Targeting Implementation of Best Management Practices in the Little Blue River Basin

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Past/Current Implementation of BMPs/Cost Share/Incentive Programs

- Voluntary
- Not geographically targeted towards locations in watershed of greatest need
- Assume that BMPs and other conservation practices implemented randomly throughout the watershed

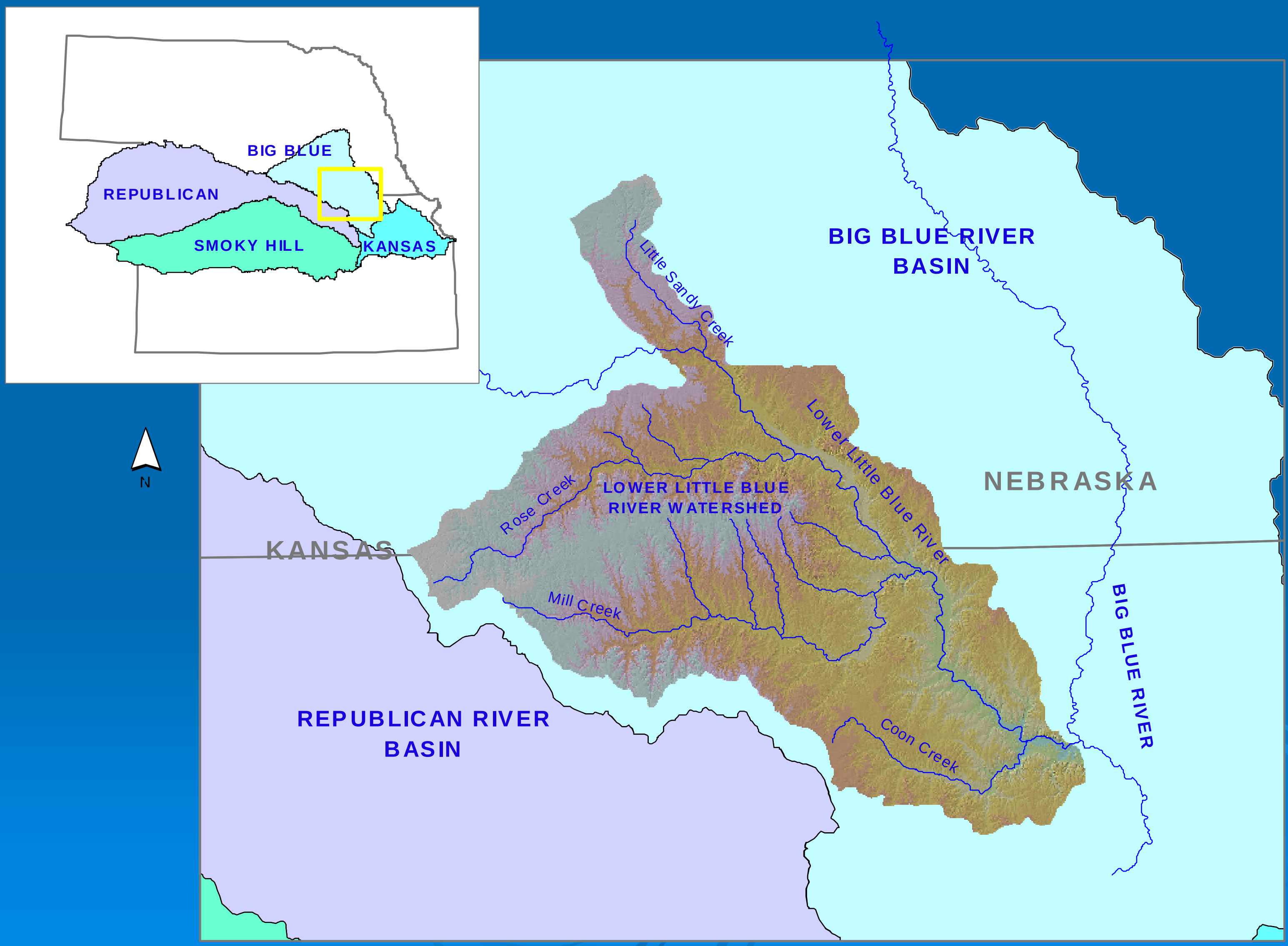
Objectives

- Identify critical areas within the watershed where BMPs would have the greatest impact.
- Evaluate on a watershed level the effects of in-field BMPs for their effectiveness at reducing sediment, phosphorus, nitrogen, and atrazine herbicide loading to surface waters.

The project described in this presentation was developed as part of the CSREES 406 funded project, "Integrated Agricultural Management Systems for Improving Water Quality In Kansas," funded in 2001.

Lower Little Blue River Basin

Lower Little Blue River Basin



Water Quality Concerns/TMDLs in the Little Blue River River Basin

- Fecal coliform bacteria
- Eutrophication
- Siltation/sediments
- Atrazine and alachlor herbicide




Tillage Systems Utilized in the Blue River Basin of Kansas[1]

Crop	Conventional Tillage	Reduced Tillage	No Tillage
	-------------------	(percent)	-------------------
Corn	48	43	9
Grain Sorghum	59	31	4

[1]Cropping Systems Survey, Devlin, Thiessen, and Lambley, 1996.

