



Effect of land cover change on runoff curve number estimation in Iowa, 1832-2001

Loren Wehmeyer, Ph.D.
U.S. Geological Survey, North Carolina Water Science Center
llwehmey@usgs.gov



Introduction

- Drastic land cover change in the first three decades of European-descended settlement in Iowa
- Milder change from 1875-2001
 - Prairie versus forest
 - Clearing
 - Soil quality
 - Geography
 - Land between the rivers
 - Mild slope
 - Climate
 - Adequate precipitation



Background

- 1832-1859, General Land Office (GLO) surveyed Iowa
- 1875, Andreas' Illustrated Atlas of the State of Iowa (IASI)
- 2001, National Land Cover Dataset (NLCD 2001)

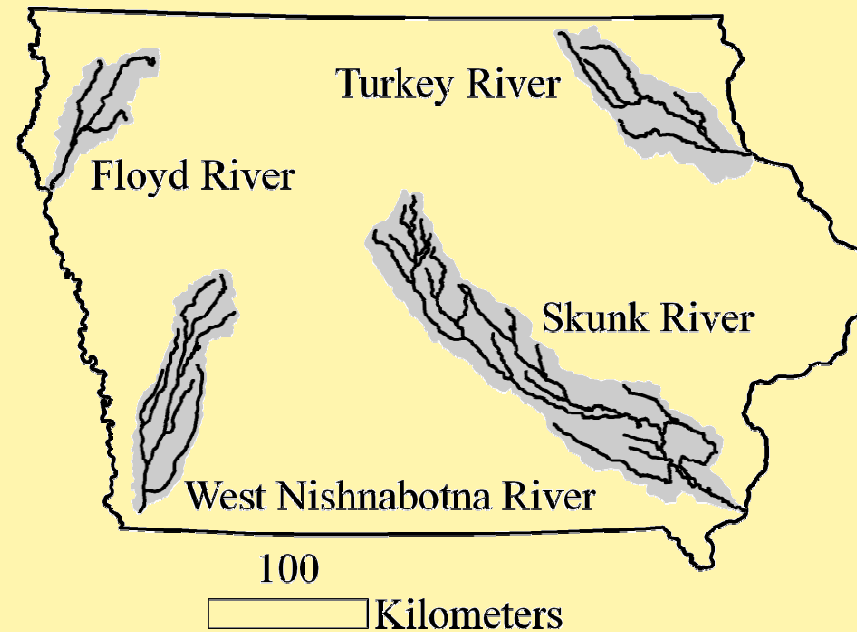


Purpose and Scope

- Quantify the hydrologic impact of the land cover change
- Compare pre- and post-settlement to modern composite runoff curve number (CN)



Project watersheds



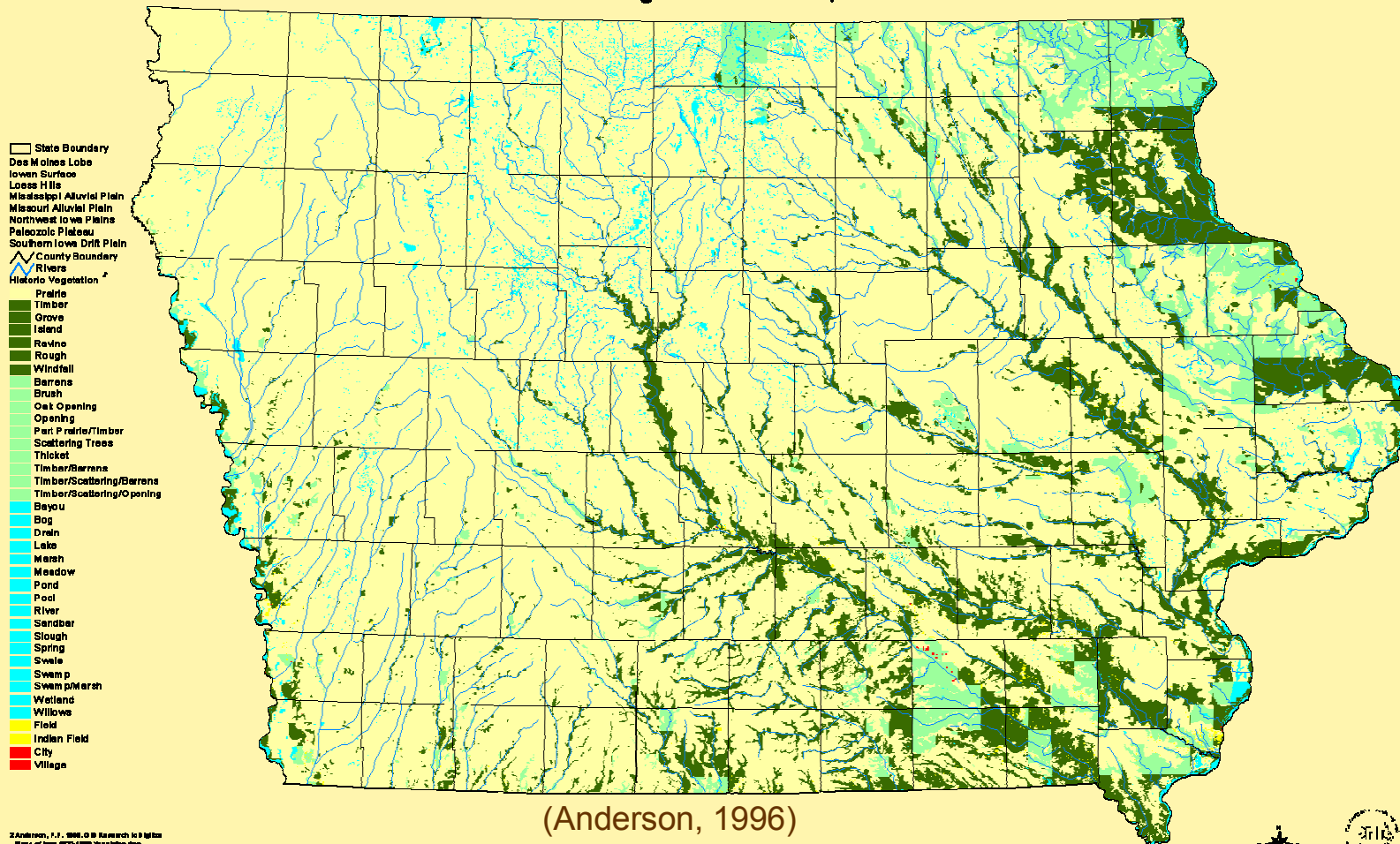
Watershed	Drainage area (km ²)	Mean channel slope (m/km)	Average annual precipitation (cm)
Turkey River	4,408	0.66	89
Skunk River	11,419	0.23	94
Floyd River	2,313	0.52	70
West Nishnabotna River	4,310	0.56	85



