2015 Annual Report

Illinois CREP

Conservation Reserve Enhancement Program

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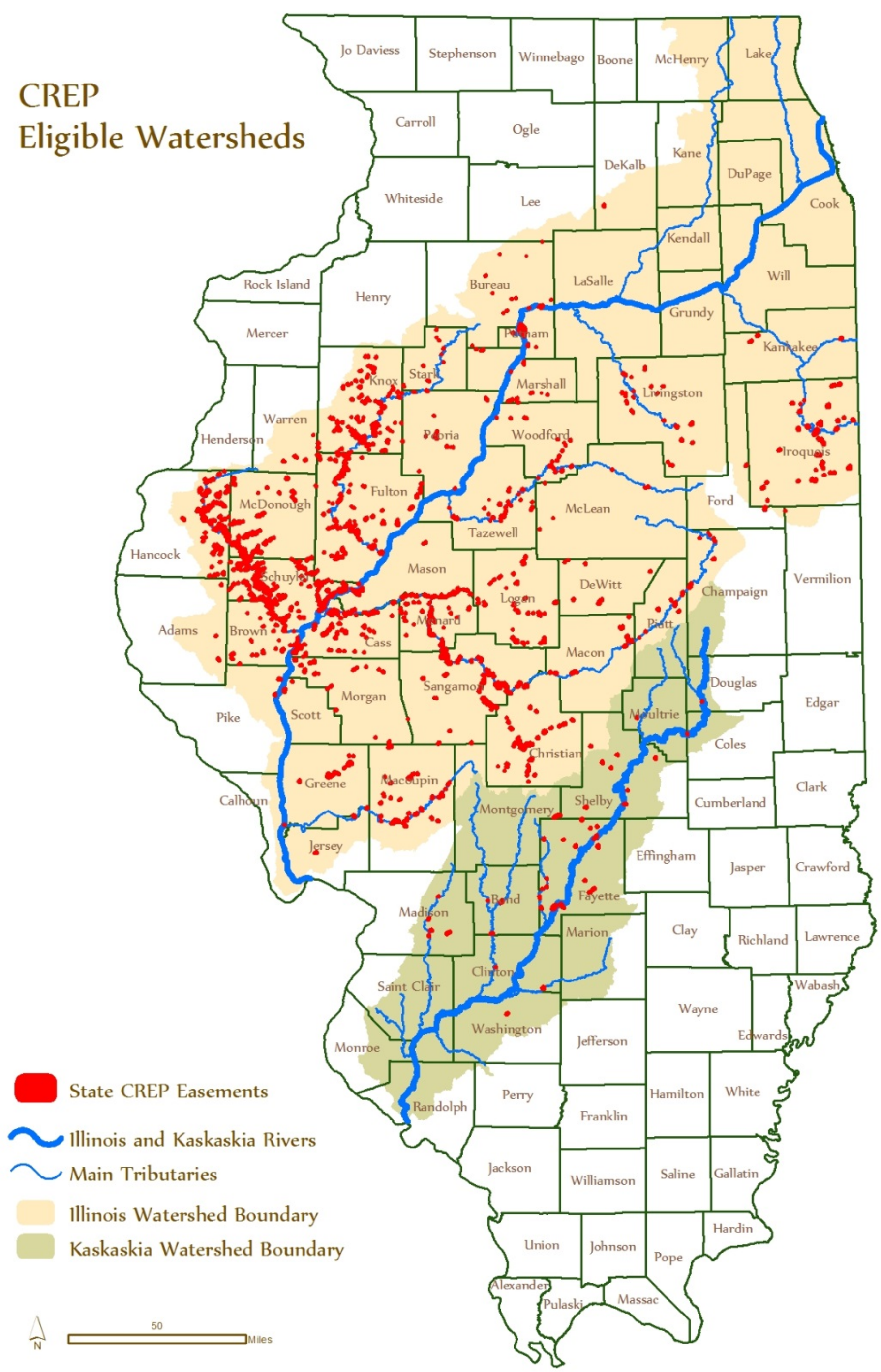
CREP ELIGIBLE AREA AND EXECUTED EASEMENTS



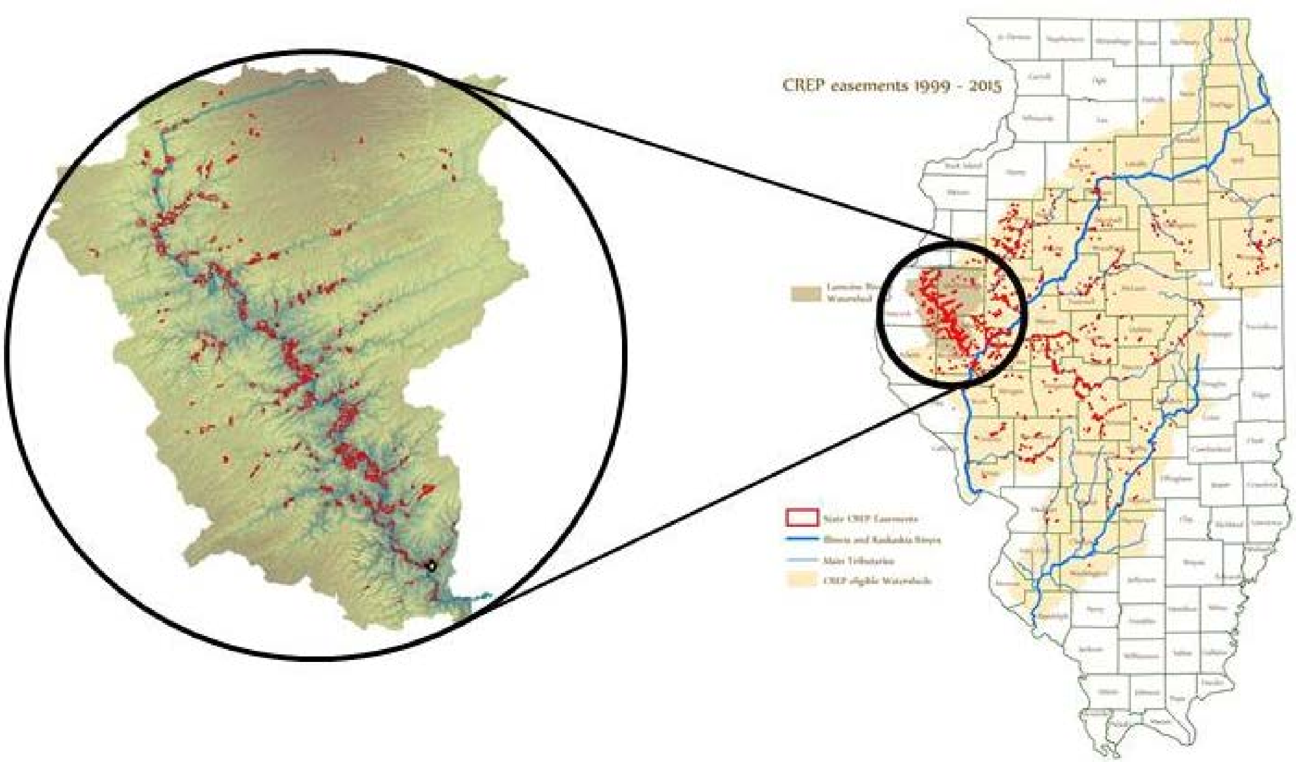
EXECUTIVE SUMMARY

The Illinois Conservation Reserve Enhancement Program (CREP) is a state incentive program tied to the Federal Conservation Reserve Program (CRP). CREP provides long term environmental benefits by allowing 232,000 acres of eligible environmentally sensitive lands within the Illinois and Kaskaskia River Watersheds to be restored, enhanced, and protected over periods ranging from 15 years to perpetuity. CREP continues to be driven by locally led conservation efforts, which is evident by increased landowner support. This program is a prime example of how partnerships between landowners, governmental entities, and non-governmental organizations can network to address watershed quality concerns.

Having worked hand-in-hand with USDA over the years, Illinois CREP has been instrumental in facilitating the ongoing restoration and management efforts within the Illinois and Kaskaskia River Watersheds. To achieve the goal of improving water quality within the targeted watersheds CREP has utilized a variety of Best Management Practices (BMP's) designed to protect and restore miles of riparian corridors. CREP is one of the many tools used by IDNR conservation partners to implement the IDNR Illinois Comprehensive Wildlife Action Plan (IWAP), which provides a framework for the restoration of critical habitats, increasing plant diversity and expanding habitat for species in greatest need of conservation on an agricultural dominated landscape.

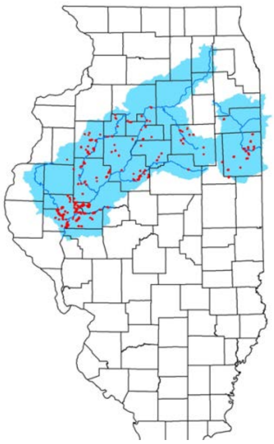
Illinois CREP continues to be a successful and very popular program. Currently there are 126,805 acres enrolled in Federal CREP contracts at an average rental rate of $212.30 per acre. The State has been successful in executing 1,396 CREP easements protecting 90,171 acres.

CREP's overall success is notably highlighted by the response within the watershed of the Lamoine River, a major tributary of the Illinois River (see map below). Overall, there are 3,271 miles of streams within the watershed, spread out over five counties. 326 long-term CREP Easements, adding up to over 25,500 acres of protected land, have been established in the area and more than 50% of those acres were converted from cropland. The Lamoine River itself is approximately 131 miles long, with 92 miles flowing directly through or alongside CREP properties. In other words, 70% of the main river is under long-term protection providing a valuable riparian corridor of wildlife habitat while also significantly contributing to the overall water quality improvement in the Illinois River.

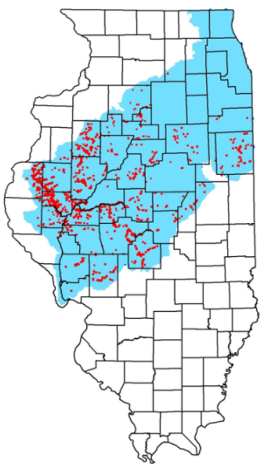


Illinois CREP Timeline

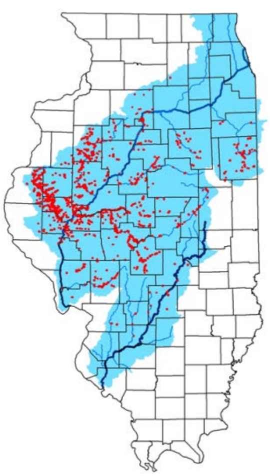
1998 - 2000



1998 - 2007



1998 - 2015



Map images depict the eligible watersheds in blue, and CREP easement locations in red

CREP is a federal-state program that was created by a Memorandum of Agreement (MOA) between the U.S. Department of Agriculture, the Commodity Credit Corporation, and the State of Illinois in March 1998. Enrollments into this program began on May 1, 1998. The MOU was amended several times during the early years to clarify terms, increase the number of practices offered, and to expand the eligible area.

In 2005 the IDNR, in cooperation with other conservation partners, initiated the implementation of The Illinois Comprehensive Wildlife Action Plan (ICWAP). The ICWAP's goals are to use consistent science-based natural resource management principles, to increase the amount and quality of habitat available to support Illinois' native plant and animal species and other game species; promote their population viability, and regulate the recreational, commercial, and scientific utilization of those species; to ensure their long-term persistence and abundance and provide for their appreciation and enjoyment by future generations of Illinoisans while also expanding the frontiers of natural resource management. CREP easements which lie within the ICWAP's priority areas will provide long term protection of quality habitats identified by the ICWAP's goals.

Due to insufficient State funds the Illinois CREP was temporarily closed to open enrollment in November 2007. However, monitoring and land stewardship continued.

In October 2010, after overwhelming public support The Illinois General Assembly appropriated $45 million to reopen and expand CREP to include the Kaskaskia River Watershed. The USDA, Commodity Credit Corporation, and the State of Illinois subsequently amended their Memorandum of Agreement (MOA) to include the Kaskaskia River Watershed with the Illinois River Watershed.

Since 2010 a total of 159 state easements have been approved in the Kaskaskia and Illinois River Watersheds totaling 13,018 acres; the acres in the Kaskaskia River Watershed totaling 4,708 acres and those in the Illinois Watershed totaling 8,310 acres. The average acreage per enrollment is 81.87 acres.

Since the program started in 1998, landowners have voluntarily enrolled 90,171 acres in CREP through 1,396 easements to help improve and restore natural habitats in the Illinois CREP eligible area. In the last year alone (10/1/2014 – 9/30/2015) 31 state easements were closed protecting 2,847 acres overall, 1,201 acres in the Kaskaskia River Watershed and 1,646 acres in the Illinois River Watershed.

July 1, 2015 - Due to the lack of a state budget, the Illinois Department of Natural Resources is unable to offer state options under the Conservation Reserve Enhancement Program. Therefore the FSA and IDNR temporarily suspended CREP enrollment (as of preparation of this report CREP is still suspended).

Recent Outreach, Stewardship, and Monitoring

The county Soil and Water Conservation Districts (SWCD) within the CREP area are the driving force spearheading CREP on the local level.

The Illinois Department of Natural Resources (IDNR) has partnered with the Illinois Environmental Protection Agency (IEPA) and the Association of Illinois Soil and Water Conservation Districts (AISWCD) to hire six (6) CREP Resource Specialists. These specialists are dedicated to counties primarily in the Illinois River Watershed to assist the SWCD's with landowner outreach and enrollment. IDNR has also partnered with the National Great Rivers Research and Education Center (NGRREC) who were awarded a National Fish and Wildlife Fund Grant to hire four (4) Land Conservation Specialists to market CREP and assist the districts as needed in counties primarily in the Kaskaskia River Watershed.

The State continues to monitor and evaluate sediment and nutrient delivery to the Illinois River. Nutrient and sediment data have been collected since the program's inception in 1999. According to the Illinois State Water Survey's (ISWS) recent data indicates that both sediment and nutrient delivery to the Illinois River has gradually either stabilized or decreased as a result of the implementation of BMP's in the Illinois River watershed. The most significant outcome has been the slow decreasing trend of nitrate-N yield from major tributary watersheds.

The IDNR is working with the University of Illinois' Critical Trends Assessment Program (CTAP) staff to maintain a biological monitoring program for CREP to assess the conservation practices and wildlife habitat on property enrolled in CREP. CTAP samples the bird communities of forests, grasslands, and wetlands using point-count based methods. During data collection, the presence and abundance of each species seen or heard during the count period is recorded.

The IDNR is also working with Illinois Natural History Survey to maintain a basin-wide monitoring and assessment program for wadeable streams in the Kaskaskia River. Baseline information on aquatic macroinvertebrates (EPT), freshwater mussels, and fish have been collected at selected reaches using a stratified random sampling design to characterize conditions throughout the watershed and provide for long-term trends assessments. Populations of selected species are monitored in focal reaches associated with high biological diversity (BSS reaches) or sensitive taxa (enhanced DO reaches, SGNC).

Program Expenditures

The Memorandum of Agreement (MOA) for the Illinois CREP details the formula to determine the overall costs of the program: total land retirement costs (which will include the CRP payments made by the Commodity Credit Corporation (CCC) and the easement payments or the bonus payments made by Illinois), the total reimbursement for conservation practices paid by the CCC and Illinois, the total costs of the monitoring program, and the aggregate costs of technical assistance incurred by Illinois for implementing contracts and easements and a reasonable estimate of the cost incurred by the State to develop conservation plans.

Since the CRP contract payments are annual payments spread out over 15 years, a 2.9 percent net present value (NPV) discount rate (per MOA) was used to compare the CRP payments to the State Easement payments.

Per the current agreement, the State of Illinois must contribute 20% of the total program costs. Based on USDA reports at https://arcticocean.sc.egov.usda.gov/ IDNR contributed 23.32% of the total program costs based on the following calculations;

$403,810,522.50 (15 years x 126,805 acres x 212.30 avg. rental rate = $403,810,522.50) given to IDNR by USDA FSA* was amended by IDNR to reflect the 2013 re-enrollment of expired CRP acres with perpetual CREP easements ($1,528,283.64),

2015 USDA Report	$403,810,522.50
2013 USDA CREP re-enrollments	($1,528,283.64)
Amended total	$402,282,238.86

**- End of September-2015 Summary of active Contracts by Program Year, CRP – Monthly Contracts Report, Program year 1998 - 2015*

CREP Enrollment and Financial Figures

Illinois CREP Summary 1998 - Sept 30, 2015	
Number of Current Federal Contracts - 6,962	Current Federal Acres - 126,805
Number of State Easements - 1,396	Total State Protected Acres - 90,171

CREP Contributions 1998 - Sept 30, 2015	IDNR	USDA *	USDA (NPV 2.9%) **
Acres Enrolled as of Sept, 30 2015	90,171	126,805.00	
Total Life of Contract Rent (15 Yrs)		$402,282,238.86	$261,999,363.98
Cost Share		$21,077,916.31	$21,077,916.31
Monitoring [a]	$6,679,668.52		
AISWCD CREP Assistants IEPA 319 [b]	$2,180,665.94		
Illinois State Enrollments [c]	$71,572,168.41		
IDNR In-Kind Services [d]	$5,668,182.49		

a – Illinois Natural History Survey, National Great Rivers Research and Education Center, Illinois State Water Survey and United States Fish and Wildlife Service.
b – Association of Illinois Soil and Water Conservation Districts CREP Specialists.
c – Landowner Easement Payment, Practice Cost Share, SWCD administrative costs, property survey costs, title and recording fees.
d – IDNR staff personal services associated with CREP enrollment and management.

Total CREP Contribution 1998 – Sept 30, 2015	IDNR	IDNR/USDA *	IDNR/USDA **
USDA Total		$423,360,155.17	$283,077,280.29
IDNR Total	$86,100,685.36		
Program Total		$509,460,840.53	$369,177,965.65
% of IDNR Program Contribution		17%	23.32%
IDNR Easement Payments Total	$71,572,168.41	$494,932,323.58	$354,649,448.70
% of IDNR Easement Contribution		14%	20%

*** September 2015 Payment and Practice Summary of active CREP Contracts by Program Year, CRP – Monthly Contracts Report**
https://apps.fsa.usda.gov/CRPReport/monthly_report.do?method=displayReport&report=September-2015-ActiveCrepContractsSummaryByProgramYear-17

**** Net Present Value (NPV) https://www.whitehouse.gov/omb/circulars_a094/a94_appx-c**

Illinois CREP Goals

The goals for the Illinois CREP were revised in 2010 to reflect the expansion into the Kaskaskia River Basin and to highlight the importance of the connection to the Mississippi River and the Gulf of Mexico. The goals of the program are:

- **Goal 1:** Help meet the Federal goals to reduce nitrogen loading to the Mississippi River and the Gulf of Mexico, thereby helping to reduce hypoxia in the Gulf of Mexico.
  - **Goal 1a**: Reduce the amount of silt and sedimentation entering the main stem of the Illinois and the Kaskaskia Rivers by 20 percent;
  - **Goal 1b**: Reduce the amount of phosphorus and nitrogen in the Illinois River and Kaskaskia River by 10 percent;
- **Goal 2:** Increase by 15 percent, the populations of waterfowl, shorebirds, nongame grassland birds, and State and Federally listed threatened and endangered species such as bald eagles, egrets, and herons;
- **Goal 3:** Increase the native fish and mussel stocks by 10 percent in the lower reaches of the Illinois River (Peoria, LaGrange, and Alton reaches) and Kaskaskia River.

