Iowa Conservation Practices: Historical Investments, Water Quality, and Gaps

Presentation prepared for the Iowa Farm Bureau Conservation and Environmental Issues Conference, June 28, 2006

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Interim and preliminary results from project

- Funded by Iowa Farm Bureau Federation, Iowa Corn Growers Association, the Iowa Soybean Association, and the Leopold Center for Sustainable Agriculture
- Thanks to IDALS and NRCS for providing key cost-share data (more information on poster)
- Iowa Department of Natural Resources, previous study provided starting point

Key Topics

1. Briefly summarize DNR work
2. Goals of current project
3. Project progress
   - Information Sources
   - Usage of Practices and Statewide Acreage
   - Costs of Practices
   - Hydrologic Modeling and Water Quality
4. Challenges and Gaps

1. CARD/DNR Study

DNR goals:

1. Provide estimate of Iowa's "needs" for non-point source pollution water quality control
2. Inform the debate in Iowa concerning water quality

Study:

1. Summarize baseline water quality and land use
2. Identify set of conservation practices in each watershed
3. Predict water quality (sediment and nutrients) under this set of practices
4. Compute cost of those practices (provides "needs" answer)

2. Current Study

Goals:

1. What conservation practices are currently in place in Iowa, what is their coverage, and what is the cost of these practices?

2. What are (and have been) the effects of this investment on water quality?

3. What would it take to improve water quality to obtain specific standards?

What practices?

Land Retirement (CRP)


Terraces


Contour farming


Grassed waterways

Conservation tillage

(Mulch till >30% residue, no-till >60%)

Project progress: Information Sources

Conservation Programs Used

	EQIP	**IFIP**	**CRP**
Description	Federal Conservation Program	State Conservation Program	Federal Conservation Program
Program Function	Cost Sharing and Incentive Payments	Cost Sharing and Incentive Payments	Cost Sharing, Maintenance Incentive Payments, and Rental Payments
Coverage	Contour Farming Filter Strips Grassed Waterways Nutrient Management Terraces Tillage Practices	Contour Farming Contour Stripcropping Filter Strips Grassed Waterways Terraces Tillage Practices	Land retirement
Years	1997 to 2005	1997 to 2005	2004
Positives	1. The entire population of contracts that received assistance is included. 2. During the practices contract period the practice is required to be maintained in working condition.	1. The entire population of contracts that received assistance is included. 2. During the practices contract period the practice is required to be maintained in working condition.	The entire population of CRP land is included.
Negatives	1. Only includes records where the practice was cost-shared on or offered incentive. 2. Available records are more highly aggregated than IFIP records.	1. Only includes records where the practice was cost-shared on or offered incentive.	Aggregated for all practices

Surveys Used

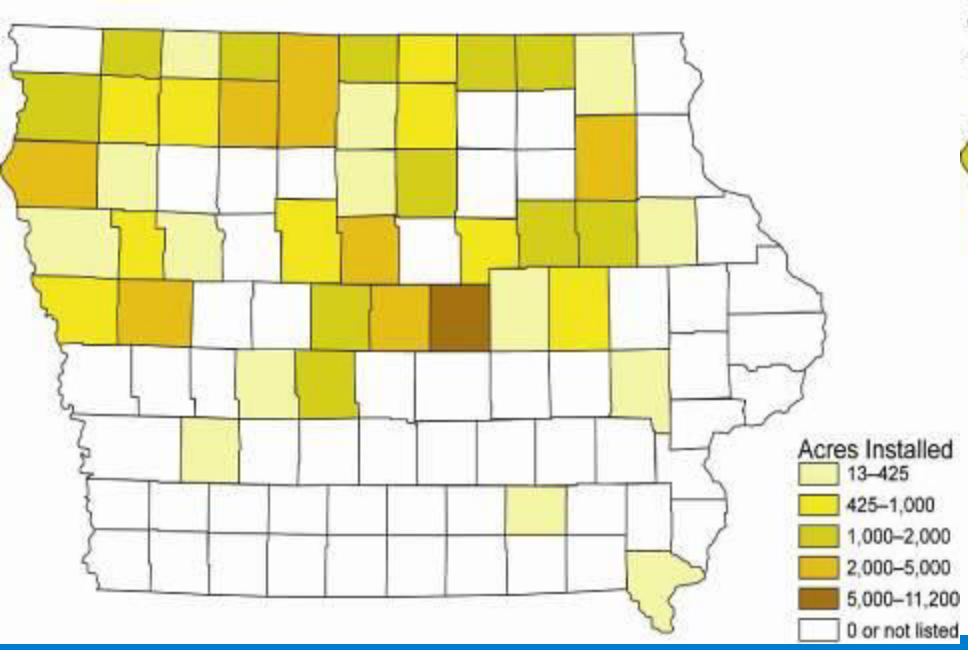
	NRI	**CTIC**
Description	USDA Survey	Reported findings from the USDA's Crop Residue Management Survey
Coverage	Contour Farming Contour Stripcropping Filter Strips Grassed Waterways Terraces Erodibility Measures	CRP Tillage Practices
Years	1997	2004
Nature of Survey	statistically based survey. Data were collected using a variety of imagery, field office records, historical records and data, ancillary materials, and a limited number of on-site visits	"best estimates" of district conservationist are combined with Cropland Transect Surveys
Positives	1. Records the total coverage of the practices (both those that received financial assistance and those that were installed voluntarily without funding).	1. Records the total coverage of the practices (both those that received financial assistance and those that were installed voluntarily without funding).
Negatives	1. Conservation practice usage is calculated from a sample and so assumptions are made about the population.	1. Aggregate data (at the county level) that cannot be directly used in water quality modeling.

Project progress: Usage of Practices and Statewide Acreage

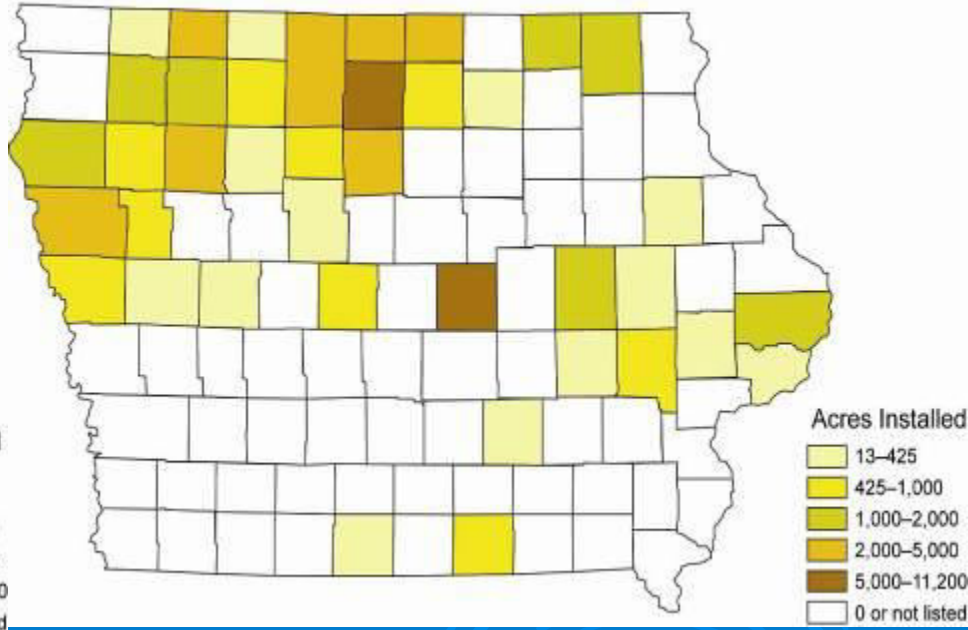
No-Till Installed

(only some counties pay incentive)

