

Start

Water Quality, Ecological Effects and Tile Drainage in South Dakota



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Acknowledgments

- Kurt Foreman, USFWS
- Jesse Lisburg, USFWS
- Rex Johnson, USFWS



Note: The findings and conclusions presented herein are those of the author and do not necessarily represent the views of the U.S. Fish and Wildlife Service.

Overview

- **Introduction to agricultural tile drainage**
- **Tile drainage effects on wetlands and water quality**
- **Service Trust Resources in Eastern SD**
- **Efforts to reduce tile drainage effects**

The Problem

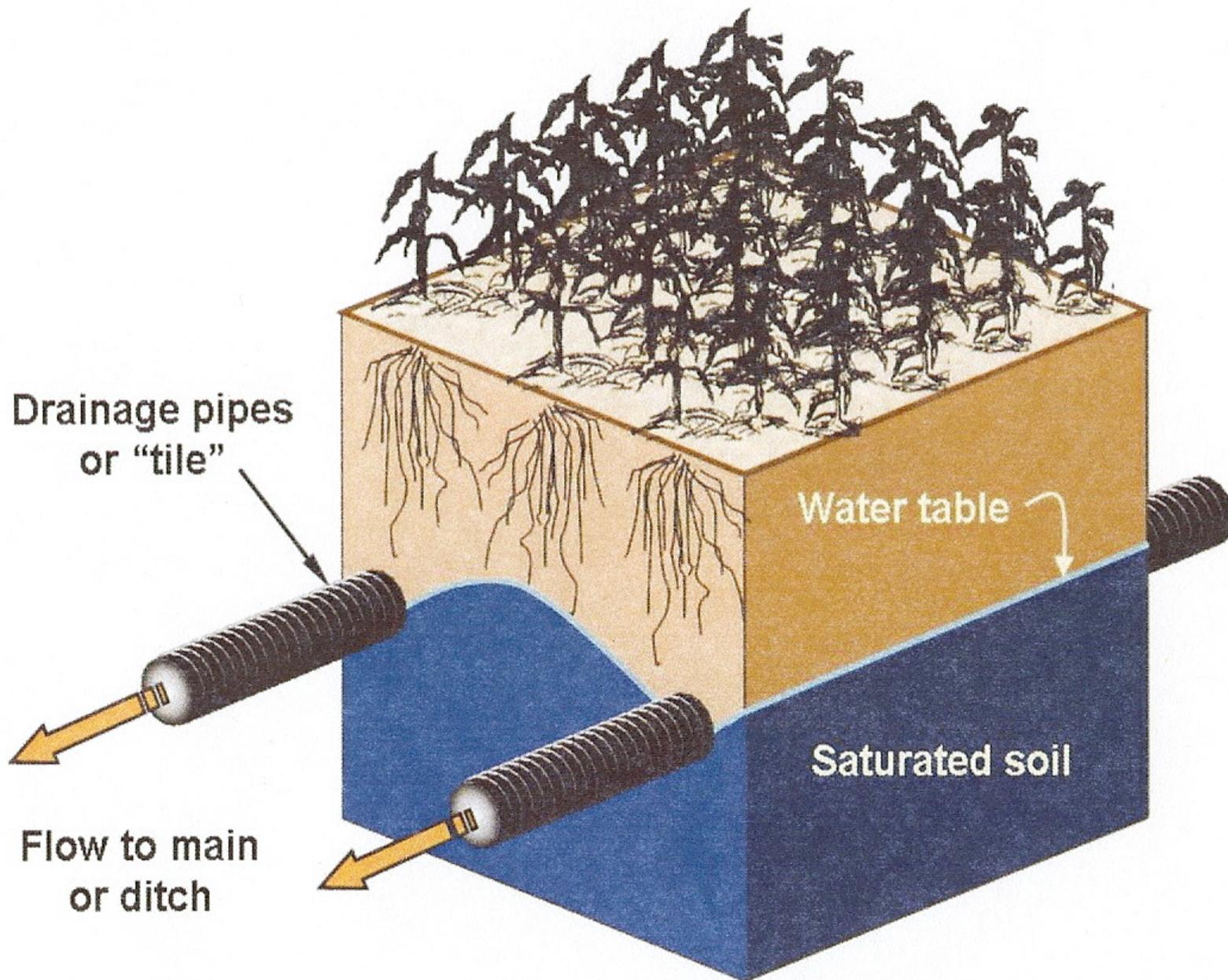
- **The Prairie Pothole Region of South Dakota Provides key habitat for Service Trust Species**
- **Tile Drainage in this Region is increasing and can result in wetland loss and water quality issues.**
- **Pro-active evaluations to reduce the negative effects of tile may be lacking.**

