



2005 – 2010 Consumptive Use of Small Man-made Water Bodies in the Platte Surface Water Basin above Columbus

Amy Wright, MS
Integrated Water Management Analyst
Nebraska Department of Natural Resources



Department of Natural Resources

Background

- **Nebraska New Depletion Plan**
 - NDNR will not permit any new surface water uses (Jan. 1, 2006 and later) unless adverse effects are prevented or offset
 - NDNR requires permits for reservoirs over 15 acre-feet (af)
 - NDNR does not require permits for smaller reservoirs and sandpits
 - For new or expanded sandpits, or new reservoirs (no permits), the cumulative impact will be estimated
 - Any adverse effects on state protected and target flows will be offset
- Impacts from new reservoirs, and new/expanded sandpits will be evaluated every five years, using 2005 as a baseline

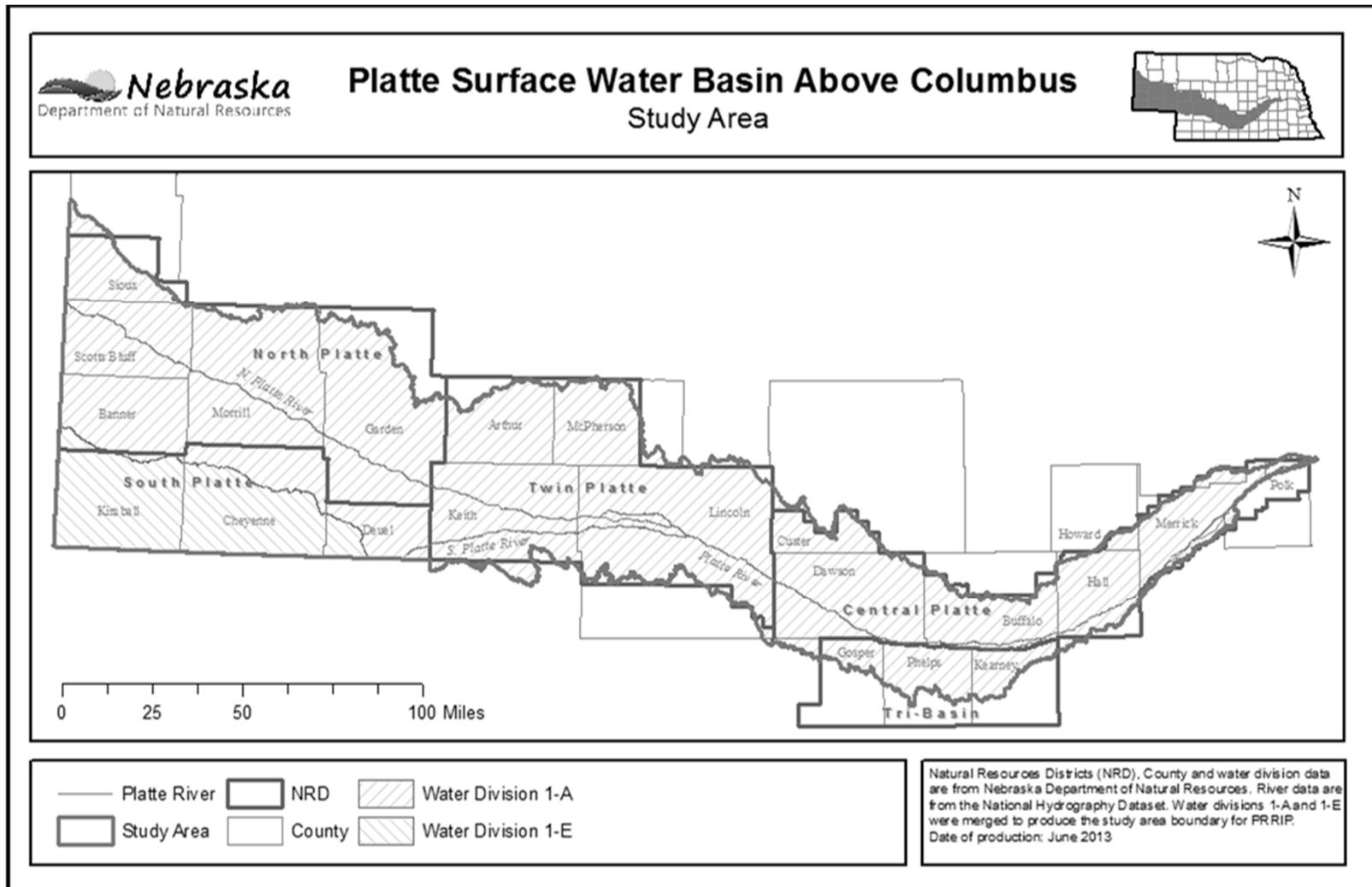
Background

- NDNR put forth a significant effort in 2005 to digitize water bodies
- Farm Service Agency (FSA) aerial imagery was scanned for entire area, all water was outlined
- Features were then categorized according to water body type
 - Sandpits, reservoirs, and “other”
- 1200 working hours

Objectives

- Create a new spatial inventory of water bodies for 2010
- Compare the 2005 and 2010 inventories to identify new reservoirs, and new or expanded sandpits
- Determine whether permits/offsets existed for new/expanded features
- Use an ET calculator to estimate impacts of non-permitted features
 - “Prior land cover” to “open water” ET differences

Study Area: Platte SW Basin above Columbus



Comparison of 2005 and 2010 Aerial Imagery

- 2010 much more wet compared to 2005
- Semi -automated procedure was developed to identify 2010 water bodies