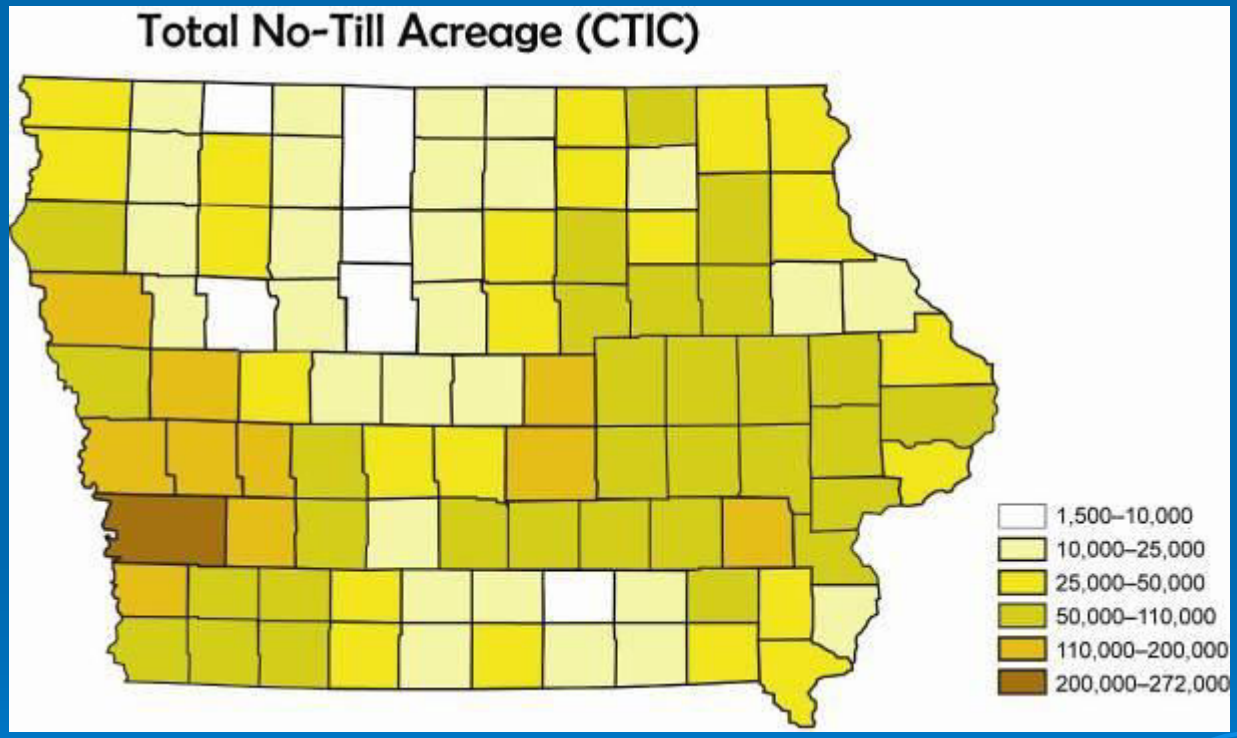
EQIP



IFIP

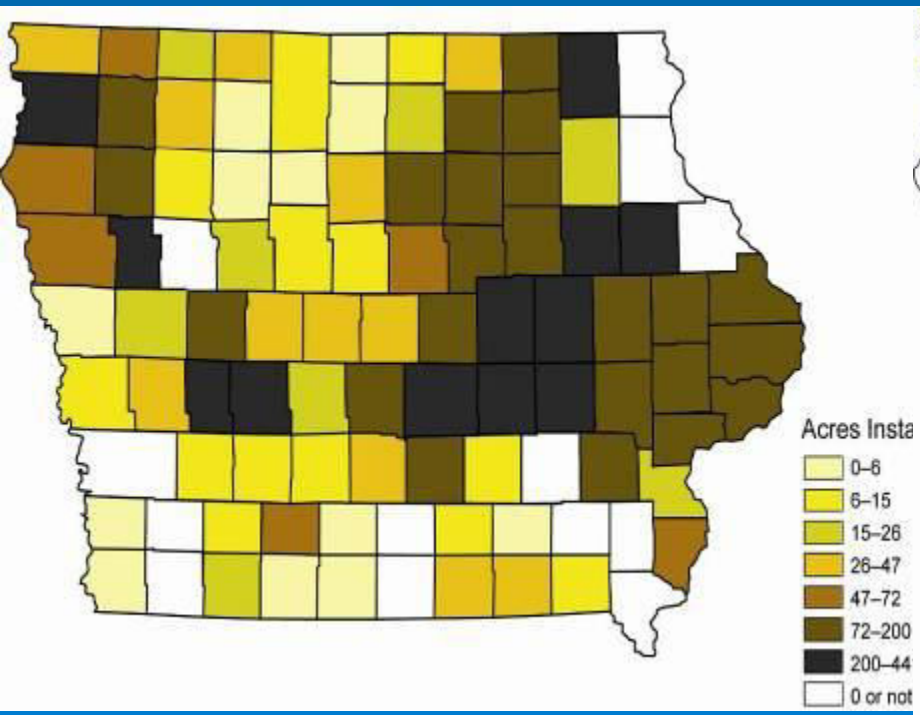


No-Till Usage for 2004

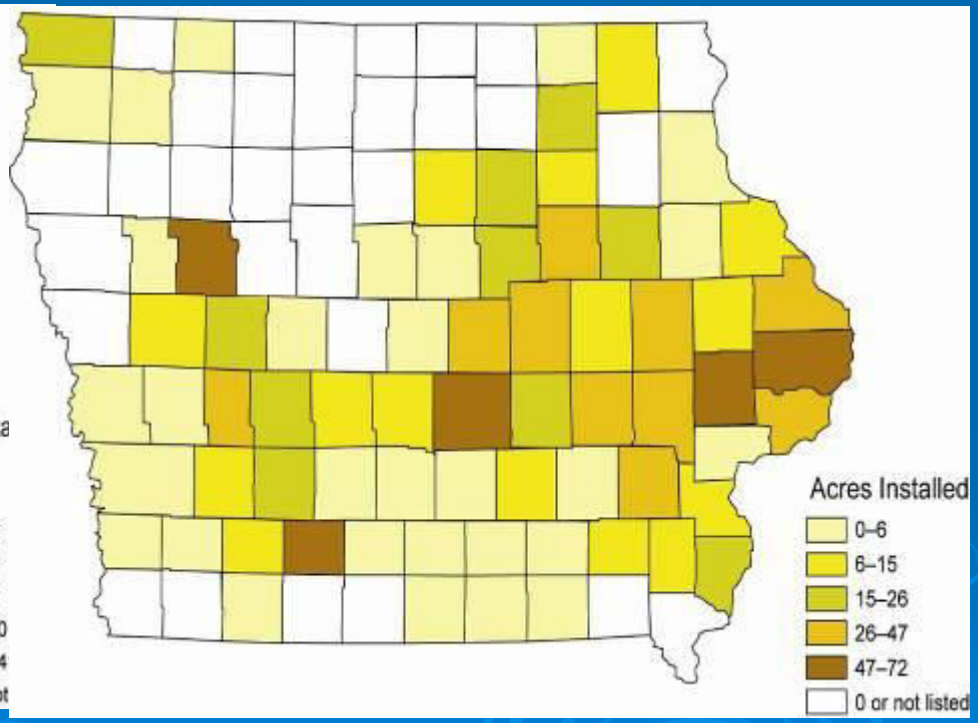


Grassed Waterways Installed

IFIP

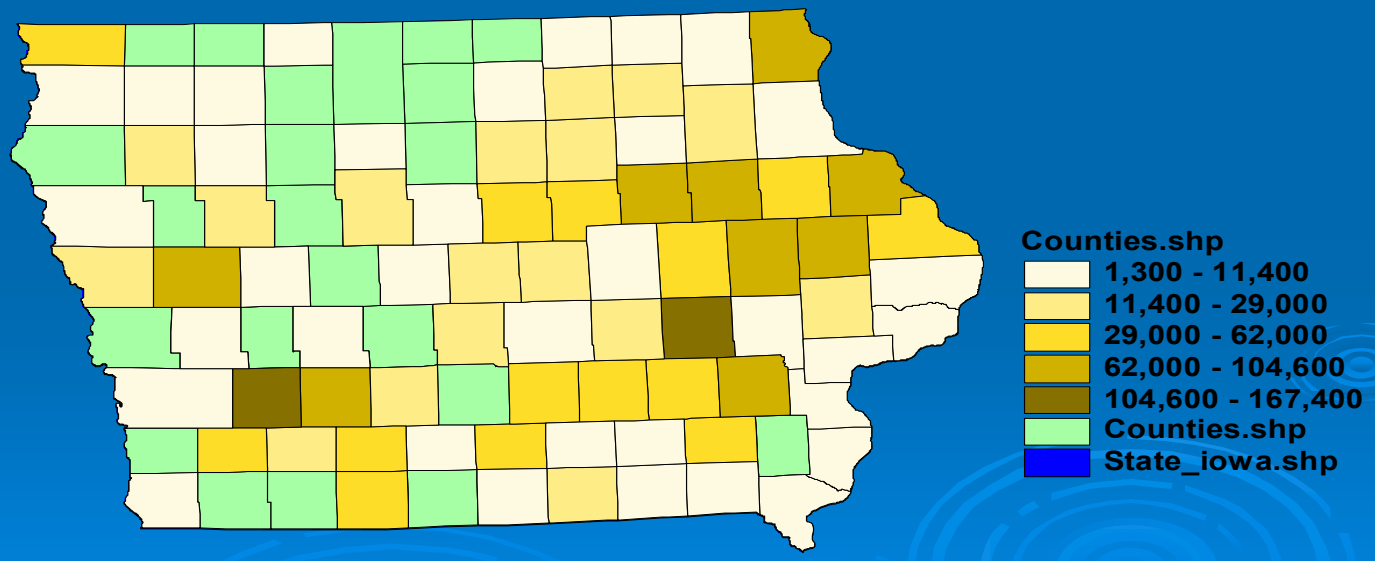


EQIP



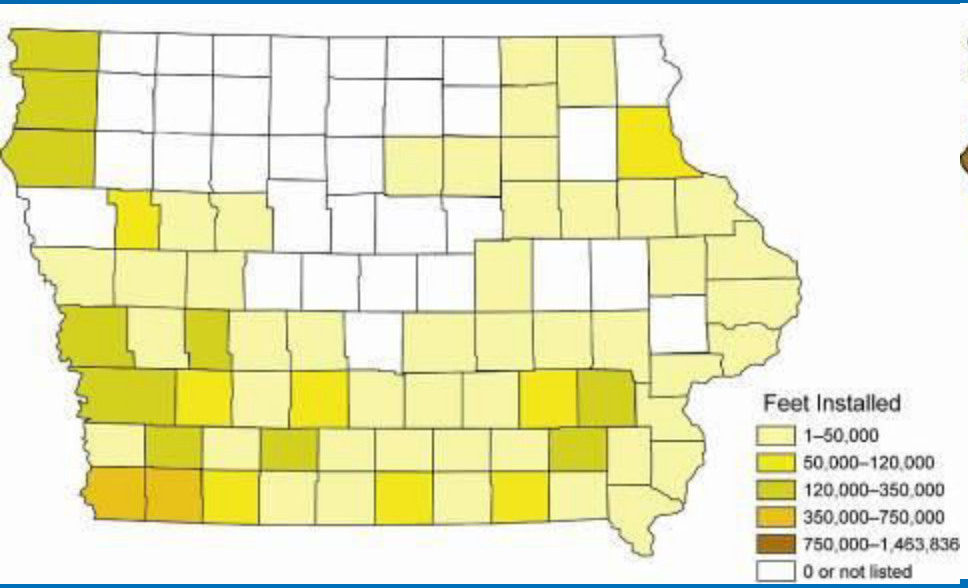
Acres of Grassed Waterways

Survey Name	Acres of Grassed Waterways in Iowa
NRI	2,225,900 acres

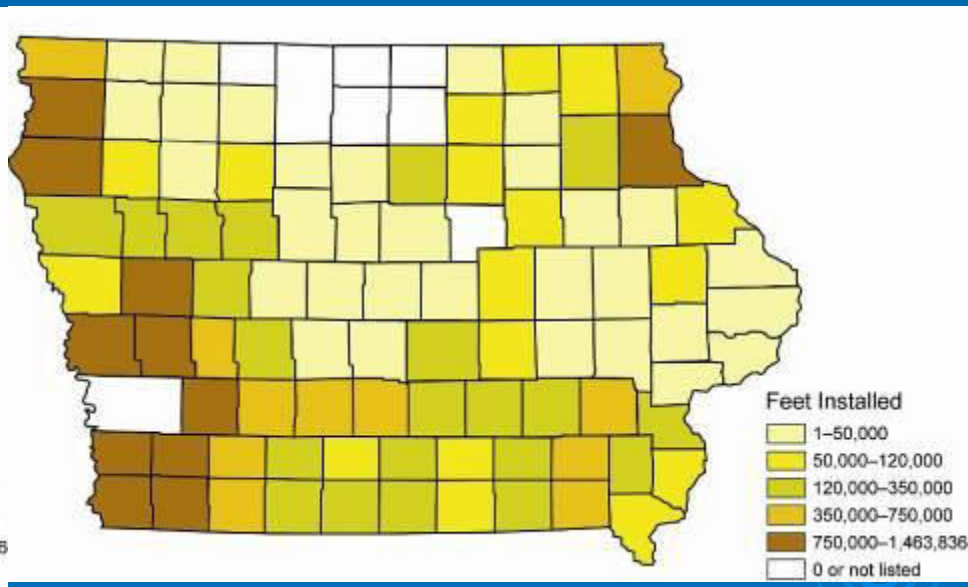


Terraces Installed

EQIP

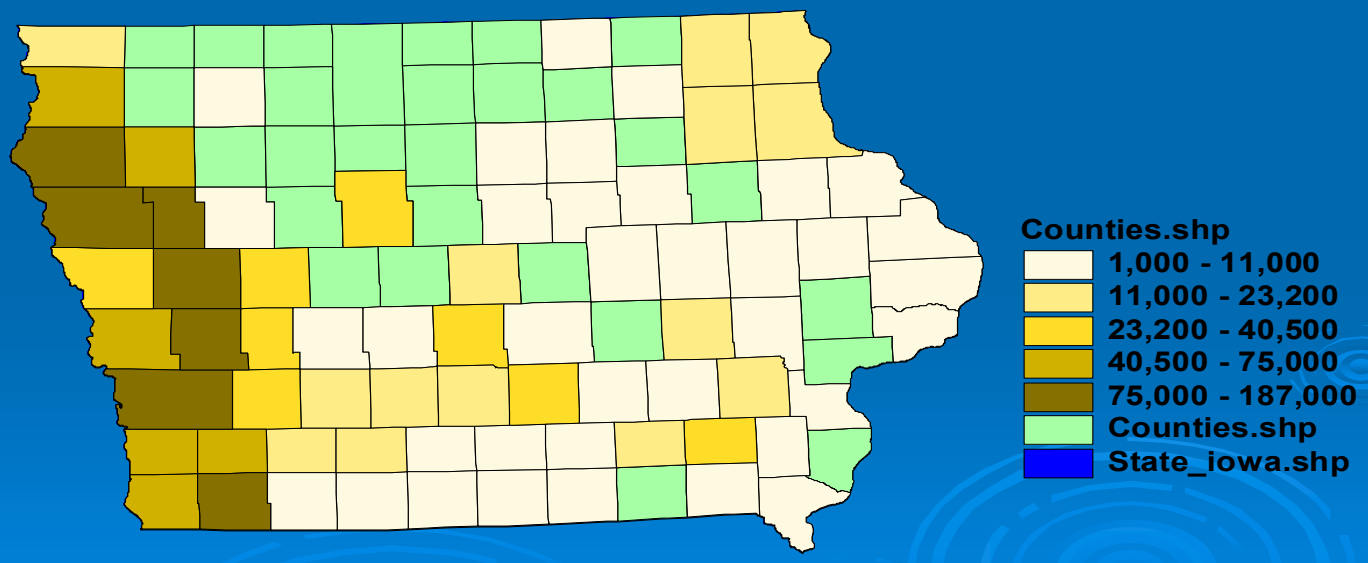


IFIP



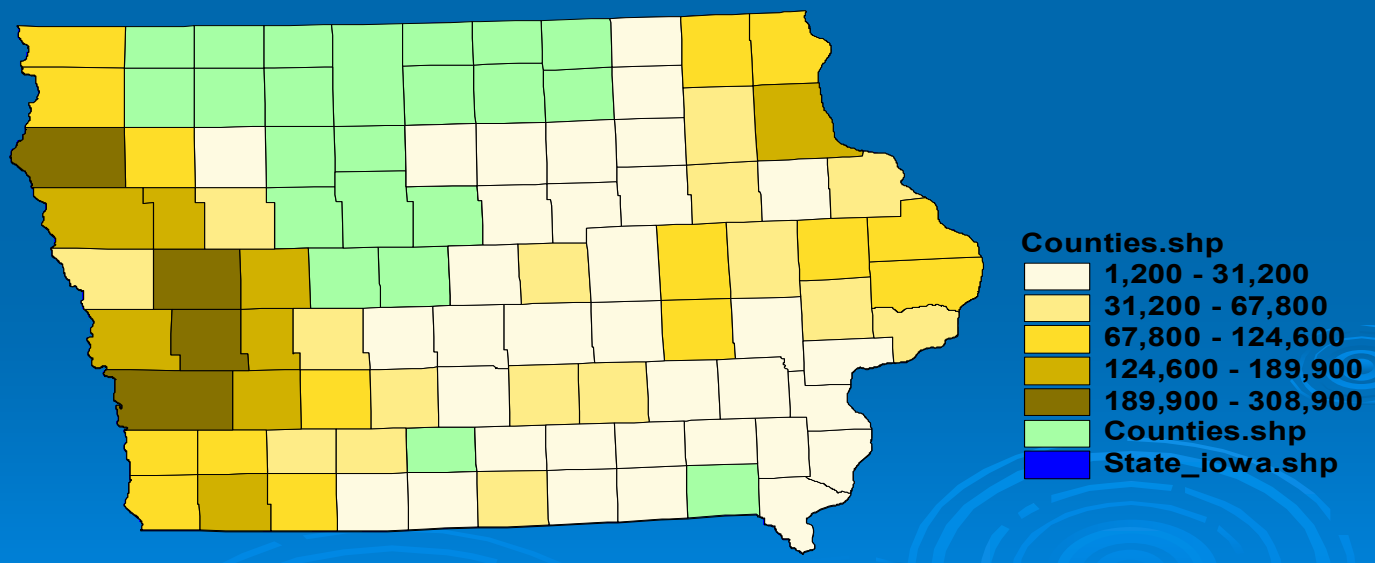
Acres of Terraces