Agricultural Drainage Tile



*Installation with
a Tile Plow*





Tile Drain Outfalls



Targeted Tiling

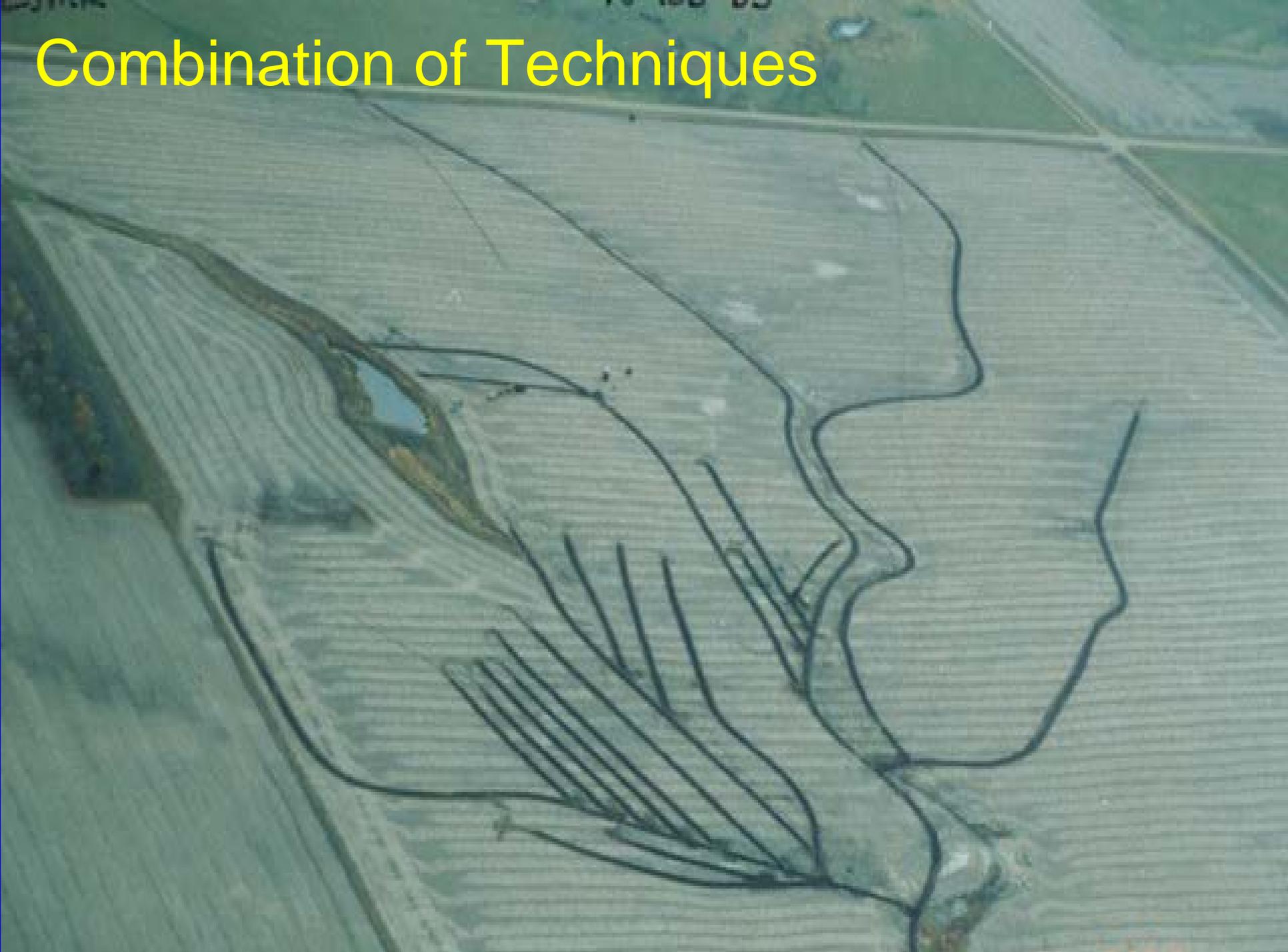


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Pattern Tiling



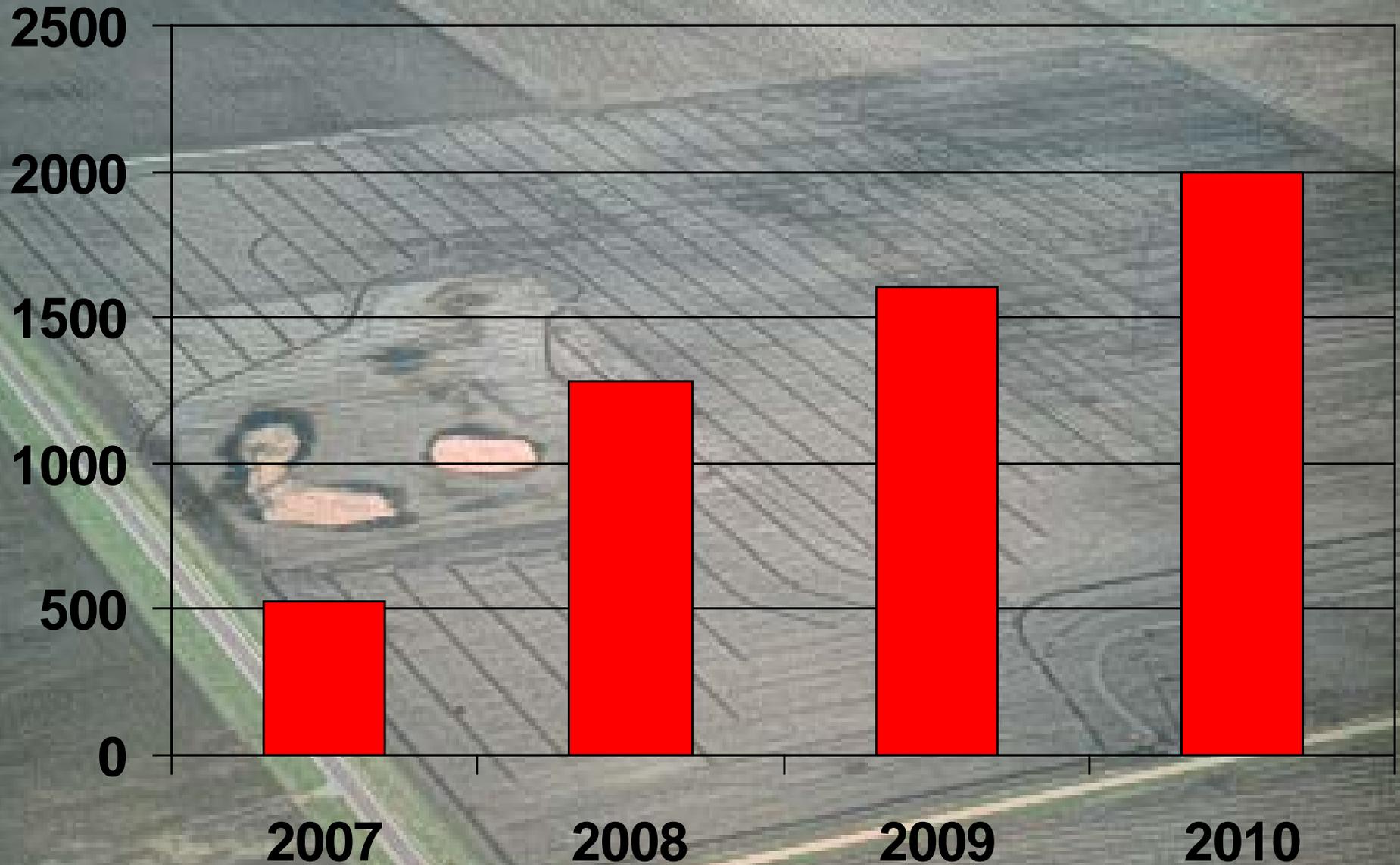
Combination of Techniques



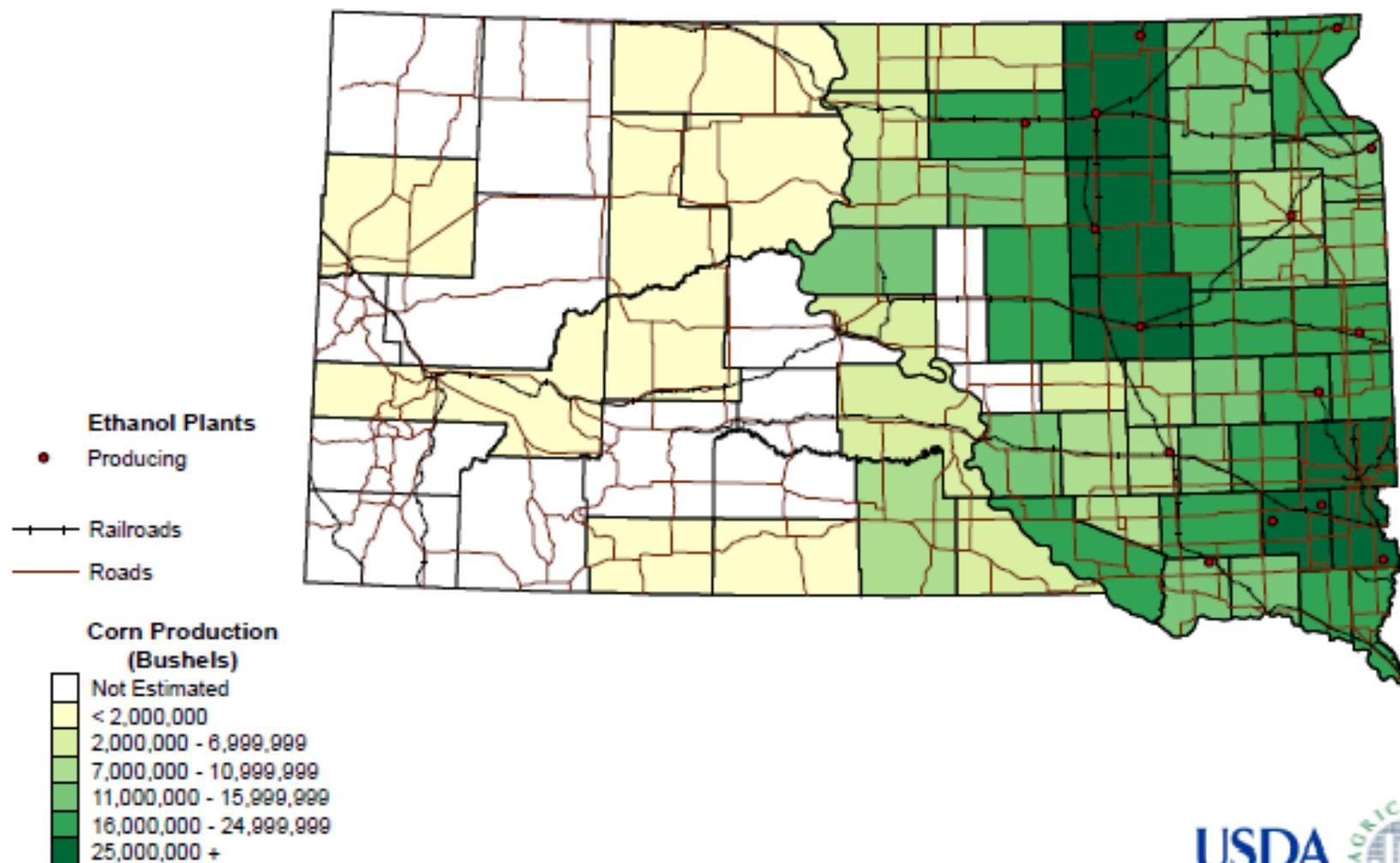
Pattern Tiling