2005



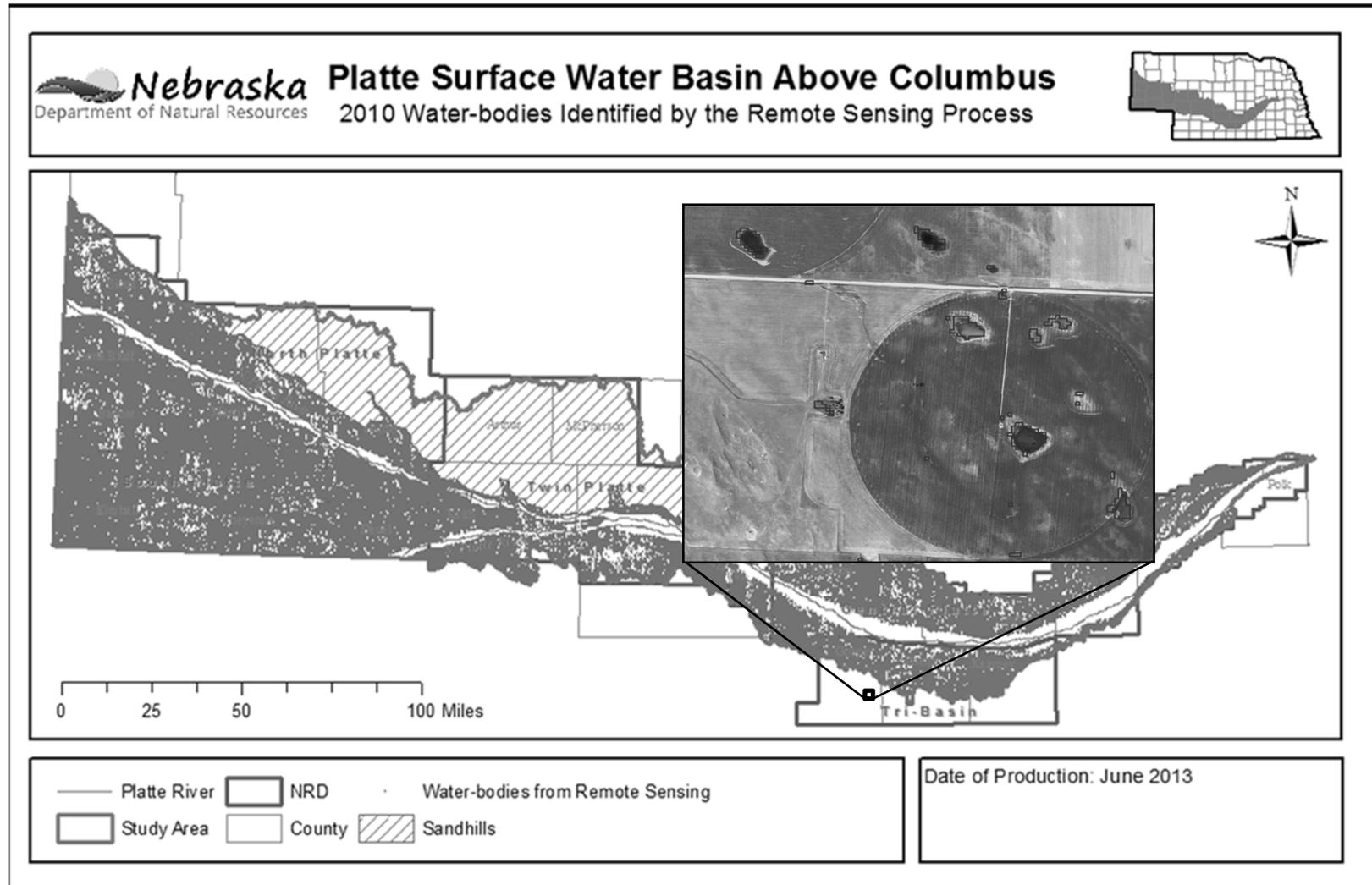
2010



2010 Semi-automated Procedure to Identify Water Bodies

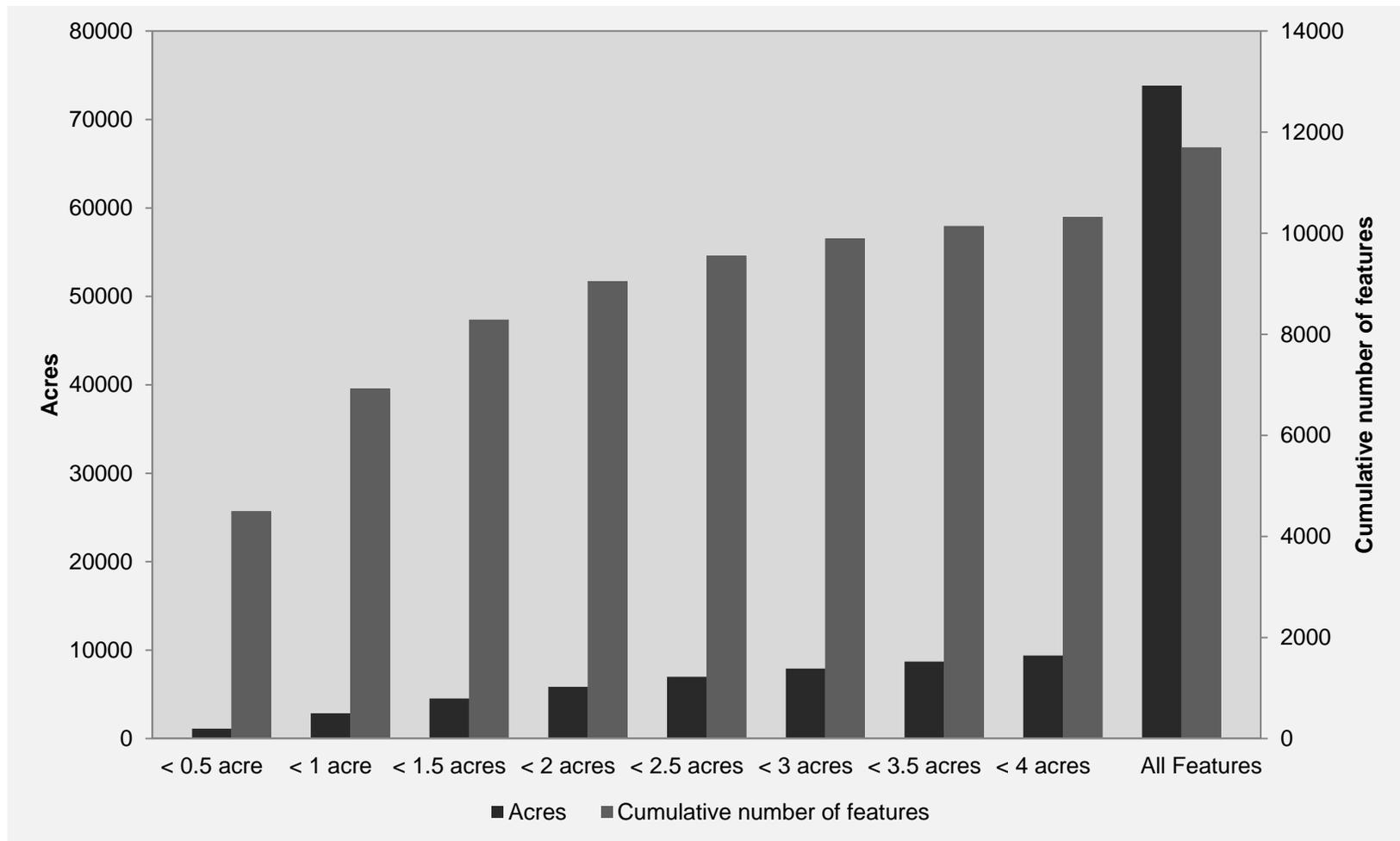
- FSA imagery infrared (IR) band was manipulated to get “first cut” water bodies
 - Water has strong absorption in IR
 - Pixels with low IR values were extracted and converted to features
 - Features less than 1 acre were removed
- Manual clean up and categorization of water bodies
 - Pixelated edges removed
 - Undetected features added
 - Categorization of 2010, re-categorization of 2005