Historical data

- General Land Office (GLO) Township Plat maps

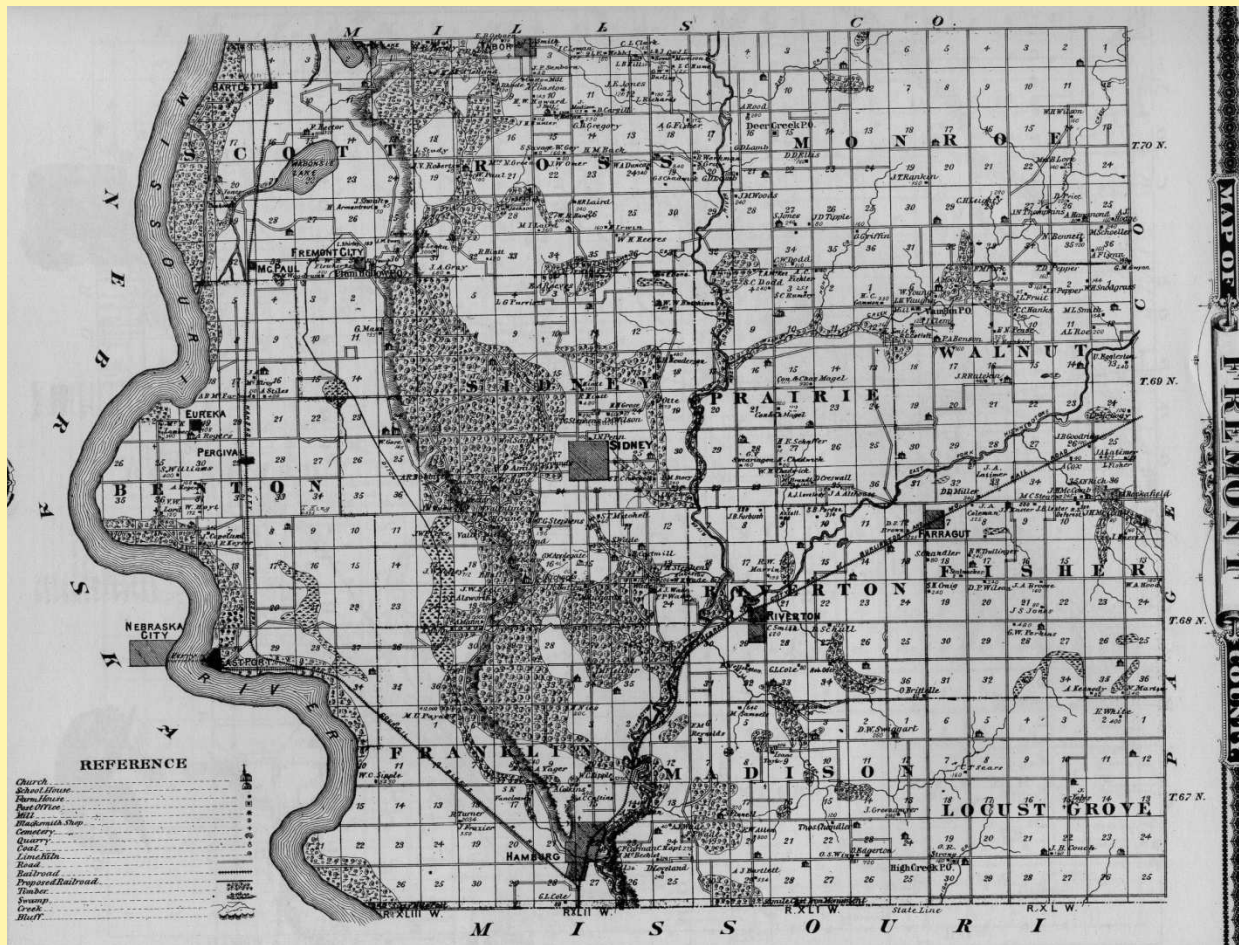
Historic Vegetation of Iowa, 1832 - 1859





Historical data

- Andreas' Illustrated Atlas of Iowa (IASI)