Wetland Determination Requests in Eastern South Dakota



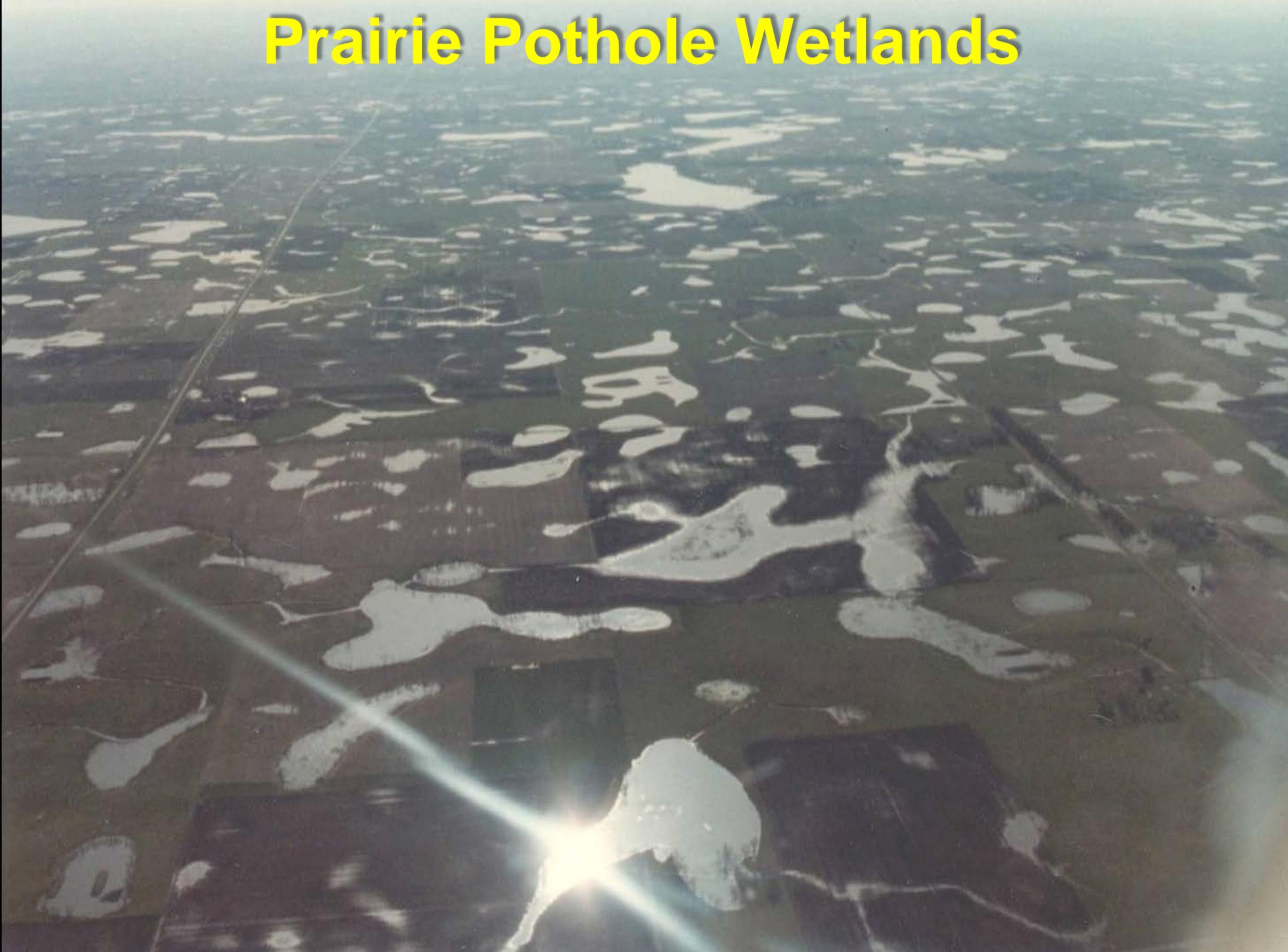
South Dakota Corn for Grain 2009 Production by County and Location of Ethanol Plants As of January 19, 2010



Adverse Effects Related to Tile Drainage

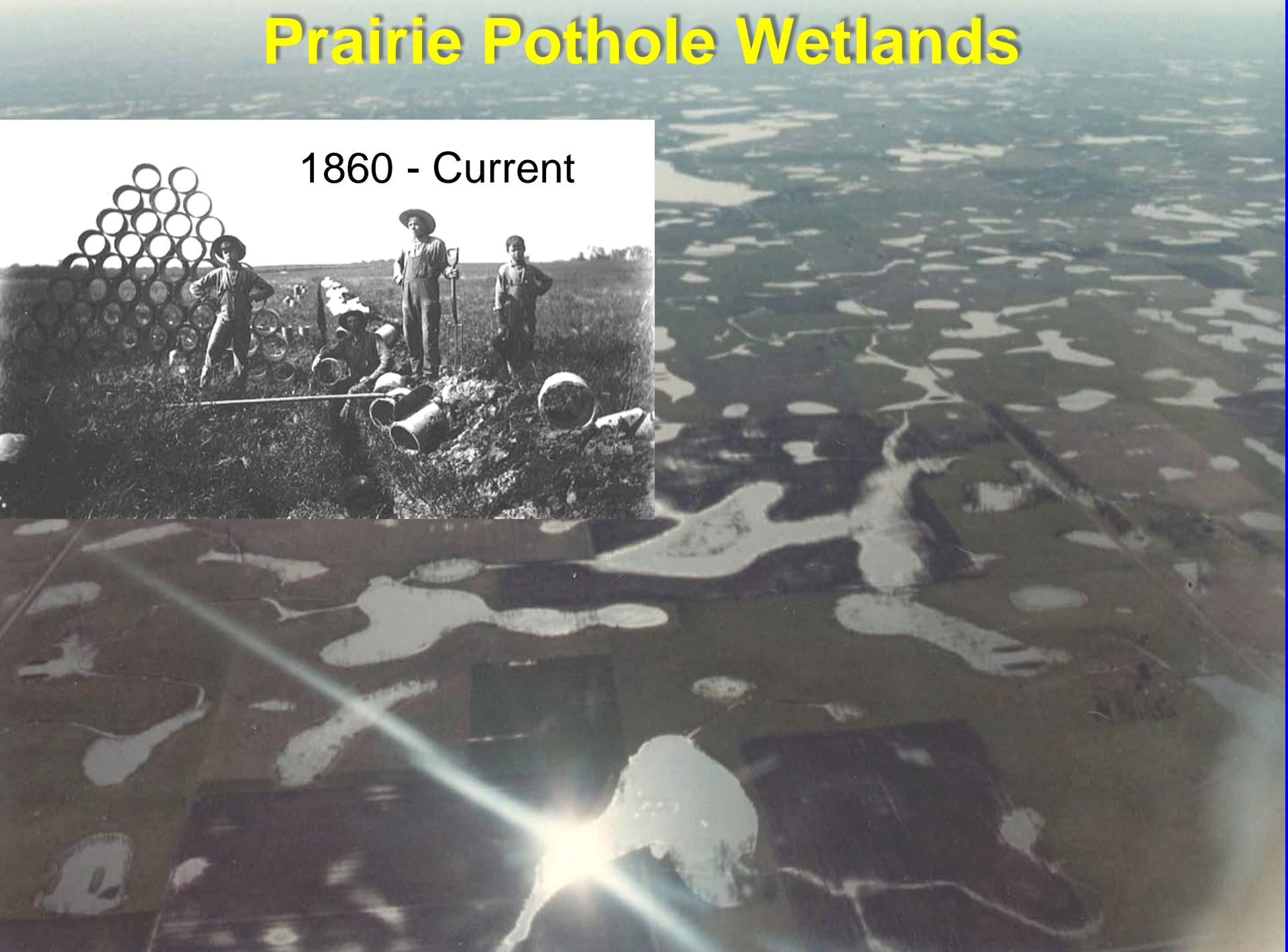
- **Wetland Loss**
- **Altered Wetland Habitat**
- **Water quality Degradation**