Utilized SWAT Model

SWAT Model

1980-2002

Crop specific land use

BMPs

Tillage & Residue

Field Buffers

Contour Farming

Terraces

- 1300 sq. mile watershed
- 42% cropped; 54% rangeland/pasture
- 22 different land management scenarios
- BMP effects on sediment, nutrients and atrazine loading

Soil & Water Assessment Tool (SWAT) Model[1]

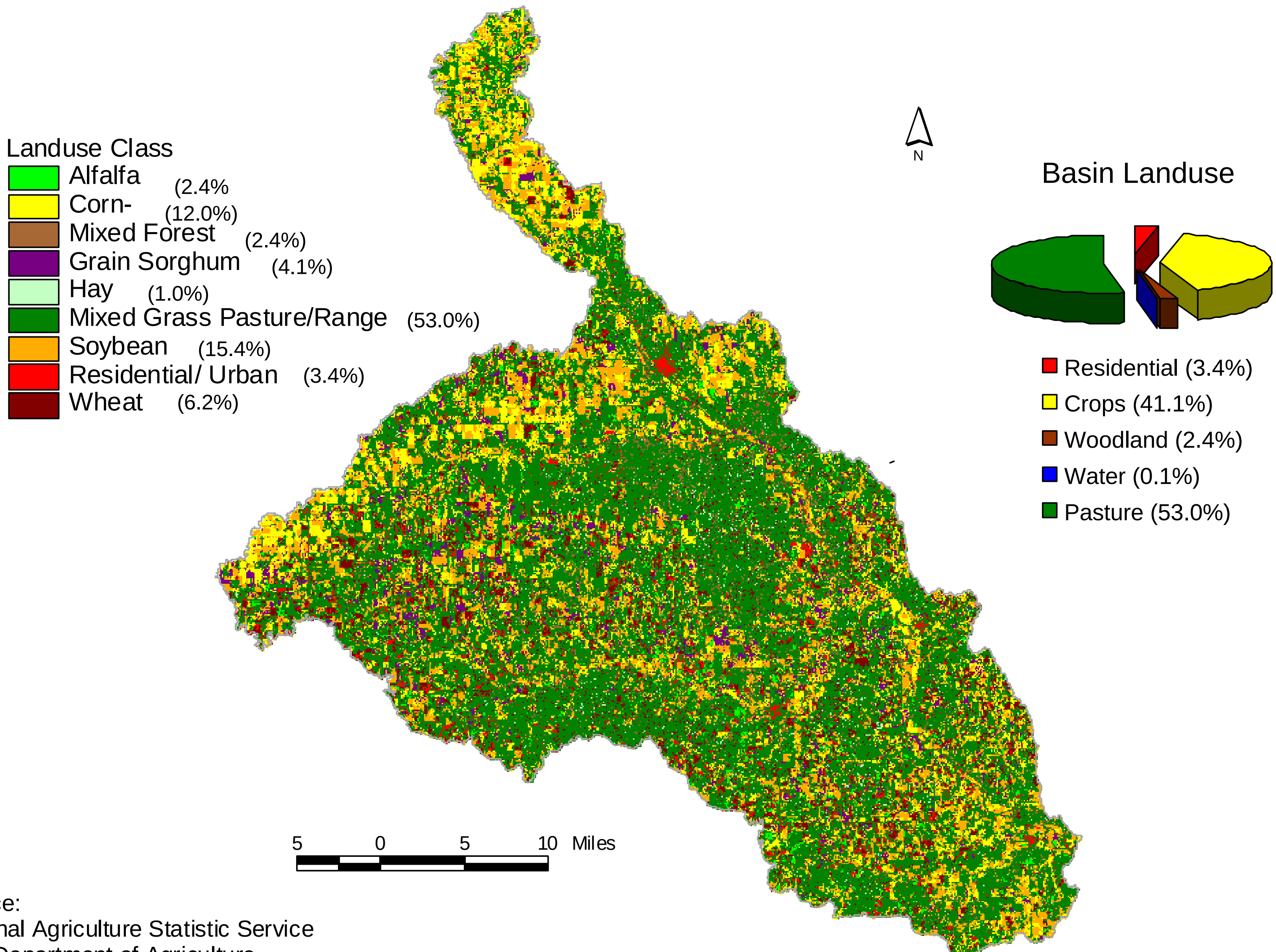
- Physically-based, continuous-time, watershed-scale, hydrologic model
- Overland Flow (Land Phase): NRCS Curve Number (CN) or Green-Ampt Infiltration Method
  - CN or infiltration capacity vary about a range according to soil hydrologic group, land management, and antecedent moisture condition
- Antecedent soil moisture condition determined by soil K-factor and water balance
- Water balance: Uses real-world weather station data to simulate historical weather conditions and calculate water balance

[1]SWAT model developed by Dr. Jeff Arnold at the USDA-ARS Grassland, Soil and Water Research Laboratory at Texas A&M; supported by U.S. EPA through BASINS.

SWAT Model

- Channel flow: Overland flow routed to stream channels and tributaries and managed temporally and spatially by Muskingum or Variable Storage Routing methods
- Sediment Loading: Modified Universal Soil Loss Equation
  - Sediment = $Q_{CN} \times K_{USLE} \times C_{USLE} \times P_{USLE} \times LS_{USLE}$
  - Simulate land management (e.g. tillage) by modifying C factor, P factor and CN
- Calibrate overland flow and discharge with USGS stream gages
- Major Inputs:
  - Topography, Soils, Hydrography, Land Use, Weather & Management

Major Landuse in Lower Little Blue Basin in 2001



Source:
National Agriculture Statistic Service
U.S. Department of Agriculture

SWAT Model: Management

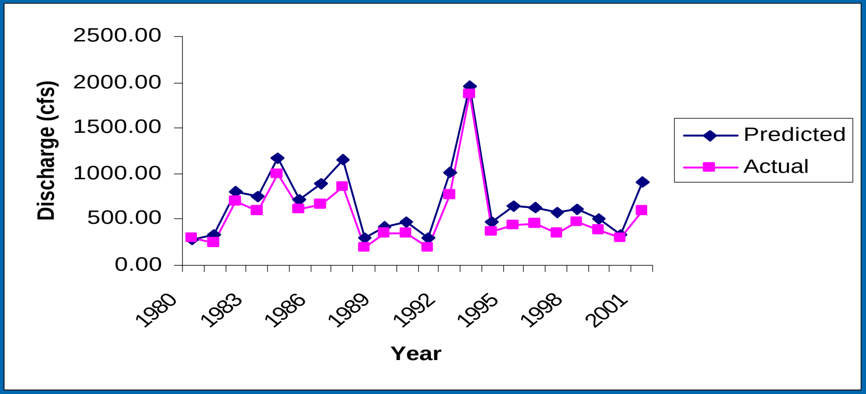
Inputs	Conventional	No-Till	Native
Tillage	Yes	No	No
Pesticide	Yes; same rate	Yes; same rate	No
Fertilizer	Yes; same rate	Yes; same rate	No
Fallow (No Residue)	Yes	No	No
Growing Season CN	Moderate to High	Moderate to High	Low to Moderate
C Factor	High	Moderate	Low
P Factor	Same value	Same value	Always = 1
Manning's "n"	Low	Moderate	High