Monitoring Progress toward Achieving CREP Goals

Pollutant Load Reduction Report

(Monitoring Goals 1a & 1B)

To better understand CREP's impact on water quality, a spatially based pollution load model was developed to estimate field level pollutant loading from Nitrogen, Phosphorus and Sediment. By analyzing soils, land-use and precipitation data the model provides both annual and storm event loading for individual land parcels within the Illinois River basin. Accepted equations for calculating runoff and soil erosion are integrated into the model to provide realistic estimations of the quantity and distribution of pollution loading throughout. Data collected between years 2002 and 2011 were used for model calibration of rainfall values and for evaluating in-stream water quality. Final model results for annual pollution loading are calibrated to existing in-stream water quality data.

Approximately 90,000 acres of State CREP were enrolled since the program opened. Within this total 51,300 acres of crop conversion will prevent following pollutants from entering the Illinois and Kaskaskia Rivers:

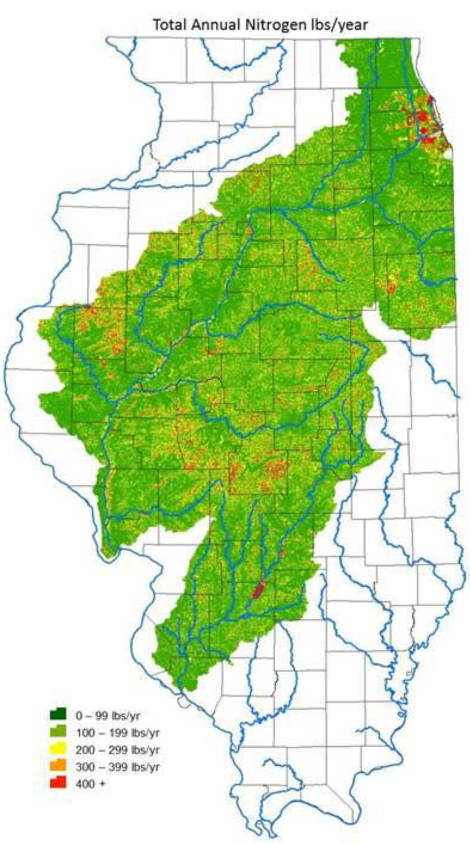
- 330,134 lbs of Nitrogen per year
- 165, 067 lbs of Phosphorus per year
- 165, 067 tons of Sediment per year

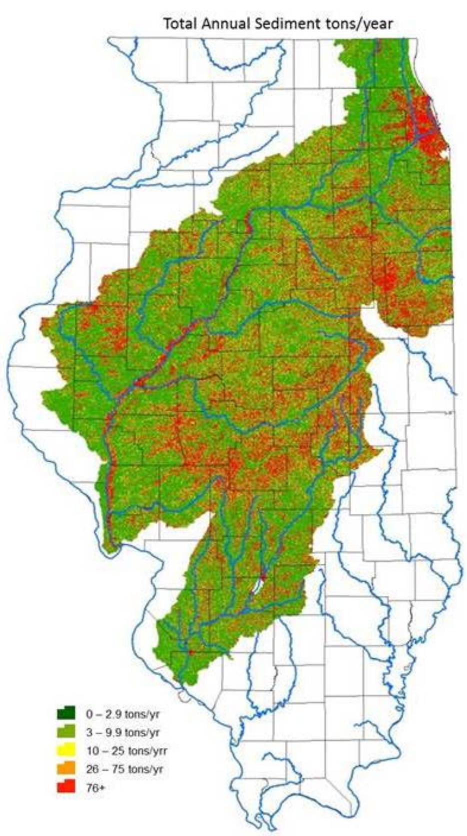
This one-time investment in a CREP easement will reduce non-point source inputs to the Mississippi River basin by the following amounts over a 15 year period:

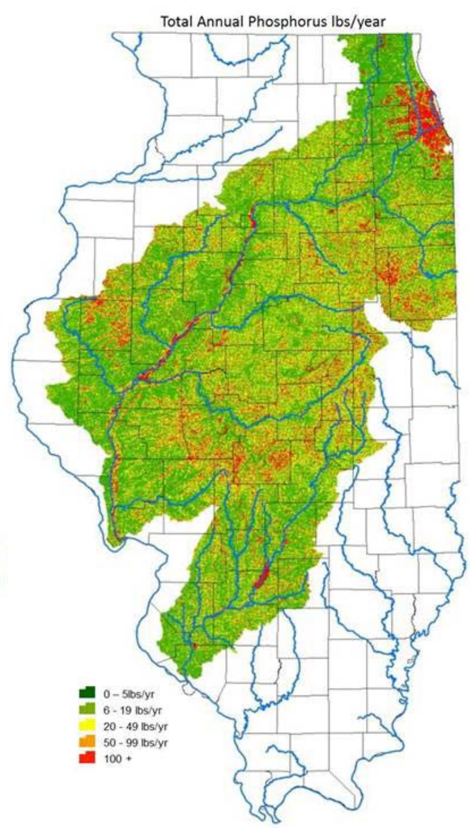
- 4,952,010 lbs of Nitrogen
- 2,476,005 lbs of Phosphorus
- 2,476,005 tons of Sediment

This one-time investment in a CREP easement will reduce non-point source inputs to the Mississippi River basin by the following amounts over a 100 year period:

- 33,013,400 lbs of Nitrogen
- 16,506,700 lbs of Phosphorus
- 16,506,700 tons of Sediment







Load Reduction Methodology for GIS model

1) Predicted Average Annual Soil Loss (ton/acre/yr) = USLE

Before Treatment = R*K*LS*C before

- A slope - 0.24
- B,C, D slope - 0.12
- E, F slope - 0.06

After Treatment = R*K*LS*C After

- Permanent seedings - 0.003
- Tree plantings - 0.004
- Wetlands - 0.0001

2) Sediment Delivery Ratio = ((acres/640)^-0.125)*0.42
3) Sediment Delivery (ton/acre/year) Before = ("before" Predicted Avg Annual Soil Loss * Sediment Delivery Ratio)
4) Sediment Delivery (ton/acre/year) After = ("after" Predicted Avg Annual Soil Loss * Sediment Delivery Ratio)
5) Estimated Sediment Load Reduction (ton/yr)
   = contributing acres * (result from #3 – result from #4)
6) As per EPA recommendation, the following averages are used for N and P
   - Average for nutrients would be for every Ton of soil saved a corresponding amount of P would be 1 lb and for N it would be 2 lbs.

Monitoring and Evaluation of Sediment and Nutrient Delivery to the Illinois and Kaskaskia Rivers – Illinois State Water Survey

(Monitoring Goals 1a and 1b)

Please reference Appendix C for the Illinois River Report and Appendix D for the Kaskaskia River Report

The Conservation Reserve Enhancement Program (CREP) was initiated as a joint federal/state program with the goal of improving water quality and wildlife habitat in the Illinois River basin. Based on numerous research and long-term data in the Illinois River basin, the two main causes of water quality and habitat degradations in major river corridors were known to be related to sedimentation and nutrient loads. Based on this understanding, the two main objectives of the CREP were to reduce the amount of silt and sediment entering the main stem of the Illinois and Kaskaskia Rivers by 20 percent; and to reduce the amount of phosphorous and nitrogen loadings to by 10 percent. To assess the progress of the program towards meeting the two goals, the Illinois Department of Natural Resources (IDNR) and the Illinois State Water Survey (ISWS) are developing a scientific process for evaluating the effectiveness of the program. The process includes data collection, modeling, and evaluation.

The monitoring and data collection component consist of a watershed monitoring program to monitor sediment and nutrients for selected sub-watersheds within the Illinois and Kaskaskia River basins and also to collect and analyze land use data throughout the river basins. Historically, there are a limited number of sediment and nutrient monitoring stations within those river basins, and most of the available records are of short duration. To fill the data gap and to generate reliable data for small watersheds, the Illinois Department of Natural Resources funded the Illinois State Water Survey to initiate a monitoring program to collect precipitation, hydrologic, sediment, and nutrient data for selected small watersheds in the Illinois and Kaskaskia River basins that will assist in making a more accurate assessment of sediment and nutrient delivery. For the Illinois River basin, five small watersheds located within the Spoon and Sangamon River watersheds were selected for intensive monitoring of sediment and nutrients. Three monitoring stations are located in the Spoon River watershed which generates the highest sediment per unit area in the Illinois River basin, while the Sangamon River watershed, the largest tributary watershed to the Illinois River and delivers the largest total amount of sediment, has 2 monitoring stations. The four small watersheds selected for intensively monitoring sediment and nutrient in the Kaskaskia River basin are located within the Crooked Creek, North Fork Kaskaskia River, Hurricane Creek and Shoal Creek watersheds. Two of the monitored watersheds are direct tributaries to Carlyle Reservoir, a U.S. Army Corps of Engineers impoundment on the Kaskaskia River.

The five Illinois River Basin monitoring stations were established in 1999 and are the most detailed data available in the watershed. The full report presents the data that have been collected and analyzed at each of the monitoring stations. The Kaskaskia River basin monitoring stations were established in 2014 after assessing and evaluating many physical, geological, biological, land cover and CRP program data and information, as well as impacts of the 2012 drought. The data collection started in one of the coldest winters recorded in the region for some time. This was followed by a particularly wet spring and summer of 2014 and spring of 2015. A full progress report for the Kaskaskia River also presents the data collected and preliminary analyses for each of the monitoring stations.

As outlined in the Illinois River Basin Restoration Plan, the alternative of no-action in the Illinois River watershed would have resulted in increased sediment delivery to the Illinois River and habitats and ecosystem would continue to degrade. However, analysis of the available long term data from different sources and the most recent data from the CREP monitoring program, indicate that sediment and nutrient loads from the tributary watersheds are gradually decreasing or stabilizing as a result of implementation of conservation practices in the watershed. We have also observed a recent rise in phosphorus delivery from the major tributaries since 2007 primarily driven by dissolved phosphorus. These increases are not observed from the CREP monitoring sites. With the knowledge that reduction in sediment delivery from large watersheds takes time to move through the system, the indication of stabilized sediment delivery shows progress is being made in restoring the Illinois River watershed. If the present trends continue for the next 10 to 15 years, sediment and nutrient delivery to the Illinois River will be significantly reduced, and lead to improved ecosystem in the river and tributary watersheds in the long-term. The Kaskaskia River basin hydrology, sediment, and nutrient monitoring is already establishing that the monitored sites exhibit different concentrations and yields between each watershed and in some areas in contrast to the Illinois River Basin monitoring results. Due to the two years of monitoring occurring during above average spring/summer precipitation, continued monitoring in future years will provide the climate variability needed to properly assess loadings and impact of CREP.

Establishing a Biological Monitoring Program for CREP to Assess the Conservation Practices and Wildlife Habitat on Property Enrolled – Illinois Natural History Survey

(Monitoring Goal 2)

Please reference Appendix B for the full species list

The Illinois Department of Natural Resources (IDNR) is working with the University of Illinois' Critical Trends Assessment Program (CTAP) staff to establish a biological monitoring program for CREP to assess the benefit of conservation practices and wildlife habitat to avian species on property enrolled in CREP. The monitoring program samples the bird communities of shrublands, grasslands, and wetlands at randomly selected CREP easements using point-count based methods. During data collection, the presence and abundance of each species seen or heard during the count period is recorded. Avian point counts are conducted in 180 individual easements larger than 3.0 ha within 4 specific state CREP conservation practices, CP23, CP4D, CP22, and CP3A in the Illinois River watershed. Average size of sample easements was 11.4 ha and the range was 2.97 – 78.5 ha. Species data will be used to determine CREP easement contribution to regional and state population goals for species of conservation concern. After four years, sampling efforts have detected 103 bird species using CREP easements. Species of conservation concern with frequent detections include Field Sparrow, Dickcissel, Eastern Meadowlark, Northern Bobwhite, and Yellow - breasted Chat, Yellow-billed Cuckoo, Brown Thrasher, Willow Flycatcher and Bell's Vireo. CREP easements appear to be providing habitat for many early successional species.

Utilizing data from surveys conducted at CREP easements we have calculated density estimates for species of concern at our study sites. This is particularly important given the Illinois Wildlife Action Plan (IWAP) population goals for these species. Based on our density estimates we have been able to extrapolate the total number of these species using CREP sites in Illinois and preliminary analysis suggests that CREP sites may be providing enough habitat for some species of concern to achieve those population goals. A notable example is the Bell's Vireo whose IWAP goal is increasing the population by 4000 and based on our sampling CREP may be contributing 6800 – 13,600 (170-340% of the goal) birds. Another important example is the Willow Flycatcher whose IWAP goal is increasing the population by 16,000 and based on our sampling CREP may be contributing 10,000 – 20,000 (63 – 125% of the goal) birds. While important, population contributions of CREP sites to the other species of concern listed above have been more modest particularly for grassland birds. As this project moves forward, we plan to determine what management can be applied to CREP sites to improve upon these gains.

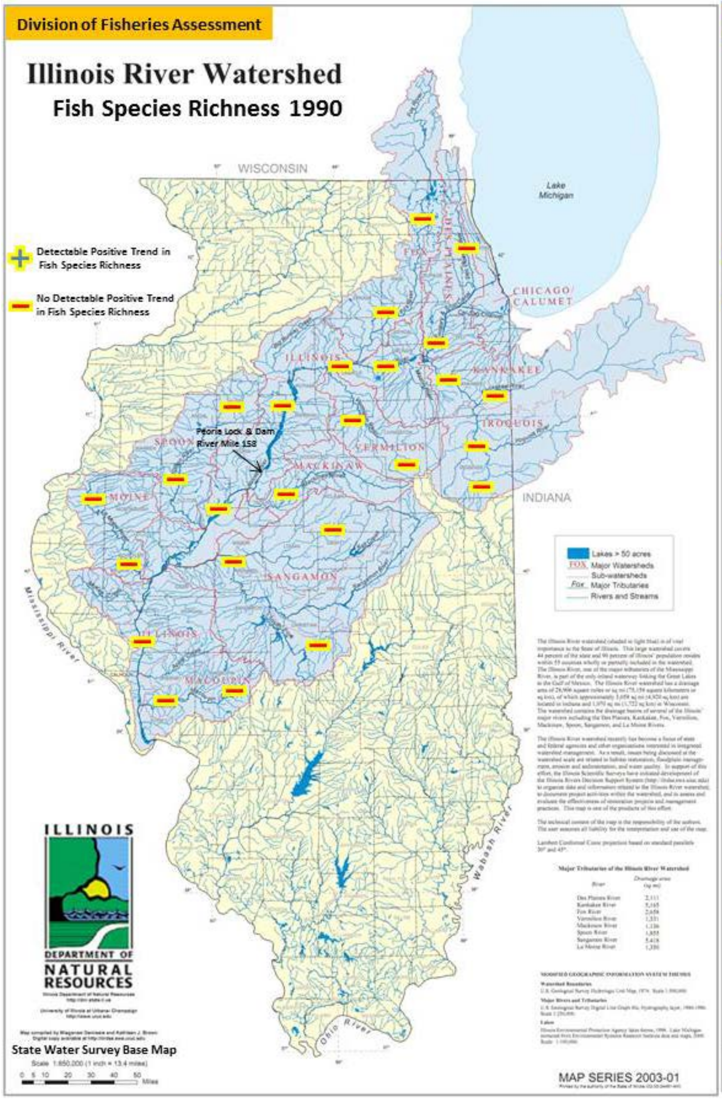
In addition to monitoring the number of birds using CREP sites we also carried out nest searches from 2013-2015 at 14 focal sites to understand the breeding ecology of select shrubland birds including the Bell's Vireo, Brown Thrasher, Field Sparrow, and Willow Flycatcher. Our interest in these birds' nests includes determining their nest survival, brown headed cowbird nest parasitism rates, and fledgling rates. From 2013-2015 we found 499 Bell's Vireo nests, 198 Willow Flycatcher nests, 156 Field Sparrow nests, and 134 Brown Thrasher nests. We are currently in the process of analyzing this data in order to determine how the nest success of these species compares with populations occupying non-restored habitats.

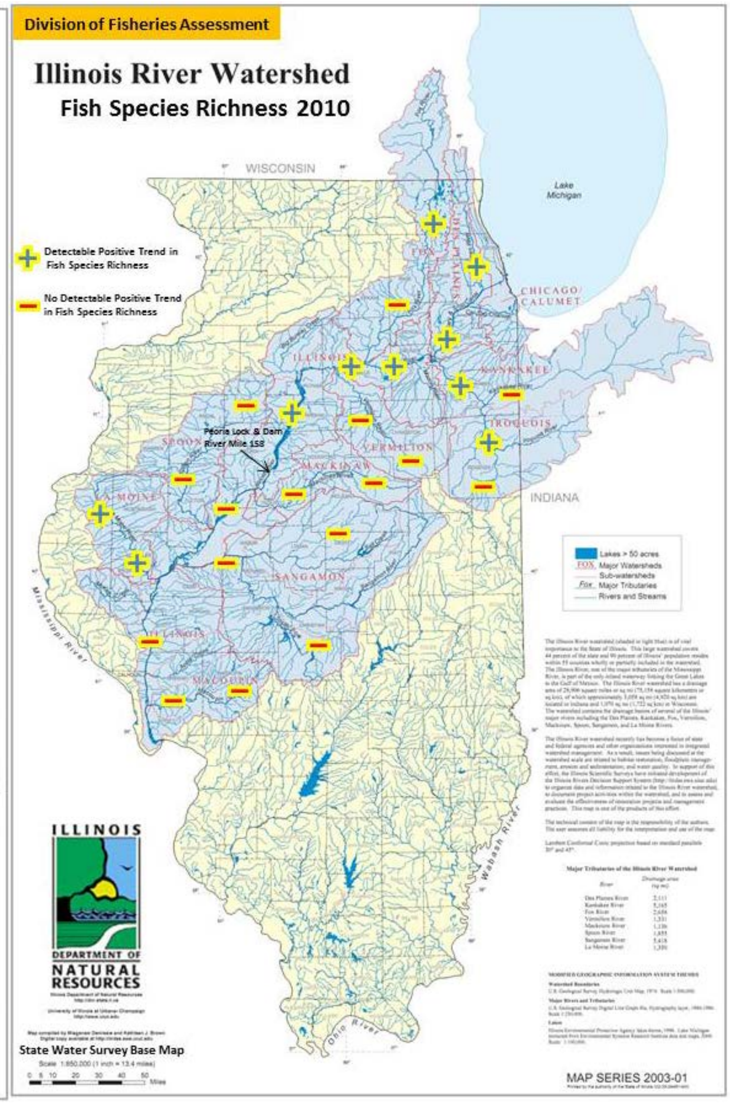
The Recovery of the Illinois River Basin*

(Monitoring Goal 3)

The Illinois River Basin contains 15 major watershed areas or basins comprised of 305 Hydrologic Units (HU). Within each HU, IDNR field biologists have evaluated the ecological well-being of the majority of the hydrounits under the IEPA cooperative basin survey project since the early 1980's. Fish species richness for 9 of the 15 major basins (river mainstem and tributary waters) are covered below in summary Table 1. Illinois River mainstem and tributary waters showing positive fish species trends are summarized in the table below and coresponding maps of 1990 and 2010 fish species richness for the Illinois River Basin.

Fish Species Richness determined by DNR fish sampling data from Illinois River Basin (see graphs below)	**Mainstem**	**Tributaries**	**1990**	**2000**	**2010**	**Fish Species Richness trend detected (+)**
Illinois River above RM 158	X		11	16	20	+
Illinois River all stations	X		13	16	19	+
Marseilles Pool (RM 246 to 271)	X		14	15	21	+
Starved Rock Pool (RM 231 to 245)	X		9	14	18	+
Peoria Pool (RM 158 to 230)	X		13	17	21	+
Major Watersheds						
Fox River	X		4	10	22	+
		X	15	16	18	+
Kankakee River	X		21	30	35	+
	X		22	26	28	+
	X		13	17	21	+
		X	2	13	23	+
LaMoine River	X		13	17	22	+
		X	17	18	19	+





**Information from "The Recovery of the Illinois River Basin – Status Report, IDNR Division of Fisheries, 2011*

Monitoring and Assessment of Aquatic Life in the Kaskaskia River for Evaluating IDNR Private Lands Programs – Illinois Natural History Survey

(Monitoring Goal 3)
Please reference Appendix A for the full report.