Semi-Automated Water Procedure – “first cut” water bodies from FSA IR band



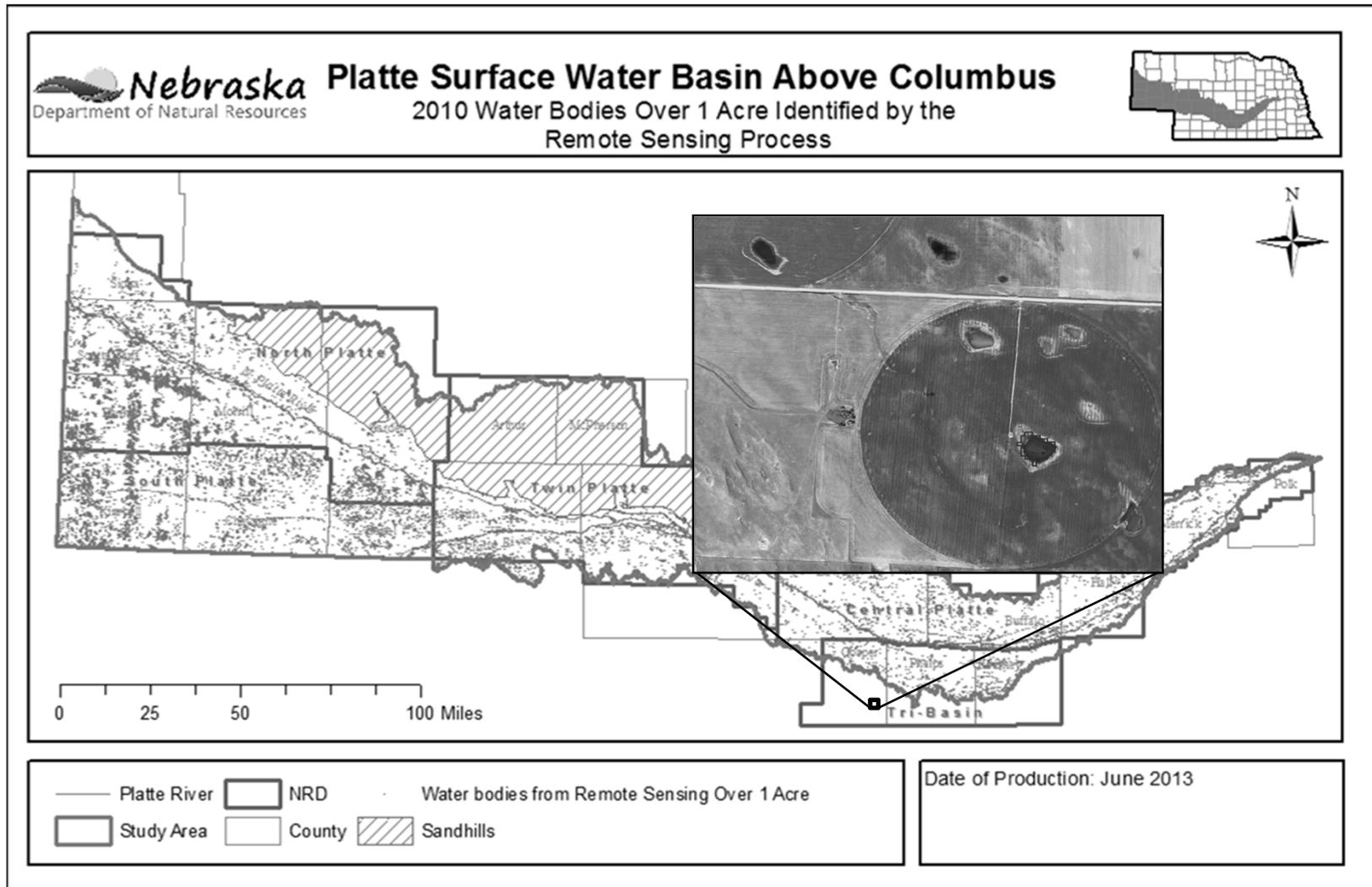
1,205,301 features (194,002 acres)

Semi-Automated Procedure – The one acre threshold



* Based on 2005 inventory

Semi-Automated Procedure – The one acre threshold



19,043 features (122,431 acres)

Manual clean up and categorization of water bodies

Pixelated edges smoothed

Before



After



Legend

-  2010 Water body
-  2015 Water body

Manual clean up and categorization of water bodies

Undetected features digitized

Before



After



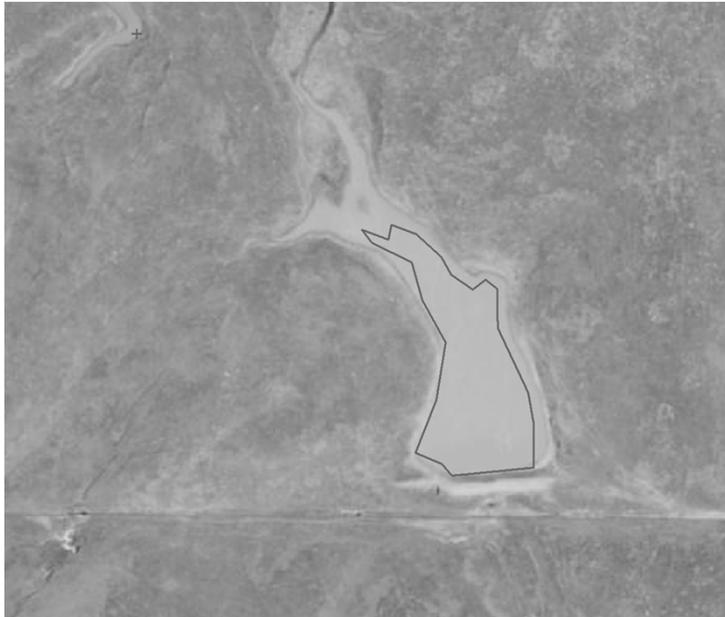
Legend

-  2010 Water body
-  2005 Water body

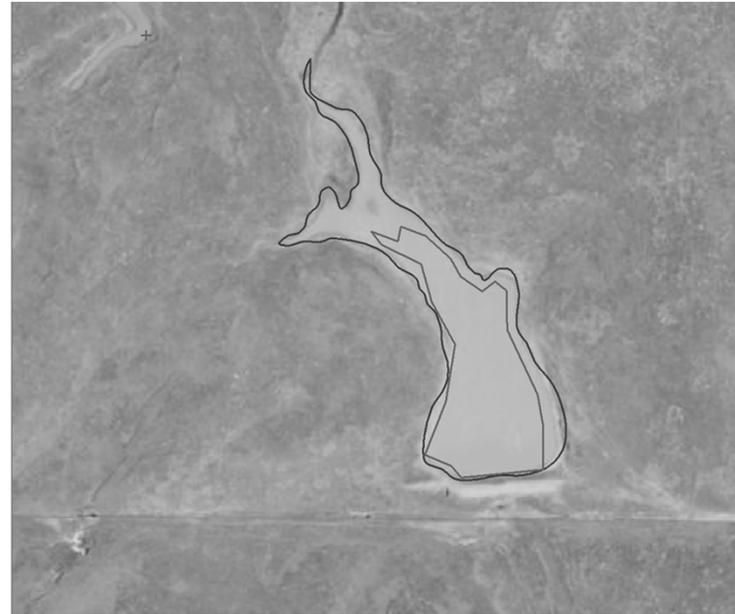
Manual clean up and categorization of water bodies