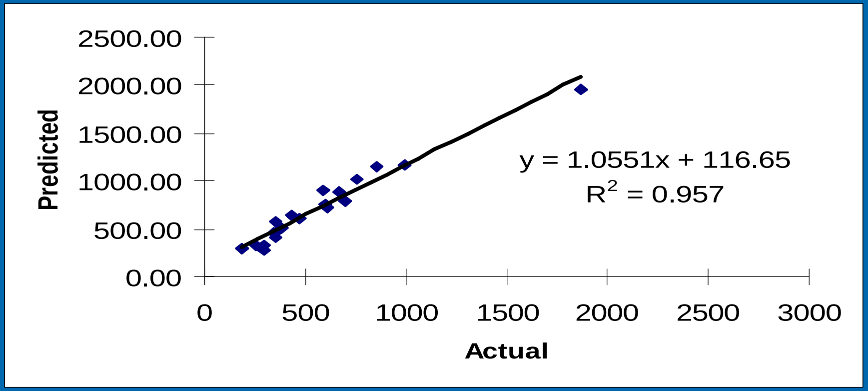
CORN	CvT	NoT
C Factor	0.42	0.13
P Factor	1.00	1.00
Manning's "n"	0.09	0.30
CN-A	67	64
CN-B	78	75
CN-C	85	82
CN-D	89	85

CONVENTIONAL TILLAGE CORN					NO TILLAGE CORN				
Date	Practice	Description	Rate	Curve No.	Date	Practice	Description	Rate	Curve No.
27-Mar	Tillage	Tandem Disk Reg 14-18 ft	--	Fallow	27-Mar	--	--	--	--
5-Apr	Fertilizer	Anhydrous Ammonia	125 lbs/ac	--	5-Apr	Fertilizer	Anhydrous Ammonia	125 lbs/ac	--
11-Apr	Tillage	Field Cultivator GE 15 ft	--	Fallow	11-Apr	--	--	--	--
12-Apr	Pesticide	Dual (metalochlor)	2 lbs/ac	--	12-Apr	Pesticide	Dual (metalochlor)	2 lbs/ac	--
13-Apr	Pesticide	Aatrex (atrazine)	1.6 lbs/ac	--	13-Apr	Pesticide	Aatrex (atrazine)	1.6 lbs/ac	--
14-Apr	Pesticide	Counter	6.5 lbs/ac	--	14-Apr	Pesticide	Counter	6.5 lbs/ac	--
15-Apr	Fertilizer	18-46-0	50 lbs/ac	--	15-Apr	Fertilizer	18-46-0	50 lbs/ac	--
16-Apr	Plant	Corn	--	Hydrol. Group	16-Apr	Plant	Corn	--	Hydrol. Group
1-Oct	Harvest & Kill	Corn	--	--	1-Oct	Harvest & Kill	Corn	--	--
15-Nov	Tillage	Chisel Plow GT 15 ft	--	Fallow	15-Nov	--	--	--	--