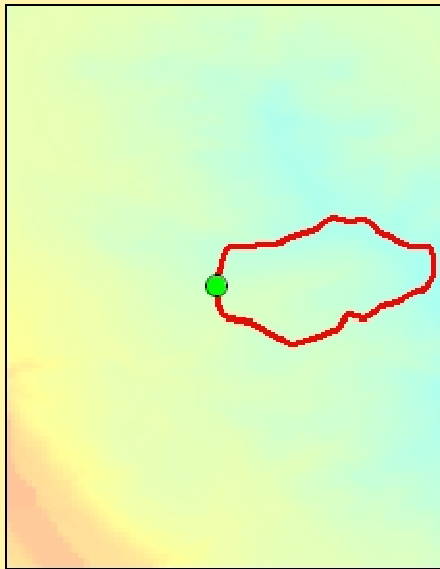


(Andreas, 1875)

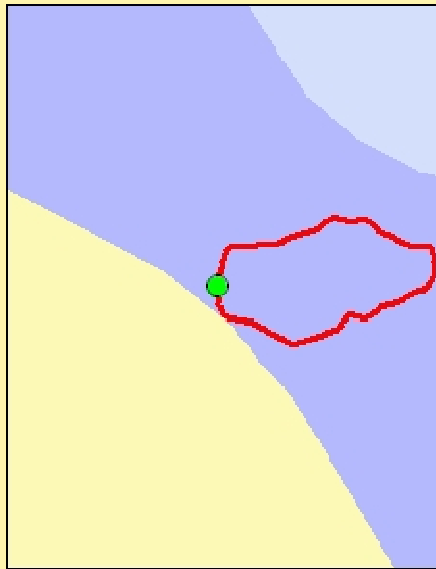


Modern data

Topography



Soil



NLCD 2001





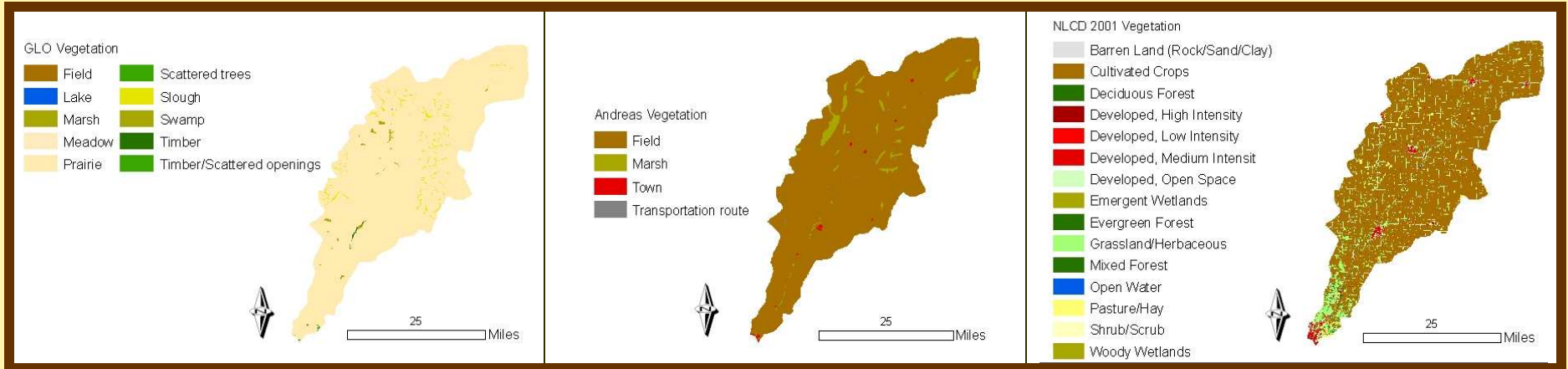
Approach

GLO	IASI	NLCD 2001	HSG B	HSG C	HSG D
-	Transportation route	Dirt streets	82	87	89
Field	Field	Straight row crops	78	85	89
Timber	Timber	Woods	55	70	77
Village	Town	Residential 1/2 acre	70	80	85