Survey Name	Acres of Terraces in Iowa
NRI	1,997,900 acres



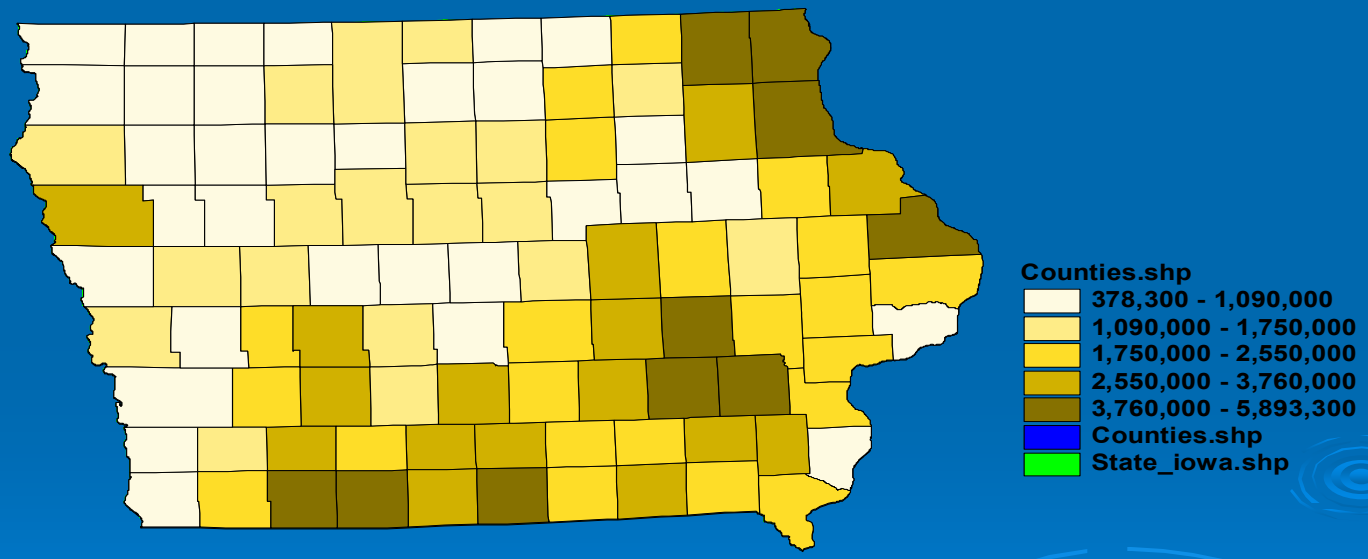
Acres of Contour Farming

Survey Name	Acres of Contour Farming in Iowa
NRI	5,148,200 acres



Acres Enrolled in CRP in 2004

Program Name	State Total Enrolled
CRP	1,894,488.2 acres



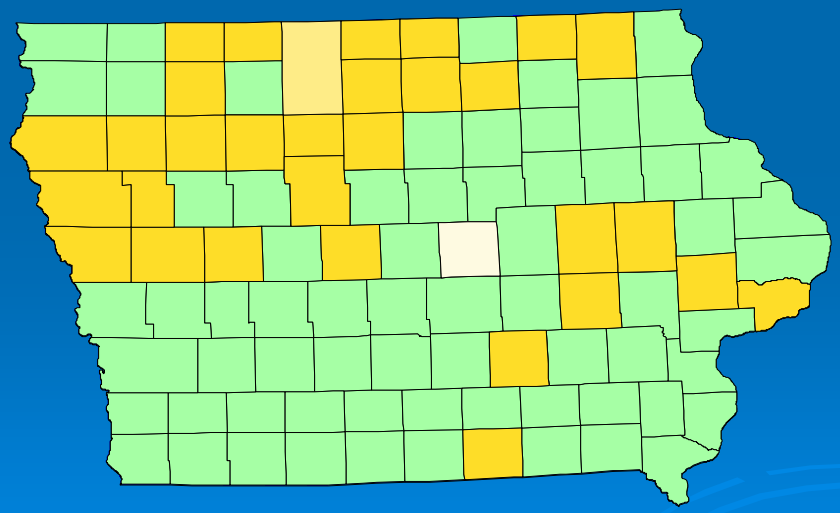
Project progress: Costs of Practices

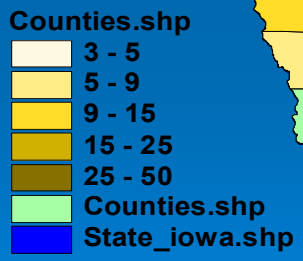
Average Cost Per Acre for No-Till

Program	Total Installed	Total Cost	Average Cost
EQIP	55,319 acres	$770,930.32	$13.94 / acre
IFIP	13,810 acres	$67,811.20	$4.91 / acre