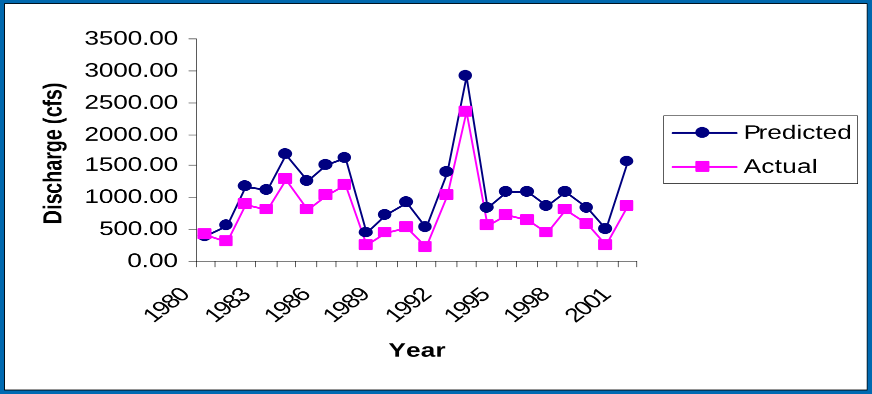
SWAT Streamflow Calibration

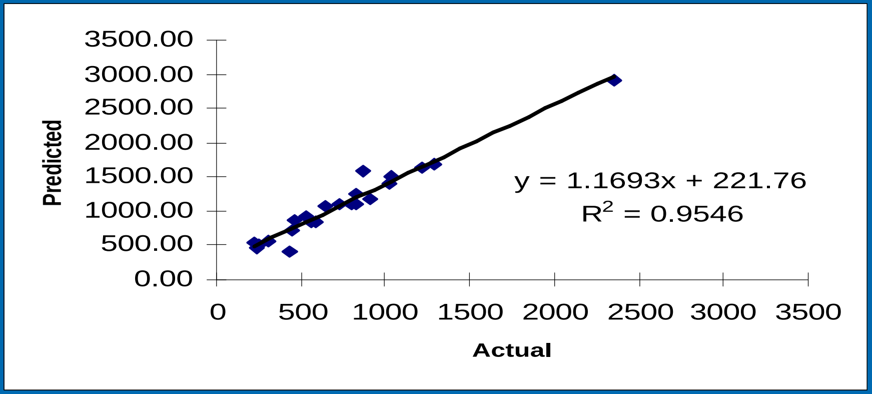
Little Blue @ Hollenberg



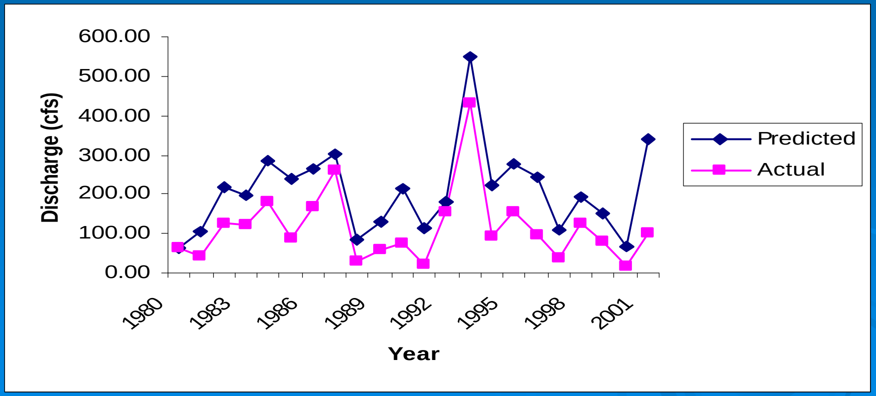


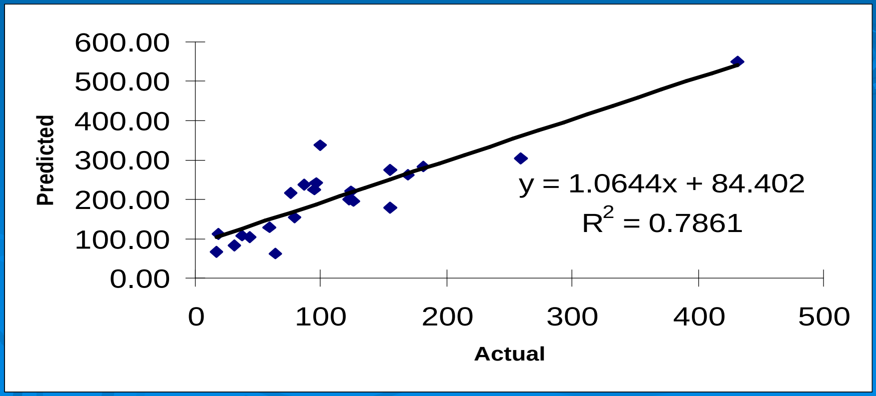
Little Blue @ Barnes





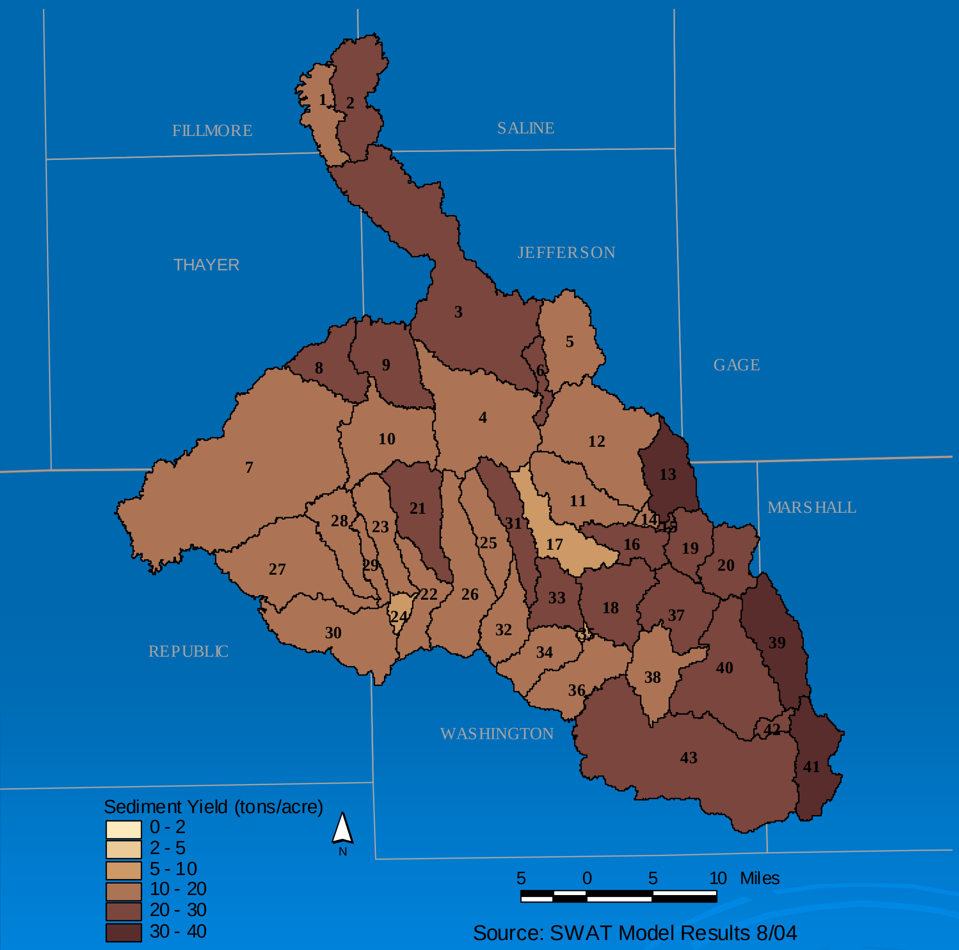
Mill Creek @ Washington