Beginning in July of 2012 we initiated a basin-wide monitoring and assessment program within the Kaskaskia River Basin. Our monitoring program is designed to quantify changes in biological condition and separate treatment effects (stressors) from regional and temporal background effects. To accomplish this we have conducted paired biological, chemical, and physical habitat sampling at sites throughout the basin. Sampling sites were selected using a stratified random design with sub-basin, stream size, and proportion of protected land in the watershed as strata. To date these efforts have included biological sampling for fish and macroinvertebrates at over 80 sites throughout the basin. We have also identified a smaller number of sites (16) to monitor annually to provide additional information on regional and interannual variability in stream condition and track the status of selected populations of sensitive species.

In addition we have compiled existing information on fish, mussels, macroinvertebrates, water chemistry, and in-channel habitat for the Kaskaskia River Basin from IDNR, INHS, and IEPA databases to supplement our collections. This includes historical information as well as IDNR/IEPA Intensive Basin Survey fish and habitat collection data from 56 sites in 2012, and INHS mussel collections at 95 sites made from 2009-2012.

Efforts are currently underway to use these data to describe baseline conditions against which to measure future change in biological condition of fish and mussel stocks as CREP enrollments continue and mature within the Kaskaskia River Basin.

Work during this period continued monitoring efforts to characterize fish assemblages, benthic macroinvertebrate assemblages, physical habitat and water quality in streams within the Kaskaskia basin. During summer of 2015, 48 locations were surveyed, bringing the total locations over three survey seasons to 139 (Figure 1). Many of these locations have been surveyed in multiple years to evaluate interannual variation of stream characteristics or to compliment concurrent studies, and therefore the total number of monitoring events (i.e., efforts to characterize the physiochemical and biological attributes of a stream) is 179.

Specific tasks completed during this reporting period include measuring water quality characteristics at a subset of survey locations in fall 2014, resurveying many of the focal sites and the Illinois State Water Survey (ISWS) study locations (i.e., fixed sites) for a second or third year, surveying additional basin-wide status locations and surveying some locations selected to increase data coverage at streams with relatively high CRP density. As streams with CRP densities greater than 10% are rare in the Kaskaskia River basin, we selected stream reaches with local watersheds above this threshold to ensure evaluated locations covered the range of CRP densities present in the basin.

Monitoring conducted during the three years of this study (2013-2015) can be categorized according to their purpose (Table 1, Figure 2). Ninety-two basin-wide status assessment locations have been surveyed to provide an evaluation of physiochemical and biological characteristics throughout the basin. These sites were selected in a manner that would allow assessment of trends throughout the entire basin rather than of individual sites. Fifteen locations selected from streams of biological significance have been surveyed during each of the three study years to evaluate impacts of private land programs in areas of conservation concern (high biodiversity and high dissolved oxygen streams). The ISWS has selected four locations for monitoring of discharge and sediment and nutrient loading. All four of these locations were surveyed for this study in both 2014 and 2015. An additional 31 locations were selected to provide data for student research or to gain a better understanding of processes influencing stream characteristics. For example, two surveys on the same date were conducted at nine locations to evaluate spatial heterogeneity of biota and habitat within a stream segment. Sixteen surveys were conducted at tributaries to the two large reservoirs to evaluate the influence of lentic systems on stream fish diversity.

Summer thermal characteristics were monitored at 81 locations in the basin (Figure 3) during the three years of this study. Mean daily summer temperature ranged from 18.9°C to 27.2°C with a mean of 23.5°C. Water quality parameters were measured during 152 site visits in summer and 60 site visits in fall between 2013 and 2015. Mean values for these parameters were similar in summer and fall (Table 2) and are characteristic of Midwestern watersheds with high densities of agricultural land use. Fish were collected during 123 sampling events between 2013 and 2015. Mean standardized abundance (number of individuals per 100m of sampled stream) was 323.3 and mean standardized species richness (number of species per 100m of sampled stream) was 11.8.Index of Biotic Integrity (Smogor 2000) scores calculated from sampled fish assemblages had a range of 13 (very low) to 55 (moderate) and a mean of 36.3 (indicating an average condition within the moderately low category; Table 3). The seven overall most abundant fish species in wadeable streams of the Kaskaskia River watershed were all minnows, but that pattern varies by subwatershed (Table 4). Green sunfish is the most frequently collected species in the watershed and in three of the four subwatersheds; however, frequency of occurrence patterns vary across the subwatersheds amongst the remaining species (Table 5). QHEI scores (OEPA 2006) for the watershed range between 21 (impaired) and 77.5 (excellent) with a mean of 51.8 (moderate, Table 6). IHI scores (Sass et al. 2011) for the watershed range between 5 and 24 (which are the minimum and maximum scores possible) with a mean of 18.3, which is near the middle of the index gradient (Table 7).

Work conducted during this reporting period was performed primarily by one FTE research scientist aided by the Principle Investigators, two graduate students and three hourly workers. A total of eleven hourly workers (mainly undergraduate students) have assisted staff during the three years of study.

Monitoring Freshwater Mussel Communities

(*Monitoring Goal 3*)

With help from State Wildlife Grant funding, IDNR and INHS collaborated to collect data on mussel communities in Illinois. Many of the sampling locations occur within the CREP Eligible Area; the Illinois River and Kaskaskia River Watersheds. Among those areas surveyed throughout the state, locations in the watersheds of the La Moine River, Sangamon River, Illinois River tributaries, and the Kaskaskia River were sampled.

Sampling of the mussel community of the La Moine River detected all known species historically reported and even detected four species not previously known to exist in the basin. Those four species share a common fish host, the freshwater drum, which may indicate success of the fish is closely tied to the appearance of those species. Recruitment within this basin was reported to be moderate to high, suggesting mussel communities to be viable and self-sustaining.

Historically, the Sangamon River supported more than 40 species of freshwater mussels, however only 29 were detected during the recent sampling effort. There were, however, multiple sites which continue to display high levels of species-richness and diversity. Consistent with previous studies, in the reach between Decatur and Springield fewer species and smaller populations were detected compared with other areas in the basin. Areas in decline are likely seeing effects of habitat loss due to land cover change and channelization, sedimentation as well as agricultural and industrial nutrient and pollutant runoff (Price et al., 2012).

The sampled tributaries of the Illinois River were geographically categorized into Upper, Middle, and Lower Illinois tributaries. Tributaries feeding into the Lower Illinois were the most species-rich, while those in the Upper Illinois were the least. Overall, the tributaries of the Illinois sampled and reported on were neither particularly abundant nor diverse with regards to mussel communities. The most common species detected mirror the same diversity found throughout the state as well as tributary streams of the Mississippi River. Common factors limiting diversity in the sampled areas are similar to limitations in other areas including: small watershed size, spring flooding, flow regime changes, agricultural and industrial runoff, restricted connectivity and altered habitats. There were a few sampling sites which should be noted for their mussel communities, however. At one site, McKee Creek, high rates of recruitment were detected.. While at another site, Tomahawk Creek, the State-Threatened slippershell mussel was collected in extraordinarily high numbers (Stodola et al. 2013).

Multiple mussel surveys have been conducted on the Kaskaskia River between 1954 and 2008. Comparing results of the recent survey, species richness is slightly lower with 32 total species detected compared to 43 historically. Also, dominant species comprising the mussel communities of the Kaskaskia appears to have shifted slightly over time. Overall, recruitment is relatively poor in the Kaskaskia River basin, however there are still many sites which display remarkably high recruitment rates. Shoal Creek has been shown both historically and currently to be a very high quality area for mussels and both species richness and abundance were high (Shasteen et al. 2013).

References:

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PARTNER UPDATES

Illinois Environmental Protection Agency

One of the key missions of Illinois EPA is to monitor and protect the water resources of Illinois; these resources are relied upon for drinking water, fishing, transportation and recreational use and other environmental and economic benefits. One of the most dramatic improvements in water quality that Illinois EPA has documented has taken place on the Illinois River.

Illinois EPA has eight Ambient Water Quality Monitoring Sites on the main channel of the Illinois River. Water chemistry is collected at these sites nine times per year. There are approximately 475 Intensive Basin Survey Sites in the Illinois and Kaskaskia River watersheds. These sites are monitored "intensively" once every five years. The monitoring includes water chemistry, macro-invertebrates, fish, habitat, sediment and at some sites fish tissue contaminants are collected. This information is cooperatively collected with the Illinois Dept. of Natural Resources, a partnership that began many years ago and continues annually.

The monitoring shows that the Illinois River mainstream water quality has improved significantly since the passage of the Federal Clean Water Act in 1972. Early improvements were due primarily to point source controls, such as additional treatment requirements and limits on discharges from wastewater treatment plants. The majority of water quality improvements over the last fifteen years have been from the implementation of nonpoint source management programs that reduce urban and agricultural runoff, and programs such as CREP.

As reported by the Illinois EPA in their 2014 Integrated Report, of the *stream miles assessed* in the Illinois River Basin for Aquatic Life Use Support attainment, 67.8% were reported as —Good, 27.6% as —Fair, and 4.6% as —Poor. This compares to statewide figures of 60.8% —Good, 34.0% —Fair, and 5.2% —Poor.

Illinois EPA continues to participate on the State CREP Advisory Committee and continues to provide financial assistance to local soil and water conservation districts so they can assist landowner enrollment into CREP. Since 1999, more than $2,136,000 of Section 319 grant funds have been spent to hire and train personnel responsible for outreach and the enrollment process.

The benefits derived through this financial support is not only efficiency in the sign-up process to increase CREP enrollment, but it also allows the existing SWCD and NRCS staff to continue to implement the other conservation programs so desperately needed to improve water quality in the Illinois and Kaskaskia River watersheds.

Other Illinois EPA programs that complement CREP include:

Section 319: Since 1990, the Illinois EPA has implemented 293 Clean Water Act Section 319 projects within the Illinois and Kaskaskia River Watersheds. The Agency receives these federal funds from USEPA to identify and administer projects to prevent nonpoint source pollution. These projects include watershed management planning; best management practices implementation and outreach efforts. Illinois EPA has dedicated nearly $67 million with another $57 million of local and state funds for total project costs of over $124 million towards these projects to help improve the health of the Illinois and Kaskaskia Rivers, their tributaries and ultimately the Mississippi River and Gulf of Mexico. Hundreds of conservation practices have been installed in the Illinois and Kaskaskia River watersheds by dozens of our partners through the Section 319 program. Traditional practices such as terraces and waterways are dotting the landscape along with porous pavement parking lots, green roofs and miles of rural and urban stabilized streambank.

Since 1990, the 319 NPS program, through on the ground implementation can show load reductions in the Illinois and Kaskaskia River watersheds of: 568,600 lbs. of nitrogen, 260,334 pounds of phosphorus, and 221,414 tons of sediment per year, each and every year since the Best Management Practices were implemented as a result of 319 grant projects between Illinois EPA and our local partners, in both the private and government sectors. The Illinois EPA invites you to visit http://water.epa.gov/polwaste/nps/success319/ for a sample of Illinois' 319 success stories.

IGIG: Since 2011, the Illinois EPA has implemented 31 Illinois Green Infrastructure Grant Program for Stormwater Management (IGIG) projects within the Illinois and Kaskaskia River watersheds. IGIG is administered by the Illinois EPA. Grants are available to local units of government and other organizations to implement green infrastructure best management practices (BMPs) to control stormwater runoff for water quality protection in Illinois. Projects must be located within a Municipal Separate Storm Sewer System (MS4) or Combined Sewer Overflow (CSO) area. Funds are limited to the implementation of projects to install BMPs. Illinois EPA has dedicated over $15 million with another $5 million of local funds for total project costs of over $20 million towards these projects to help improve water quality in the Illinois and Kaskaskia River watersheds.

Construction Site Inspection Program: Illinois EPA continues to implement a program in partnership with nineteen soil and water conservation districts covering twenty-two counties. Those partners located with the Illinois and Kaskaskia River watersheds include the Champaign, DeKalb, Jersey, Kane/DuPage, Kankakee, Kendall, Knox, Macon, Madison, McHenry/Lake, Monroe, North Cook, Peoria, St. Clair, and Will/South Cook County Soil and Water Conservation Districts. District staff complete on-site NPDES Construction Stormwater Permit inspections and provide technical assistance in implementing best management practices to minimize runoff to nearby water bodies. This program is a natural fit for properly developing acreage that does not qualify for CREP.

Total Maximum Daily Load (TMDL): TMDLs are a tool that Illinois EPA uses to restore impaired watersheds so that their waters will meet Water Quality Standards and Full Use Support for those uses that the water bodies are designated. A TMDL looks at the identified pollutants and develops, through water quality sampling and modeling, the amount or load reductions needed for the water body to meet its designated uses. USEPA has approved 268 completed TMDL evaluations and Illinois EPA is currently developing another 232 TMDLs in the Illinois and Kaskaskia River watersheds.

Partners for Conservation: A total of 72 lake monitoring (study) or protection/restoration projects have been conducted in the Illinois and Kaskaskia River watersheds via the Illinois EPA's Illinois Clean Lakes Program and Priority Lake and Watershed Implementation Program. Over $11.8 million of local and state funds have been allocated for these efforts.

Excess Nutrients: A High Profile Water Quality Issue

The impact of excess nitrogen and phosphorus in rivers, lakes, streams and the Gulf of Mexico has become a very high profile water quality issue. Under the right conditions, nutrients can cause excessive algal blooms, low oxygen and nuisance conditions that adversely impact aquatic life, drinking water and recreational uses of the water. The Illinois EPA has identified many waterbodies in the state with these problems.

Nitrogen and phosphorus come from municipal wastewater treatment, urban stormwater, row crop agriculture, livestock production, industrial wastewater and combustion of fossil fuels. In other words, most aspects of modern society contribute to this pollution problem. The proportion of loading to a particular waterbody from these sources varies from watershed to watershed, with point sources and urban storm water being most important in urbanized watersheds and row crop and/or livestock production being predominant contributors in agricultural watersheds.

Illinois EPA has several on-going efforts concerning nutrients. The first is identification of eight watersheds that are considered our —KIC Nutrient Priority Watersheds. Six of the eight designated watersheds are in the Illinois River Basin, they are: Lake Bloomington, Lake Evergreen, Lake Decatur, Lake Springfield, Vermilion River (Illinois Basin) and Lake Mauvaisse Terre. Each of these watersheds has a Total Maximum Daily Load developed or being developed for one or two nutrient pollutants (nitrogen and phosphorus) for the priority watersheds above. The agency is partnering with a program called —KIC 2025 (www.kic2025.org). KIC 2025 is a commodity industry driven program being implemented in the watersheds listed above. This program seeks to educate the agricultural sector, dedicate significant resources toward research to reduce nutrient losses and enhance nutrient efficiency, educate suppliers and farmers, and measure the adoption of in-field practices to enhance nutrient stewardship beginning in priority watersheds and expanding over years to a state-wide nutrient stewardship program. The Agency is also involved in the Mississippi River Basin Initiative in the Indian Creek Watershed (Livingston County, Vermilion-Illinois Basin). The Agency is providing funds for significant outreach and water quality monitoring that includes weekly growing season sampling and monthly year-round sampling. Lastly, the Agency, Illinois Department of Agriculture and a group of stakeholders recently completed (July, 2015) the Illinois Nutrient Loss Reduction Strategy document that sets a path for reducing nutrient losses on Illinois lands to downstream waters. The strategy has identified 11 priority watersheds for nutrient loss reduction efforts. Five of these watersheds are located in the Illinois River Basin. These include the Upper Fox, DesPlaines, Lower Illinois-Senachwine Lake, Vermilion-Illinois Basin, and Upper Sangamon watersheds. This document, in response to the Gulf Hypoxia Task Force and U.S. EPA leadership will guide the Agency as we address nutrient concerns in the future. The Illinois EPA invites you to visit http://www.epa.illinois.gov/topics/water-quality/watershed-management/excess-nutrients/nutrient-loss-reduction-strategy/index to examine the complete Illinois Nutrient Loss Reduction Strategy.

In conclusion, the Illinois and Kaskaskia River basins are a valuable resource that we are working hard to protect and restore. Illinois EPA will continue long-term monitoring of the rivers and their watersheds and will continue to pursue funds to help implement CREP and other water quality restoration and protection projects and to work with citizen groups and local government and industry to continue the progress we all have made.

Current Management Approaches and Issues

TMDL load limits are required to be implemented through National Pollutant Discharge Elimination System permits, which address point sources—municipal or industrial wastewater dischargers. Management of non-point source pollution is through voluntary implementation of best management practices (BMP) contrary to point sources which are regulated through permit limits.

Cost-share incentives to implement/install BMPs include federal Conservation Reserve Program and state Conservation Reserve Enhancement Program, state Partners for Conservation Program, various Farm Bill conservation programs and Section 319 non-point source management grants. The federal Farm Bill programs, though relatively well-funded, are not consistently targeted at water quality improvement, nutrient reduction or locations most in need of BMPs.

There are various other efforts through state agricultural groups, industry and non-profit organizations to promote the use of agricultural BMPs, but these efforts are not consistently coordinated nor targeted to particular watersheds. In addition, the degree of implementation of key nutrient-related BMPs is not comprehensively quantified or mapped, so the collective status of BMP implementation in the state is unknown.

Available data do indicate that Illinois producers are not over-applying fertilizers or manure and that the traditional suite of conservation practices will not be adequate to achieve such large reductions. Absent the development of an economically viable third crop such as a perennial for biofuels, the costs to significantly reduce nutrient losses from agriculture could be billions of dollars.

New and expanding major (one million gallons per day or greater design flow) municipal sewage treatment plants and some sewage treatment plants discharging to certain lake watersheds are required by Illinois Pollution Control Board regulations to limit total phosphorus to 1.0 mg/L on a monthly average basis. Plants currently achieving this level of phosphorus reduction represent 9% of the approximately 900 municipal discharges in the state. However, of the 214 major municipals discharges, whose effluent constitutes a large majority of the phosphorus loading from point sources, 25% are required to remove phosphorus. Requiring phosphorus removal from the minor facilities would be very costly for customers on a per capita basis and would represent a relatively small portion of the total point source phosphorus discharged. Therefore at this time minor facilities will not be targeted for reducing phosphorus discharge.

What U.S. EPA Expects

U.S. EPA expects states to establish numeric water quality standards for phosphorus and nitrogen and to carry out the other pieces of the Clean Water Act framework, as appropriate. U.S. EPA's Inspector General issued a finding in 2009 that U.S. EPA had not done enough to get state numeric nutrient water quality standards established. In response, U.S. EPA has developed a —corrective action plan which includes a commitment to identify states where federal promulgation of nutrient water quality standards is required. U.S. EPA has been petitioned and sued by various environmental groups for failure of states to establish numeric nutrient standards, so there is mounting pressure on U.S. EPA and states to address nutrients by developing numeric nutrient water quality standards.

States have concerns on the issue of numeric nutrient water quality standards. They raise two main points:

1. There is not a straightforward relationship between nutrient concentration in the water and adverse effects, so a statewide —one size fits all standard that meets the test of scientific defensibility is almost unachievable; and

2. The Clean Water Act programs are effective for point sources but do not assure reductions from non-point sources that are often the predominant contributors of nutrients in a particular watershed.