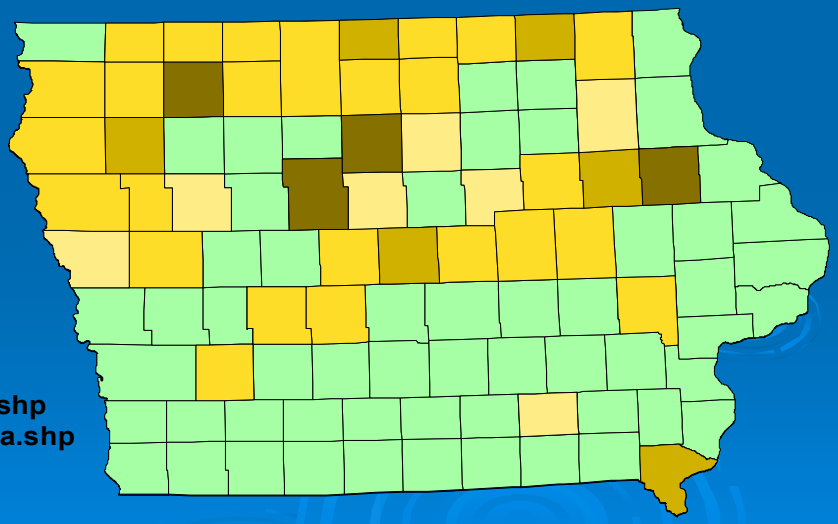
*Note: “No-Till” under EQIP includes no-till & strip till

IFIP





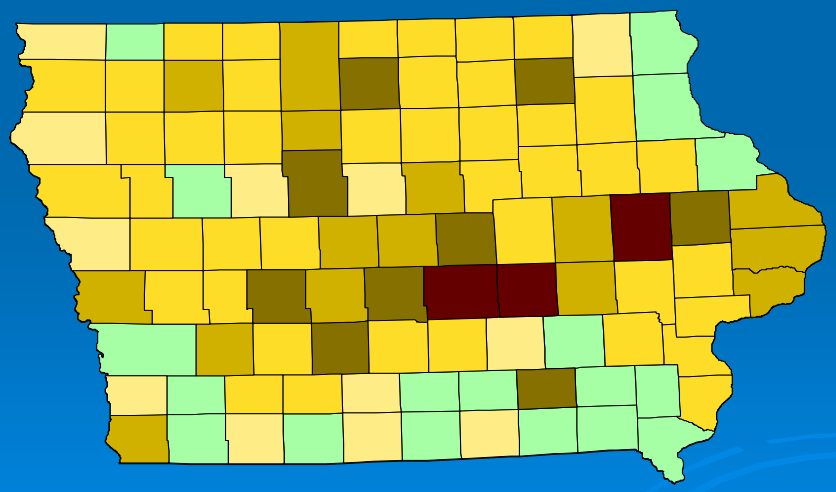
EQIP

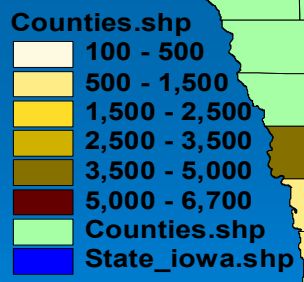


Costs for Grassed Waterways

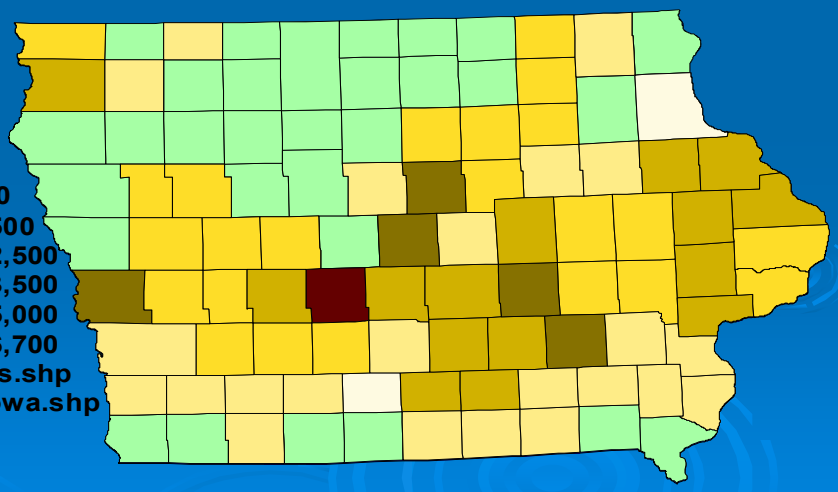
Program	Total Installed	Total Cost	Average Cost
EQIP	1,204 acres	$2,611,183.37	$2,168.68 / acre
IFIP	8,129 acres	$21,928,454.04	$2,697.56 / acre

IFIP



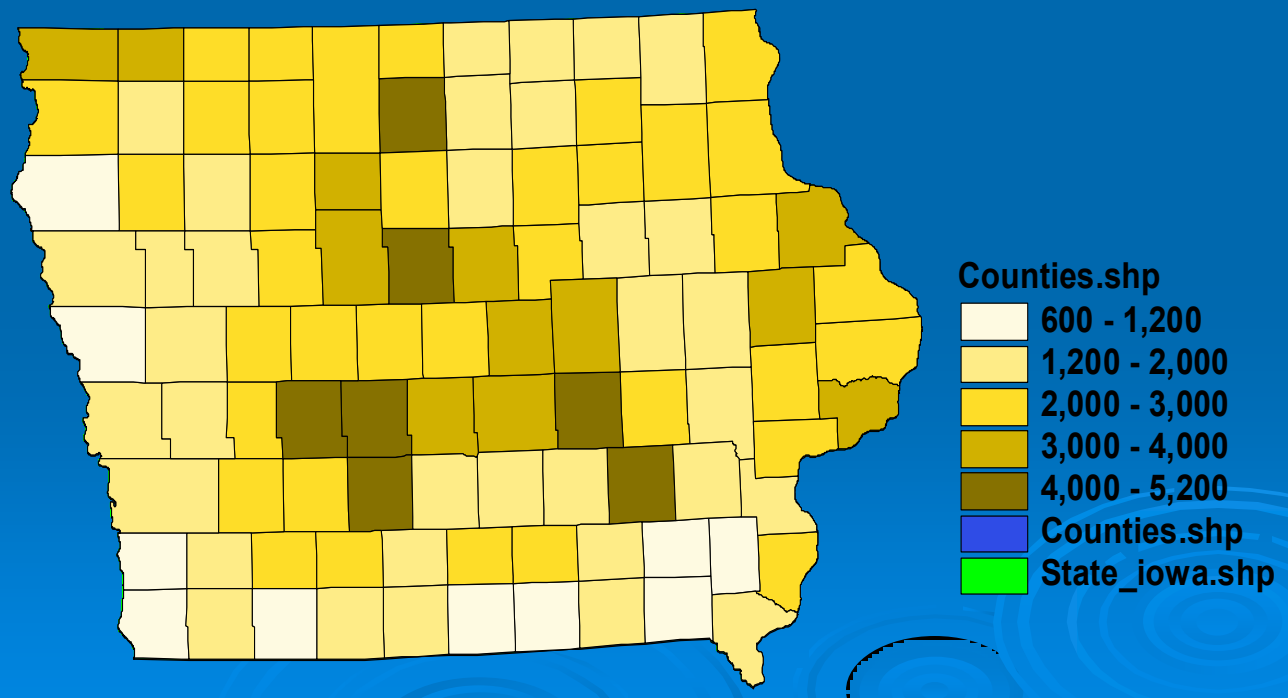


EQIP



Estimates of Average Cost for Grassed Waterways

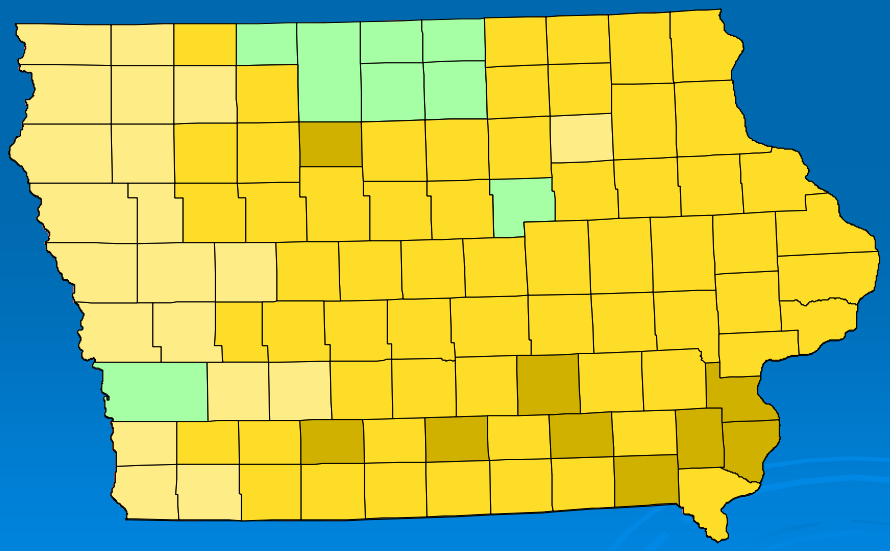
- The average cost of a waterway tends to be very variable due to the unique conditions of each waterway



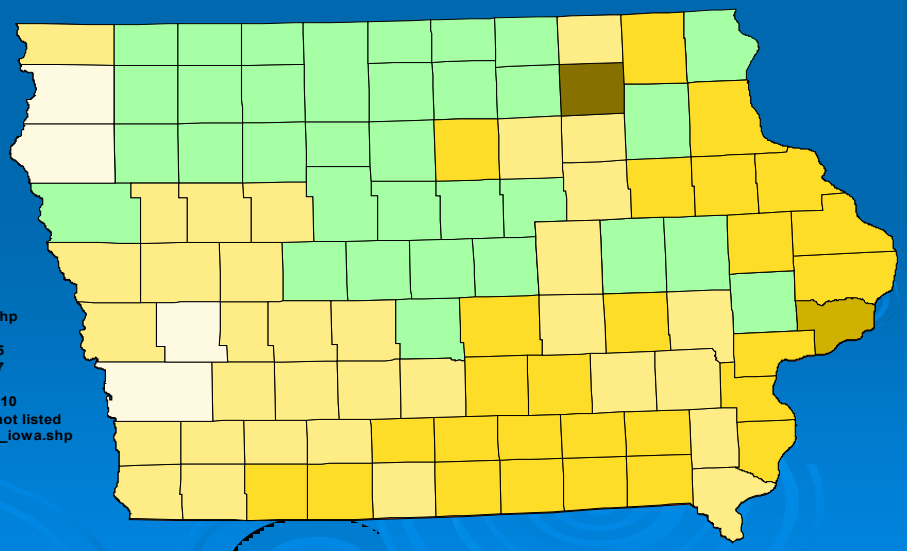
Costs for Terraces

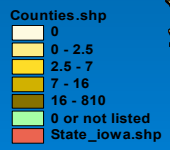
Program	Total Installed	Total Cost	Average Cost
EQIP	4,921,417 feet	$9,251,694.90	$1.88 / ft
IFIP	26,240,971 feet	$74,518,537.78	$2.84 / ft