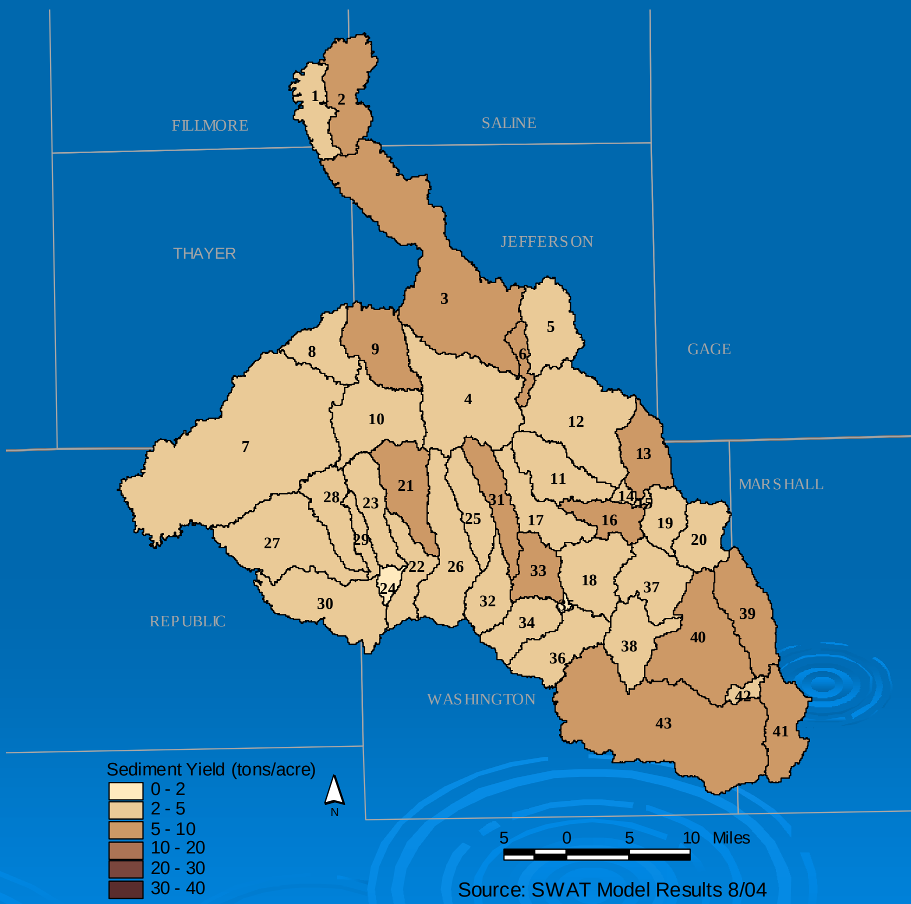


Sediment Losses – Tilled vs. No Tilled

*Conv. Tillage to No Tillage: 77% Yield Reduction in Basin



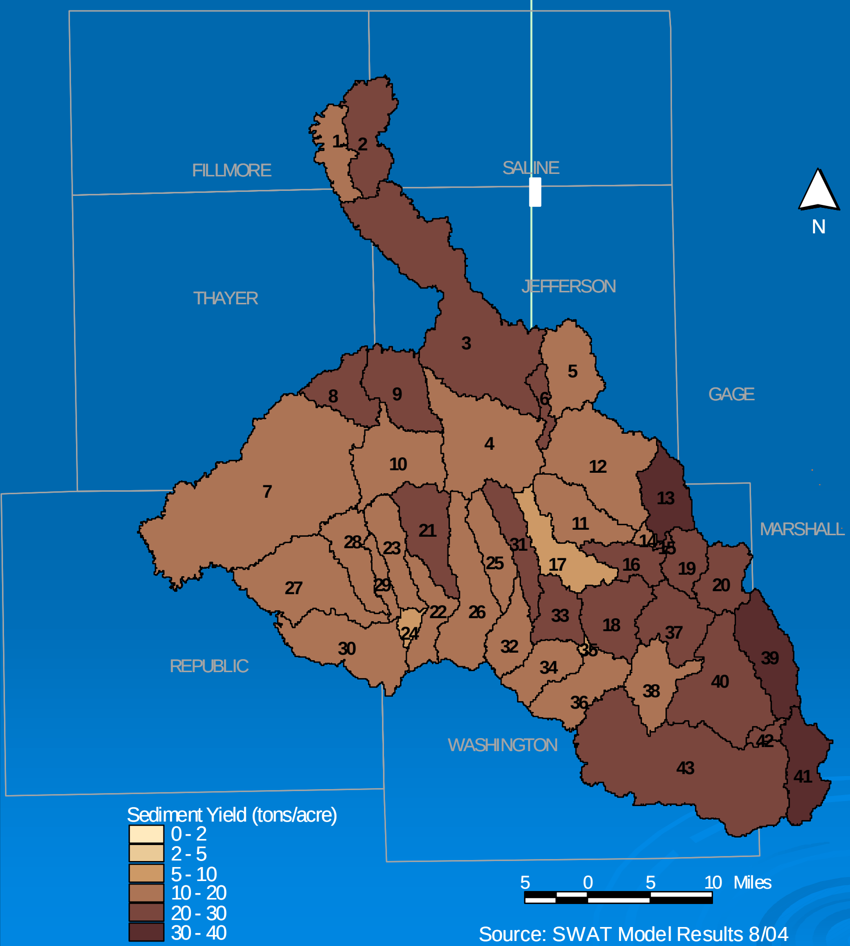
Conventional Tillage



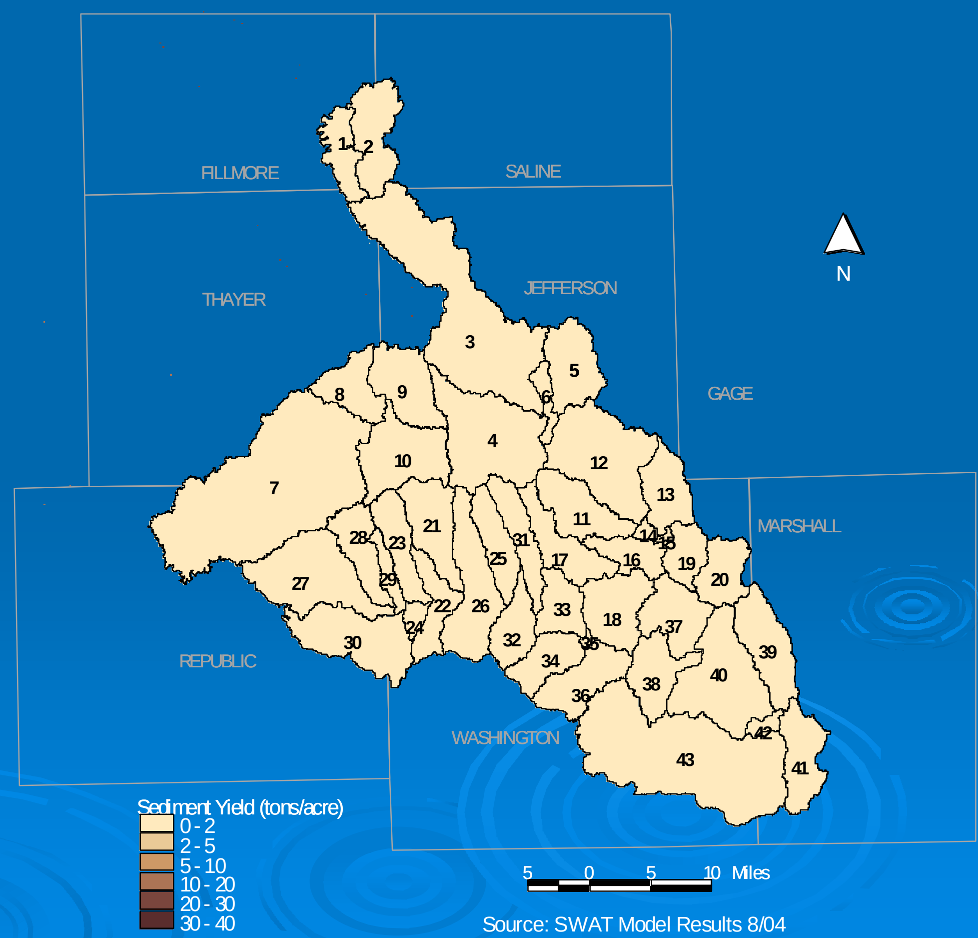
No Tillage

Sediment Losses – Tilled vs. No Tilled w/ Field Buffers