Undetected features digitized

Before



After



Manual clean up and categorization of water bodies

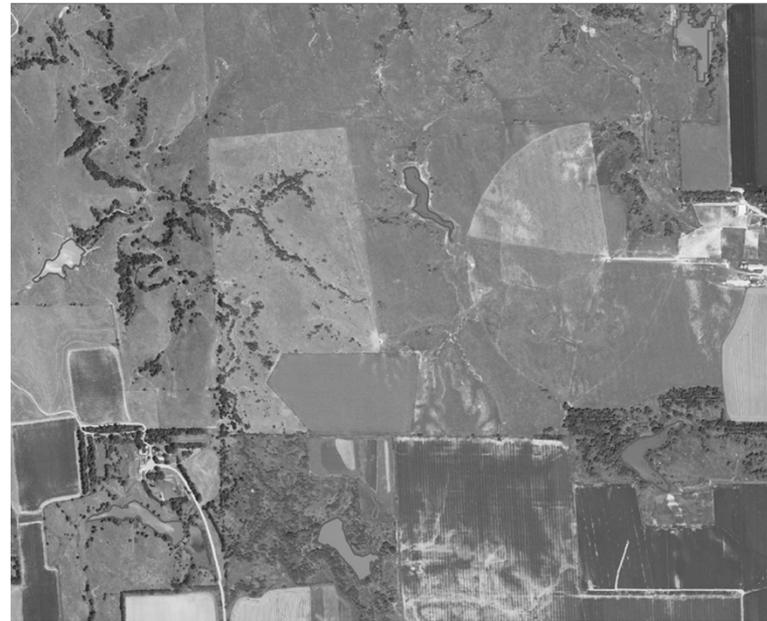
Water bodies categorized

(sandpits, reservoirs, feedlots, golf courses, reuse pits, watering hole)

Sandpits (and others)