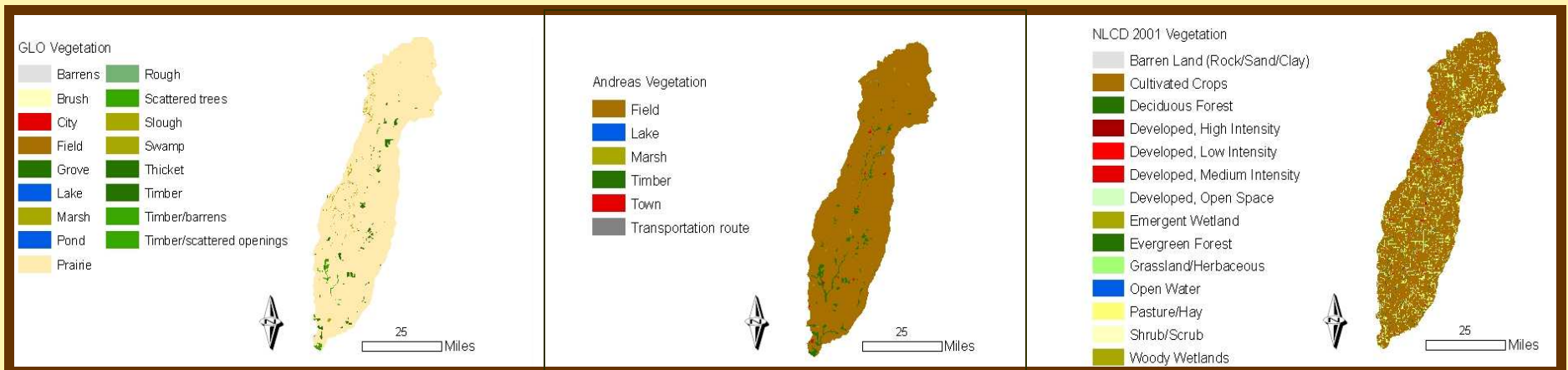


Land cover

Floyd



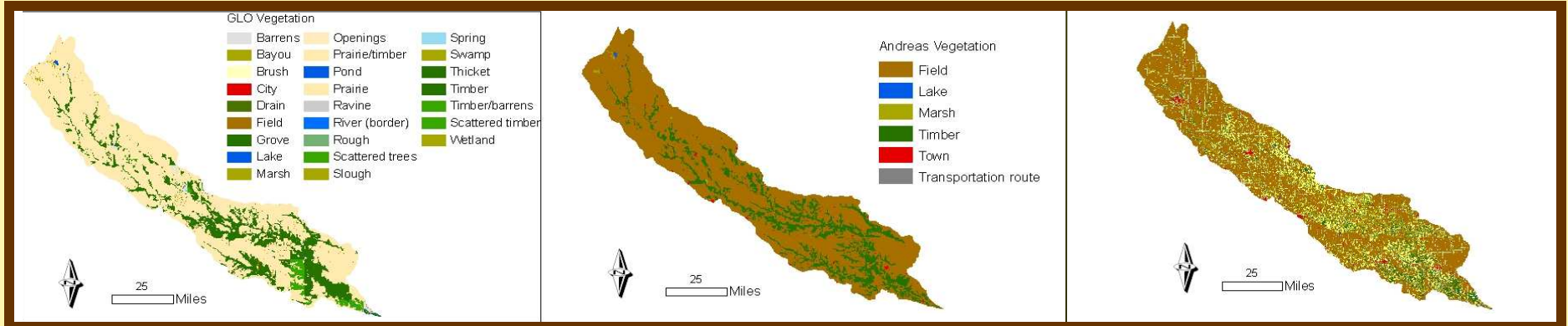
West Nishnabotna



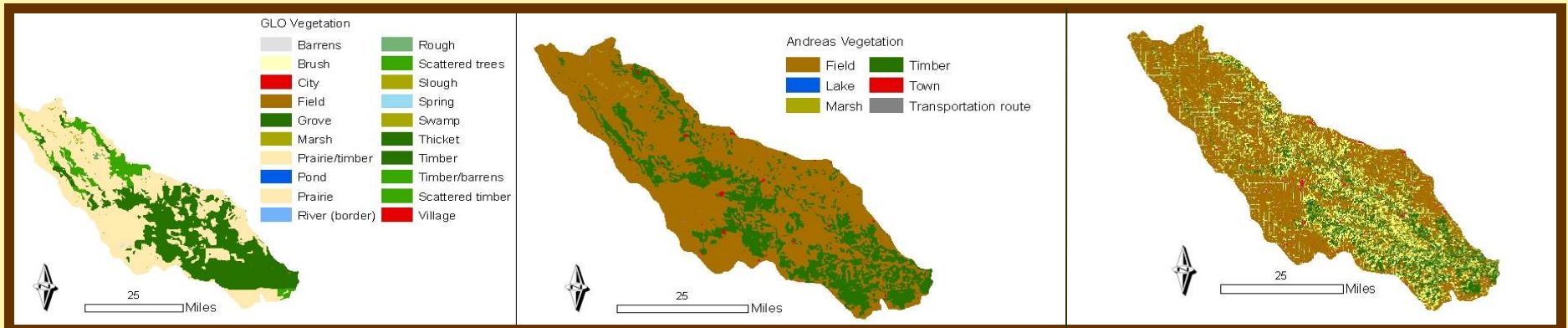


Land cover

Skunk



Turkey



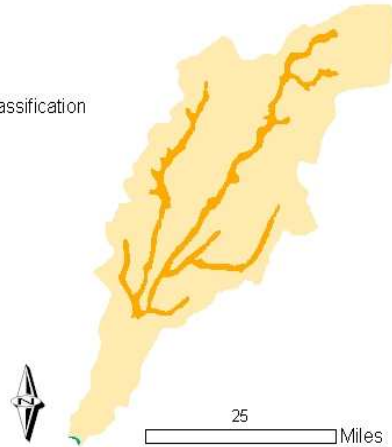


Hydrologic Soil Group

Floyd River

Hydrologic Soil Group Classification

- B
- B/D
- D



Turkey River

Hydrologic Soil Group Classification

- B
- C



West Nishnabotna River

Hydrologic Soil Group Classification

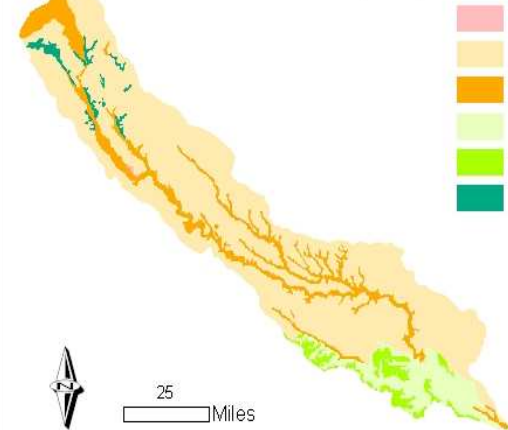
- B



Skunk River

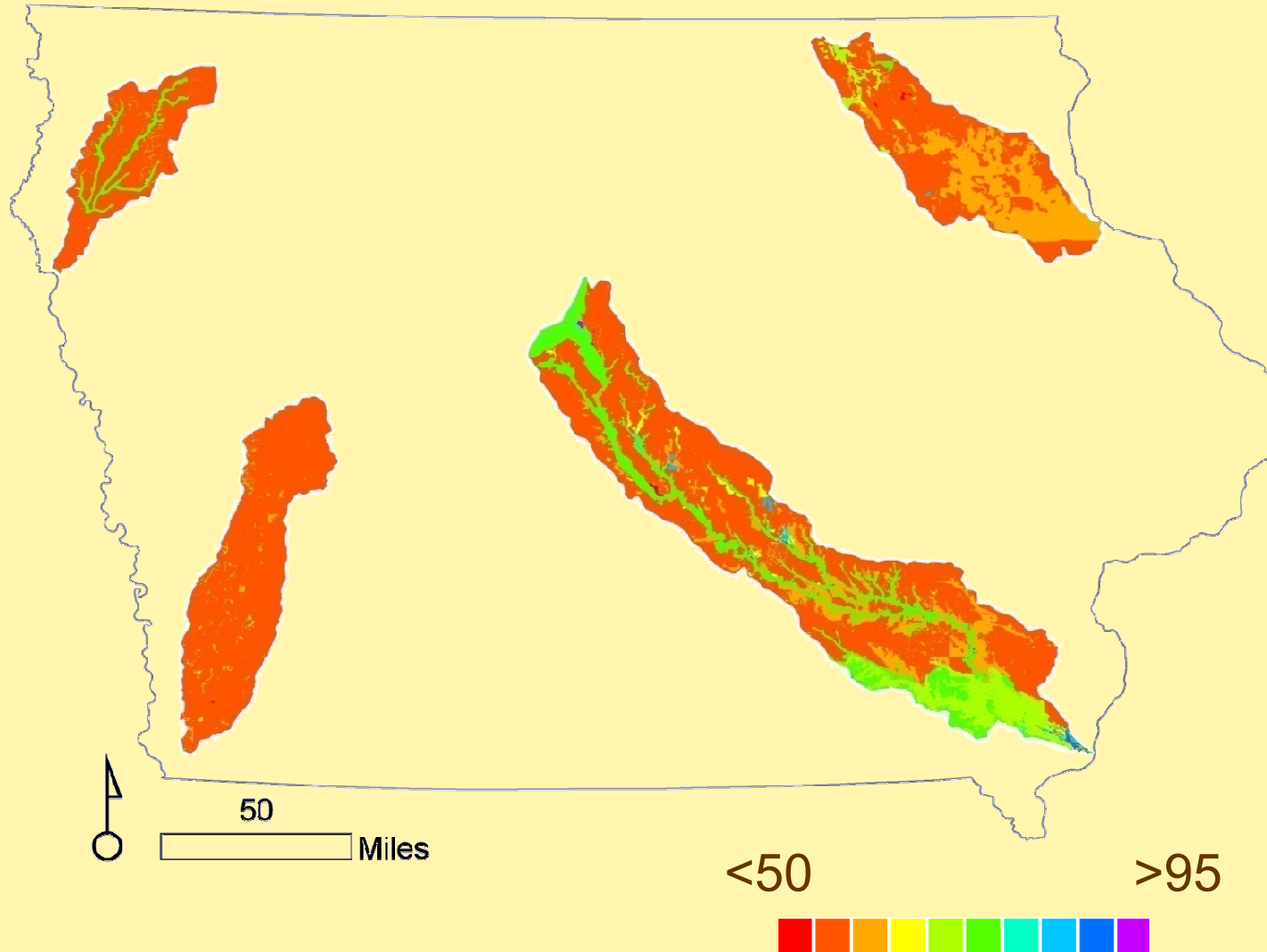
Hydrologic Soil Group Classification

- A
- B
- B/D
- C
- CD
- D



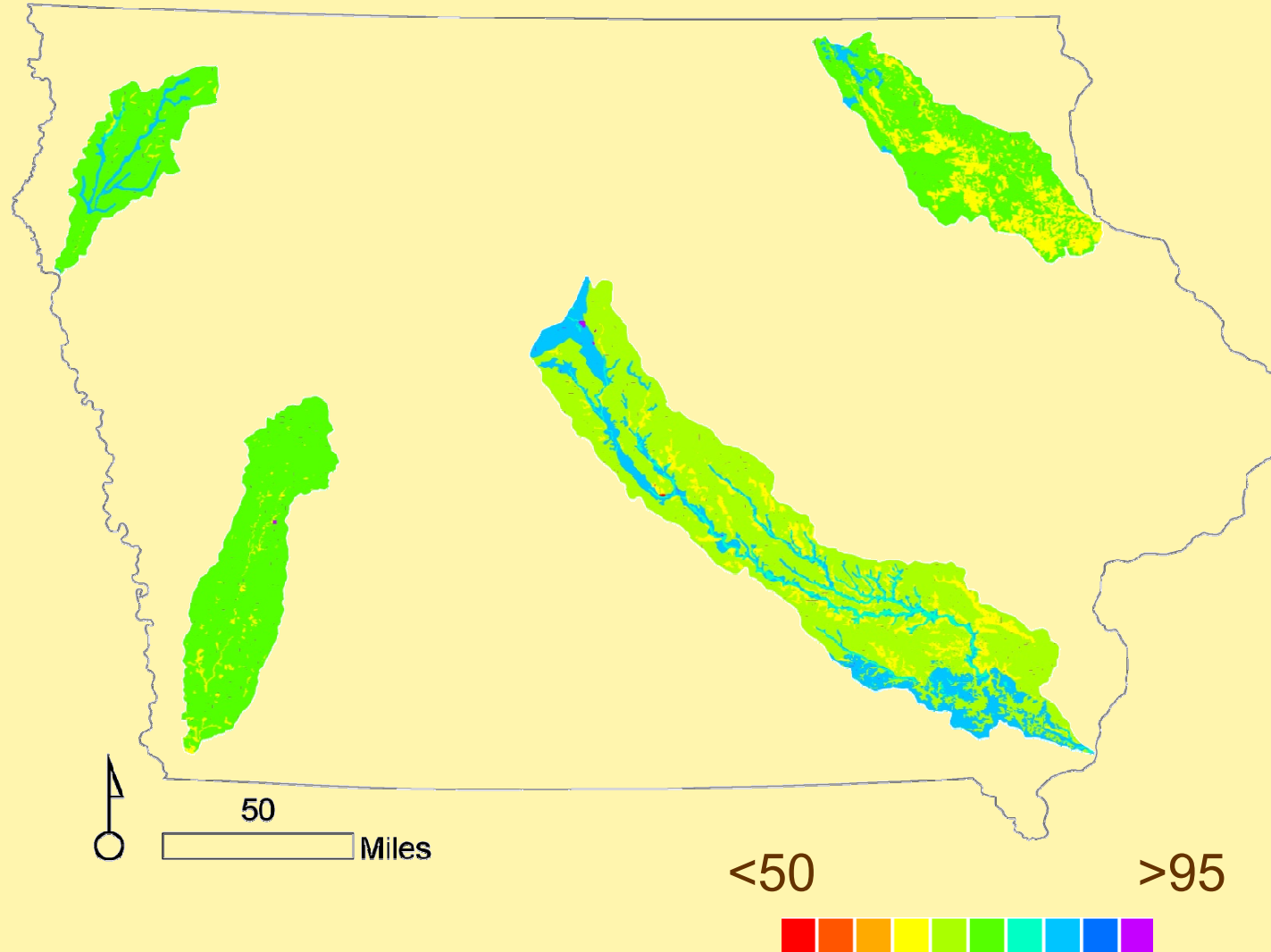