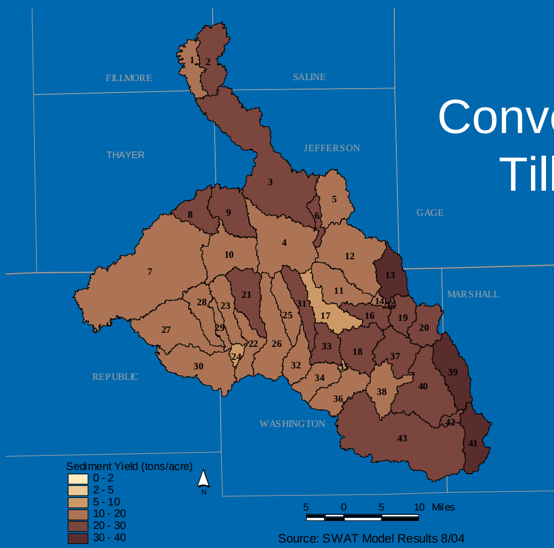
***Scenario*:**
Conventional Tillage **(fall chisel; spring disk)**
No BMPs



***Scenario*:**
No-tillage
20 m field buffers

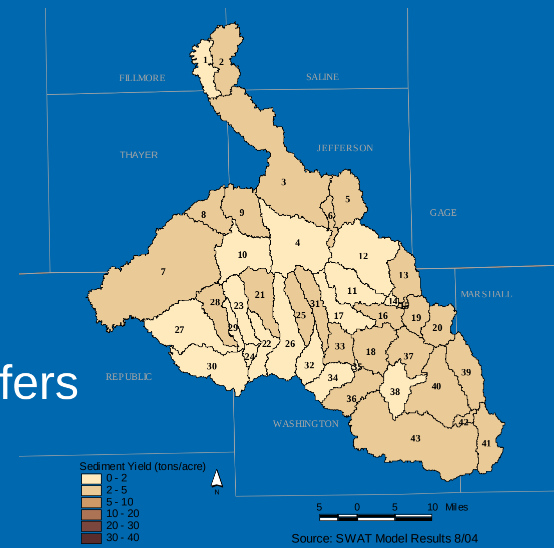


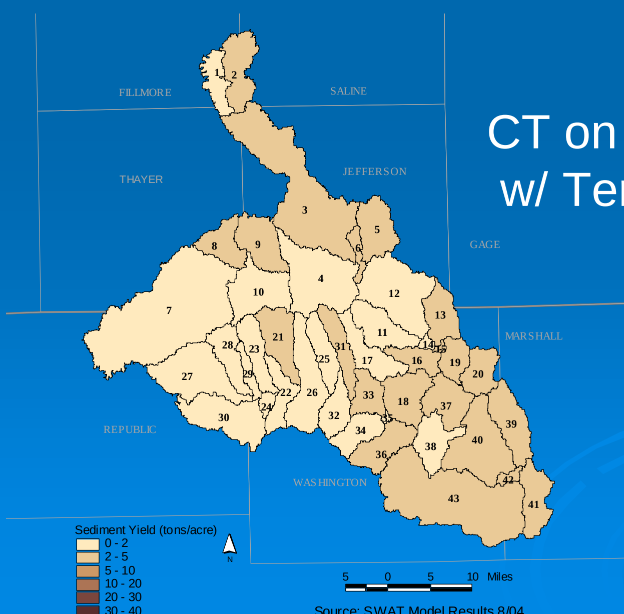
Effectiveness of Conservation Practices on Sediment Losses



Conventional Till (CT)