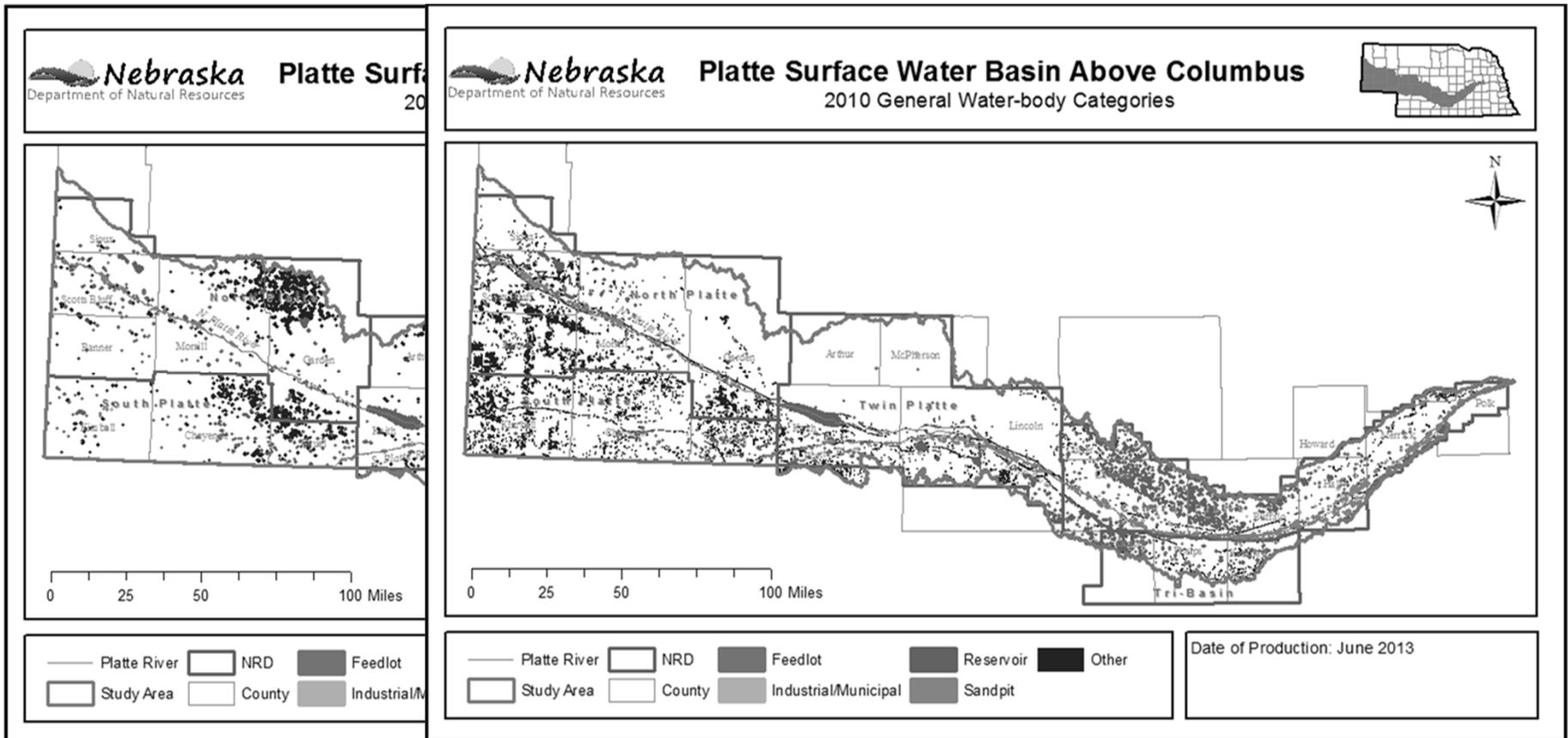
Reservoirs



Legend

- Feedlot
- Industrial/Municipal
- Reservoir
- Sandpit

Classification of Water Bodies

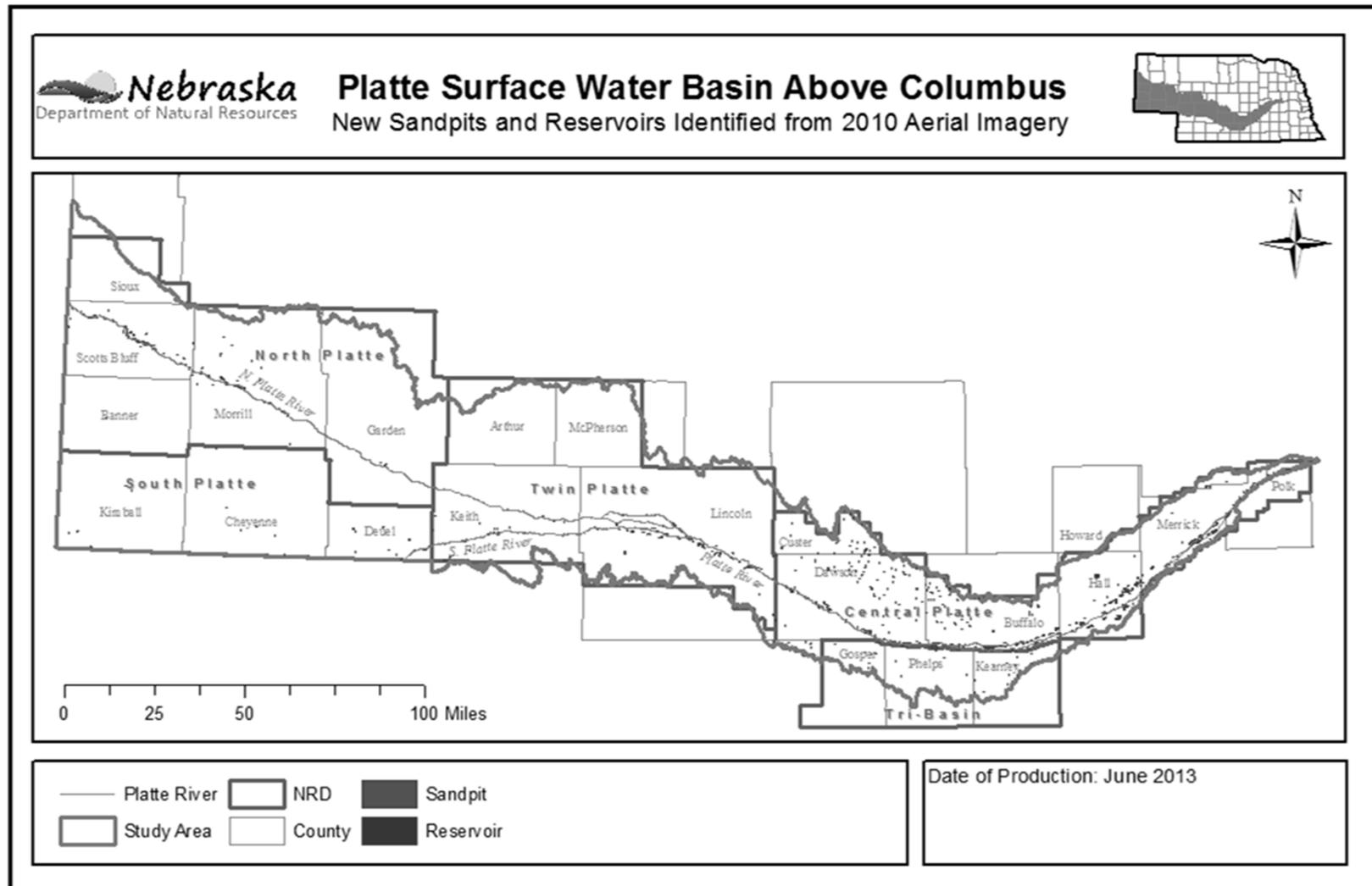


3,166 water body features in categories of interest (56,011 acres)

Overlay of 2005 and 2010 features

- NNDP calls for only new or expanded sandpits and new unpermitted reservoirs
- Identified reservoirs which are not present in 2005
- Identified new sandpits or sandpits that had significantly changed since 2005
- More detailed analyses were conducted on features meeting these criteria

Potential Sandpits and Reservoirs for Change Analysis



758 sandpits and reservoirs in 2010 inventory but not in 2005 inventory (3,723 acres)

Criteria for Inclusion in Change Analysis

Reservoirs

- New embankment
- No permits
 - Surface water right or dam safety plan
 - If a right or plan exists, check for depletions and offsets
- NRD Review

Sandpits

- Active gravel pit
- No estimated depletions or offsets
- NRD review
- Account for land reclamation

Reservoir Change Analysis Criteria: New Embankment

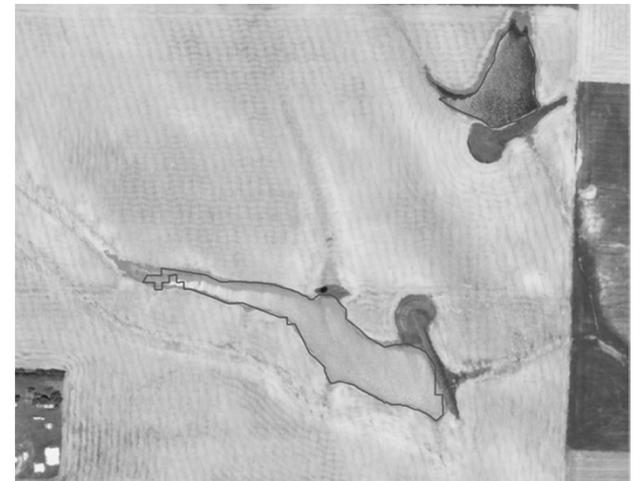
- New embankment physically present after 2005



2005



2006



2010

Reservoir Change Analysis Criteria: No Permits

- Checked for storage permits
 - Dam Safety (inventory and non-inventory)
 - Surface Water Rights
 - If permitted, checked for any associated depletions and offsets

CHANGE ANALYSIS RESERVOIR IDENTIFICATION PROCESS		
Procedure	Number of Features	Area (acres)
Reservoirs classified from 2010 imagery	1,578	45,507
Reservoirs not included in 2005 inventory	573	1,521
Reservoirs with new embankments between 2005 and 2010	11	405
New reservoirs with permits between 2005 and 2010	2	386
New unpermitted reservoirs between 2005 and 2010	9	19

Sandpit Change Analysis Criteria: Activity

- Sandpit criteria
 - Sand around new/expanded sandpits
 - Looked at expanded portions, accounted for reclaimed portions