Prairie Pothole Wetlands



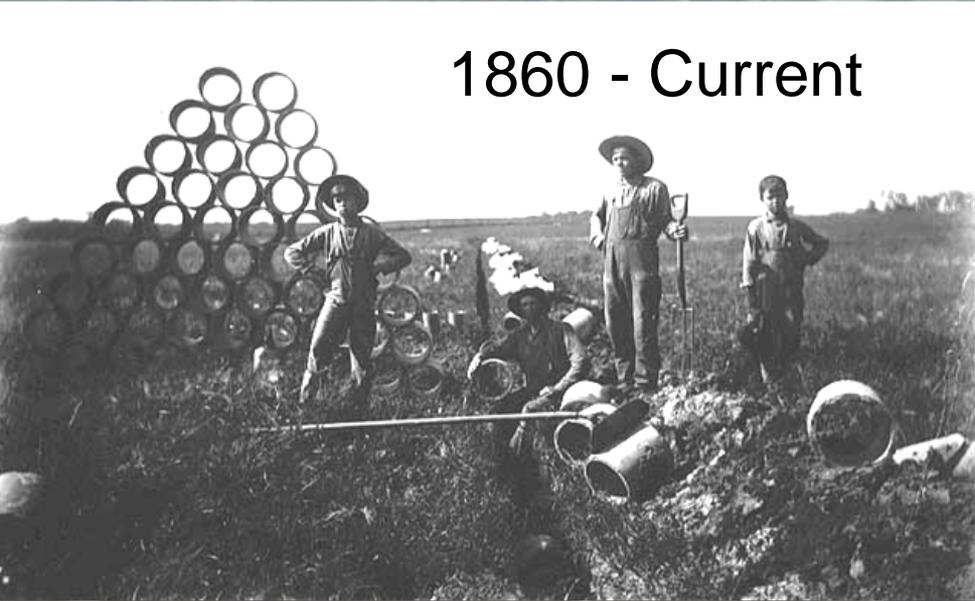
Prairie Pothole Wetlands

1860 - Current



Prairie Pothole Wetlands

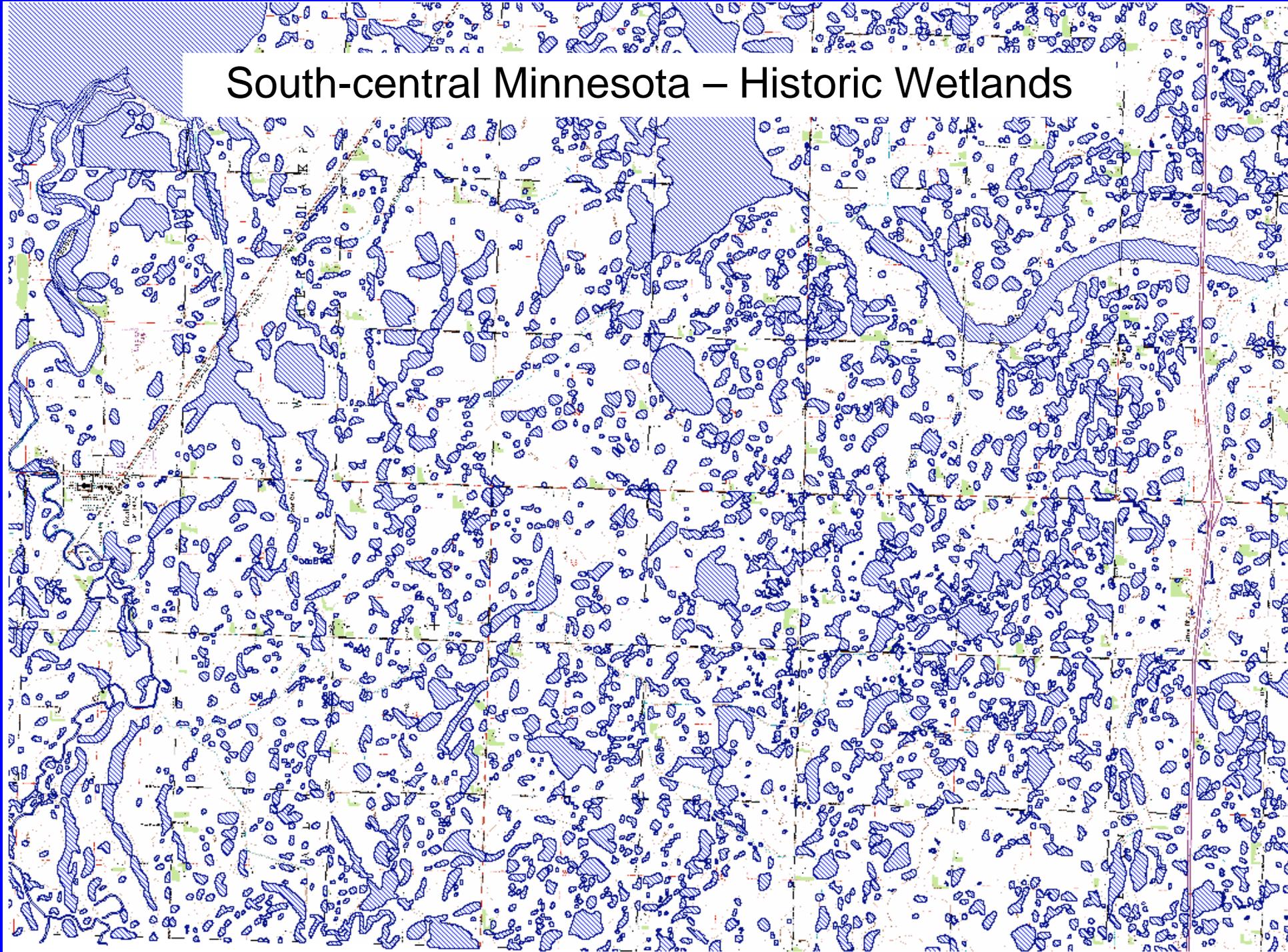
1860 - Current



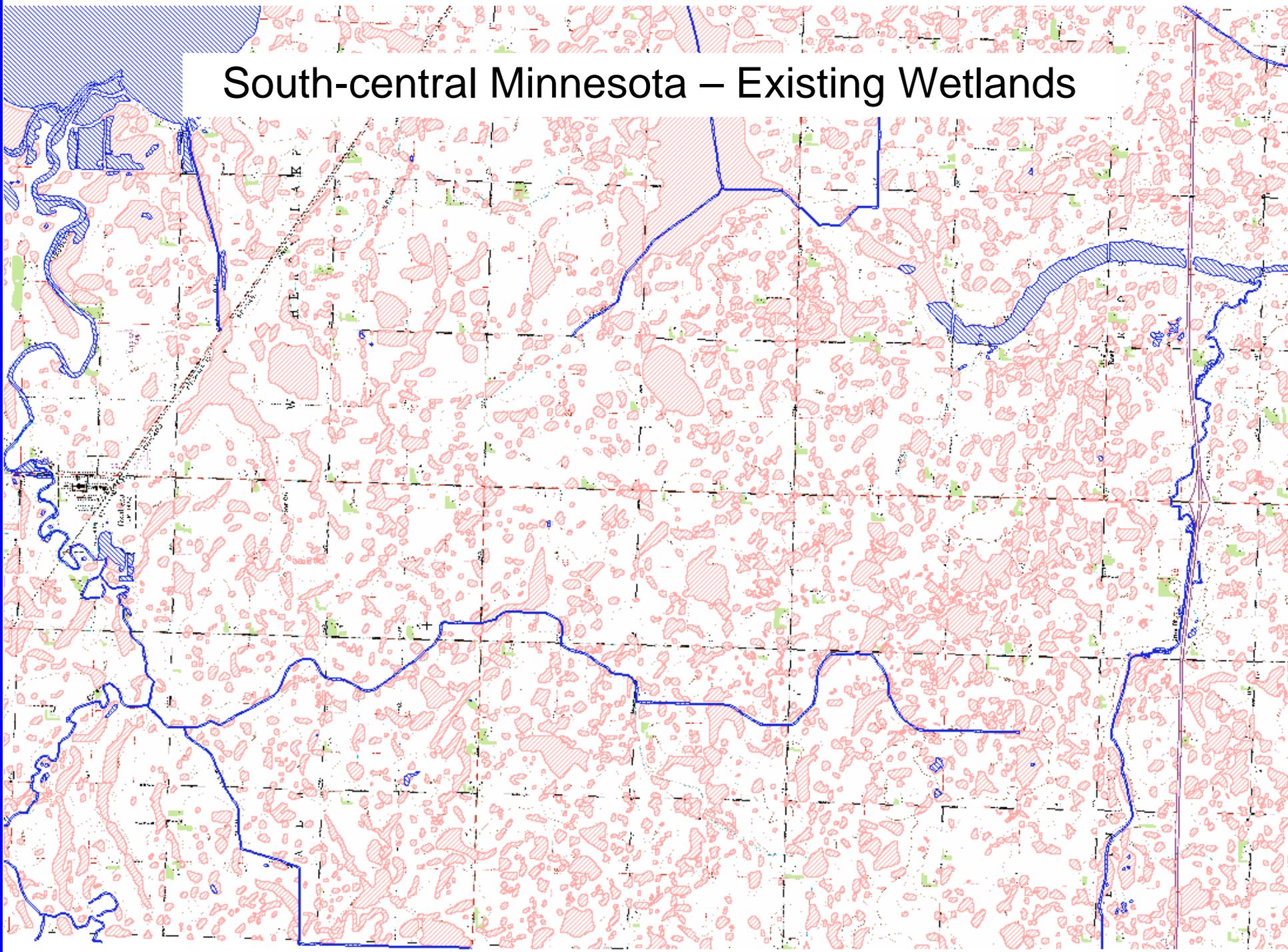
Percent of Wetlands lost

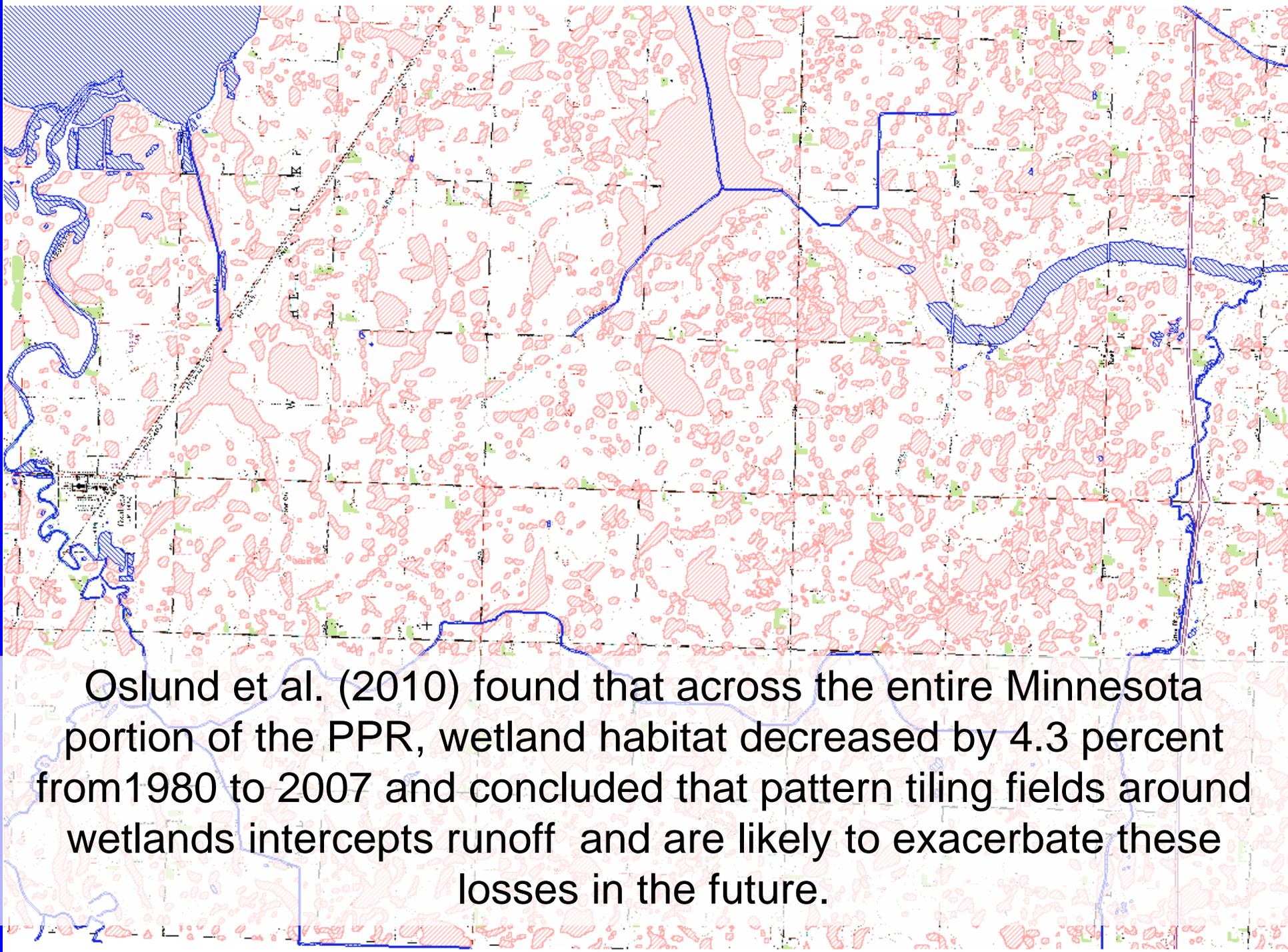
- Montana 20%
- S. Dakota 35%
- N. Dakota 49%
- Minnesota 82%
- Iowa 99%

South-central Minnesota – Historic Wetlands



South-central Minnesota – Existing Wetlands





Oslund et al. (2010) found that across the entire Minnesota portion of the PPR, wetland habitat decreased by 4.3 percent from 1980 to 2007 and concluded that pattern tiling fields around wetlands intercepts runoff and are likely to exacerbate these losses in the future.

Alteration of Wetland Habitat



Temporary/Seasonal



*Semi-permanent /
Permanent*

Alteration of Wetland Vegetation



***Emergent aquatic
vegetation***



Undesirable vegetation

Tile Drains and Water Quality



Tile Drains and Water Quality



Good: Can decrease phosphorus, some pesticides, and sediments compared to surface drained fields

Tile Drains and Water Quality



Good: Can decrease phosphorus, some pesticides, and sediments compared to surface drained fields



Not Good: Increased nitrates (10 – 40 mg/L, USEPA) some pesticides, and sediments.