Through Illinois' Nutrient Loss Reduction Strategy the Illinois EPA has continued its commitment to using a science based approach to developing water quality standards. A Nutrient Science Advisory Committee has been convened to guide the development of nutrient criteria that helps protect aquatic life in Illinois' streams and rivers. It is comprised of scientific experts nominated by the stakeholder sectors represented in the Illinois Nutrient Loss Reduction Strategy Policy Working Group. Illinois EPA will propose numeric nutrient criteria to the Illinois Pollution Control Board in a rulemaking process based on the findings and determinations of the committee. The Illinois EPA will work with stakeholders to develop a plan for implementing the numeric nutrient criteria before filing the rulemaking with the Board.

Illinois Department of Agriculture

The Illinois Department of Agriculture (IDOA) administers numerous soil and water conservation programs that produce environmental benefits in the Illinois River Watershed. In FY14, the Partners for Conservation Program (PFC), administered by IDOA, allocated over $177,975 to 40 counties that have significant agricultural acreage in the Illinois River Watershed for cost-sharing the installation of upland soil and water conservation practices. With the assistance from County Soil and Water Conservation Districts (SWCDs), the PFC provides up to 70% of the cost of constructing conservation practices that reduce soil erosion and protect water quality.

Conservation practices eligible for partial funding under the PFC include terraces, grassed waterways, water and sediment control basins, grade stabilization structures and nutrient management plans. A total of 83 projects have been completed with significant environmental benefits to the Illinois River Basin during with fiscal year 2014 funding. These conservation projects were constructed and are responsible for bringing soil loss to tolerable levels on 986 of acres of land. This translates into over 15,471 fewer tons of soil loss over the next 10 years.

The IDOA provided grant funding to county SWCD offices in the Illinois River Watershed for operational expenses. Specifically, these funds were used to provide financial support for SWCD offices, programs, and employee' expenses. Employees, in turn, provided technical and educational assistance to both urban and rural residents in the Illinois River Watershed. Their efforts are instrumental in delivering programs that reduce soil erosion and sedimentation that ultimately protects water quality.

In an effort to stabilize and restore severely eroding streambanks that would otherwise contribute a large amount of sediment to the Illinois River and its tributaries, the IDOA, with assistance from SWCDs, administers the Streambank Stabilization and Restoration Program (SSRP). The SSRP is a component of the Partners for Conservation Program that provides funds to construct low-cost techniques to stabilize eroding streambanks. In all, over 1,725 feet of streambanks have been stabilized to protect adjacent water bodies

Illinois Department of Natural Resources

Illinois Recreational Access Program (IRAP)

One of the more challenging problems facing Illinois and the Department of Natural Resources (IDNR) is to provide more public outdoor recreational access and opportunities in Illinois. In order to carry on our outdoor traditions, it is important to connect youth and families to land and opportunities. 95 % of Illinois is privately owned and ranks 46th for public lands for recreation but hosts more than 323,000 hunters and 780,000 fishermen and millions of other recreational users.

Through the Illinois Recreational Access Program (IRAP), the IDNR is increasing public recreational opportunities for the following activities:

- Youth Turkey Hunting
- Fishing (Ponds and Streambanks)
- Non-Motorized Boat Access on Public Waterways
- Outdoor Naturalist (Birding, Nature Watching and Outdoor Photography)

Utilizing resources obtained through a grant from the US Department of Agriculture's Voluntary Public Access and Habitat Incentive Program, the IDNR began leasing private land in November of 2011 from private landowners so that outdoor recreationalists will have more places to go. IRAP is targeting CREP enrollments but it is also available to all eligible farm, ranch, and forested land in the 68 county CREP areas.

In addition to the annual stipend lessees receive, emphasis is placed on developing a conservation management plan for the landowner and assisting with the implementation of the management plan. Resources for habitat protection and enhancement come from IRAP, CREP, EQIP, WHIP, NWTF and other cost-share programs.

- IRAP has leased approximately 11360 acres in 27 counties within the Illinois and Kaskaskia River Watersheds.
- Made available 311 spring turkey hunting opportunities to youth hunters
- Received 114 youth applications to participate in 2014 spring turkey hunting on IRAP leased sites.
- Continued to implement BMPs in the Honey Creek watershed in Macoupin County involving private landowners, the city of Carlinville, USFWS, NWTF and others partnering together to implement an Illinois Forest Management Plan.
- 17 management plans have been written for IRAP leased properties.

Landowners can enroll their land in any combination of the three turkey seasons: Youth Season, Regular Season 3 and Regular Season 4. If the land isn't enrolled for a particular season, the land will remain open for the landowner to use at their discretion.

IRAP received its second VPA-HIP grant in 2014 and will be adding the following activities:

- Archery Deer Hunting (October 2015)
- Adult first-time turkey hunting (beginning spring 2016)
- Waterfowl hunting (2016)
- Small game hunting (2016)
- Upland game hunting (2016)

Partners for Conservation

Partners for Conservation (formerly Conservation 2000 – or C2000) is a multi-agency, multi-million dollar comprehensive program designed to take a holistic, long-term approach to protecting and managing Illinois' natural resources. The

Illinois Department of Natural Resources administers the Ecosystems Program and the Critical Trends Assessment Program (CTAP), a statewide ecosystem assessment and monitoring program.

The Ecosystems Program**,** a landmark program, is based upon an extensive network of local volunteers working to leverage technical and financial resources to promote ecosystem based management primarily on private lands. With 95% of the state in private ownership (non-state owned), the main objective of the program is to assist in the formation of public/private partnerships, *Ecosystem Partnerships*, to develop plans and projects on a watershed scale with an ecosystem-based approach. There are two key criteria established for the Ecosystems Program. One, that they must be voluntary, and based on incentives rather than government regulation; and, two, they must be broad-based, locally organized efforts, incorporating the interests and participation of local communities, and of private, public and corporate landowners.

Since its inception in 1996, the C2000 Program has awarded more than $16.4 million in C2000 grants to Ecosystem Partnerships in the **Illinois River watershed** basin for projects providing a variety of conservation practices and outreach. Another $17.75 million has been leveraged as match for these projects for a total of more than $34 million for 489 projects. Accomplishments from these projects include: 15,899 acres of habitat restoration, 169,756 feet of stream bank restoration, 1,814 sites have been or are being monitored, and more than 685,745 people have been educated on watershed protection and restoration.

Natural Resources Conservation Service (NRCS)

Conservation Accomplishments in the Illinois River Watershed

NRCS provides technical assistance to farmers, ranchers, and forest landowners as well as financial assistance through a number of Farm Bill conservation programs. Through the conservation title of the 2014 Farm Bill, NRCS provides cost-sharing for improved farming practices through the Environmental Quality Incentives Program (EQIP) and the Conservation Stewardship Program (CSP); and secures easements to protect agricultural lands and wetlands through the Agricultural Conservation Easement Program (ACEP). NRCS also has floodplain easements through the Emergency Watershed Protection Program (EWP).

In the Illinois River watershed as of the end of September 2015, there are a total of 1,582 active EQIP and CSP contracts. The dollar value of the 458 EQIP contracts in the Illinois River watershed is $7,466,146. In CSP, the Illinois River watershed has 1,114 active contracts covering 934,057 acres. A total of 42 ACEP conservation easements and 4 EWP-Floodplain Easements covering 12,771 acres are active in the Illinois River watershed.

For additional information on NRCS conservation programs, please visit www.nrcs.usda.gov.

US Fish and Wildlife Service

Partners for Fish and Wildlife

The US Fish and Wildlife Service (USFWS) Partners for Fish and Wildlife Program (Partners) has supported the Illinois River Conservation Reserve Enhancement Program (CREP) since its inception. The addition of the Kaskaskia River watershed to the CREP program has expanded the opportunities for a collaborative effort to support landscape scale restoration. The Midwest Region's Partners program assists with projects that conserve or restore native vegetation, hydrology and soils associated with imperiled ecosystems such as bottomland hardwoods, native prairies, marshes, rivers and streams. Collaborating with the Illinois and Kaskaskia River CREP has provided opportunities on a landscape scale for restoration, enhancement, and preservation of these natural habitats on private land. Benefits from this collaboration are the enhancements of privately–owned land for Federal Trust Species, such as migratory birds, inter-jurisdictional fish, threatened and endangered species of plants and animals, and other species of conservation concern. Federally listed threatened and endangered species, particularly the threatened decurrent false aster (*Boltonia decurrens*) have benefited from the Illinois CREP. Equally significant are both direct and indirect benefits to National Wildlife Refuge lands located on or near the Illinois and Kaskaskia Rivers' that accrue as a result of expanded habitat adjacent and near the Refuges, as well as improved water quality that results from implementing approved conservation practices.

Partners' primary contribution to the Illinois and Kaskaskia River CREP has been technical assistance through participation on the CREP Advisory Committee, providing technical and policy assistance input to the program. At the local level, Partners personnel coordinate with local NRCS, SWCD, and Illinois DNR staff as necessary on individual or groups of projects. CREP has opened a host of opportunities for habitat restoration, enhancement, and preservation on private land that fulfills the objectives of a broad coalition of Federal, State, local, and non-government conservation organizations.

Within the Illinois and Kaskaskia River Watersheds, individual Partners projects compliment CREP and other habitat programs. The Partners program provides a tool for restoration and enhancement of habitats on private lands that may not be eligible for other landowner assistance programs. Partners' local coordinators also review the full range of landowner assistance programs with each potential cooperator and refer landowners to CREP and other USDA and Illinois DNR programs that best meet their habitat development and economic goals.

For more information about the Partners for Fish and Wildlife Program please contact: gwen_kolb@fws.gov.

Illinois Farm Bureau

Illinois Farm Bureau (IFB) continues to publicize and promote the Conservation Reserve Enhancement Program (CREP). IFB also used their statewide radio network to highlight details of the program. Information on CREP was sent directly to county Farm Bureaus® (CFB) via e-mail. Illinois Farm Bureau continues to provide input about CREP through various groups and committees and also continues to voice support for the program. CREP is another tool producers can use that provides cost share incentives and technical assistance for establishing long-term, resource-conserving practices and is a positive program in Illinois.

Association of Illinois Soil and Water Districts (AISWCD)

The AISWCD, in partnership with the Illinois Environmental Protection Agency and the Illinois Department of Natural Resources, helped with administration of the CREP program, by providing funding to SWCDs through a two-year grant funded in part by IEPA 319 and IDNR CREP funds. The grant, which began in June 2012, is a cooperative effort between IEPA, IDNR and the AISWCD.

Through the grant, six positions have been established in strategic workload areas of the Illinois River basin. The six CREP Resource Specialists (CRSs) work with groups of SWCDs within Land Use Councils to monitor existing contracts and work with landowners to enroll additional acres into the Illinois River CREP Area. In addition, the CRSs work with interested landowners to help them enroll acres in the Federal CRP in an effort to increase the acres that will also be eligible for enrollment in CREP. CRSs are also working with landowners to help develop post enrollment management plans for their CREP acres.

The ability to utilize six full-time staff to work exclusively with the CREP program is helping to expedite the enrollment process, increasing the level of monitoring of existing contracts and providing landowners with additional services to benefit their CREP acres and ultimately increase water quality benefits attributable to the Conservation Reserve Enhancement Program.

AISWCD, over the past year, has kept track of CRSs timesheets, expense vouchers, trainings, and insurance. The office administers payment to the Housing Districts quarterly, and issues paychecks and expense voucher checks to the CRSs monthly.

This past year has seen some turnover in the CRS position with five of the six positions currently active. Due to state funding in the grant agreement the sixth CRS position has not been filled, but interviews will be conducted soon in 2016 to fill that position.

We thank IDNR and IEPA for their continued support in the CREP program. This program has provided monetary income for both AISWCD and Soil & Water Conservation Districts while also helping to preserve and enhance Illinois' natural resources. All-in-all, this program has provided many benefits and we hope to see it continue into the future.

The Nature Conservancy

The Nature Conservancy's Mackinaw River Program, along with partners McLean County Soil and Water District, NRCS, FSA, and the City of Bloomington have worked with landowner and producers in McLean County to implement the Farmable Wetlands Program (Conservation Practice-39) in Illinois, under the Conservation Reserve Program (CRP). These wetlands are built specifically capture and treat tile drainage water before entering adjacent waterways through denitrification by bacteria and uptake through vegetation. Since 2013, five CP-39 wetlands have been installed in watersheds of the Mackinaw River in McLean County, with four more slated for construction in the fall of 2015 and spring of 2016. Two tile-treatment wetlands were also constructed on City of Bloomington property in 2013 and 2014 near Lake Bloomington and Evergreen Lake. All wetlands will be monitored by The Nature Conservancy, UIUC, and the City of Bloomington to determine their nutrient loss effectiveness.

National Great Rivers Research and Education Center

Providing boots-on-the-ground since 2012, the National Great Rivers Research and Education Center's (NGRREC) *Illinois CREP Initiative* has focused efforts within the newest CREP-eligible watershed—the Kaskaskia River basin. Working in partnership with soil and water conservation districts and the Illinois Department of Natural Resources, Land Conservation Specialists with NGRREC are dedicated to outreach with private landowners about CREP, one-on-one attention with agricultural producers about CREP options and the CREP process, and technical assistance with to complete CREP projects and manage CREP conservation easement parcels.

NGRREC's *Illinois CREP Initiative* is supported by the National Fish and Wildlife Foundation and the Illinois Department of Natural Resources. It adds to other long-term agricultural conservation initiatives at NGRREC, including efforts providing technical assistance to agricultural producers who participate in the Conservation Reserve Program and other USDA conservation programs. Together, agricultural conservation efforts complement NGRREC's research and education missions as they provide high-quality, science-based technical assistance and develop innovative outreach strategies to agricultural producers and private landowners.

The National Great Rivers Research and Education Center is a partnership of Lewis and Clark Community College, the University of Illinois, and the Prairie Research Institute's Illinois Natural History Survey. The Costello Confluence Field Station is located immediately downriver from the Melvin Price Locks and Dam in East Alton.

Illinois National Wild Turkey Federation – Healthy Forests, Woodlands and Waters in the Illinois and Kaskaskia River Basins

Grant Agreement Final Report

Project Start Date: October 1, 2010

Project End Date: December 31, 2013

Objectives for this project are listed below, along with the performance measures to be included in all quarterly, annual and final reports. This report covers the entire project.

OBJECTIVES

1) Re-forest floodplains and riparian corridors of the lower Illinois and upper Kaskaskia Rivers and their tributaries. IDNR projected that 10,708 acres of new tree plantings would be enrolled in each of the Kaskaskia and Illinois River watersheds. The 2 NWTF foresters would each meet with at least 50 landowners per year to develop plans for 1,000 acres of tree plantings in each watershed per year. Over 3 years, a total of 3,000 acres of new tree plantings would be planned in each forester's area of responsibility.

2) Improve the quality of existing private forest land in the lower Illinois and upper Kaskaskia River watersheds. Each NWTF forester would meet with at least 25 forest landowners per year to provide technical assistance and write management plans that qualify for EQIP and/or FDA cost share assistance. A total of 75 forest landowners in each watershed would receive technical assistance, accounting for about 2,250 acres of planned forest improvement practices.

3) NWTF foresters, along with the Regional Biologist, would conduct 2 public information/habitat workshops per year to inform landowners of available programs and educate potential CREP and EQIP participants. The attendance goal was 40 participants per meeting.

PERFORMANCE MEASURES AND REPORTING

From the onset of the project it became apparent that modifications would be required to address challenges and new opportunities to provide forest management expertise for the agency. This report captures accomplishments based on these modifications from the original contract that more accurately capture progress for Objectives 1 and 2 and reflect the full range of assistance requested by IDNR and NRCS. Performance measures for Objective 1 originally included the number of landowner CREP consultations, the number of tree planting plans written, and the number of reforestation acres planned in the designated CREP counties. We have also reported new assistance measures, including the number and acres of CRP tree planting plans, along with the acres of previously written tree plantings that we site reviewed and certified.

Performance measures for Objective 2 originally included the number of forest management plans written and the number of acres affected by those plans. We have also reported new assistance measures, including the number and acres of EQIP forest management reviews, the number of landowner consultations on forest management, and the number and acres of CREP easement reviews. We also included the acres of forest inventories we performed. This shows the forest management plans we expect to be completed in the next few months.

Objective 3 performance measures originally included the number of attendees at the informational meetings/workshops and the resulting number of new CREP applications. However, we subsequently found that the number of CREP applications cannot be reported due to concerns about confidentiality. Therefore only the number of field days/workshops and number of participants are reported below.

REPORT

We encountered a number of challenges during this project, but we feel that we successfully addressed them and provided significant benefit to the Citizens of Illinois as well as to our agency partners.

Project initiation was delayed until March 21, 2011 because Illinois CREP sign up re-opening did not occur in the fall of 2010 as expected. NWTF could not begin the hiring process until we were certain that the program would become available. The NWTF hired two excellent candidates when CREP was eventually re-opened in 2011. Unfortunately this three month delay significantly reduced the time available to deliver conservation achievements in the first year. We then lost one of the foresters a little more than half way through the project when he accepted a permanent job opportunity. Due to the limited time remaining in the project, and the high productivity level of the remaining forester, the NWTF decided to not fill the vacant position. We were confident that we could meet plan goals within the established timeframe with one forester.

High crop prices and other factors resulted in lower than expected public participation in the CREP program, which negatively impacted Objective 1 accomplishments. The foresters completed every CREP tree planting plan and consultation available, even going outside the original project counties when necessary. As a direct result of this situation, IDNR foresters and NRCS District Conservationists referred CRP tree planting plans, reviews of past tree planting plans, and other reforestation programs to our foresters. When these reviews of completed plantings revealed that they did not meet the minimum specifications and standards set by NRCS we performed additional site visits and consultations with contractors to bring them into compliance. We also assisted NRCS with CRP/CREP re-enrollments by reviewing sites and determining if they met the minimum specification and standards prior to being re-enrolled. If the site did not meet minimum standards the forester notified NRCS what needed to be done to bring them up to standard. This allowed for higher quality habitat within established CRP/CREP sites.

EQIP funding for plan implementation was significantly reduced shortly after we began project implementation. As a result the NRCS offices dramatically reduced promoting forest management EQIP practices, which in turn reduced public interest in forest management plans in the focus areas. We then began reviewing proposed CREP easements and certifying that all previously completed EQIP forestry practices met standards. This ensured that forests on those lands were adequately managed to provide high quality wildlife habitat and timber value. The resulting management recommendations on CREP easements were reported to IDNR.

Relevant to Objective 3, we assisted/hosted 12 field days to teach landowners about forest management and opportunities for USDA and state assistance programs. We easily surpassed our stated goal by reaching an additional 180 landowners.

While we encountered numerous obstacles to the successful completion of this grant as originally written, we feel that in the end we exceeded expectations and provided excellent forest management services to our agency partners and citizens. NWTF foresters met unexpected challenges by actively seeking out other means to employ their expertise to provide services required by the partners. The resulting collaboration between our foresters, IDNR and NRCS focused on much-needed technical field reviews for completed CRP, CREP and EQIP forestry practices. These reviews revealed many implemented practices that did not meet NRCS standards. Contractors then brought these implemented practices up to standard. The net result was an additional 9,482 unanticipated acres of assured quality habitat in the lower Illinois and upper Kaskaskia River watershed focus areas from 163 technical reviews. This was in addition to 4,942 prescribed tree planting and forest management plans that were planned under the original agreement.