2005



2010



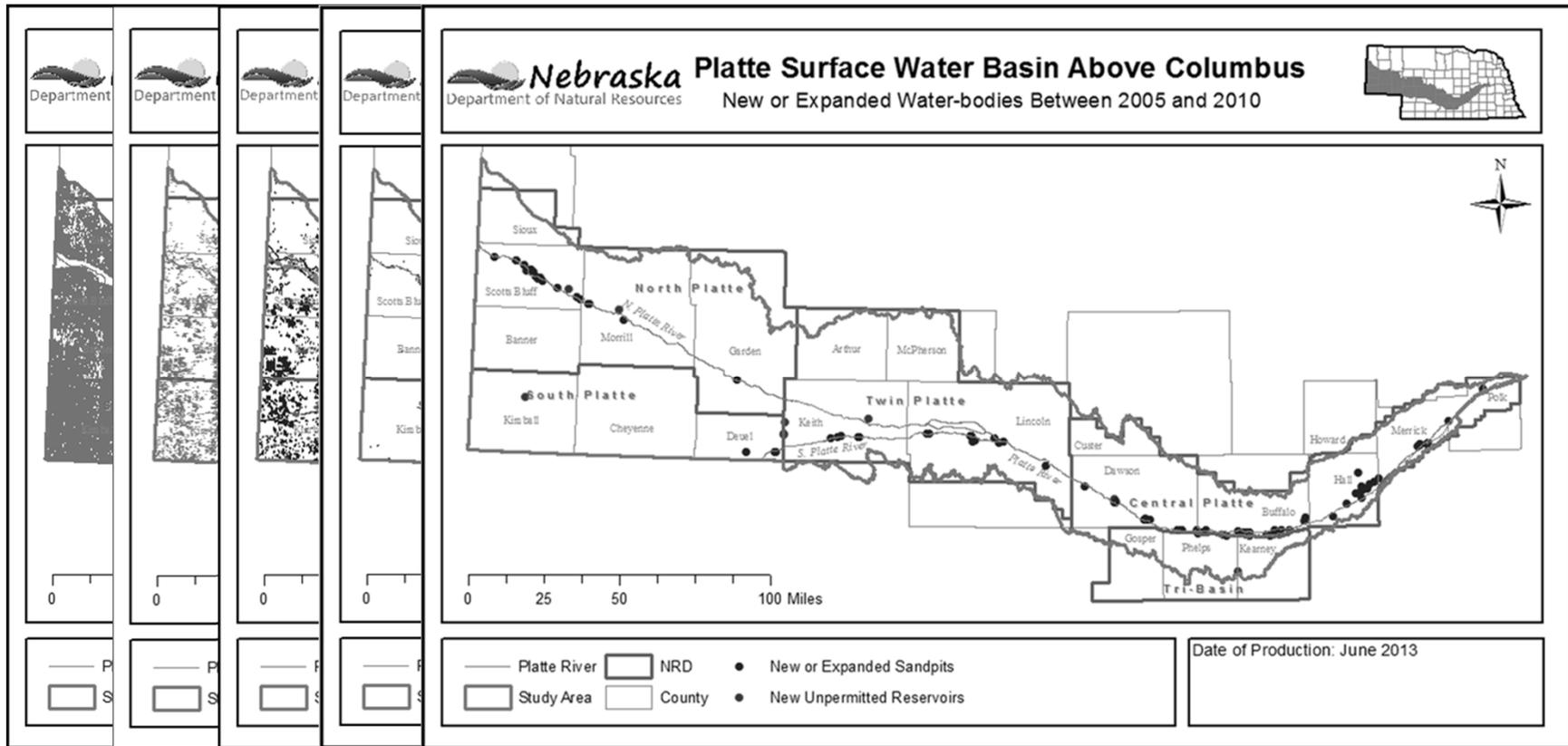
Reduced Areas
Expanded Areas

Sandpit Change Analysis Criteria: No Offsets

- Checked for sandpits with depletions estimates
 - If offsets are in place, exclude from analysis

CHANGE ANALYSIS SANDPIT IDENTIFICATION PROCESS		
Procedure	Number of Features	Area (acres)
Sandpits classified from 2010 imagery	1,005	8,050
Sandpits with area change from 2005	185	2,202
New/expanded sandpits identified from visual analysis	98	736
New sandpits with offsets	4	8
New/expanded sandpits between 2005 and 2010	94	728

Water Bodies for Change Analysis



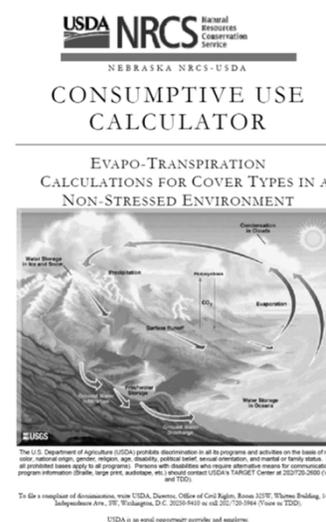
Reservoirs: 9 (19 acres); Sandpits: 94 (728 acres)