GLO Curve Number



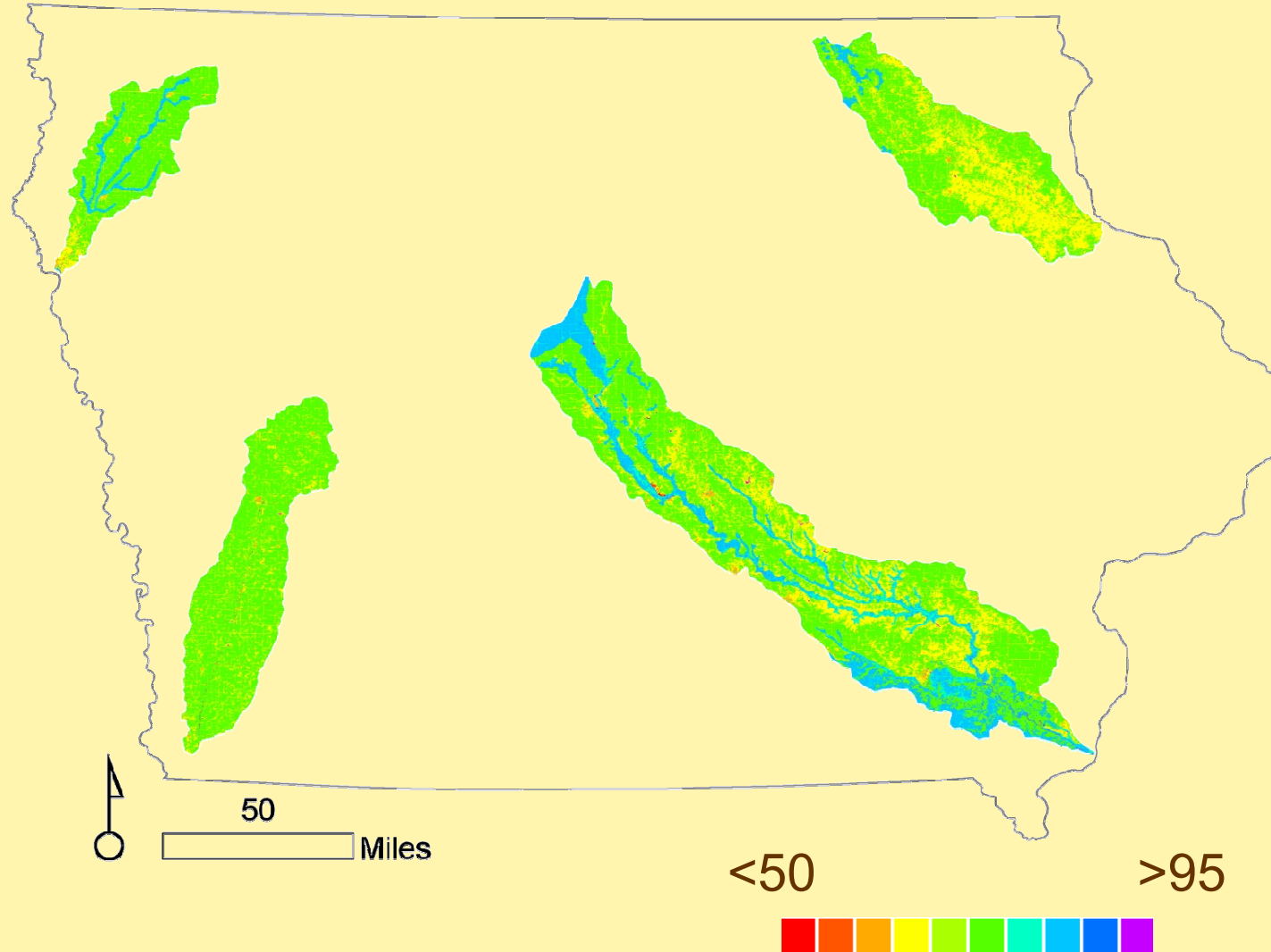


IASI Curve Number



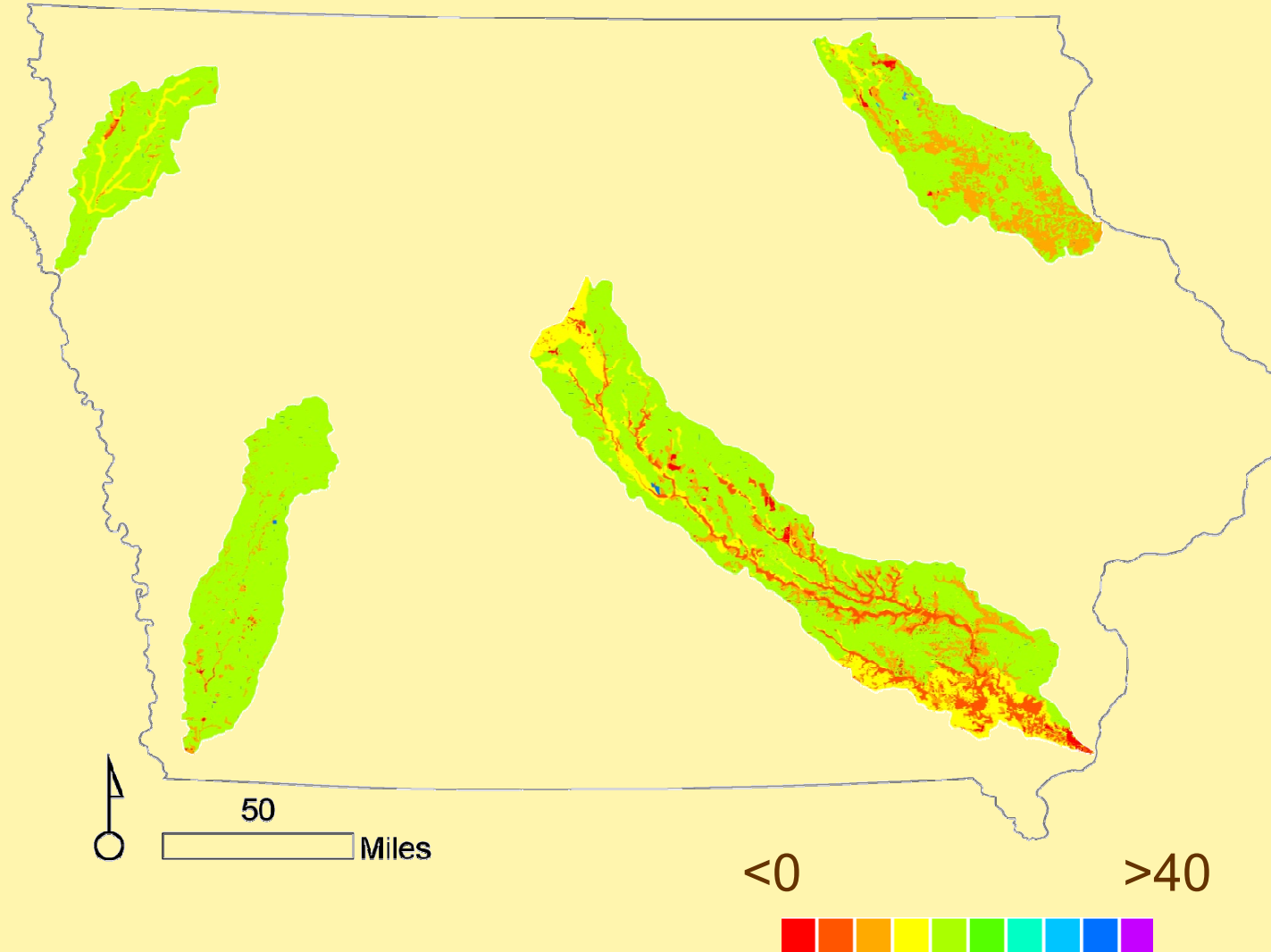


NLCD 2001 Curve Number



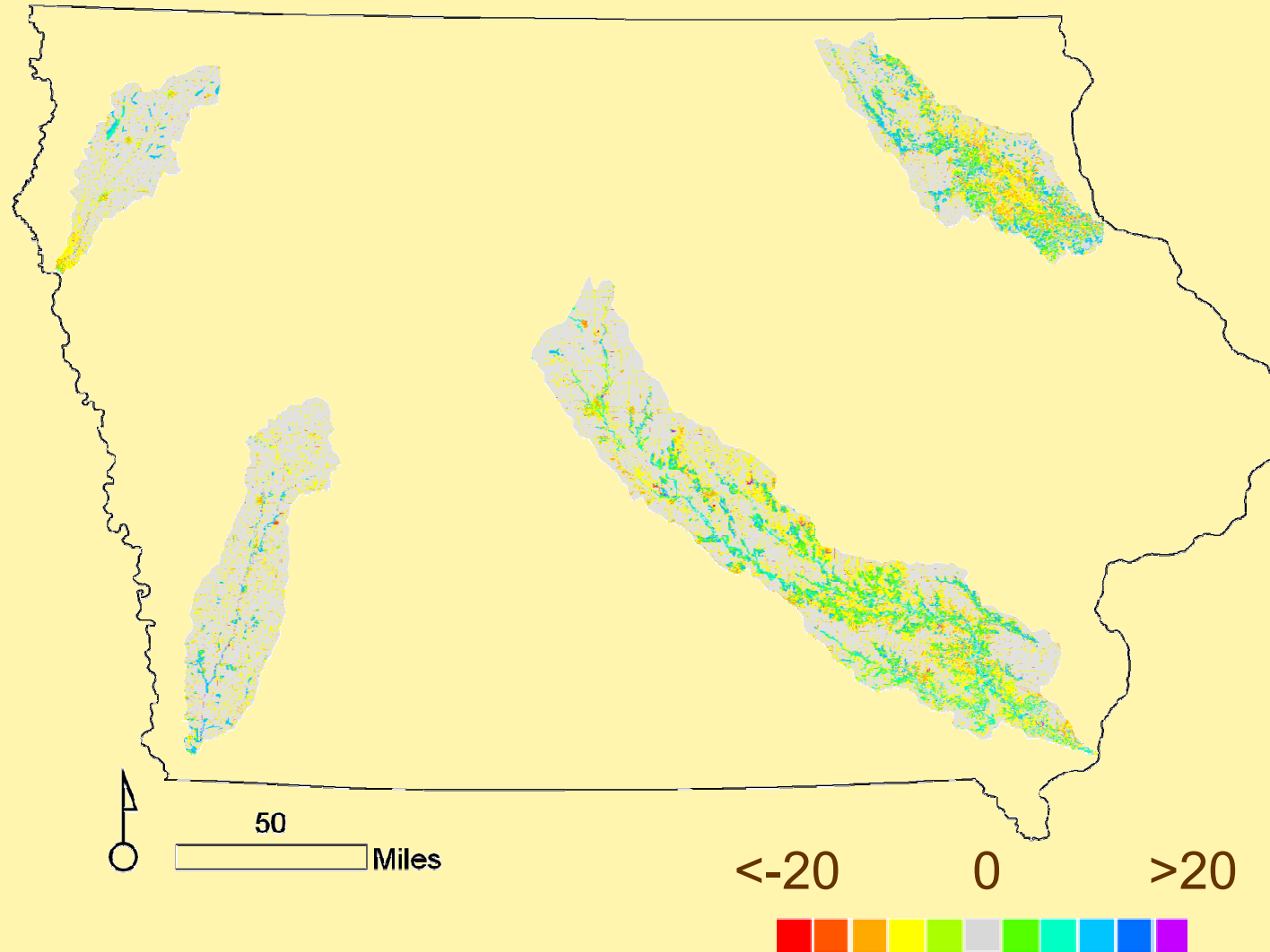


GLO-IASI CN change





IASI-NLCD 2001 CN change





Forest change statistics

Percentage of forested watershed

Watershed	GLO	Δ	IASI	Δ	NLCD 2001
Turkey River	43	-16	27	-13	14
Skunk River	22	-2	20	-13	7
Floyd River	0	0	0	1	1
West Nishnabotna River	2	2	4	-2	2
Weighted average	20	-4	16	-9	7



Results

Curve number change over time

Watershed	GLO CN	Δ	IASI CN	Δ	NLCD 2001 CN
Turkey River	59.3	15.7	75.0	-1.1	73.9
Skunk River	63.5	15.2	78.7	-1.1	77.6
