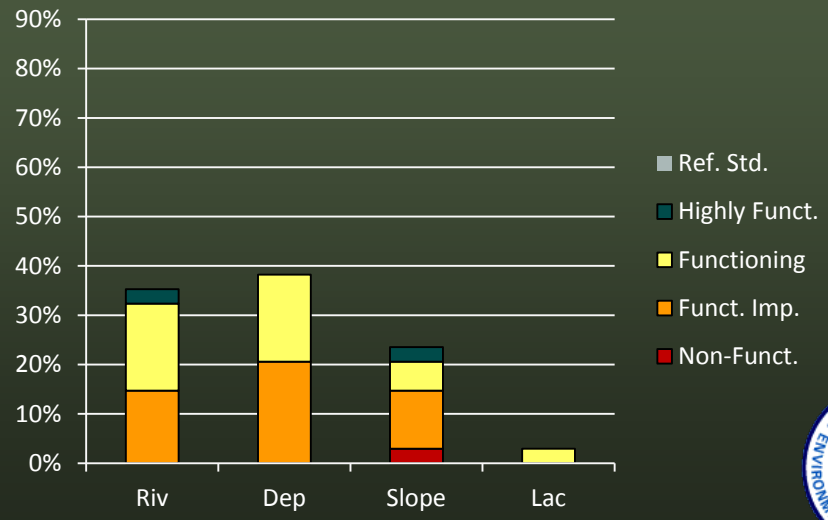



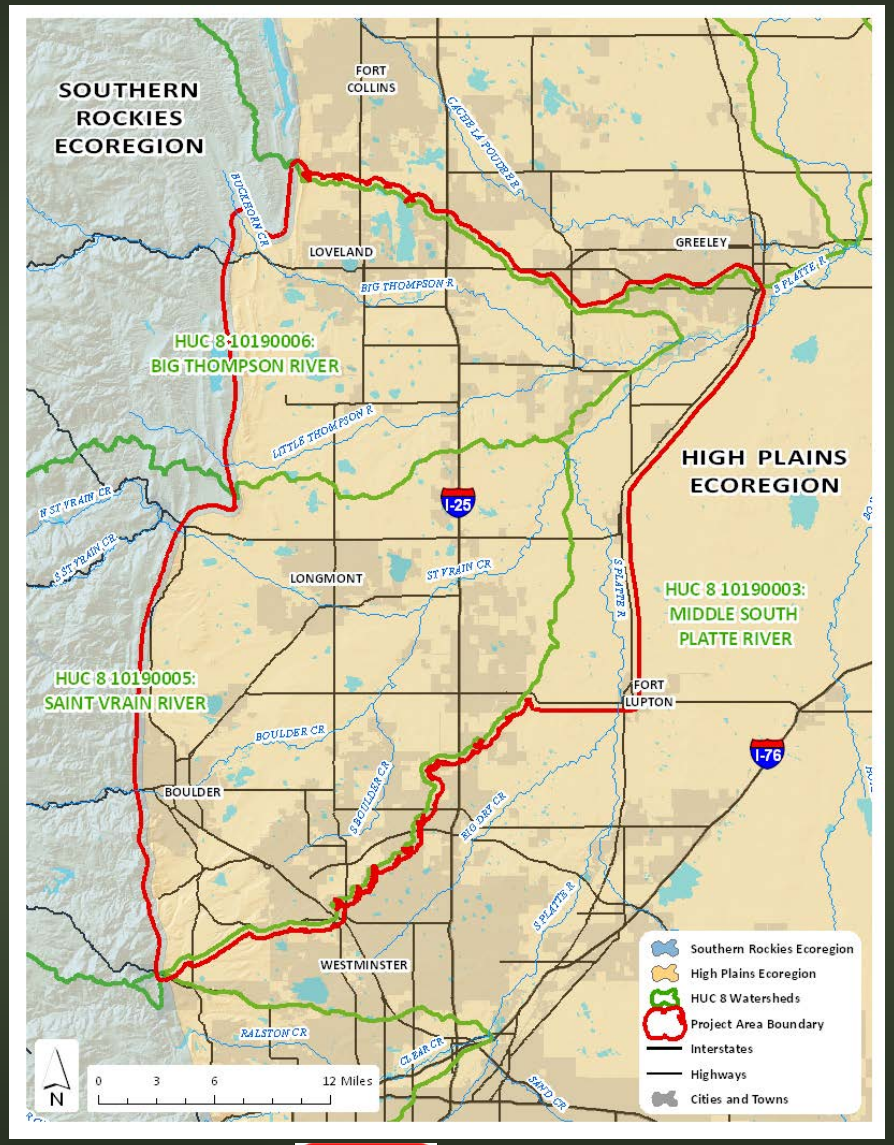
# Wetland Regulation / Section 404

U.S. Army Corps, U.S. EPA,

Colo. Dept. of Transportation

- Watershed approach to mitigation
- Pilot project in urban Front Range
- Analysis of current and historic wetland extent based on NWI mapping
- Demonstrate how condition (EIA, FQA) and functional (FACWet) assessments can aid planning and goal setting