Evapotranspiration (ET) estimation using NRCS ET
calculator

METHODS

NRCS ET Calculator

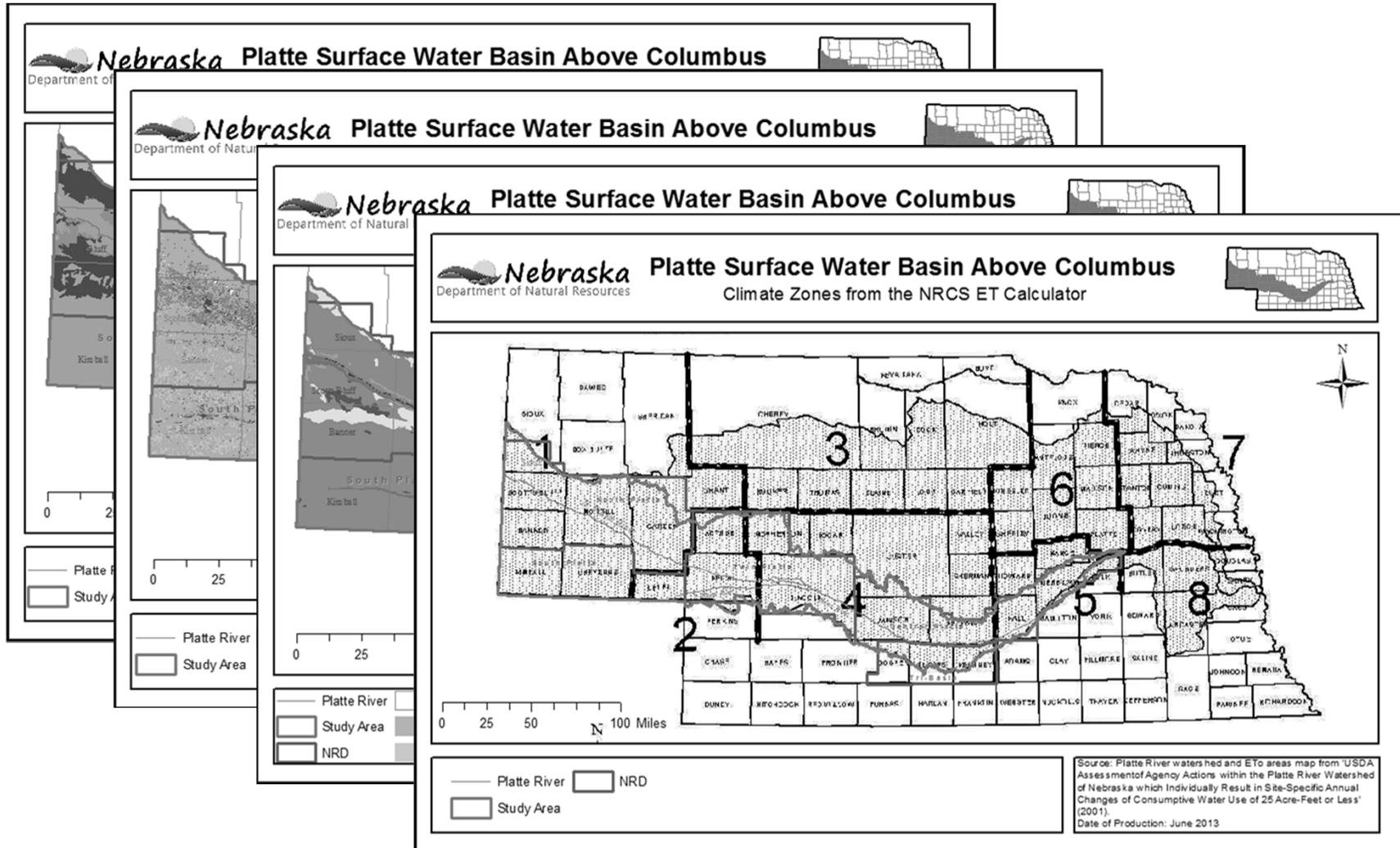
- Created by Natural Resources Conservation Service (NRCS)
- Consumptive use change assessment in Platte basin
- Average monthly ET of 46 land covers
 - Grasslands
 - grass cool mid; grass cool short; grass cool tall; grass warm mid; grass warm short; grass warm tall; grass pasture good; grass pasture bad
 - Wetlands
 - wet tall grasses; wet cattail/bulrush moist; wet cattail/bulrush standing water; wet linear; wet short veg moist; wet short veg standing water
 - Water
 - water shallow; water deep
- March to November ET



Methods: ET Calculation

- Inputs for ET Calculator
 - Location and acres
 - GIS process
 - Soil type
 - STATSGO
 - Land cover
 - CALMIT 2005 land cover dataset
 - UNL CSD native vegetation
 - Location in ET climate areas
 - NRCS consumptive use calculator guide

Methods: ET Calculation



Methods: ET Calculator

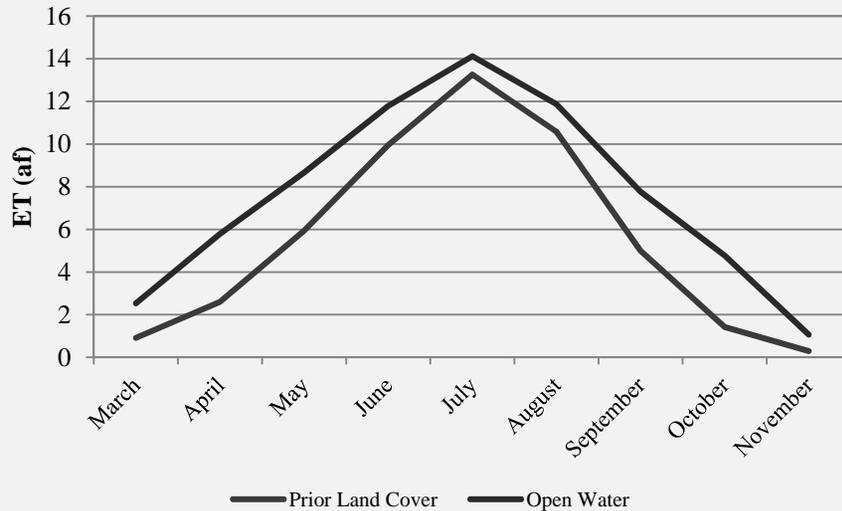
Assumptions/Decisions

- 2005 land cover
 - CALMIT land cover
 - UNL CSD native grasses
 - Wet tall grasses for wetlands
 - Average ET of cottonwoods and willows for riparian trees
- 2010 land cover
 - Shallow water (<1m) for reservoirs
 - Deep water (>1m) for sandpits
- Reclaimed sandpit land
 - 2010 land cover: Sand
- Irrigation application timeframe: May to September