Floyd River	60.4	18.6	79.0	-1.2	77.8
West Nishnabotna River	58.2	19.4	77.6	-1.1	76.5
Composite mean	61.4	16.4	77.8	-1.1	76.7



Example

Assume:

52 km² basin

24-hour rainfall distribution of Des Moines

two percent slope

hydraulic watershed length of 442 meters

$T_c = 51$ minutes

Land Cover	CN	2-year m ³ /s	5-year m ³ /s	10-year m ³ /s	25-year m ³ /s	50-year m ³ /s	100-year m ³ /s
GLO	61	64	155	230	328	405	534
IASI	77	277	439	553	688	788	951
NLCD 2001	76	260	420	532	668	766	927

- 50% change exceedance flood (2-year flood) increased 306%
- 1% change exceedance flood (100-year flood) increased 74%



Conclusions

- Land cover change within three decades was drastic
- Deforestation and urbanization between 1875-2001 compensated by improved agricultural land management (pasture has lower CN than straight row crops)
- How much are conclusions limited by data



Acknowledgements

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This project was supported by:





Approach

GLO land cover	IASI land cover	NLCD 2001 land cover	HSG A	HSG B	HSG C	HSG D
-	Transportation route	Dirt streets	72	82	87	89
Barrens	-	Woods-grass combo	32	58	72	79
Bayou	-	-	100	100	100	100
Brush	-	Brush	30	48	65	73
City	-	Residential 1/8 acre	77	85	90	92
Field	Field	Straight row crops	67	78	85	89
Grove	-	Woods	30	55	70	77
Marsh	Marsh	-	100	100	100	100
Meadow	-	Meadow	30	58	71	78
Pond	-	-	100	100	100	100
Prairie	-	Meadow	30	58	71	78
Prairie/timber	-	Woods-grass combo	32	58	72	79
Ravine	-	-	100	100	100	100
River (border)	-	-	100	100	100	100
Rough	-	Brush	30	48	65	73
Scattered timber	-	Woods-grass combo	32	58	72	79
Scattered trees	-	Woods-grass combo	32	58	72	79
Spring	-	-	100	100	100	100
Swamp	-	-	100	100	100	100
Thicket	-	Woods	30	55	70	77
Timber	Timber	Woods	30	55	70	77
Timber/barrens	-	Woods-grass combo	32	58	72	79
Timber/openings	-	Woods-grass combo	32	58	72	79
Village	Town	Residential 1/2 acre	54	70	80	85
Wetland	-	-	100	100	100	100