Tile Drains and Water Quality

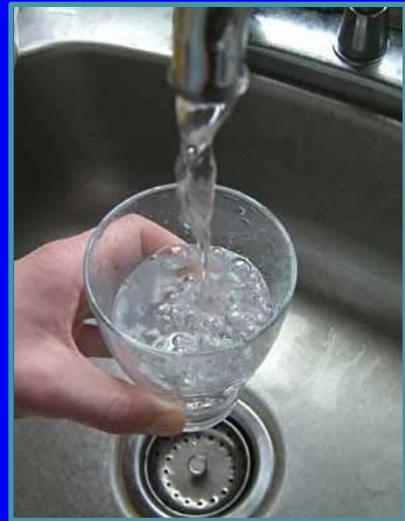


Compared to land in natural forest or perennial grassland, conversion and drainage of land for agriculture usually increases peak runoff rates, sediment, and pollutant loads to surface-water resources.”
(Blann et al. 2009)

Nitrate Toxicity



Nitrates and Human Health



“The average nitrate concentration in the Raccoon, a main source of drinking water, has doubled in the 27 years the Des Moines Water Works has kept detailed records, said L.D. MCMullen, waterworks general manager and national expert on water regulations...He and other water quality officials put much of the blame on the increasing number of drainage tiles used in Iowa.”

Des

Moines Register, May 17, 2002.

- **SWDA standard 10 mg/L NO₃-N**
- **(Ward et al. 2010) ≥ 5 mg/L was related to a nearly three-fold increase in thyroid cancer risk for women with $>$ five year's use of a public water supply**

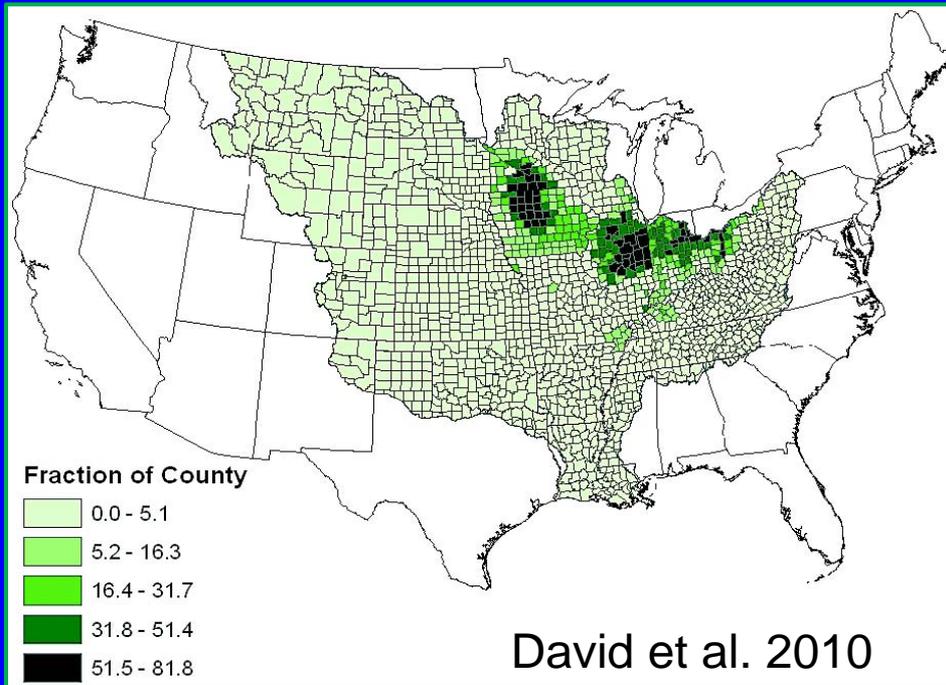
Nitrates and Aquatic Life

- **< 90 mg/L NO₃-N safe for warmwater fish (USEPA 1986)**
- **NO₃-N background 0.24 mg/L, > 5 mg/L eutrophication (USGS 2010)**
- **< 2 mg/L NO₃-N benchmark for aquatic life (Camargo et al. 2005).**
- **SD acute 88 mg/L and chronic 50 mg/L**