IFIP



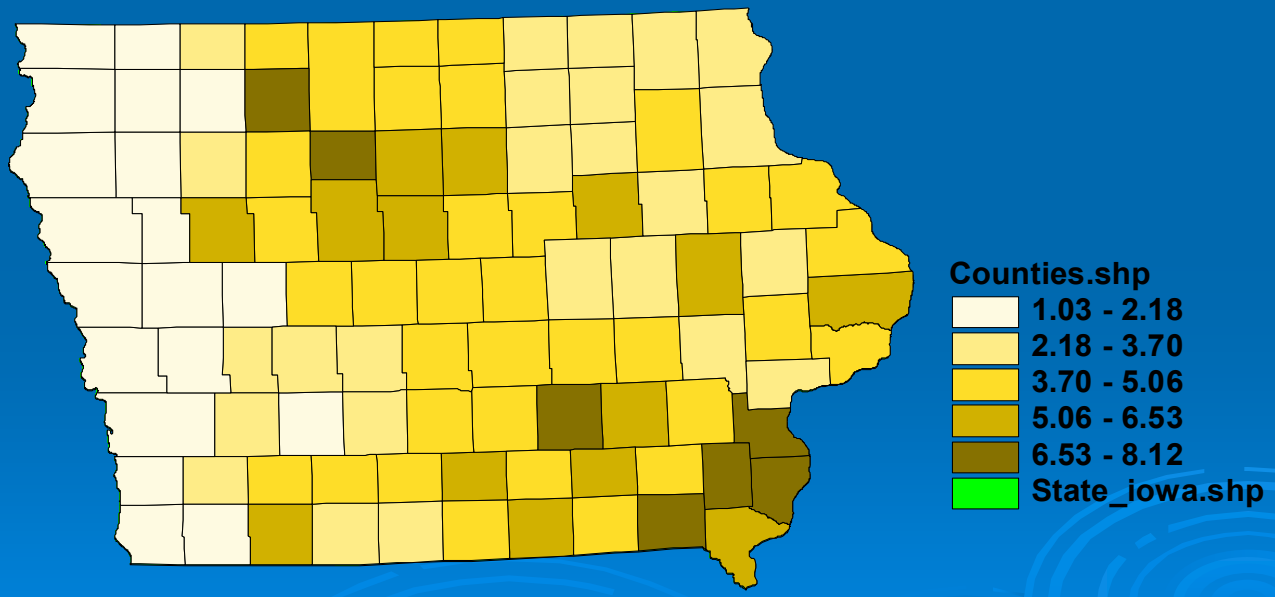
EQIP





Estimates of Average Cost for Terraces

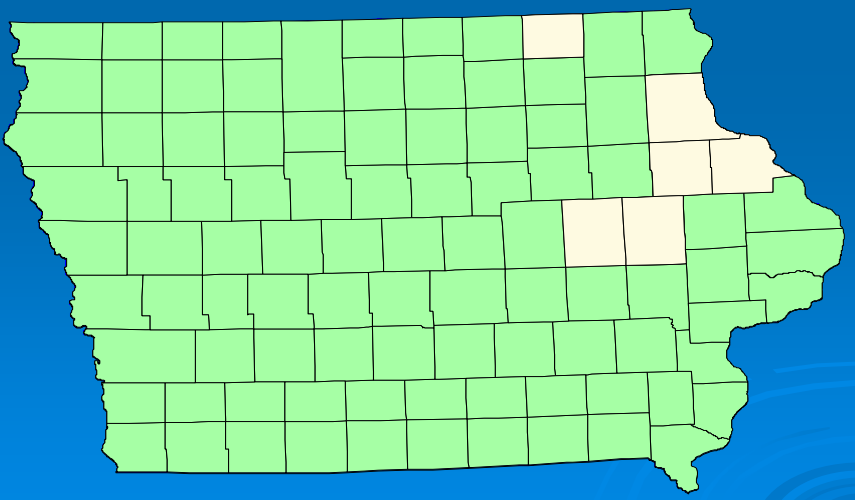
- The average cost of terraces tend to increase across Iowa from east to west
- The average cost of terraces varies depending on the type

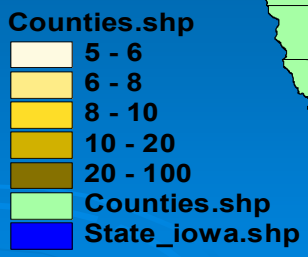


Costs for Contour Farming

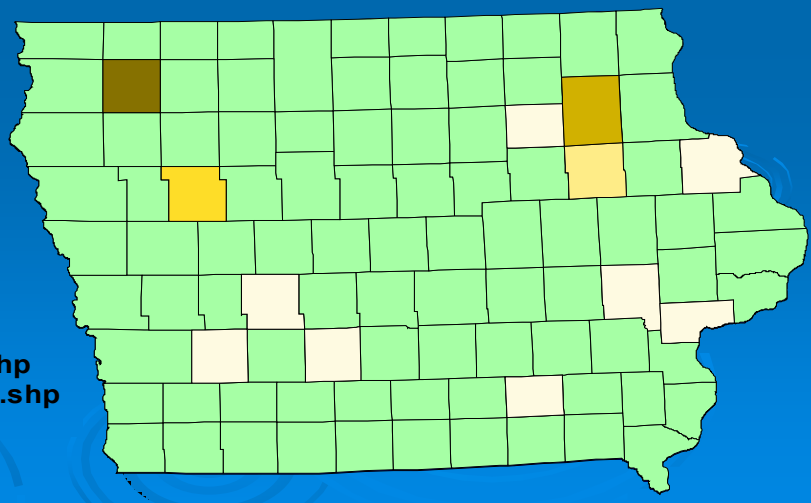
Program	Total Installed	Total Cost	Average Cost
EQIP	1,832 acres	$14,220.33	$7.76 / acre
IFIP	1,098 acres	$6,510.00	$5.93 / acre

IFIP



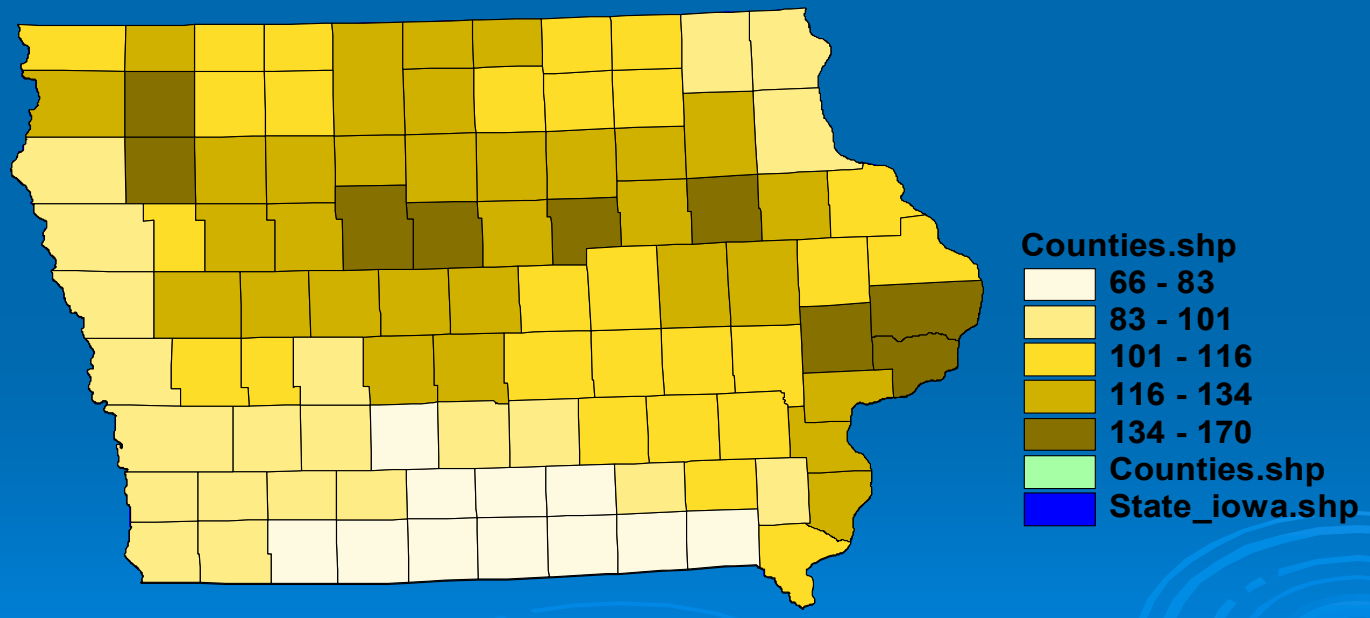


EQIP



Average Cost CRP in 2004

Program	Total Enrolled	Total Payments	Average Payment / acre
CRP	1,894,488.2 acres	$191,777,013.50	$101.23 / acre



Total Costs of the Practices

Practice	Cost
Terraces	$765,574,186
Grassed Waterways	$106,698,847
Contour Farming	$30,889,200
Contour Stripcropping	$3,552,000
No-Till	$104,308,740
Much Till	$82,861,900
CRP	$191,777,014

$872,273,033

$413,388,854

- The first two practices are structural practices.
- Divide the installation costs over the lifespan of the practices (terrace: 25yrs, GW: 10 yrs), then the sum of annual payment is: $41,292,852.
- The cost numbers for the rest of the practices are annual payments.
- Then the total annual costs would be:

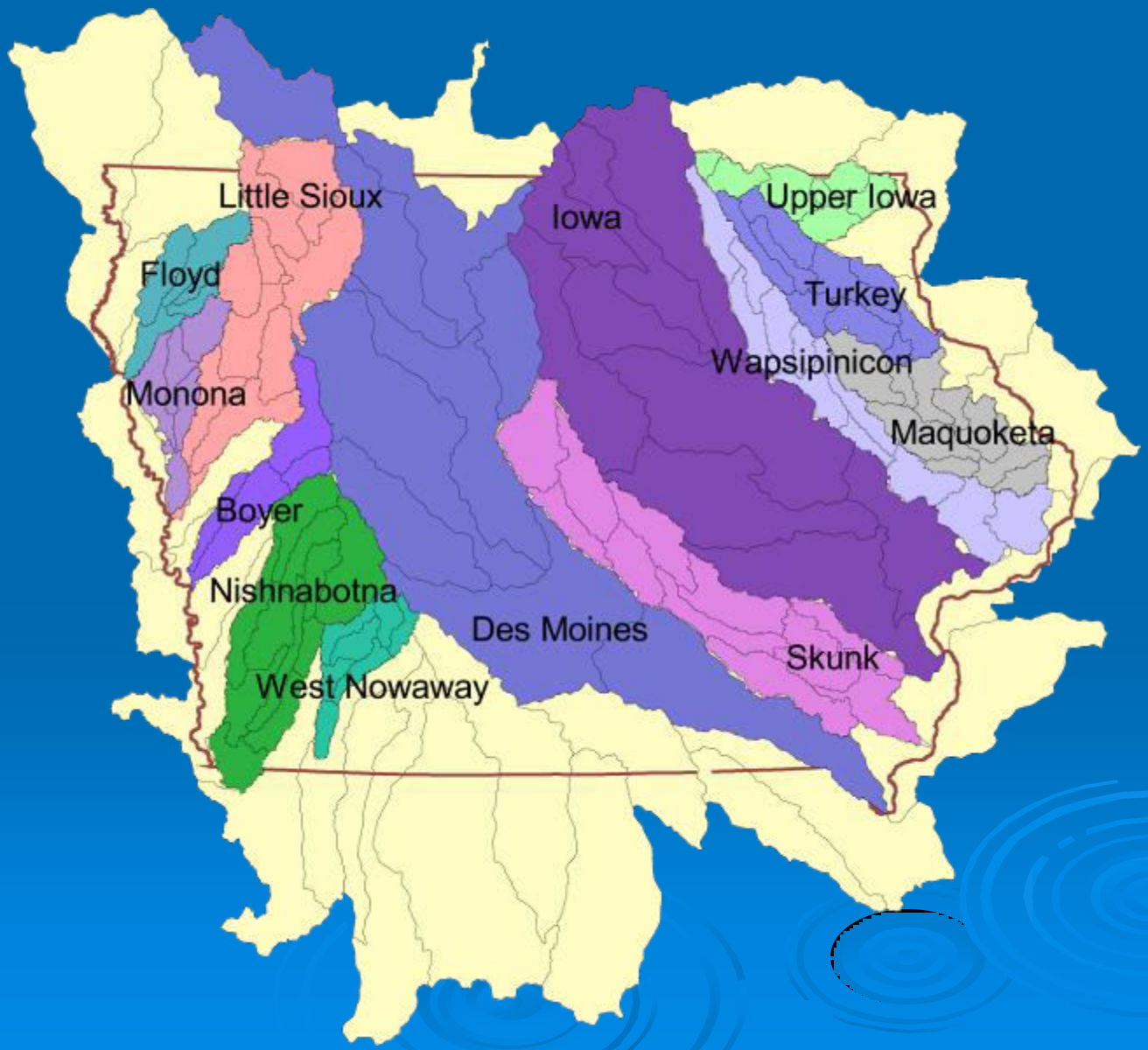
$41,292,852 + $413,388,854 = $454,681,706

Project progress: Hydrologic Model and Water Quality

SWAT – Soil and Water Assessment Tool

- Outcome of more than 30-yrs of model development experience of USDA-ARS
- Watershed based water quality model
- It was developed to predict the impact of land management practices on water, sediment and agricultural chemical yields
- Simulates hydrology, sediment, nutrients, and pesticides
- Required input data on topography, land use, soil, management, and climate

Watersheds in Iowa



SWAT Modeling of Iowa Watersheds

- Latest version SWAT2005 was used
- Applied to all 13 watersheds separately
- Calibrated and validated for streamflow on annual, monthly and daily basis at watershed outlets
- Simulation was conducted for 20 years over the period of 1986 to 2005.

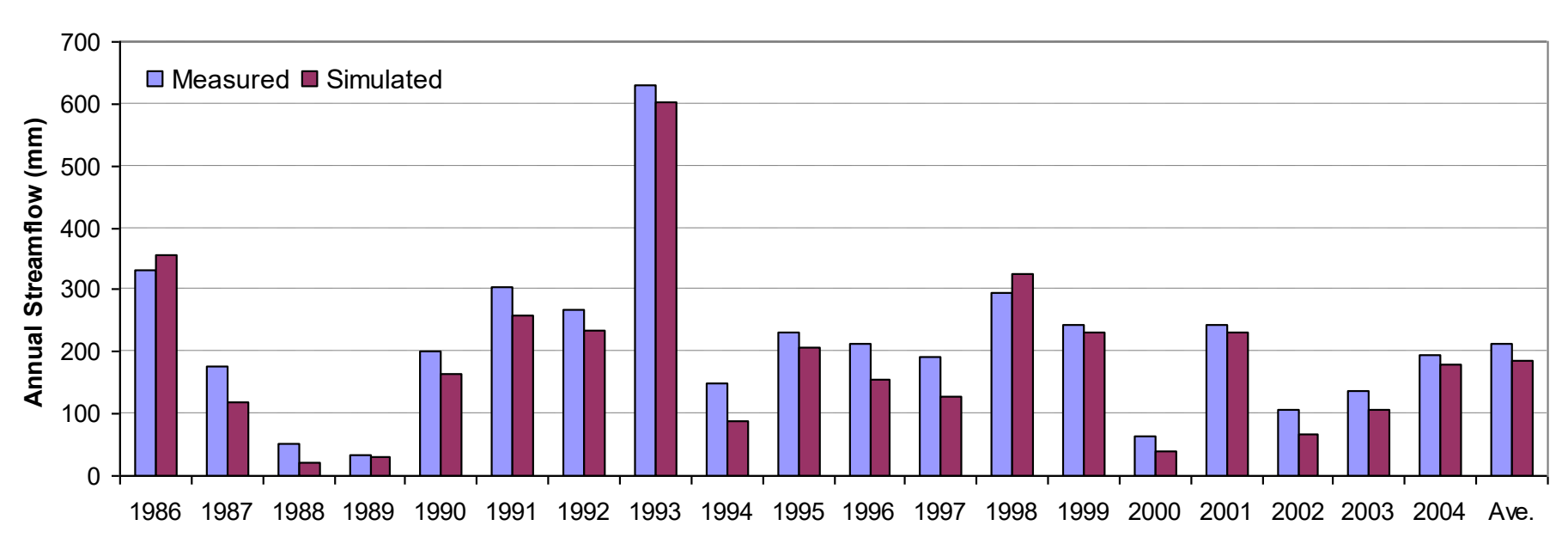
Watershed Characteristics (Source: NRI)

	Watershed Area (km^2)	*Pasture*	*Crop*	# of NRI Points
		% of watershed		
Floyd	2,387	12	84	646
Monona	2,338	14	80	396
Little Sioux	8,356	10	82	1,929
Boyer	2,830	22	68	602
Nishnabotna	7,675	22	71	1,500
Nodaway	2,068	32	52	432
Des Moines	36,125	11	70	8,154
Skunk	10,841	20	61	2,332
Iowa	31,528	7	76	8,072
Wapsipinicon	6,434	18	71	1,515
Maquoketa	4,781	28	55	1,210
Turkey	4,353	22	55	913
Upper Iowa	2,444	19	53	658

Conservation Practices (Source: NRI & CTIC)

% of watershed	CRP	Conservation Tillage			Contour	Strip Cropping	Terrace	Grassed waterways	Tile Drainage
		Mulch	No-till	Total					
Floyd	1	48	2	50	21	0	11	0	6
Monona	3	43	3	46	40	0	22	2	3
Little Sioux	3	33	15	48	15	0	7	2	21
Boyer	3	12	3	15	44	0	20	11	4
Nishnabotna	3	18	5	23	50	1	23	11	4
Nodaway	9	18	6	24	26	1	8	16	2
Des Moines	5	36	7	44	4	0	2	3	25
Skunk	7	27	7	34	7	0	3	7	13
Iowa	5	38	9	47	6	0	1	9	25
Wapsipinicon	2	38	13	51	7	0	1	10	29
Maquoketa	4	22	6	28	17	3	2	13	8
Turkey	3	21	11	32	16	2	2	2	8
Upper Iowa	4	10	6	15	13	5	3	10	6