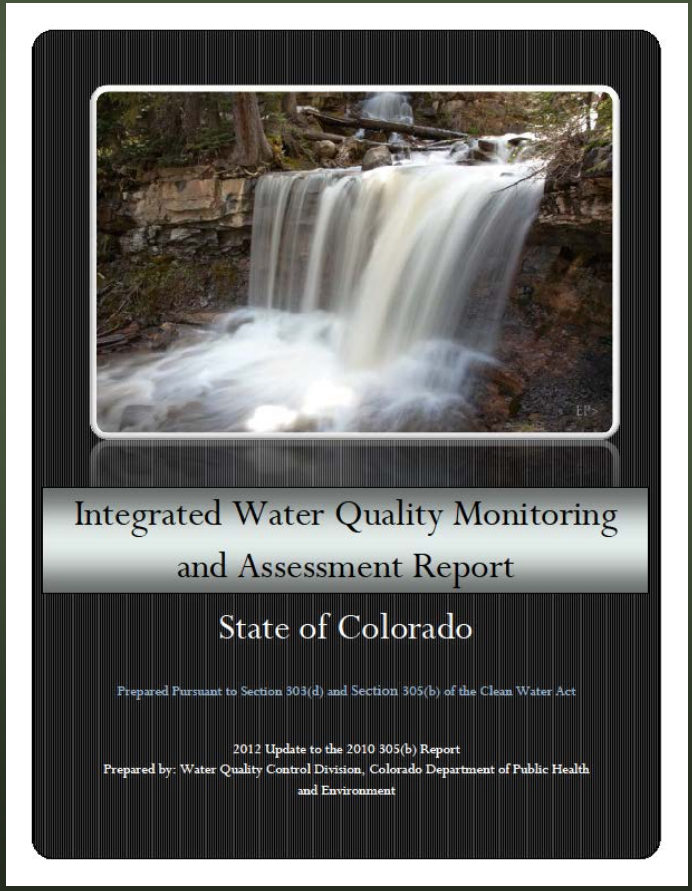


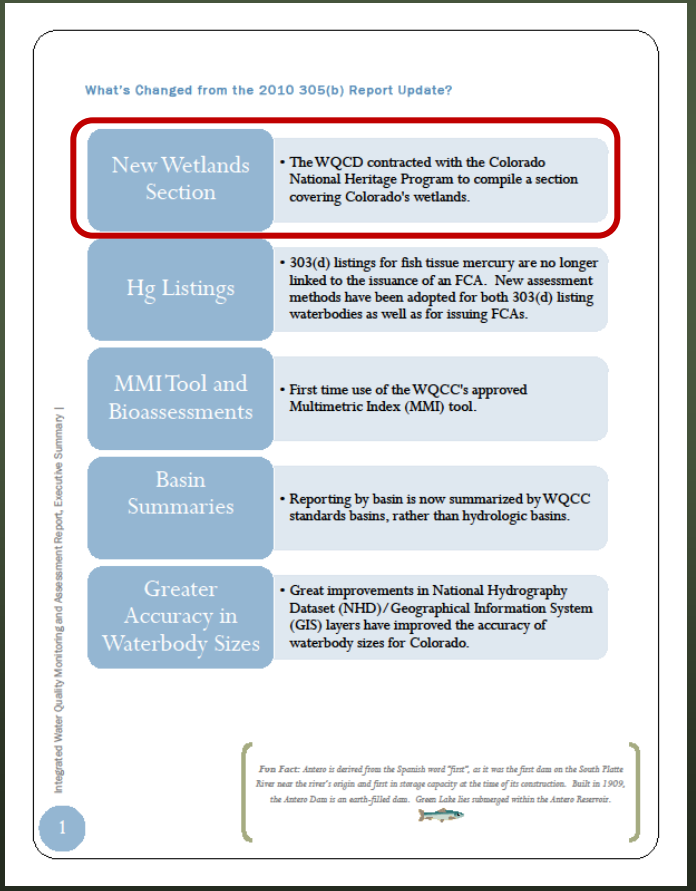



# Water Quality Standards for Wetlands

Colo. Dept. of Public Heath and Environment

- Narrative water quality standards for wetlands, but rarely applied
- New Wetlands Section in the Integrated Water Quality Monitoring and Assessment Report (303d and 305b)



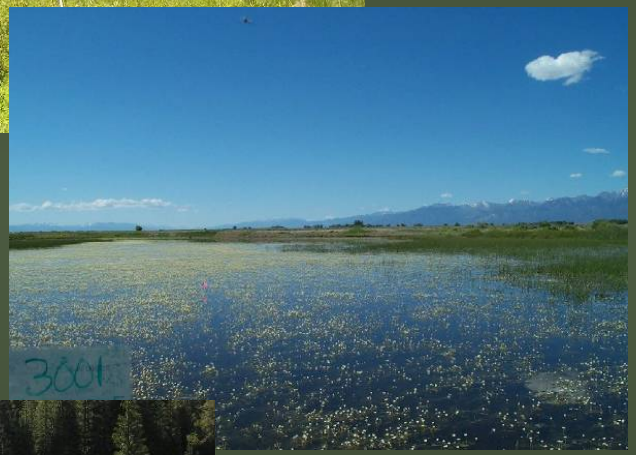
# Direct and Indirect Benefits

Direct Benefits:

- Uses described previously
- Access to WPDG funding

Indirect Benefits:

- Enhanced relationship with partners
- Excellent communication tool
- Refines our mission, provides talking points about our work
- Organizing framework for upcoming website and other communication tool
- Enables us to take advantage of other funding opportunities beyond EPA



# Acknowledgements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- CPW: Brian Sullivan, Jon Kindler, Grant Wilcox
- CDOT: Rebecca Pierce
- US ACE: Matt Montgomery, Tim Carey
- Local partners in the Rio Grande and North Platte
- Many others helped built the foundations!


Questions?