Objective 1

CREP/CRP Tree Planting Site Visits: 239

Tree Planting Plans: 123

Tree Planting Acres: 1,570 acres planned

Tree Planting Acres reviewed/certified: 3026

Objective 2

Forest Management Plans Written (EQIP and FDA): 62 plans

Acres of Forest Management Planned: 3,372

Acres of Forest Inventories: 5,731

Forest Landowner Consultations: 323

EQIP Forest Management Practice Reviews: 120

EQIP Forest Management Acres Reviewed/Certified: 3,298 acres

CREP Easement Reviews: 51

CREP Easement Forested Acres Protected: 3,158

Objective 3

Outreach Field Day Events Attended: 12

Field Day Public Attendance: 783

APPENDIX A

ILLINOIS NATURAL HISTORY SURVEY
PRAIRIE RESEARCH INSTITUTE

Monitoring and Assessment of Aquatic Life in the Kaskaskia River for evaluating IDNR Private Lands Programs: Annual Report 2015

Leon C. Hinz Jr.
and
Brian A. Metzke

Illinois Natural History Survey
Prairie Research Institute
University of Illinois

16 November 2015

INHS Technical Report 2015 (36)

Prepared for: Illinois Department of Natural Resources
Office of Resource Conservation

Unrestricted: for immediate online release.

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Annual Summary Report

Project Title:
Monitoring and Assessment of Aquatic Life in the Kaskaskia River for evaluating IDNR Private Lands Programs.

Project Number:
RC13CREP01

Contractor information:
University of Illinois at Urbana/Champaign
Prairie Research Institute
Illinois Natural History Survey
1816 South Oak Street
Champaign, IL 61820

Annual Reporting Period:
1 July 2014—30 June 2015

Annual Project Report Due Date:
16 November 2015

Principle Investigator:
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Prepared by:
Leon C. Hinz Jr. and Brian Metzke, INHS

Goals/ Objectives:
(1) Develop and initiate monitoring program that provides a basin-wide assessment of status and trends for aquatic life in wadeable streams of the Kaskaskia River; (2) track the status of selected populations of sensitive species in focal reaches of the Kaskaskia River associated with enhanced DO regulations, BSS designation, and presence of SGNC; (3) evaluate the influence of conservation easements and associated practices on biological communities within the Kaskaskia River Basin.

Project Title: Monitoring and Assessment of Aquatic Life in the Kaskaskia River for evaluating IDNR Private Lands Programs.

Narrative:

Work during this period continued monitoring efforts to characterize fish assemblages, benthic macroinvertebrate assemblages, physical habitat and water quality in streams within the Kaskaskia basin. During summer of 2015, 48 locations were surveyed, bringing the total locations over three survey seasons to 139 (Figure 1). Many of these locations have been surveyed in multiple years to evaluate interannual variation of stream characteristics or to compliment concurrent studies, and therefore the total number of monitoring events (i.e., efforts to characterize the physiochemical and biological attributes of a stream) is 179.

Specific tasks completed during this reporting period include measuring water quality characteristics at a subset of survey locations in fall 2014, resurveying many of the focal sites and the Illinois State Water Survey (ISWS) study locations (i.e., fixed sites) for a second or third year, surveying additional basin-wide status locations and surveying some locations selected to increase data coverage at streams with relatively high CRP density. As streams with CRP densities greater than 10% are rare in the Kaskaskia River basin, we selected stream reaches with local watersheds above this threshold to ensure evaluated locations covered the range of CRP densities present in the basin.

Monitoring conducted during the three years of this study (2013-2015) can be categorized according to their purpose (Table 1, Figure 2). Ninety-two basin-wide status assessment locations have been surveyed to provide an evaluation of physiochemical and biological characteristics throughout the basin. These sites were selected in a manner that would allow assessment of trends throughout the entire basin rather than of individual sites. Fifteen locations selected from streams of biological significance have been surveyed during each of the three study years to evaluate impacts of private land programs in areas of conservation concern (high biodiversity and high dissolved oxygen streams). The ISWS has selected four locations for monitoring of discharge and sediment and nutrient loading. All four of these locations were surveyed for this study in both 2014 and 2015. An additional 31 locations were selected to provide data for student research or to gain a better understanding of processes influencing stream characteristics. For example, two surveys on the same date were conducted at nine locations to evaluate spatial heterogeneity of biota and habitat within a stream segment. Sixteen surveys were conducted at tributaries to the two large reservoirs to evaluate the influence of lentic systems on stream fish diversity.

Summer thermal characteristics were monitored at 81 locations in the basin (Figure 3) during the three years of this study. Mean daily summer temperature ranged from 18.9°C to 27.2°C with a mean of 23.5°C. Water quality parameters were measured during 152 site visits in summer and 60 site visits in fall between 2013 and 2015. Mean values for these parameters were similar in summer and fall (Table 2) and are characteristic of Midwestern watersheds with high densities of agricultural land use. Fish were collected during 123 sampling events between 2013 and 2015. Mean standardized abundance (number of individuals per 100m of sampled stream) was 323.3 and mean standardized species richness (number of species per 100m of sampled stream) was 11.8. Index of Biotic Integrity (Smogor 2000) scores calculated from sampled fish assemblages had a range of 13 (very low) to 55 (moderate) and a mean of 36.3 (indicating an average condition within the moderately low category; Table 3). The seven overall most abundant fish species in wadeable streams of the Kaskaskia River watershed were all minnows, but that pattern varies by subwatershed (Table 4). Green sunfish is the most frequently collected species in the watershed and in three of the four subwatersheds; however, frequency of occurrence patterns vary across the subwatersheds amongst the remaining species (Table 5). QHEI scores (OEPA 2006) for the watershed range between 21 (impaired) and 77.5 (excellent) with a mean of 51.8 (moderate, Table 6). IHI scores (Sass et al. 2011) for the watershed range between 5 and 24 (which are the minimum and maximum scores possible) with a mean of 18.3, which is near the middle of the index gradient (Table 7).

Work conducted during this reporting period was performed primarily by one FTE research scientist aided by the Principle Investigators, two graduate students and three hourly workers. A total of eleven hourly workers (mainly undergraduate students) have assisted staff during the three years of study.

Objective 1: Basin-wide status and trends.

Overview: To evaluate contemporary physiochemical and biological status of streams in the Kaskaskia River basin and to provide a baseline for comparison to future conditions, stream segments were randomly selected using a stratified (size and CRP density categories) design and scouted in early 2014 for their suitability for chemical, habitat and biological surveys. In 2015, 27 basin-wide status assessment locations from the scouting group were surveyed (Figures 1 and 2).

Fall water quality measurement: In fall of 2014, water quality was measured at six basin-wide status assessment locations that had previously been surveyed in summer 2014. Dissolved oxygen, specific conductance, temperature and pH were measured using a Hach Company HQ40d Portable Multi-Meter, while nitrate nitrogen, total reactive phosphorus, ammonia nitrogen and turbidity were measured using a Hach Company DR900 Colorimeter with Test-N-Tube kits. The purpose of this effort was to capture conditions following harvest. A total of 31 fall water quality measurement events have occurred at basin-wide status assessment locations during the three years of this study.

Spring benthic macroinvertebrate collection: Benthic macroinvertebrates from the Orders Ephemeroptera, Plecoptera and Trichoptera (EPT) were collected in May 2015 at 19 basin-wide assessment locations using Critical Trends Assessment Program methods (Molano-Flores 2002). Water quality (temperature, dissolved oxygen, conductivity and pH) measurements and habitat observations (adjacent land use, bank erosion, channel morphology and sedimentation) were made at the time of EPT collection. Spring EPT survey samples have been processed and identified.

Temperature regime characterization: Continuous temperature loggers were deployed at 25 basin-wide assessment locations to evaluate summer thermal regime and 24 of those deployed were successfully retrieved. These data will be combined with those previously recovered in 2013 and 2014 (and from other sources) to build models for the purpose of predicting thermal regime throughout the Kaskaskia River basin. This model may improve understanding of biodiversity patterns in the basin, or could be used to further evaluate impacts of private land programs. This work is ongoing.

Summer water quality measurement: Summer water quality (dissolved oxygen, specific conductance, turbidity, pH, nitrate nitrogen, total reactive phosphorus, ammonia nitrogen and temperature) measurements were collected at 23 basin-wide status assessment locations in 2015. An additional 88 water quality measurement events occurred in 2013 and 2014 to describe background conditions within the basin and evaluate the relationship between private land programs and stream water quality.

Habitat Evaluation: Habitat characteristics were evaluated at each basin-wide status assessment location (n=24) using the Illinois Habitat Index (IHI, Sass et al. 2010) and the Qualitative Habitat Evaluation Index (QHEI, OEPA 2006). Results from these indices will be combined with the 65 other habitat evaluation events from 2013 and 2014 to describe background conditions within the basin and evaluate the relationship between private land programs and stream habitat.

Summer macroinvertebrate collection: Summer benthic macroinvertebrates were collected at 16 basin-wide status assessment locations in 2015. These samples have been preserved and are awaiting identification. Samples from 2013 and 2014 collections were processed (sediment separated from insects, insects stored in compact vials) during early summer 2015. These samples (64 of which were for the basin-wide status assessment) were sent to EcoAnalysts, Inc. (Moscow, ID) for identification and enumeration. Macroinvertebrate assemblage evaluations will be used to describe background conditions within the basin and the relationship between private land programs and stream biota.

Fish assemblage collection: Fish were collected at 23 basin-wide status assessment locations using electrofishing techniques. Fish were identified at the survey location and immediately returned to the streams. Index of Biotic Integrity (IBI, Smogor 2000) scores were calculated for each of these samples. Fish assemblage evaluations will be used to describe background conditions within the basin and the relationship between private land programs and stream biota.

Objective 2: Status of sensitive species (focal stream monitoring).

Overview: Focal stream survey locations (n=15, Figures 1 and 2) were established in stream segments where Biologically Significant Streams (BSS; Bol et al. 2007) and Enhanced Dissolved Oxygen streams (IDNR/IEPA 2006) overlapped. These locations were selected to evaluate impacts of private land programs in areas of conservation concern. During this reporting period efforts focused on surveying focal locations for a third summer survey season. Sampling methods used for each task are described in Objective 1.

Fall water quality measurement: In November 2014, water quality at nine of the 15 focal locations was measured.

Spring benthic macroinvertebrate collection: Spring EPT collection occurred at all 15 focal locations. All locations were also sampled in 2014 so that we might evaluate interannual variability. Identification of these samples has been completed.

Temperature regime characterization: Continuous temperature recorders were deployed at all 15 focal locations in 2015. Thirteen loggers were retrieved and contained valid data. Four focal locations have temperature data from both 2014 and 2015. These data will be used in thermal regime modeling as described in Objective 1.

Summer water quality measurement: Summer water quality parameters were measured at 12 focal locations in 2015. A total of 42 summer water quality measurement events have occurred at focal locations during this study. These data will be used in evaluations of patterns in water quality as described in Objective 1.

Habitat Evaluation: Habitat characteristics were evaluated at 12 focal locations using the IHI and the QHEI. Forty-two habitat evaluations have occurred at focal locations during this study. These data will be used in evaluations of patterns in stream habitat as described in Objective 1.

Summer macroinvertebrate collection: Benthic macroinvertebrates were collected at 12 focal locations in summer 2015. A total of 42 collections have been made at focal locations during this study. Those samples from 2013 and 2014 have been processed and sent to EcoAnalysts, Inc. for identification. These data will be used in evaluations of patterns in stream macroinvertebrates as described in Objective 1.

Objective 3: Influence of private land conservation efforts (fixed site monitoring):

Overview: ISWS selected four locations for their monitoring that we use as fixed sites (Figures 1 and 2) to evaluate physiochemical and biological characteristics while ISWS concurrently evaluates discharge, sediment loading and nutrient loading. Sampling methods used for each task are described in Objective 1.

Fall water quality measurement: In November 2014, water quality parameters at three ISWS locations were measured during a single visit to each of these sites.

Spring benthic macroinvertebrate collection: Spring EPT were collected at two ISWS locations in 2015. Three spring EPT collections have occurred during this study. Identification of these samples has been completed.

Temperature regime characterization: Continuous temperature recorders were placed in all four ISWS locations in spring 2015. Only one logger with valid data was recovered from these sites during the study.

Summer water quality measurement: Water quality measurements were made at all four ISWS locations in summer 2015. All four locations were also monitored in 2014.

Habitat Evaluation: Habitat was evaluated using the IHI and the QHEI in summer 2015 at all four ISWS locations. These four locations were also evaluated in 2014.

Summer macroinvertebrate collection: Benthic macroinvertebrates were collected at all four ISWS locations in summer 2015. ISWS locations were also visited in 2014 and benthic macroinvertebrates were collected then as well. These samples have been sorted and are currently being identified.

Fish assemblage collection: Fish were again collected at three of the ISWS locations in summer 2015. The same three were also surveyed in 2014. The forth site is too large for our gear to effectively sample.

Reporting:

Three presentations at scientific conferences (Drake et al. 2015a, Drake et al. 2015b, Drake et al. 2015c) were given. Presentations described relationships between fish assemblages and watershed CRP density. Quarterly reports and this annual report were prepared and submitted.

Literature Cited:

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Drake, L., Y. Cao, L.C. Hinz, Jr., and B.A. Metzke. 2015b. The Conservation Reserve Program and Its Effect on Fish Diversity in the Kaskaskia Basin. Illinois Chapter of the American Fisheries Society Meeting, Pere Marquette State Park, IL.

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Molano-Flores, B. 2002. Critical Trends Assessment Program Monitoring Protocols. Illinois Natural History Survey, Office of the Chief, Technical Report 2002-2, Champaign, IL. 38 pp, + Figures, Tables, and Appendix.

Ohio Environmental Protection Agency. 2006. Methods for Assessing Habitat in Flowing Waters: Using the Qualitative Habitat Evaluation Index (QHEI). Ohio EPA Technical Bulletin EAS/2006-06-1. State of Ohio Environmental Protection Agency, Division of Surface Water, June 2006.

Sass, L., L.C. Hinz, Jr., J. Epifanio and A.M. Holtrop. 2010. Developing a multi-metric index for wadeable streams in Illinois. Final Report to the Illinois Department of Natural Resources. Illinois Natural History Survey Technical Report 2010/21.

Smogor, R.A. 2000. Draft Manual for Calculating Index of Biotic Integrity Scores for Streams in Illinois.

Table 1. Frequency of survey events (data collection) and number of locations (unique stream segments) for physiochemical and biotic characterization of streams in the Kaskaskia River basin between 2013 and 2015.

	Survey Purpose					
Evaluated Characteristic	**Basin-Wide Status**	**Focal**	**ISWS**	**Student Research/ Special Questions**	**Total Events**	**Total Locations**
Fish Assemblage	83	0	6	34	123	113
Benthic Macroinvertebrate Assemblage	78	42	8	23	151	126
Spring EPT Macroinvertebrate Assemblage	68	30	3	0	101	86
Water Quality	117	66	11	16	210	126
Temperature Regime	47	18	2	0	67	60
Habitat	87	42	8	34	171	159
Total Locations:	92	12	4	31		

Table 2. Mean (and range) of seven water quality parameters measured between 2013 and 2015 in the Kaskaskia River basin.

Time period	Dissolved Oxygen (mg/L)	Conductivity (µS/cm)	pH	Nitrate (mg/L)	Ammonia (mg/L)	React. Phosphate (mg/L)	Turbidity (AHU)
Summer	7.4 (1.1 - 13.4)	603 (96 - 1570)	7.9 (7.2 - 9.0)	3.1 (0 - 16.5)	0.1 (0 - 2.5)	0.6 (0 - 6.7)	28.2 (0 - 177)
Fall	9.7 (0.4 - 17.2)	707 (293 - 2035)	8.3 (7.2 - 9.0)	2.6 (0 - 12.0)	0.3 (0 - 6.4)	1.0 (0 - 10.7)	34.4 (5 - 153)

Table 3. Mean (and range) of metrics used to evaluate fish assemblages sampled between 2013 and 2015.

Abundance (#/100m)	Richness (Species/100m)	IBI Score
323.3 (2.9 - 1919.5)	11.8 (1.1 - 21.9)	36.3 (13 - 55)

Table 4. Rank abundance for the top 20 most common fish species in wadeable streams of the Kaskaskia River basin.

		Subwatershed Rank			
Species	Watershed Rank	Upper	Shoal	Middle	Lower
Bluntnose minnow	1	1	3	8	3
Sand shiner	2	2	1	5	4
Creek chub	3	5	4	2	1
Central stoneroller	4	3	8	3	2
Red shiner	5	4	2	10	5
Bigmouth shiner	6	13	9	1	9
Silverjaw minnow	7	7	5	4	11
Green sunfish	8	15	6	6	8
Bluegill	9	16	11	7	6
White sucker	10	6	14	22	7
Blackstripe topminnow	11	8	15	9	13
Johnny darter	12	10	7	12	12
Longear sunfish	13	9	16	17	10
Redfin shiner	14	11	13	21	19
Pirate perch	15	14	27	11	14
Suckermouth minnow	16	18	10	20	17
Yellow bullhead	17	22	12	15	15
Creek chubsucker	18	17	19	19	27
Striped shiner	19	12	117	117	116
Largemouth bass	20	25	17	18	16

Table 5. Rank frequency of occurrence for the top 20 most common fish species in wadeable streams of the Kaskaskia River basin.

		Subwatershed Rank			
Species	Watershed Rank	Upper	Shoal	Middle	Lower
Green sunfish	1	2	1	1	1
Creek chub	2	3	3	4	4
Yellow bullhead	3	8	2	3	3
Bluntnose minnow	4	1	6	7	5
Bluegill	5	10	4	2	2
Blackstripe topminnow	6	4	8	6	8
Largemouth bass	7	15	7	5	6
Red shiner	8	7	5	11	12
Central stoneroller	9	6	11	19	9
Johnny darter	10	5	12	13	13
Longear sunfish	11	11	14	9	10
White sucker	12	13	16	16	7
Sand shiner	13	14	10	12	11
Redfin shiner	14	12	9	14	15
Tadpole madtom	15	16	17	15	17
Pirate perch	16	17	22	8	14
Silverjaw minnow	17	19	13	17	26
Creek chubsucker	18	9	19	20	31
Suckermouth minnow	19	25	15	22	16
Bigmouth shiner	20	23	18	21	19

Table 6. Mean and range of QHEI metric and index scores for evaluated streams in the Kaskaskia River watershed between 2013 and 2015.

	Metrics							
	Substrate	**Cover**	**Channel**	**Riparian**	**Pool-Current**	**Riffle-Run**	**Gradient**	**Index Score**
Mean:	8.1	10.1	13.0	5.9	6.2	2.3	6.2	51.8
Range:	0.5 - 15.5	5 - 15	6 - 18	2 - 10	-2 - 10	0 - 7	2 - 10	21 - 77.5
Max possible score:	*20*	*20*	*20*	*10*	*12*	*8*	*10*	*100*

Table 7. Mean and range of IHI metric and index scores for evaluated streams in the Kaskaskia River watershed between 2013 and 2015.