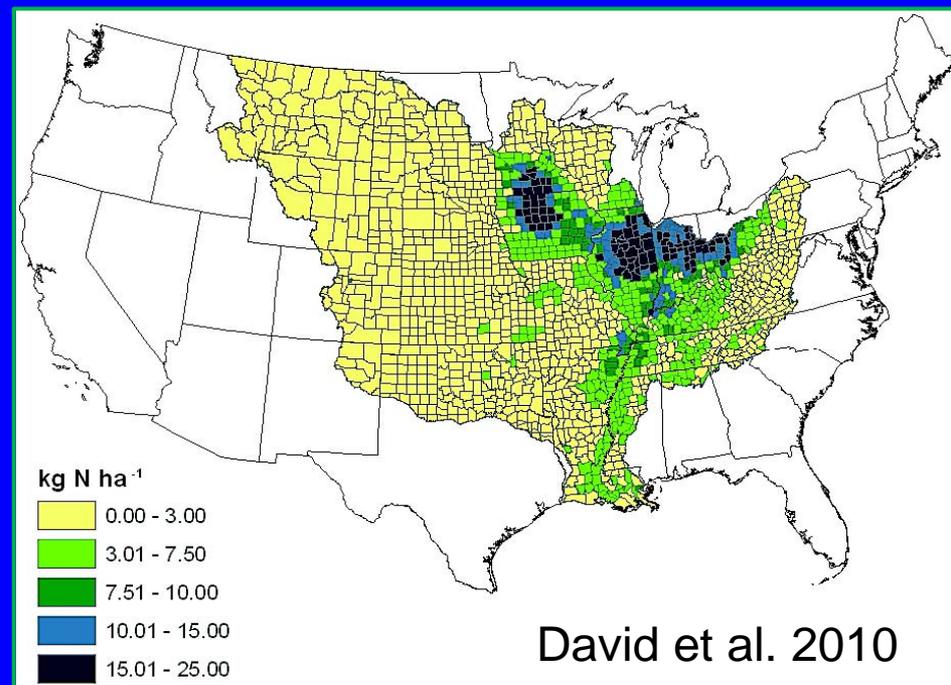
Nutrients a National Issue

- **Pathogens, sediments and nutrients = top three causes for water quality impairments (EPA, 2011).**
- **Gulf of Mexico's dead zone, 7,722 square miles in 2010 (NY Times).**

Nutrients a National Issue

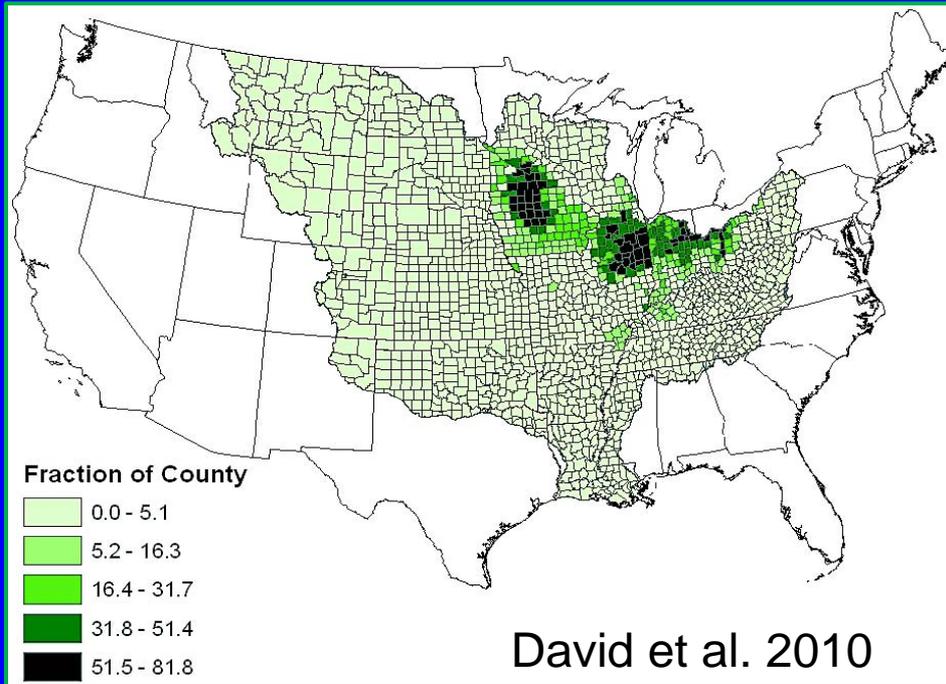


Fraction of county with tile

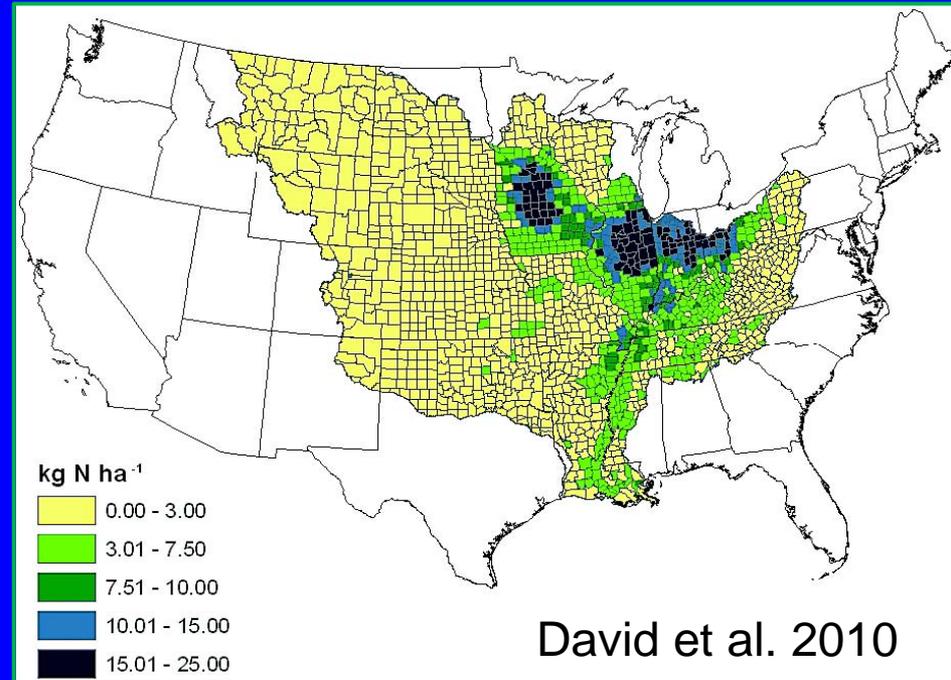


Predicted riverine nitrate N yield

Nutrients a National Issue



Fraction of county with tile



Predicted riverine nitrate N yield

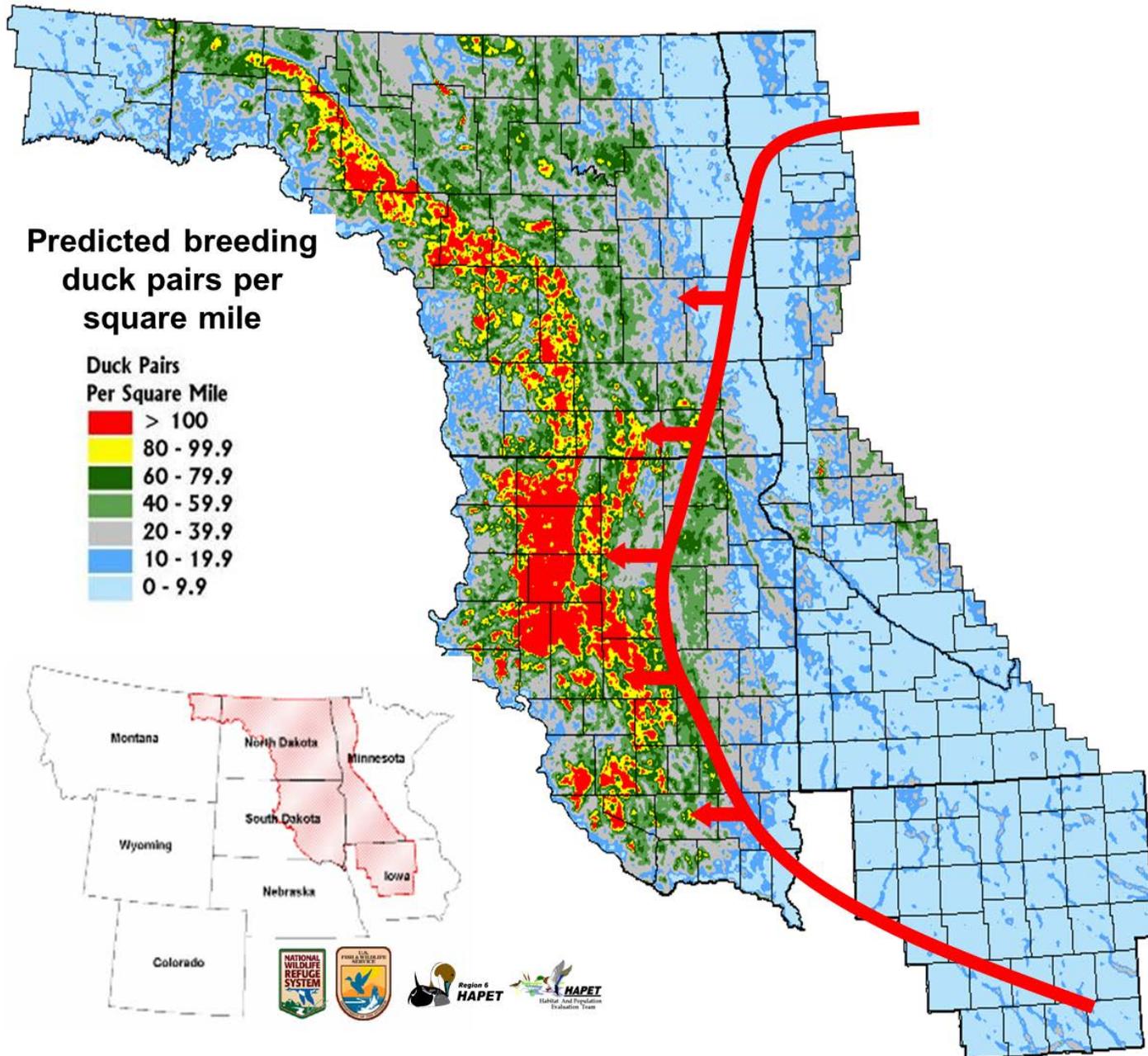
“Our modeled nitrate N yield for each county in the MRB illustrates clearly that the combination of fertilized corn on tile-drained watersheds is the dominate source of riverine nitrate N yields in the upper MRB...”