Example Calibration – Des Moines River Watershed



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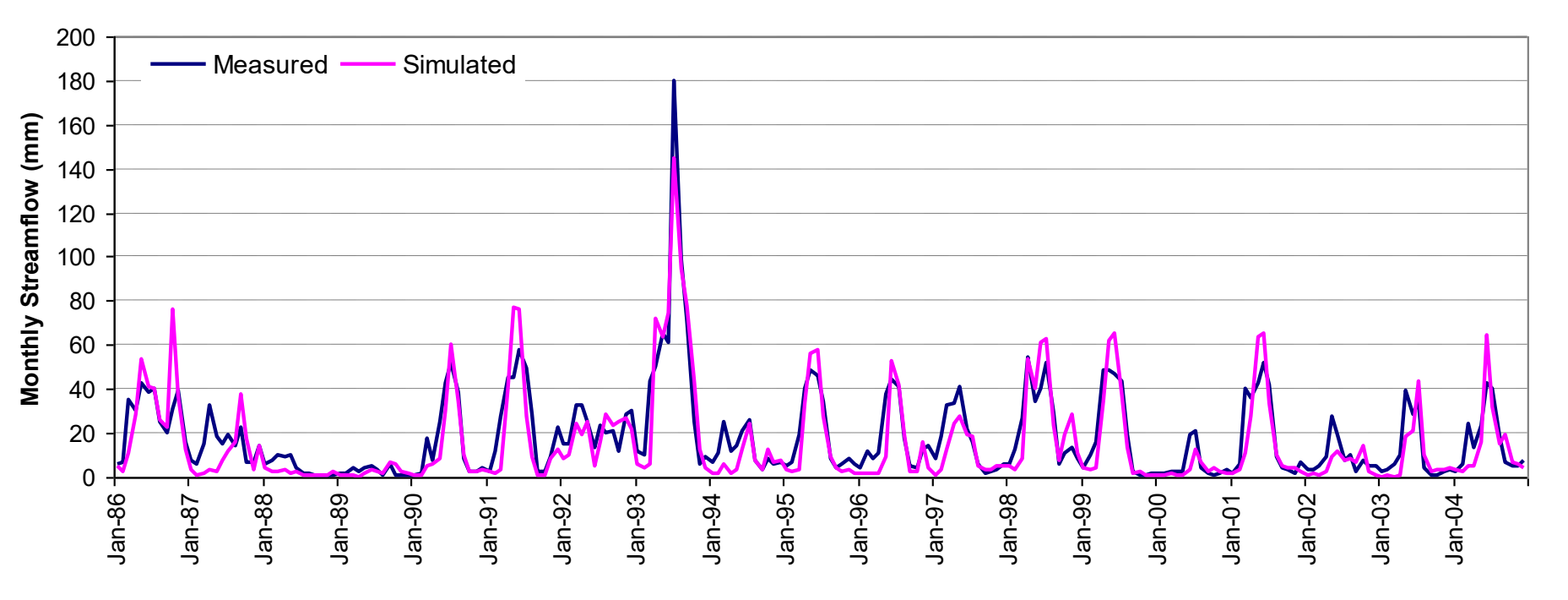
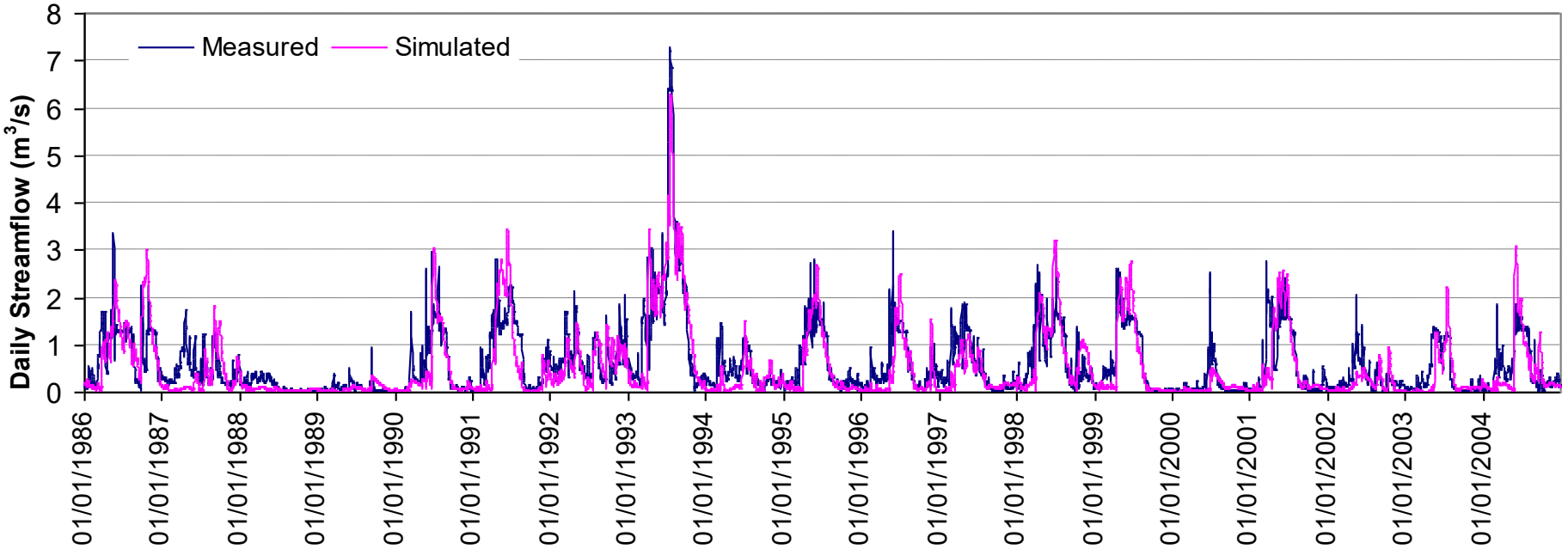


Example Calibration – Des Moines River Watershed



Simulated Baseline Results

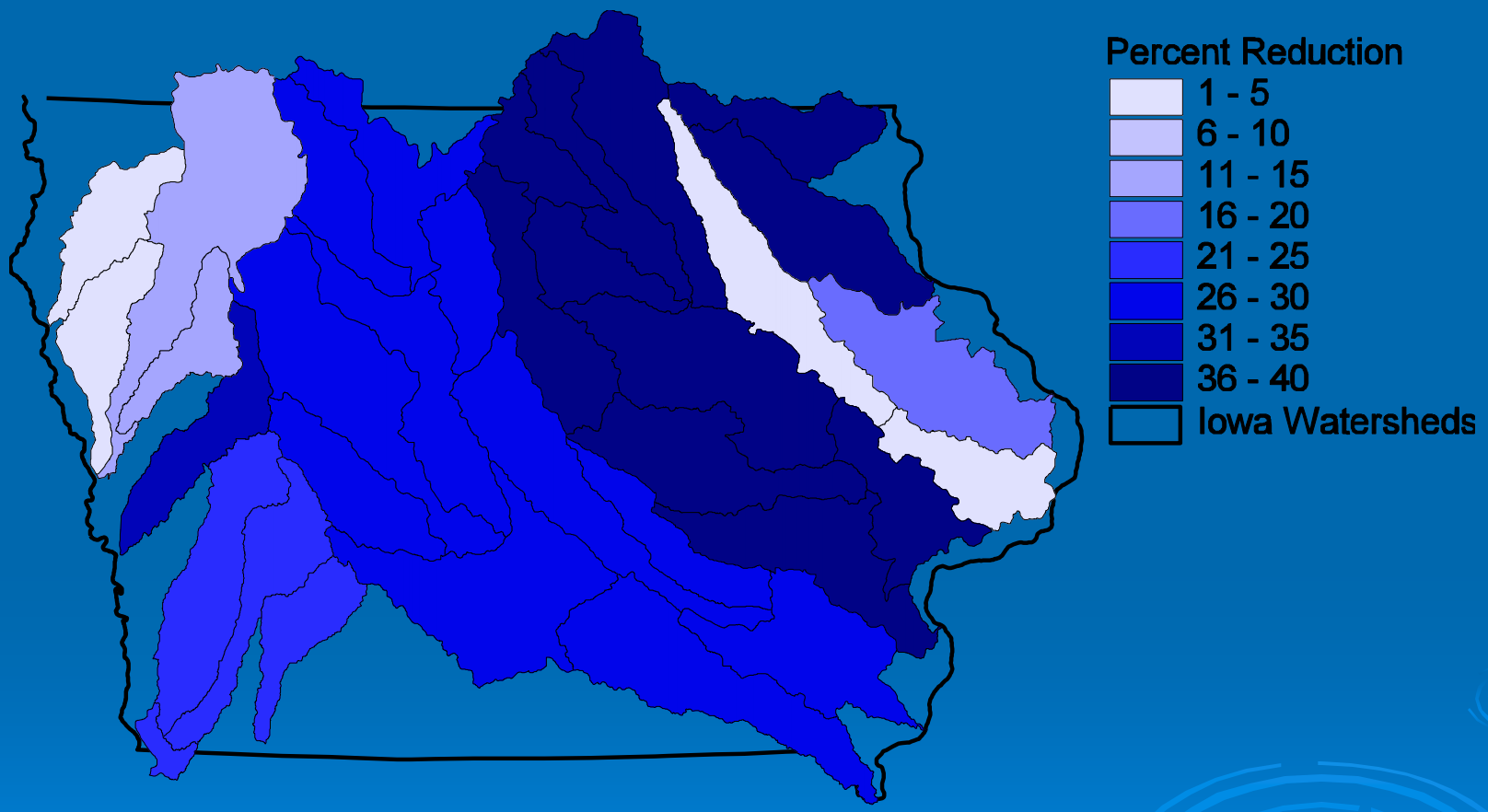
		Annual average values in *Metric tons* (1986-2005)				
	Flow (mm)	Sediment Yield	Nitrate	Org N	Min P	Org P
Floyd	111	32,930	2,508	651	195	385
Monona	124	9,705	2,234	363	209	208
Little Sioux	189	253,291	13,247	1,871	1,107	1,111
Boyer	166	110,196	2,479	1,739	494	748
Nishnabotna	217	514,832	8,108	3,379	1,354	1,634
Nodaway	216	116,918	1,289	897	283	413
Des Moines	187	354,694	60,266	3,626	3,311	2,341
Skunk	247	777,847	11,783	2,699	1,565	1,436
Iowa	271	853,025	62,376	5,149	4,037	3,078
Wapsipinicon	291	332,373	13,444	1,212	623	680
Maquoketa	270	679,224	6,685	3,026	738	1,079
Turkey	266	412,056	8,057	900	357	478
Upper Iowa	252	342,991	2,078	476	143	265

Scenario – Remove All Conservation Practices

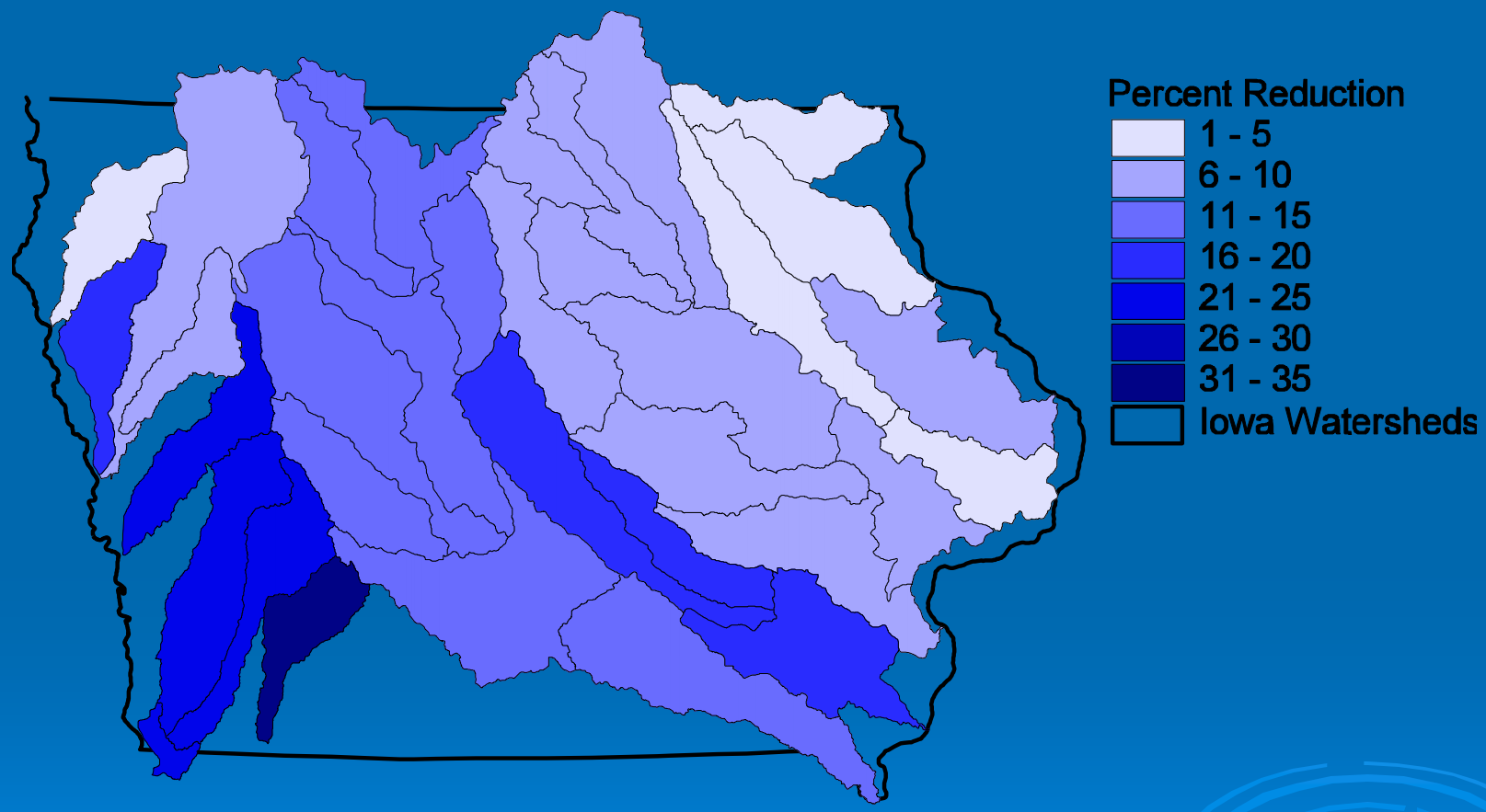
% Improvement due to Conservation Practices