	Metrics					
	Buffer and Bare Bank	**Substrate**	**Shade**	**Riffle**	**Woody Debris**	**IHI Score**
Mean:	4.2	4.3	2.9	3.5	3.4	18.3
Range:	1 - 5	1 - 5	1 - 4	1 - 5	1 - 5	5 - 24
Max. possible score:	*5*	*5*	*4*	*5*	*5*	*24*

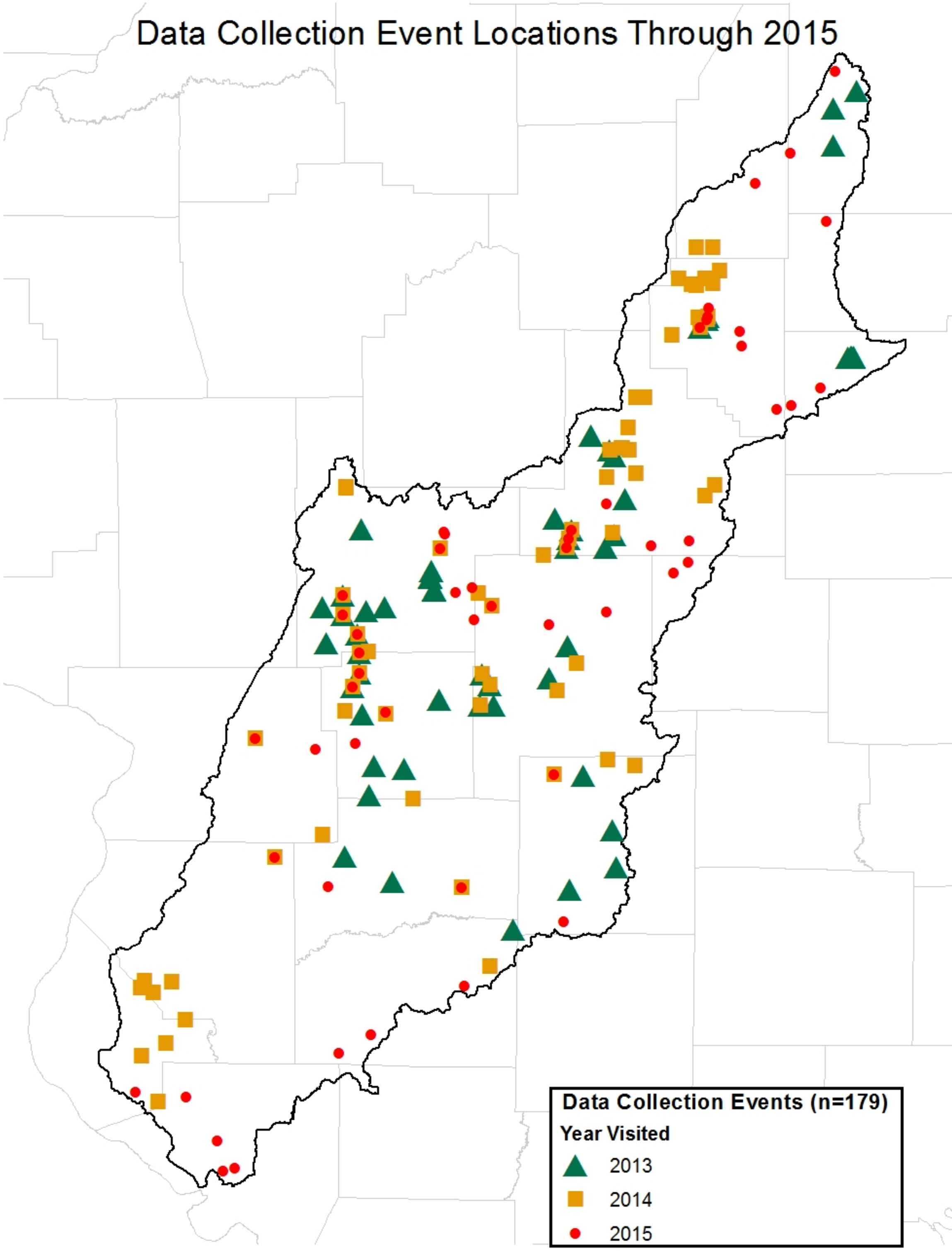

Figure 1. Location and survey year for all data collection events between 2013 and 2015.

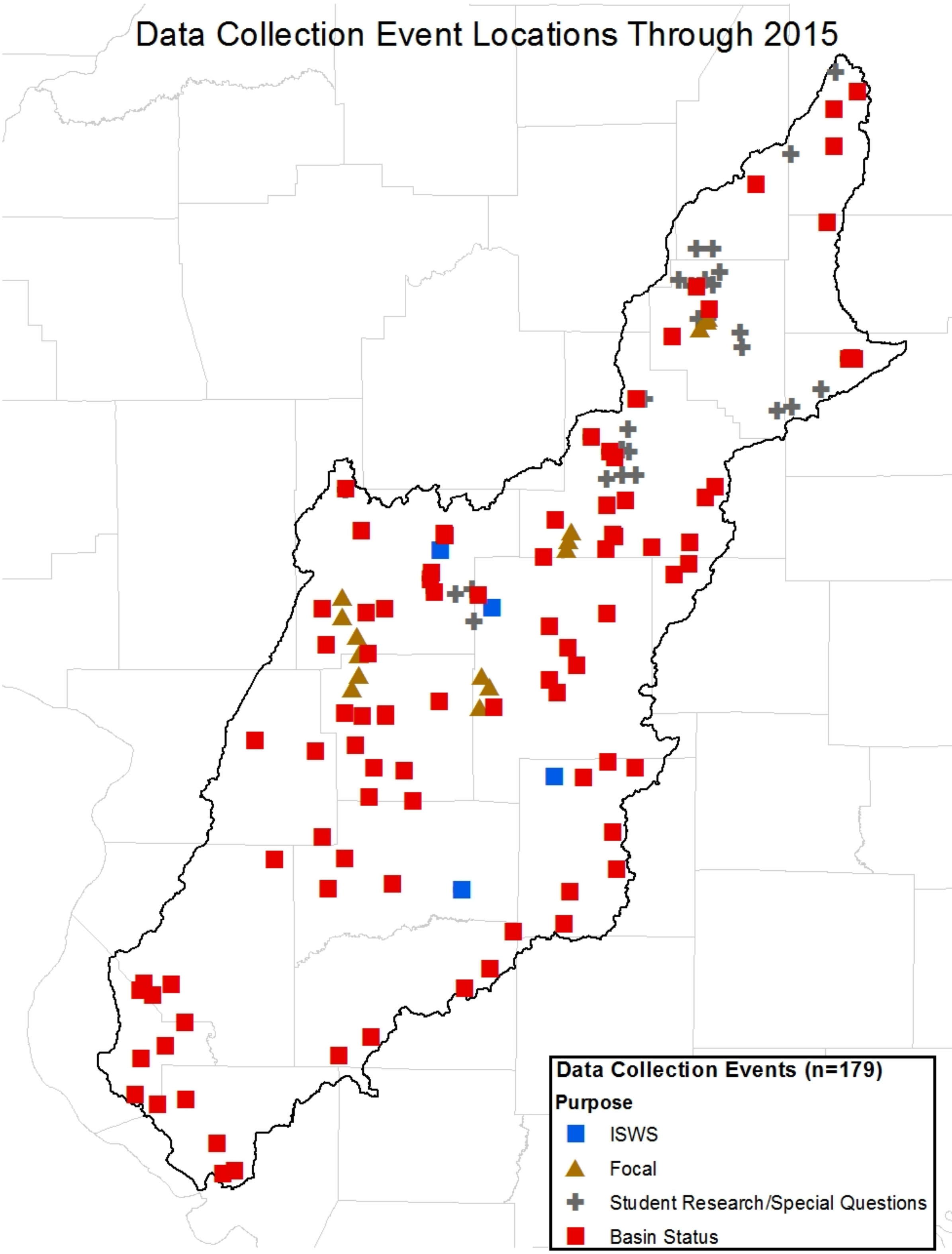

Figure 2. Location and purpose for all data collection events between 2013 and 2015.

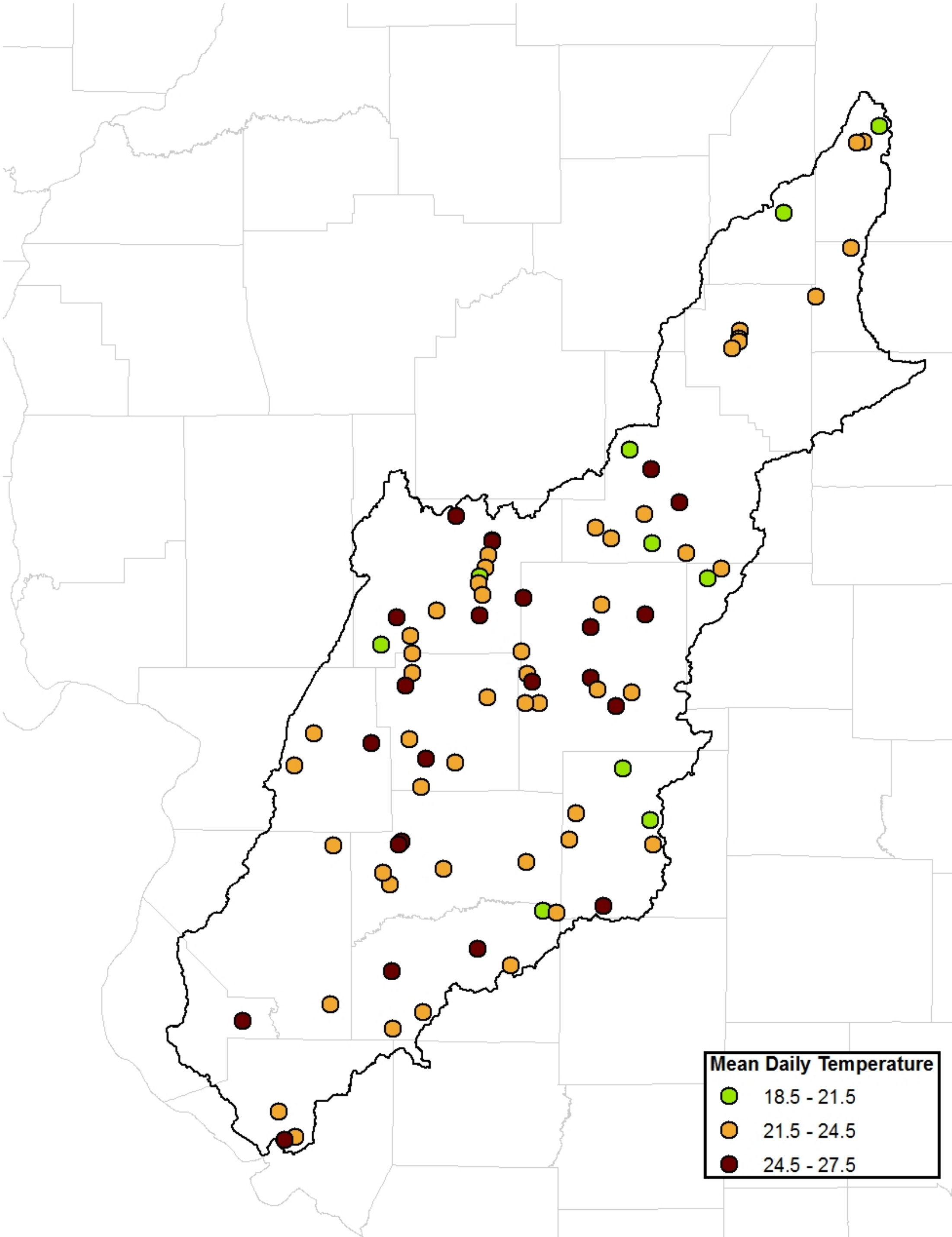

Figure 3. Location and mean daily summer temperature for all valid temperature data (n=81) recorded between 2013 and 2015.

APPENDIX B

Illinois CREP Assessment 2014 – Illinois Natural History Survey

This is a brief summary of the avian research conducted during the spring and summer of 2015 at randomly selected locations within CREP habitats.

During the fourth year of the INHS assessment of the CREP program in Illinois point count sampling continued at all locations sampled in 2012, 2013, and 2014 with continued nest searching for shrubland species at 14 sample sites. Sample sites were located in Brown, Christian, Fulton, Hancock, Knox, Logan, Menard, McDonough, and Sangamon counties. Conservation practices sampled included CP4D, CP3A, CP23, and CP22. On the ground habitat types were forest (7%), grassland (44%), and shrubland (49%). Average sample site size was 11.4 ha and the range was 2.97–78.5 ha. We conducted approximately 374-point counts at 180 CREP easements. Bird detections were similar in species composition to 2012, 2013, and 2014 surveys (results below). Overall, during nest searches in 2013-2015 499 Bell's Vireo, 198 Willow Flycatcher, 134 Brown Thrasher, and 156 Field Sparrow active nests.

Species list in order of most detected to least detected (with more than 50 detections):

Red-Winged Blackbird
Common Yellowthroat
Indigo Bunting
Field Sparrow*
American Goldfinch
Northern Cardinal
Dickcissel*
American Robin
Song Sparrow
Gray Catbird
Mourning Dove
Red-Bellied Woodpecker
American Crow
Rose-Breasted Grosbeak
Yellow-Billed Cuckoo*
Yellow Warbler
Blue Jay
Warbling Vireo
Willow Flycatcher
Yellow- Breasted Chat
Brown-Headed Cowbird
Eastern Towhee
Tufted Titmouse
Eastern Wood Pewee
Northern Bobwhite*
Great-Crested Flycatcher
Eastern Meadowlark
Bell's Vireo*
Ring-Necked Pheasant
Turkey Vulture
House Wren
Red Eyed Vireo
Baltimore Oriole
Northern Flicker
Brown Thrasher
Downy Woodpecker
Barn Swallow
Cedar Waxwing
Eastern Kingbird

Vegetation: Species encountered at CREP sites reveal that most of the plants are native, though these species are disturbance tolerant and considered weedy. Native annual weeds like common and giant ragweed, tall boneset, and annual fleabane were encountered at many sites. Common goldenrod, found at every site, is a quick growing; native perennial herb that readily colonizes disturbed soil. Other weedy native, perennials included panicled aster and hairy aster. Woody natives with a somewhat weedy habit included silver maple, eastern cottonwood, and green ash (*Fraxinus pennsylvanica).*

Native plant species were generally more abundant than non-native species, but invasive species like reed canary grass, field thistle, and Amur honeysuckle were present on some sites. Compared to randomly selected wetland and grassland sites sampled as part of the Critical Trends Assessment Program (CTAP), the CREP sites were more botanically rich and diverse, but as sites mature without management or disturbance, plant diversity is expected to decline.

APPENDIX C

Monitoring and Evaluation of Sediment and Nutrient Delivery to the Illinois River: Illinois River Conservation Reserve Enhancement Program (CREP)

by
Illinois State Water Survey
Illinois Department of Natural Resources

Prepared for the
Office of Resource Conservation,
Illinois Department of Natural Resources

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Monitoring and Evaluation of Sediment and Nutrient Delivery to the Illinois River: Illinois River Conservation Reserve Enhancement Program (CREP)

by
Illinois State Water Survey
Illinois Department of Natural Resources

1. Introduction

The Illinois River Conservation Reserve Enhancement Program (CREP) was initiated as a joint federal/state program with the goal of improving water quality and wildlife habitat in the Illinois River basin. Based on numerous research and long-term data, the two main causes of water quality and habitat degradations in the Illinois River were known to be related to sedimentation and nutrient loads. Based on this understanding, the two main objectives of the Illinois River CREP were stated as follows:

1) Reduce the amount of silt and sediment entering the main stem of the Illinois River by 20 percent.

2) Reduce the amount of phosphorous and nitrogen loadings to the Illinois River by 10 percent.

To assess the progress of the program towards meeting the two goals, the Illinois Department of Natural Resources (IDNR) and the Illinois State Water Survey (ISWS) are developing a scientific process for evaluating the effectiveness of the program. The process includes data collection, modeling, and evaluation. Progress made so far in each of these efforts is presented in this report.

Acknowledgments

The work upon which this report is based was supported by funds provided by the Office of Resource Conservation, Illinois Department of Natural Resources. Ms. Debbie Bruce and Richard Mollahan managed the project for IDNR and provided the proper guidance and support to design and operate the monitoring program and the associated research. Their continued support and guidance is greatly appreciated.

Several Illinois State Water Survey staff participated and contributed towards the successful accomplishment of project objectives. Jim Slowikowski and Kip Stevenson are responsible for the data collection and analysis. Laura Keefer was responsible for analysis of the land use data with assistance from Erin Bauer. Jas Singh and Yanqing Lian were responsible for the development of the watershed models. Elias Getahun and Vern Knapp provided the analyses on variability and trends in precipitation and streamflow in the Illinois River basin. Momcilo Markus analyzed the Illinois Environmental Protection Agency nutrient data for analyses of long-term trends. Sangeetha Chandrasekaran and Elias Getahun analyzed the Benchmark Sediment Monitoring data for long-term trend analysis. Patti Hill prepared the draft and final reports.

2. Monitoring and Data Collection

The monitoring and data collection component consist of a watershed monitoring program to monitor sediment and nutrient for selected watersheds within the Illinois River basin and also to collect and analyze land use data throughout the river basin. Historically, there are a limited number of sediment and nutrient monitoring stations within the Illinois River basin, and most of the available records are of short duration. For example, figure 2-1 shows all the active and inactive sediment monitoring stations within the Illinois River basin prior to the start of monitoring for CREP. Out of the 44 stations shown in the map, only 18 stations had records longer than 5 years and only 8 stations had more than 10 years of record. Therefore the available data and monitoring network was insufficient to monitor long-term trends especially in small watersheds where changes can be observed and quantified more easily than in larger watersheds.

To fill the data gap and to generate reliable data for small watersheds, the Illinois Department of Natural Resources funded the Illinois State Water Survey to initiate a monitoring program that will collect precipitation, hydrologic, sediment, and nutrient data for selected small watersheds in the Illinois River basin that will assist in making a more accurate assessment of sediment and nutrient delivery to the Illinois River.

Sediment and Nutrient Data

Five small watersheds located within the Spoon and Sangamon River watersheds were selected for intensively monitoring sediment and nutrient within the Illinois River basin. The locations of the watersheds and the monitoring stations are shown in figures 2-2 and 2-3 and information about the monitoring stations is provided in table 2-1. Court and North Creeks are located within the Spoon River watershed, while Panther and Cox Creeks are located within the Sangamon River watershed. The Spoon River watershed generates the highest sediment per unit area in the Illinois River basin, while the Sangamon River watershed is the largest tributary watershed to the Illinois River and delivers the largest total amount of sediment to the Illinois River. The type of data collected and the data collection methods have been presented in detail in the first progress report for the monitoring program (Demissie et al., 2001) and in the Quality Assurance Project Plan (QAPP) given in Appendix A. This report presents the data that have been collected and analyzed at each of the monitoring stations.