David et al. 2010. JEQ.

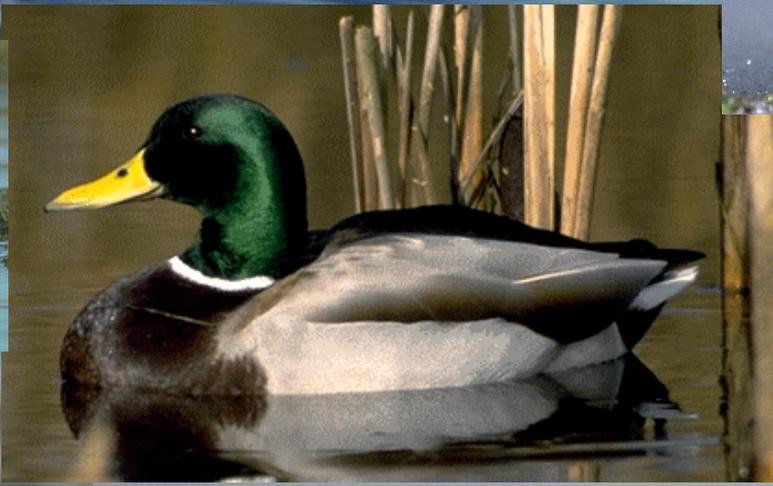
Service Trust Resources

- **Migratory Birds (MBTA, 1918)**
- **Federally Listed Species (ESA, 1973)**
- **Federal Lands and Easements (RIA, 1997)**

Waterfowl in the PPR



Waterfowl and the PPJV



Federally Listed Species



Whooping Cranes

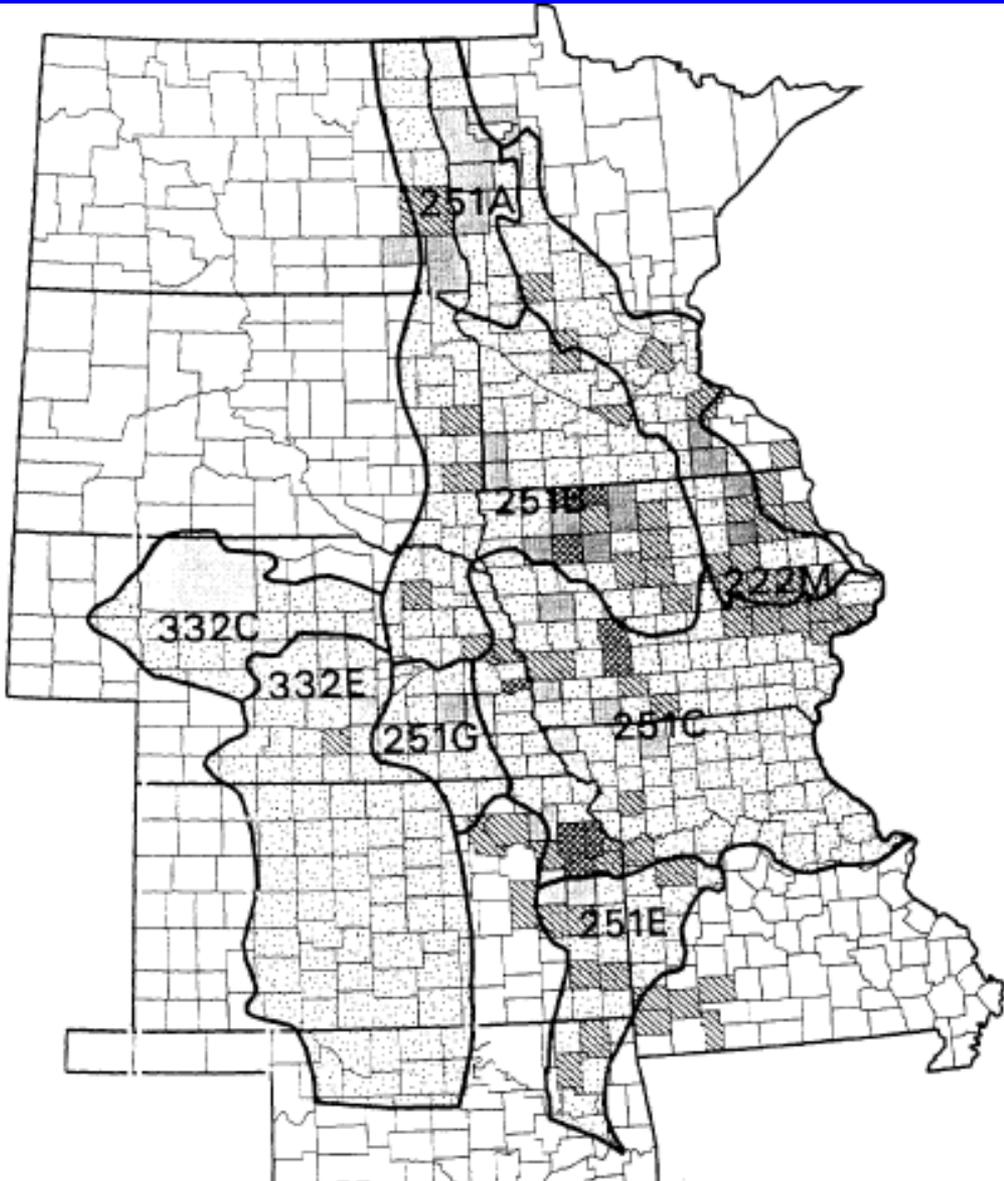


Piping Plovers



- Migrates and nests in SD
- Nesting record in Kingsbury Co

Western Prairie Fringed Orchid



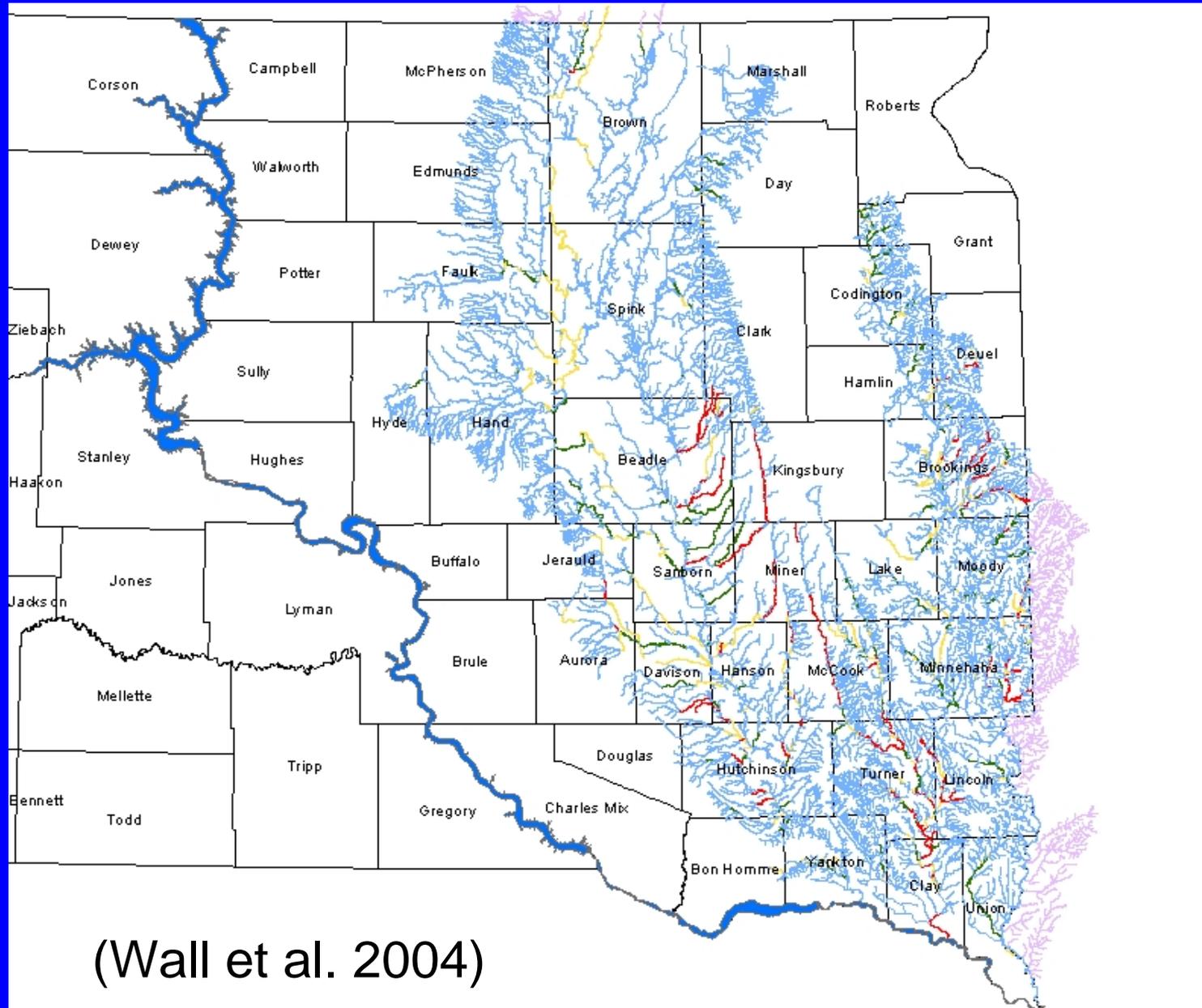
- **No known in SD**
- **Historic records
Brookings and
Minnehaha**