	Sediment	*Nitrate*	*Org N*	*Min P*	*Org P*
Floyd	4	2	45	39	42
Monona	3	18	61	55	57
Little Sioux	12	10	50	39	45
Boyer	31	23	58	47	51
Nishnabotna	21	23	52	45	47
Nodaway	22	34	55	48	50
Des Moines	26	12	38	30	35
Skunk	28	20	47	43	45
Iowa	36	6	39	34	38
Wapsipinicon	3	2	46	38	44
Maquoketa	16	6	40	35	39
Turkey	38	1	51	39	45
Upper Iowa	36	4	47	40	44

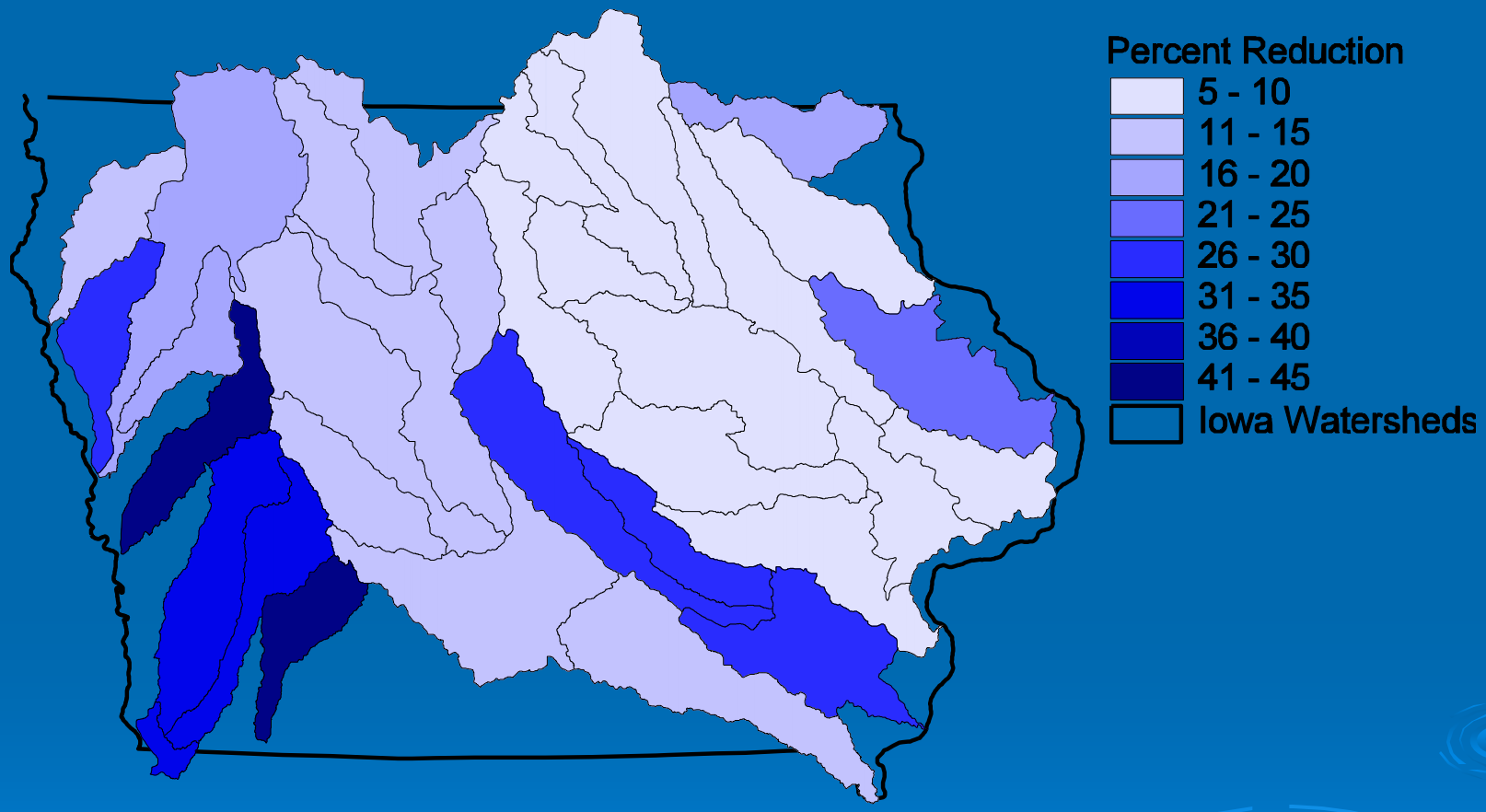
Sediment Yield Reduction



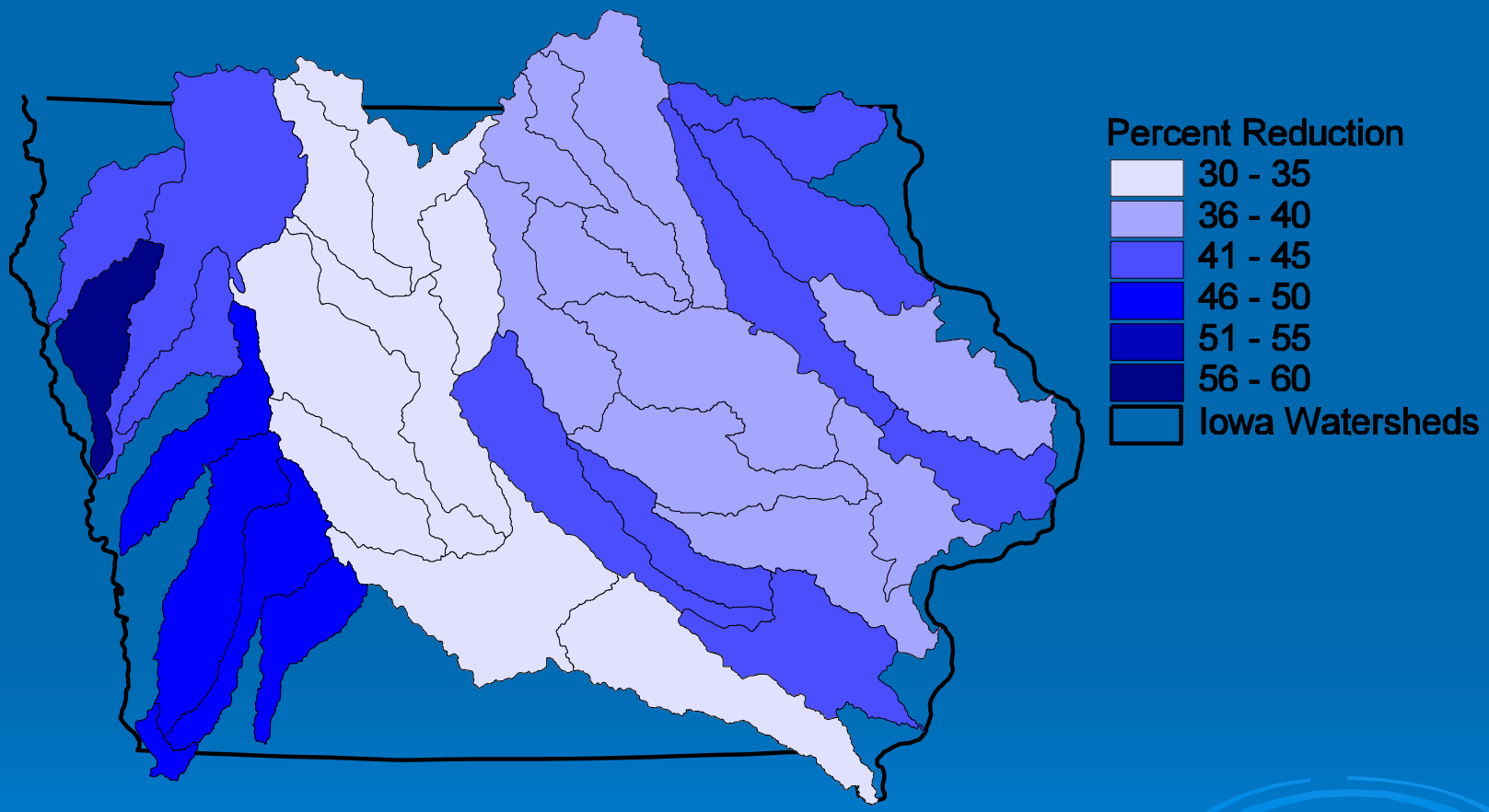
Nitrate Load Reduction



Total N Reduction



Total P Reduction



Challenges and Gaps

1. Data gaps
   - Intermittent data collection and lack of central data source makes cost data difficult to acquire/interpret
   - Inconsistent estimates of coverage of conservation practices across data sources and incomplete data on some practices
   - Limited monitoring data makes water quality calibration challenging
2. Modeling gaps
   - Omission of (constructed) wetlands and riparian buffers problematic
   - Opportunity cost of farmer's time, risk attitudes makes computation of full costs problematic
   - Modeling scale (NRI points will miss some heterogeneity)
3. Questions
   - What water quality gains can be achieved by additional placement of practices?
   - What targeting criteria to use, i.e., which practices to use in which watersheds?
   - What are the costs of conservation? How much is the cost saving of targeting?
   - What would the distributional consequences of targeting be?