Table 2-1. Sediment and Nutrient Monitoring Stations Established for the Illinois River CREP

Station ID	*Name*	*Drainage area*	*Watershed*
301	Court Creek	66.4 sq mi (172 sq km)	Spoon River
302	North Creek	26.0 sq mi (67.4 sq km)	Spoon River
303	Haw Creek	55.2 sq mi (143 sq km)	Spoon River
201	Panther Creek	16.5 sq mi (42.7 sq km)	Sangamon River
202	Cox Creek	12.0 sq mi (31.1 sq km)	Sangamon River

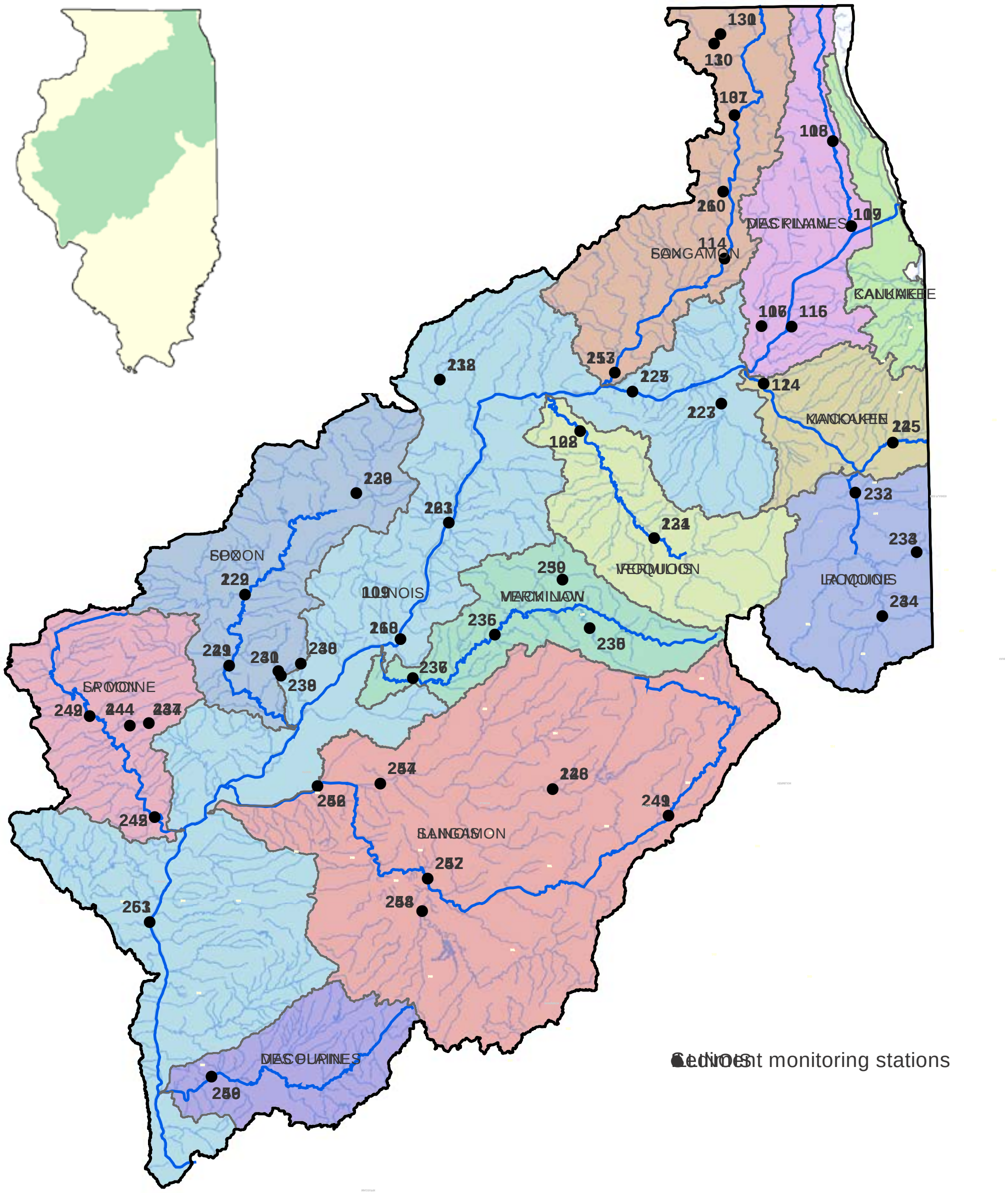


Figure 2-1. Locations of available in-stream sediment data within the Illinois River watershed, 1981-2000

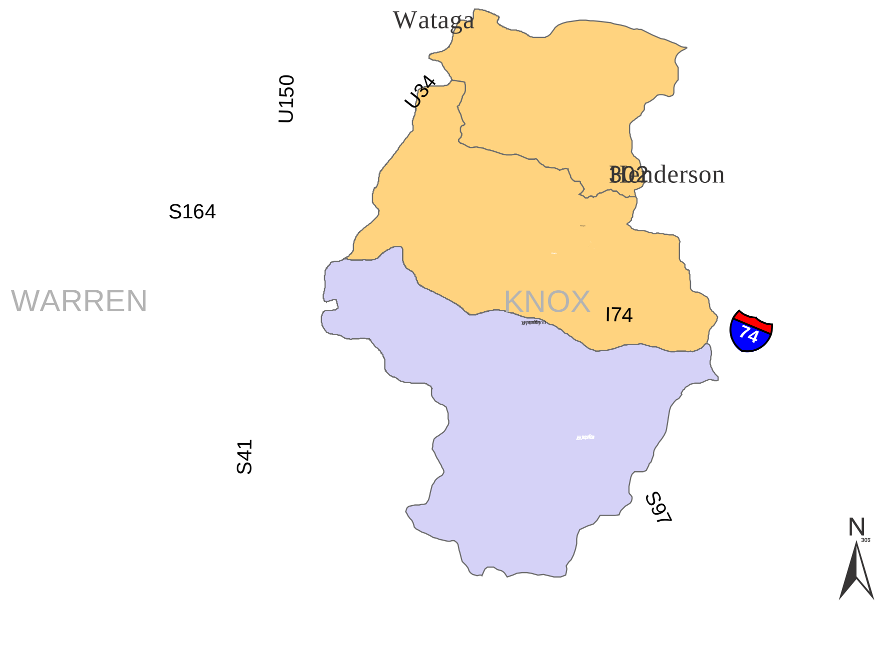


Figure 2-2. Location of monitoring stations in Court and Haw Creek watersheds

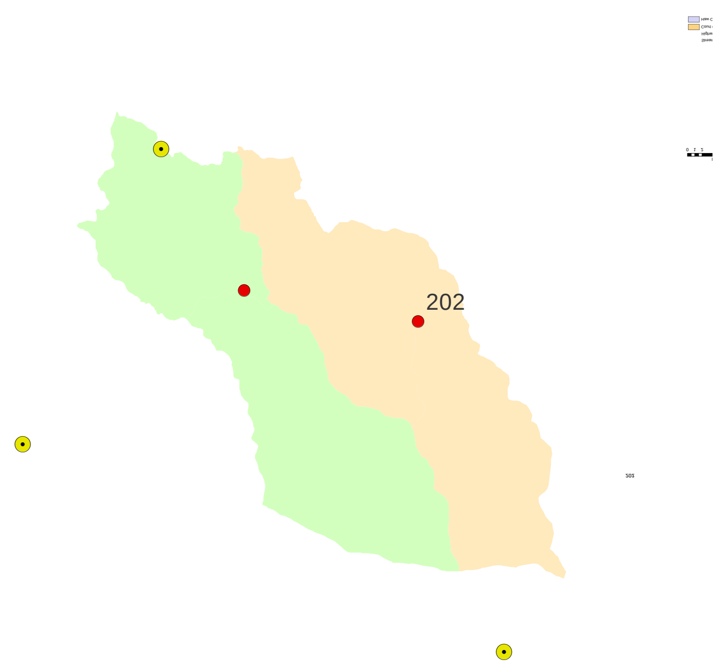


Figure 2-3. Location of monitoring stations in Panther and Cox Creek watersheds

Sediment Data

The daily streamflow and suspended sediment concentrations observed at all the five monitoring stations from Water Year 2000 to Water Year 2014 are given in Appendix B and C. Examples of the frequency of data collection are shown in figures 2-4 and 2-5 for the Court Creek Station. A summary of statistics for all stations showing the mean, medium, minimum maximum, 25th percentile, and 75th percentile are given in table 2-2. Over 30,004 samples have been collected and analyzed at the five monitoring stations since the monitoring program was initiated. As can be seen in the figures, suspended sediment concentrations are highly variable throughout a year and also from year to year depending on the climatic conditions. It is also evident that sediment concentrations are the highest during storm events resulting in the transport of most of the sediment during storm events. Therefore, it is extremely important that samples are collected frequently during storm events to accurately measure sediment loads at monitoring stations.

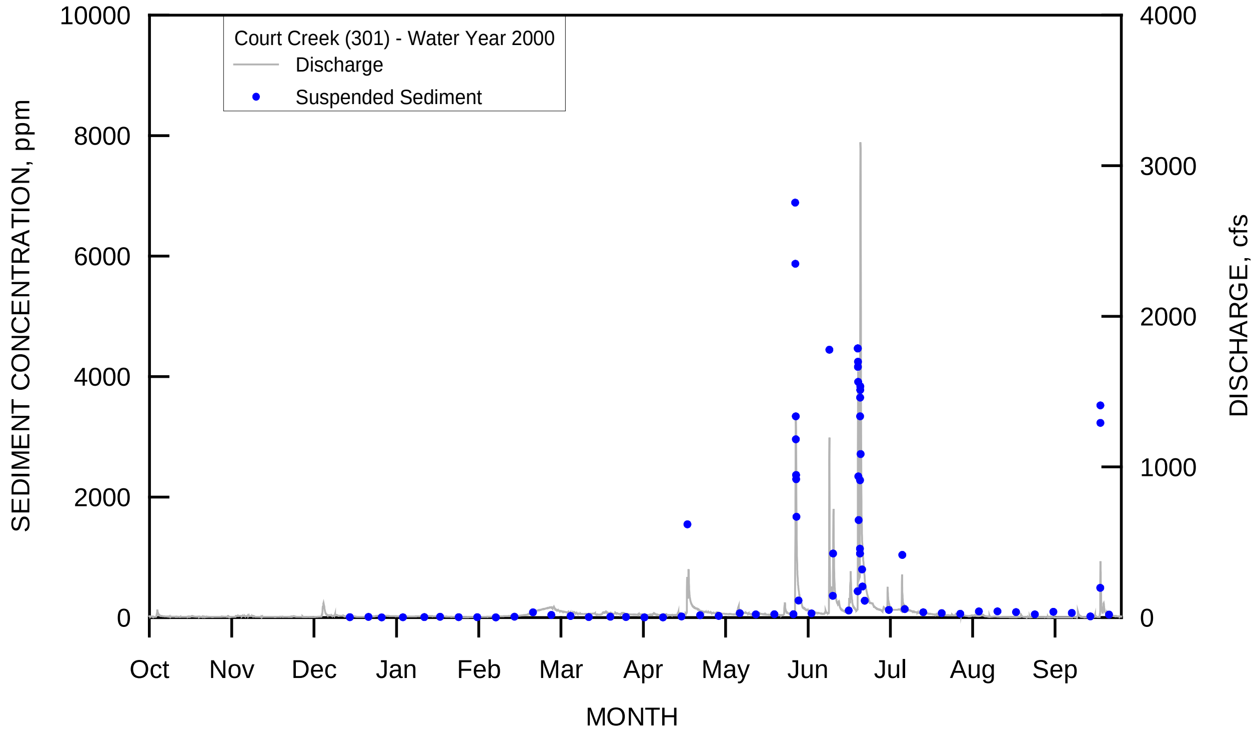
Nutrient Data

All the nutrient data collected and analyzed from Water Year 2000 through Water Year 2014 at the five monitoring stations are given in Appendices D and E. The nutrient data are organized into two groups: nitrogen species and phosphorous species. The nitrogen species include nitrate-nitrogen (NO_3-N), nitrite-nitrogen (NO_2-N), ammonium-nitrogen (NH_4-N), and total Kjedahl nitrogen (TKN). The phosphorous species include total phosphorous (TP), total dissolved phosphorous (TDP), and orthophosphate (P-ortho). Over 5,450 samples have been collected and analyzed for nitrate (NO_3-N), ammonium (NH_4-N) and orthophosphate (P-ortho). In addition, more than 3,027 samples have been analyzed for nitrate (NO_2-N), total Kjeldahl nitrogen (TKN), total phosphorous (TP), and total dissolved phosphorous (TDP). Examples of the type of data collected for the nitrogen species are shown in figure 2-5, while those for the phosphorous species are shown in figure 2-6. A summary statistics for all stations showing the mean, median, minimum, maximum, 25th percentile, and 75th percentile are given in table 2-2.

Data for the nitrogen species at all five monitoring stations show that the dominant form of nitrogen transported by the streams is nitrate-N. During storm events, the concentration of TKN rises significantly, sometimes exceeding the nitrate-N concentration. TKN is highly correlated to suspended sediment concentrations.

One significant observation that can be made from the data is the consistently higher concentrations of nitrate-N at Panther Creek and Cox Creek (tributaries to the Sangamon River) than at Court Creek, North Creek, and Haw Creek (tributaries of the Spoon River).

Data for the phosphorous species at all five monitoring stations show that most of the phosphorous load is transported during storm events. Concentrations of total phosphorous are the highest during storm events and relatively low most of the time. This is very similar to that shown by sediment and thus implies high correlations between sediment and phosphorous concentrations and loads. In terms of phosphorous concentrations, it does not appear there is any significant difference between the different monitoring stations from the Spoon and Sangamon River watersheds.



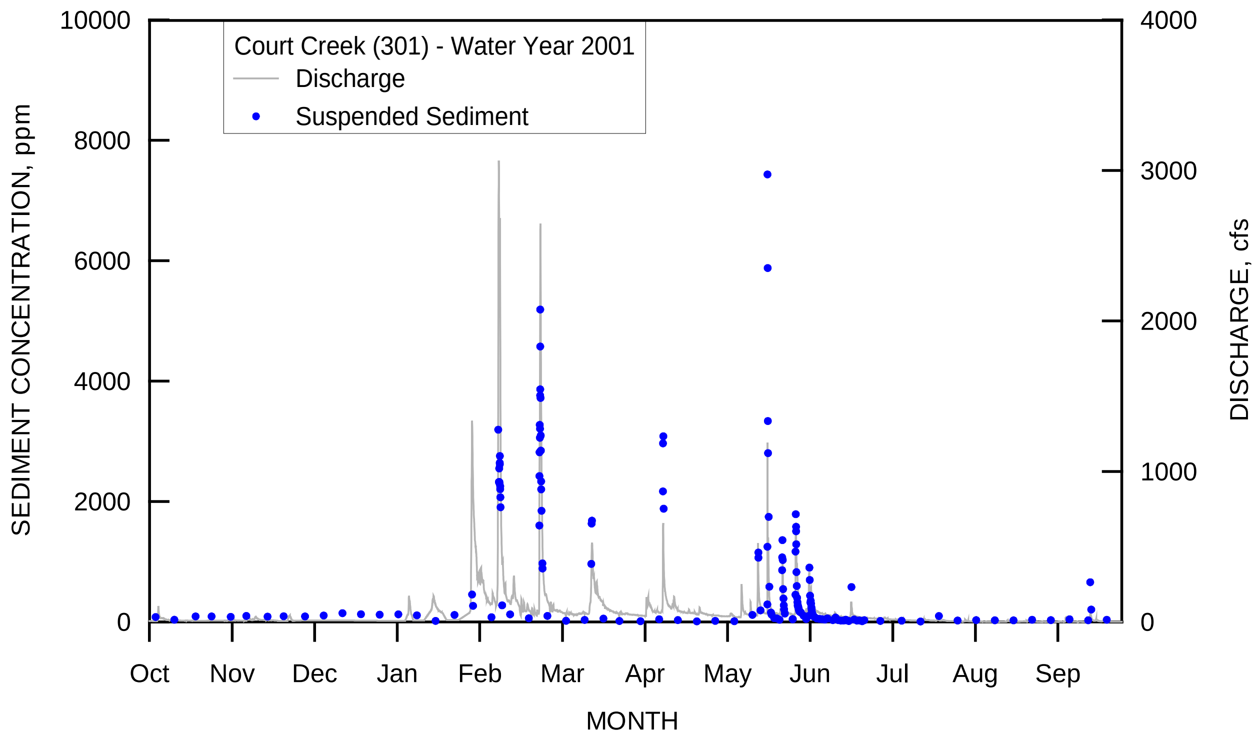
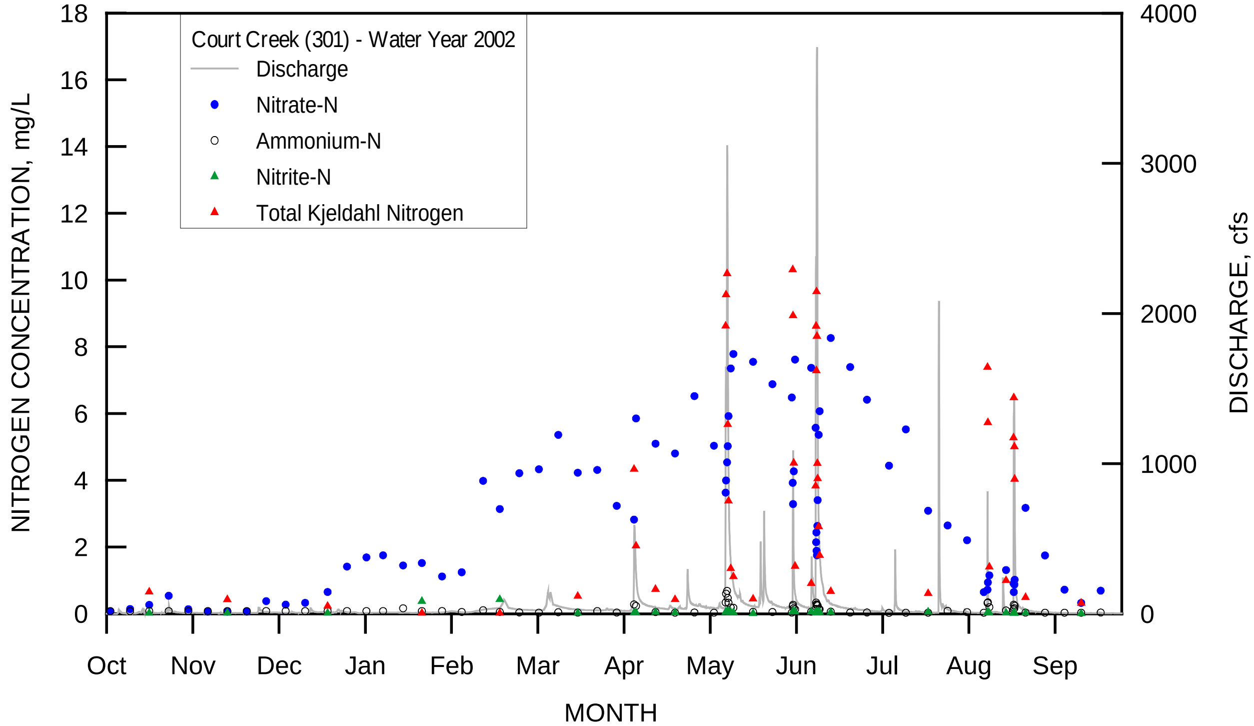


Figure 2-4. Suspended sediment concentrations and water discharge at Court Creek (301) for Water Years 2000 and 2001