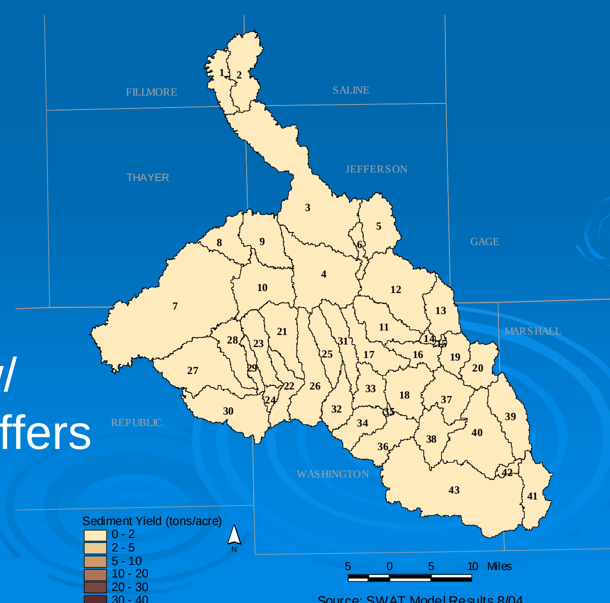
CT w/ 20 m Buffers



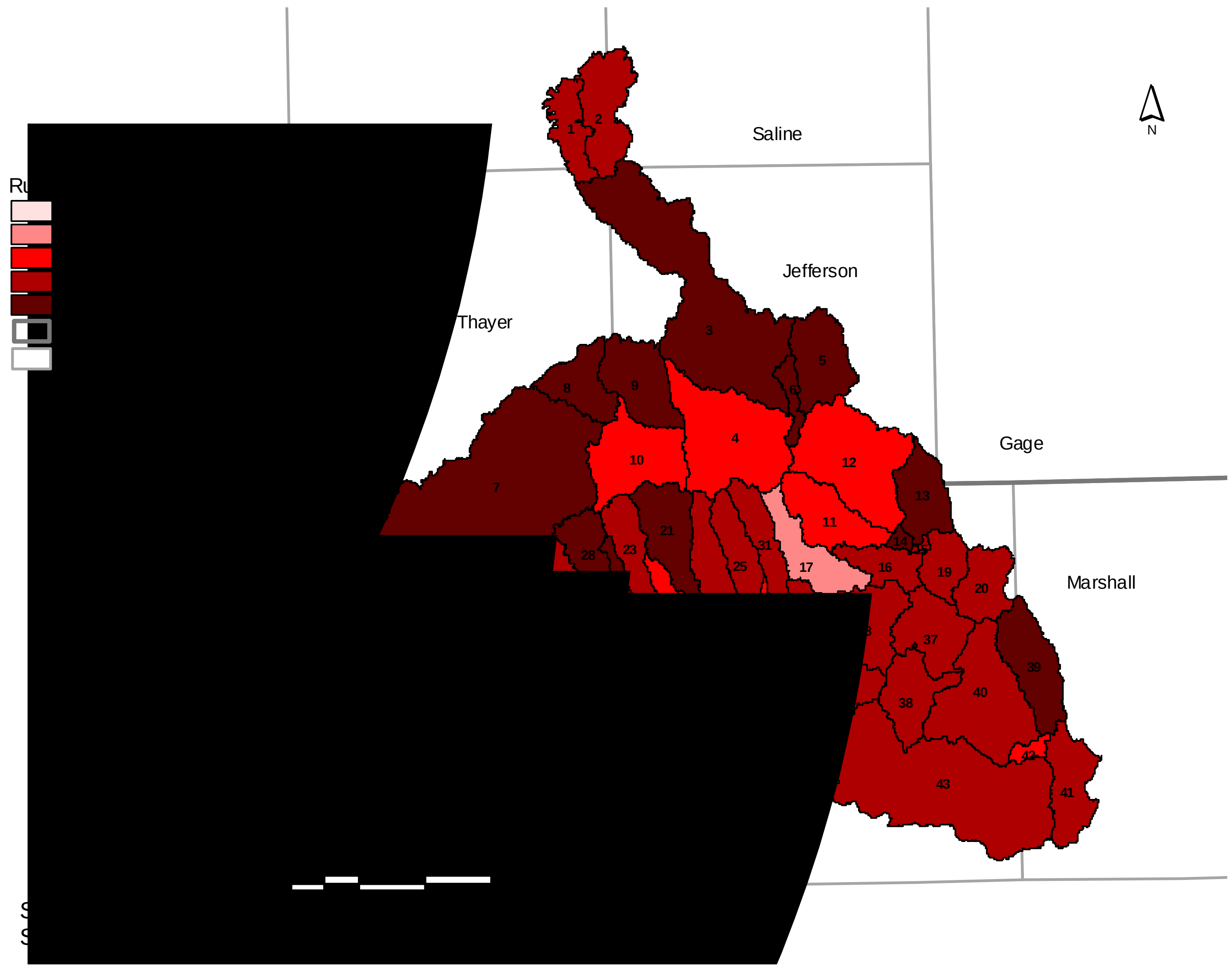


CT on Contours w/ Terraces

No Till w/ 20 m Buffers

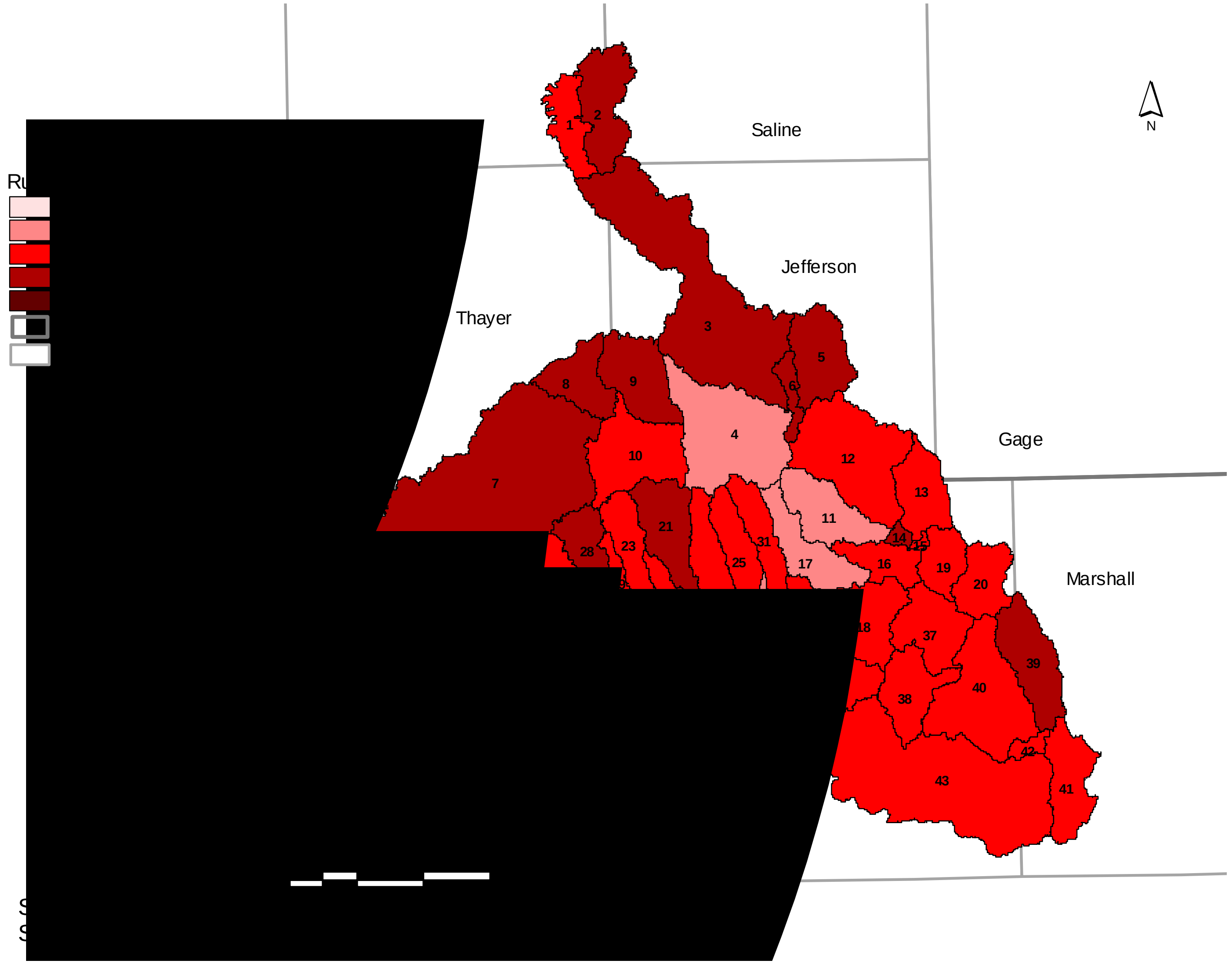


Runoff Total P Concentration, Conv. Till



Runoff Total P Concentration, No Till

*Conv. Tillage to No Tillage: 37% Yield Reduction in Basin



Effectiveness of BMP Implementation

Management	Percent Reduction (%)								
	Discharge	Sediment	Organic N	Nitrate-N	Total N	Organic P	Soluble P	Sediment P	Total P
Conventional Till (CvT)	--	--	--	--	--	--	--	--	--
CvT + 10 m Field Buffers	0.0	72.2	69.9	57.5	69.1	69.9	71.9	72.1	68.6
CvT + 20 m Field Buffers	0.0	88.6	85.9	70.7	84.9	85.9	88.3	88.5	84.3
CvT + Contours (P = 0.5)	0.9	49.9	16.9	3.2	16.0	18.8	-16.1	23.3	19.9
CvT + Contours + Terraces (P = 0.1)	0.9	89.4	57.8	2.9	54.3	60.0	-47.3	66.9	60.8
CvT + 10 m Field Buffers + Contours	0.8	85.8	74.5	58.4	73.5	75.0	67.5	78.4	74.1
CvT + 10 m Field Buffers + Contours + Terraces	0.8	96.6	85.7	58.3	84.0	86.3	59.0	90.3	85.3
CvT + 20 m Field Buffers + Contours	0.8	94.0	87.7	71.0	86.6	87.9	86.6	91.0	86.4
CvT + 20 m Field Buffers + Contours + Terraces	0.8	98.3	92.1	71.0	90.8	92.3	83.2	95.7	90.8
Mulch Till with 20% Residue	0.4	46.9	29.1	5.3	27.6	19.2	-7.9	24.2	20.6