Topeka shiner

- **Habitat modification increased water yields, incision**
- **Direct vs Indirect Toxicity**



Topeka shiner streams

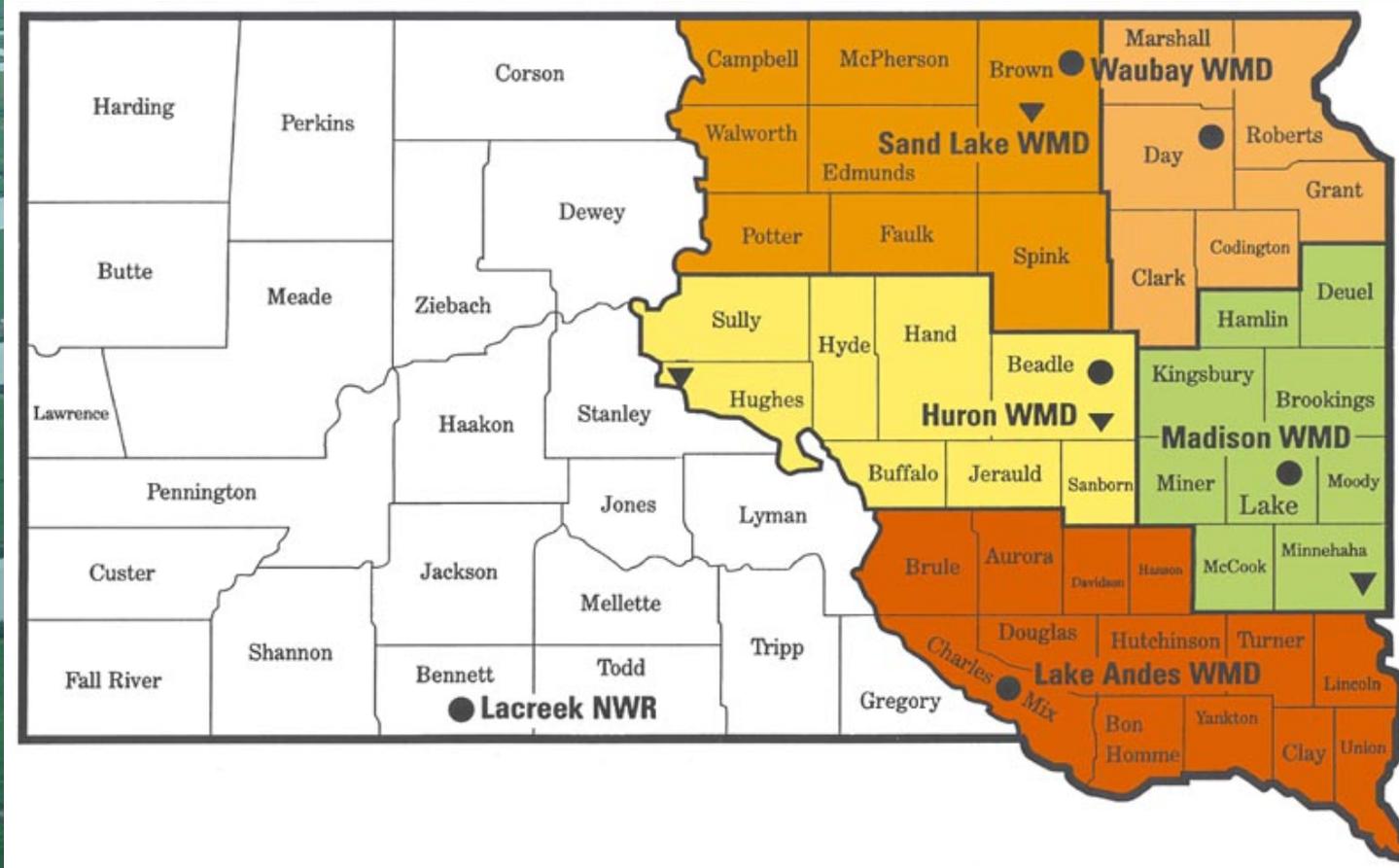


(Wall et al. 2004)

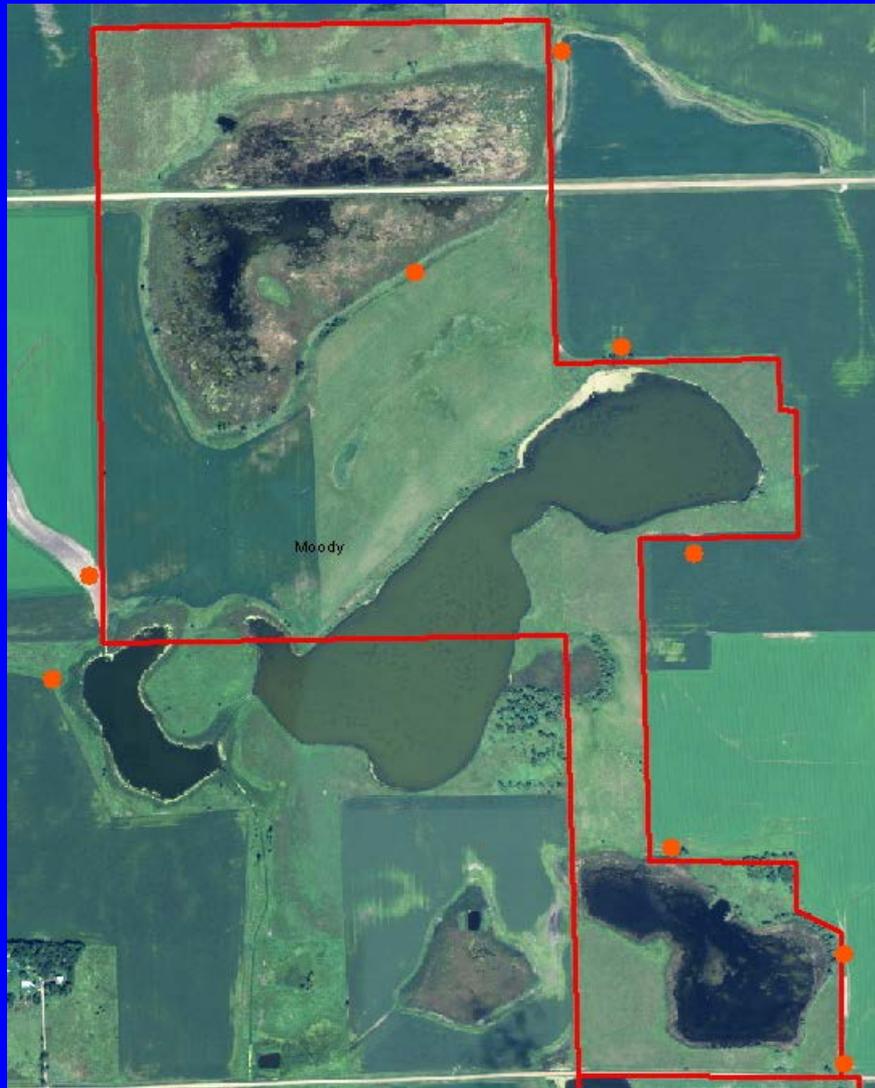
Service Trust Lands



Service Trust Lands



Tile Outlets and Service WPAs



Off-Field Remediation

Biofiltration



Constructed Wetlands

More complex crop rotations are needed

Conclusions

- **Tile drainage demand is increasing in SD**
- **Likely result in wetland loss and water quality issues.**
- **Off-field remediation, crop rotations can reduce nitrate loading, but incentives are lacking.**
- **More assessment is needed to protect wetlands and water quality.**

Questions?