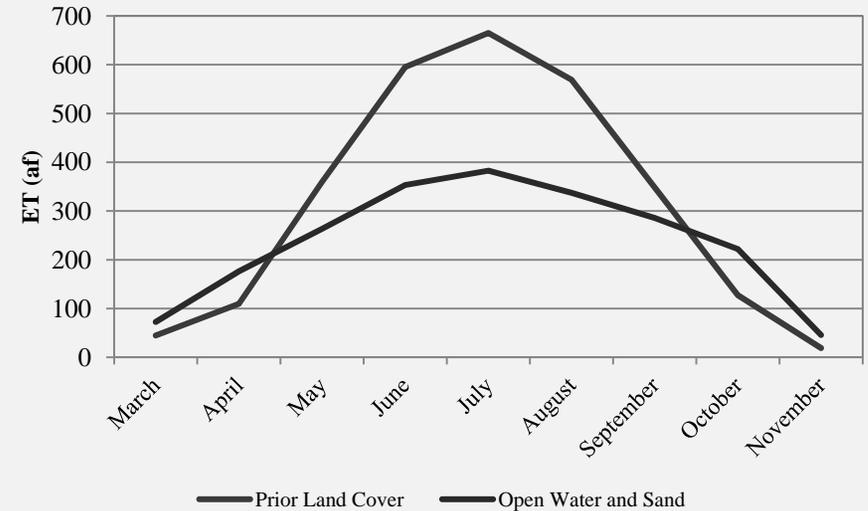
RESULTS

Results: ET Change 2005 to 2010

Platte SW Basin above Columbus ET - Reservoirs

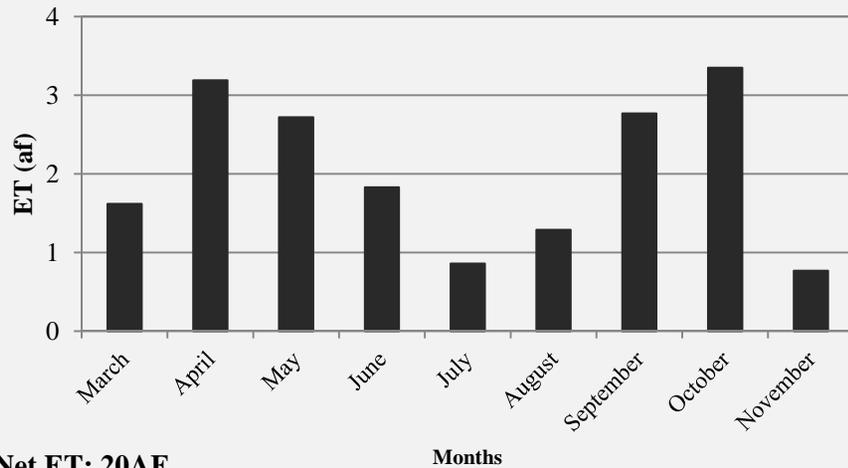


Platte SW Basin above Columbus ET - Sandpits



Results: ET Change 2005 to 2010

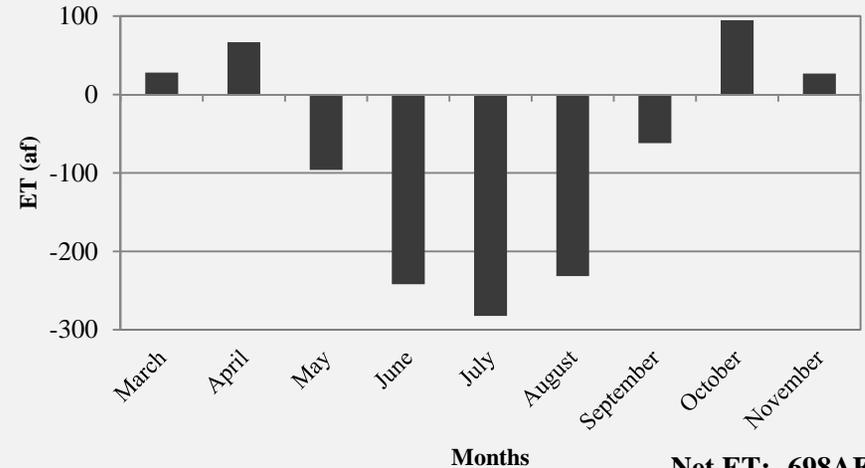
Study Area Reservoirs ET
ET Change from 2005 to 2010



Net ET: 20AF

20af ET increase from new unpermitted reservoirs

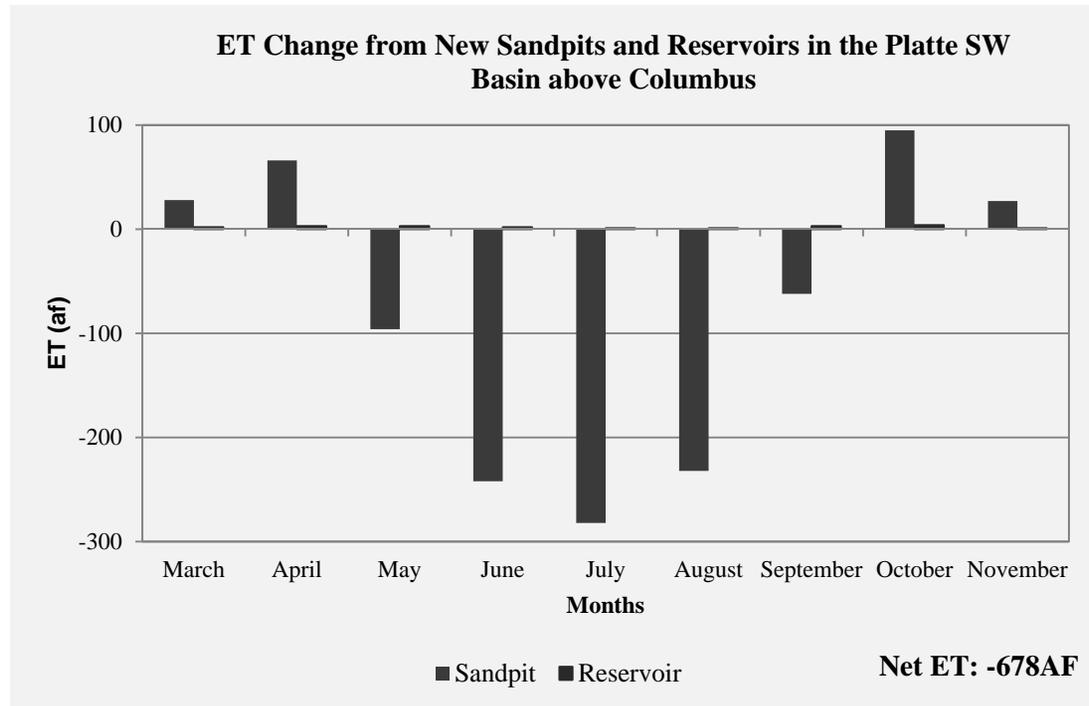
Study Area Sandpits ET
ET Change from 2005 to 2010



Net ET: -698AF

698af ET decrease from new or expanded sandpits

Results: ET Change 2005 to 2010



Overall ET decrease of 678af per year from sandpits and reservoirs

Summary

- Used geospatial technologies and FSA imagery to identify small, man-made water bodies
- Developed procedure to identify new/expanded reservoirs and sandpits without offsets
- 747 acres of new reservoirs and new/expanded sandpits were identified
- Increase in ET during all months for reservoirs
- ET increase in non-irrigation months and decrease in irrigation months for sandpits
- Overall annual decrease of 678af in consumptive use via ET
- Nearly 2000 hours invested

Data Sources

- Digital Aerial Imagery: <http://dnr.ne.gov/databank/DigitalImagery.html>
- CALMIT 2005 Statewide Land Use Data: <http://calmit.unl.edu/2005landuse/statewide.php>
- UNL CSD Native Vegetation Data: <http://snr.unl.edu/data/geographygis/NebrGISland.asp>
- National Hydrography Dataset: <http://dnr.ne.gov/databank/nhd.html>
- STATSGO Soil Data: <http://www.dnr.ne.gov/databank/statsgo1.html>
- NRCS ET Areas: NRCS Consumptive Use Calculator – Evapotranspiration Calculations for Cover Types in a Non-Stressed Environment



Thank you



Department of Natural Resources

Amy Wright, MS

Integrated Water Management Analyst

Nebraska Department of Natural Resources