Mulch Till with 50% Residue	0.8	63.4	47.0	8.6	44.6	28.5	-26.9	31.3	28.7
No Tillage (NoT)	12.5	76.9	69.8	32.4	67.5	39.5	-50.0	34.7	36.5
NoT + 10 m Field Buffers	12.5	93.2	89.0	66.4	87.6	80.7	58.2	81.6	78.6
NoT + 20 m Field Buffers	12.5	96.9	93.4	74.1	92.2	90.1	82.9	92.3	88.2
NoT + Contours	20.1	90.4	76.3	44.8	74.3	55.0	-46.2	56.5	53.9
NoT + Contours + Terraces	20.1	97.5	87.8	44.7	85.1	79.5	-72.1	83.6	78.7
NoT + 10 m Field Buffers + Contours	20.0	96.9	90.8	69.8	89.4	84.9	59.2	87.5	83.4
NoT + 10 m Field Buffers + Contours + Terraces	20.0	98.8	93.9	69.8	92.4	91.6	52.2	94.9	90.1
NoT + 20 m Field Buffers + Contours	20.0	98.4	94.1	75.5	92.9	91.8	83.3	94.6	90.1
NoT + 20 m Field Buffers + Contours + Terraces	20.0	99.1	95.3	75.5	94.1	94.4	80.6	97.5	92.8
Mixed Grass Prairie/ Range	42.4	99.3	96.0	76.5	94.8	96.2	98.8	99.1	94.5

Conclusions

- Critical areas in the watershed for targeting BMP adoption were identified.
- SWAT predicted a 75% reduction of sediments and 50% reduction of total P with basin-wide implementation of no till.
- Farming on the contour combined with installation of terraces on HE land was predicted to reduce sediment losses by 50%.
- Meeting TMDLs would require adoption of multiple BMPs.