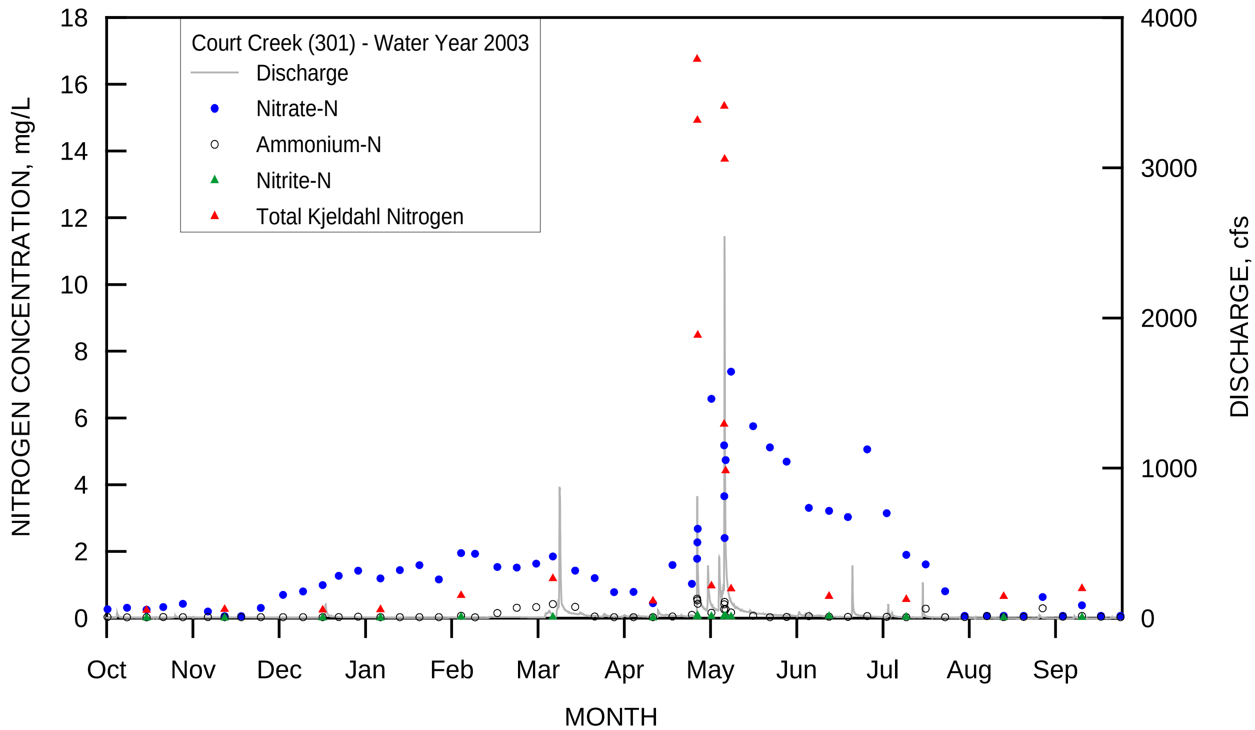
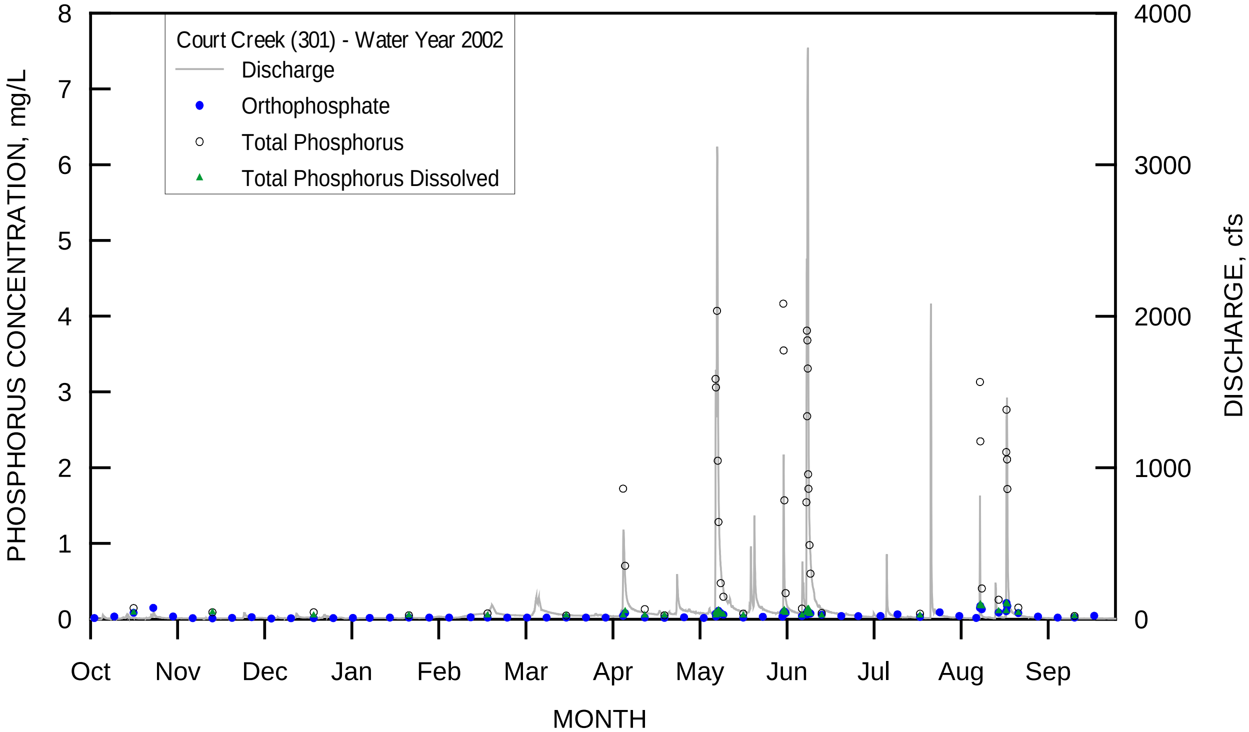


Figure 2-5. Concentrations of nitrogen species and water discharge at Court Creek (301) for Water Years 2002 and 2003

Table 2-2. Summary Statistics for Water Years 2000–2014. All concentrations in mg/L

	NO3-N	*oPO4-P*	*NH4-N*	*NO2-N*	*TKN*	*t-P*	*t-P-Dissolved*	*SSC*
Panther Creek (Station 201)								
Count	987	987	987	489	488	488	488	5971
Mean	3.85	0.12	0.10	0.03	2.34	1.00	0.18	875.6
Median	3.06	0.08	0.06	0.02	1.02	0.35	0.13	129.7
Min	< 0.04	< 0.01	< 0.03	< 0.01	< 0.12	< 0.03	< 0.03	1.47
Max	14.76	1.31	5.99	0.21	23.99	11.21	1.38	48289.0
25th Percentile	0.14	0.05	0.04	0.01	0.46	0.12	0.08	56.6
75th Percentile	6.45	0.14	0.08	0.04	2.97	1.25	0.21	438.7
Cox Creek (Station 202)								
Count	998	998	998	496	496	496	496	5281
Mean	5.52	0.21	0.68	0.05	3.51	1.12	0.31	689.8
Median	4.71	0.11	0.07	0.04	1.45	0.44	0.19	152.5
Min	< 0.04	< 0.01	< 0.03	< 0.01	< 0.14	< 0.04	< 0.03	0.95
Max	19.83	7.81	300.33	1.26	390.37	29.10	8.21	22066.5
25th Percentile	0.78	0.06	< 0.06	0.02	0.60	0.17	0.09	76.3
75th Percentile	9.08	0.23	0.21	0.05	3.47	1.37	0.36	386.9
Court Creek (Station 301)								
Count	1158	1158	1158	686	685	685	685	5671
Mean	2.94	0.08	0.15	0.04	2.50	0.85	0.12	635.4
Median	2.72	0.05	0.07	0.03	1.39	0.38	0.09	112.2
Min	< 0.04	< 0.003	< 0.03	< 0.01	0.23	0.03	< 0.03	1.93
Max	11.37	0.93	1.73	0.13	18.69	6.58	0.97	13632.0
25th Percentile	0.85	0.03	< 0.06	0.02	0.66	0.12	0.05	48.0
75th Percentile	4.71	0.09	0.17	0.05	3.35	1.17	0.13	517.3
North Creek (Station 302)								
Count	1147	1147	1147	674	674	674	674	6653
Mean	2.96	0.08	0.15	0.04	2.31	0.79	0.13	488.6
Median	2.74	0.05	0.07	0.03	1.21	0.32	0.09	96.0
Min	< 0.04	< 0.003	< 0.03	< 0.01	0.23	< 0.04	< 0.03	0.36
Max	12.66	1.05	2.43	0.19	17.95	6.69	1.07	15137.1
25th Percentile	0.62	0.02	0.06	0.02	0.63	0.11	0.05	41.2
75th Percentile	4.73	0.09	0.16	0.05	2.63	0.92	0.14	280.9
Haw Creek (Station 303)								
Count	1160	1160	1160	684	684	684	684	6428
Mean	4.35	0.09	0.13	0.05	2.36	0.79	0.13	579.8
Median	4.27	0.06	0.07	0.04	1.45	0.43	0.09	165.1
Min	< 0.04	< 0.003	< 0.03	< 0.01	0.23	0.04	< 0.03	2.17
Max	12.59	1.34	1.12	0.21	16.75	5.92	1.41	9878.8
25th Percentile	1.63	0.04	0.06	0.02	0.66	0.15	0.06	55.2
75th Percentile	6.60	0.10	0.14	0.06	3.05	1.07	0.13	630.5



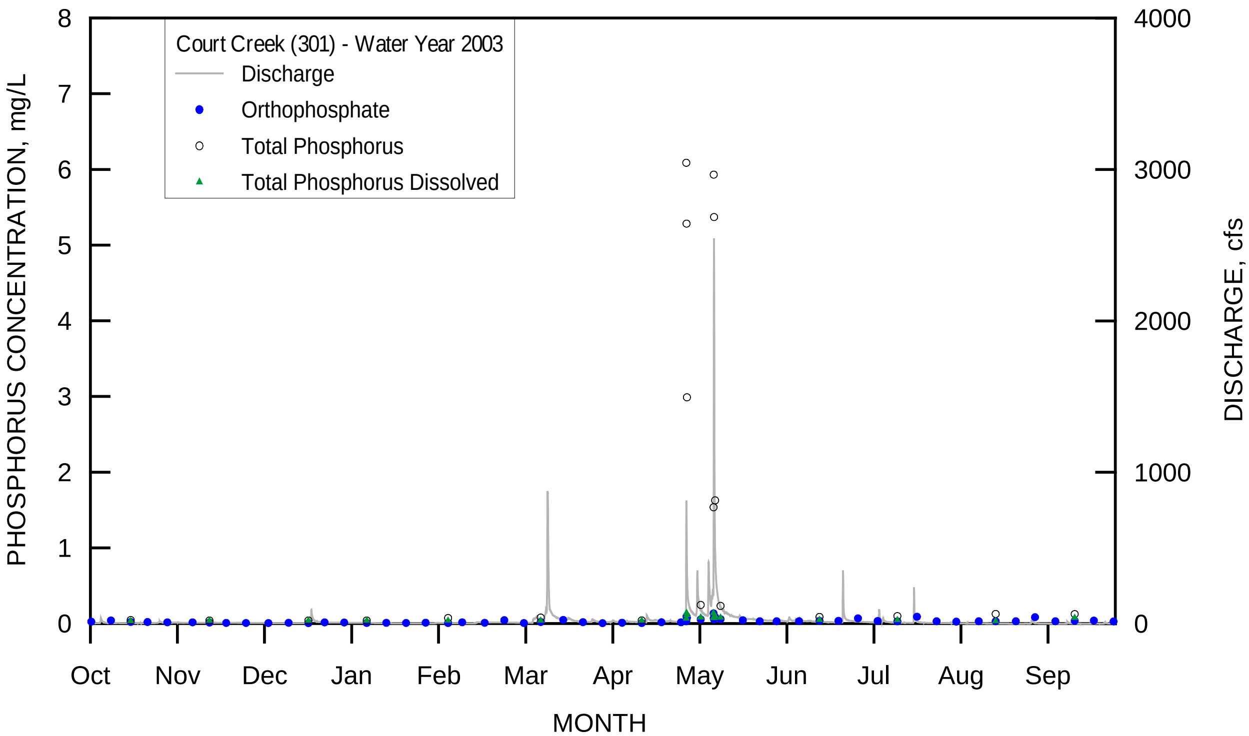


Figure 2-6. Concentrations of phosphorous species and water discharge at Court Creek (301) for Water Years 2002 and 2003

Sediment and Nutrient Loads

The sediment and nutrient concentrations and water discharges are used to compute the amount of sediment and nutrient transported past monitoring stations. Based on the available flow and concentration data, daily loads are computed for sediment and the different species of nitrogen and phosphorous. The daily loads are then compiled to compute monthly and annual loads. Results of those calculations are summarized in tables 2-3 to 2-7 for each of the five monitoring stations. Each table presents the annual water discharge, sediment load, nitrate-N load, and the total phosphorous load for one of the stations. Similar calculations have been made for the other species of nitrogen and phosphorous, but are not included in the summary tables. The annual sediment loads are highly correlated to the water discharge, and thus the wetter years, 2001, 2002, 2005, 2007, 2008, 2009, 2010, 2011, 2013 and 2014 generated more sediment at all stations as compared to drier years, 2000, 2003, 2004, 2006, and 2012. The annual sediment loads ranged from a low of 105 tons in WY2012 at Panther Creek to a high of 174,742 tons in 2009 at Court Creek. The nitrate-N loads ranged from a low of 1.8 tons in 2012 at Cox Creek to a high of 585 tons in WY2010 at Haw Creek. The total phosphorous loads ranged from a low of 0.2 tons in 2012 at Cox Creek and Panther Creek to a high of 117.6 tons in 2010 at Court Creek. For comparison purposes, the runoff, sediment, nitrate-N, nitrite-N, ammonium-N, Kjeldahl-N, total phosphorous, total dissolved phosphorous, and total ortho-phosphate phosphorous loads (for the five monitoring stations) are shown in figures 2-7 to 2-14. In terms of the total annual loads, the larger watersheds, Court and Haw, consistently carry higher sediment and nutrient loads than Panther and Cox Creeks. However, per unit area Panther and Cox generate more sediment than Court, North, and Haw Creeks.

Table 2-3. Summary of Annual Water Discharges, Sediment and Nutrient Loads at Court Creek Monitoring Station (301)

		Load		
Water Year	*Water discharge (cfs)*	*Sediment (tons)*	*Nitrate-N (tons)*	*Total phosphorus (tons)*
2000	11880	26527	131.2	35.0
2001	22100	43633	274.8	39.2
2002	17320	62898	203.7	47.9
2003	6805	21749	59.9	18.3
2004	7459	7359	76.0	7.5
2005	14400	18831	207.5	20.4
2006	5650	7897	84.3	6.5
2007	19376	48974	240.8	46.8
2008	22442	41077	265.4	45.6
2009	41207	174742	429.6	116.9
2010	44836	146202	425.9	117.6
2011	23311	55337	270.9	43.3
2012	6129	4145	36.7	4.8
2013	26158	116616	270.8	94.9
2014	14338	25407	59.9	30.4

Table 2-4. Summary of Annual Water Discharges, Sediment and Nutrient Loads at North Creek Monitoring Station (302)

		Load		
Water Year	*Water discharge (cfs)*	*Sediment (tons)*	*Nitrate-N (tons)*	*Total phosphorus (tons)*
2000	4009	6969	42.8	10.4
2001	8091	16747	102.9	12.7
2002	7372	29269	97.8	24.2
2003	3039	11422	32.9	9.1
2004	3224	2038	37.7	2.4
2005	5266	6061	76.3	7.7
2006	2151	4179	36.2	3.4
2007	7524	16702	99.3	14.3
2008	9416	19762	119.0	21.0
2009	16544	62806	167.9	45.2
2010	18577	66501	167.4	52.7
2011	9491	25979	105.4	25.2
2012	2506	2207	14.9	2.0
2013	12624	60934	121.1	44.9
2014	5374	9176	19.4	12.1

Table 2-5. Summary of Annual Water Discharges, Sediment and Nutrient Loads at Haw Creek Monitoring Station (303)

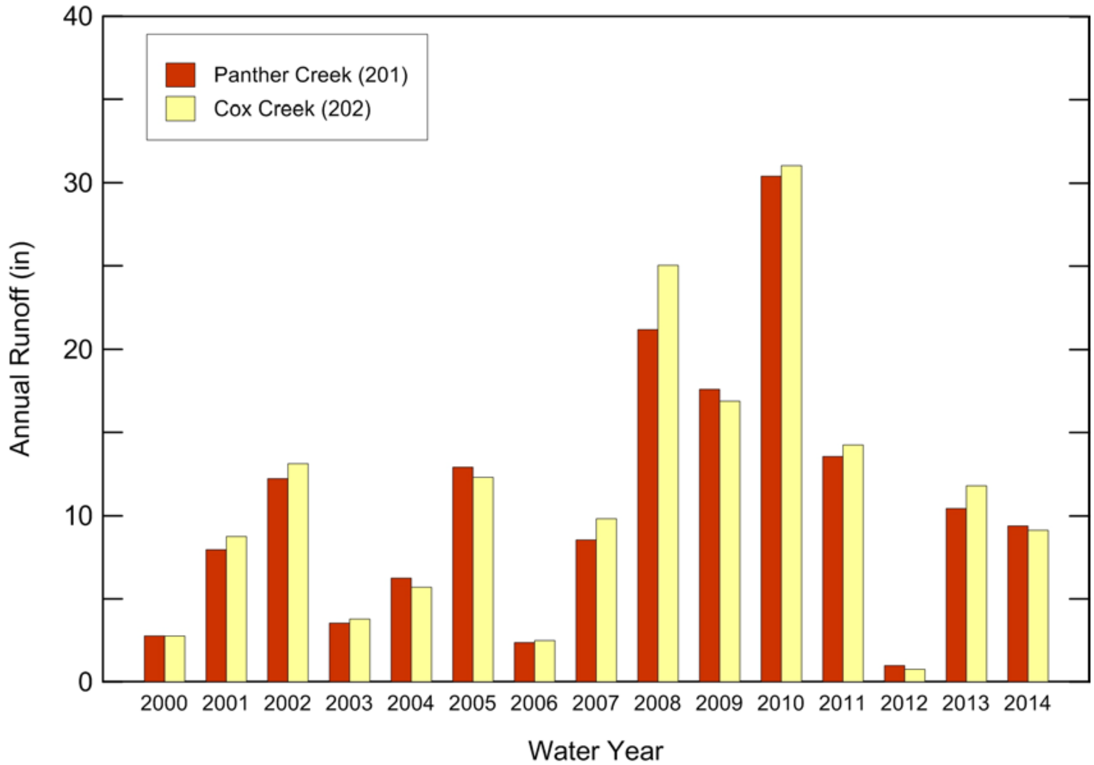
		Load		
Water Year	*Water discharge (cfs)*	*Sediment (tons)*	*Nitrate-N (tons)*	*Total phosphorus (tons)*
2000	11433	21283	162.2	32.0
2001	19878	49580	322.0	58.0
2002	15603	44221	256.5	42.8
2003	4337	5908	41.7	8.3
2004	8676	10914	143.4	12.6
2005	14661	18047	281.4	18.5
2006	5341	5770	113.7	6.0
2007	15032	20127	262.5	23.9
2008	14054	16396	227.0	25.5
2009	34003	104081	506.4	85.9
2010	40230	92974	585.2	85.4
2011	20788	37379	372.5	34.3
2012	5326	2185	55.1	3.3
2013	23581	75175	357.8	74.1
2014	14640	24149	115.3	29.8

Table 2-6. Summary of Annual Water Discharges, Sediment and Nutrient Loads at Panther Creek Monitoring Station (201)

		Load		
Water Year	*Water discharge (cfs)*	*Sediment (tons)*	*Nitrate-N (tons)*	*Total phosphorus (tons)*
2000	1236	4342	13.8	4.4
2001	3550	9839	84.9	5.1
2002	5440	34596	101.8	16.4
2003	1578	2955	26.4	1.8
2004	2787	7820	52.5	5.8
2005	5743	13793	112.2	10.2
2006	1053	2694	22.5	2.5
2007	3809	13410	75.4	10.6
2008	9437	83924	123.1	46.7
2009	7833	30921	117.7	13.9
2010	13539	56979	124.8	25.7
2011	6033	16786	72.8	9.9
2012	437	105	2.5	0.2
2013	4637	12309	123.9	6.0
2104	4184	21806	26.2	11.0

Table 2-7. Summary of Annual Water Disc harges, Sediment and Nutrient Loads at Cox Creek Monitoring Station (202)

		Load		
Water Year	*Water discharge (cfs)*	*Sediment (tons)*	*Nitrate-N (tons)*	*Total phosphorus (tons)*
2000	894	4153	10.3	5.7
2001	2833	9626	77.9	5.5
2002	4242	23207	100.6	16.1
2003	1226	1827	29.6	1.7
2004	1844	4597	45.3	3.7
2005	3976	8132	109.0	8.8
2006	806	3662	19.3	1.6
2007	3181	10105	81.5	7.2
2008	8097	73678	154.7	31.4
2009	5459	16331	135.9	8.6
2010	10040	27283	155.9	17.5
2011	4607	14021	91.5	9.6
2012	246	149	1.8	0.2
2013	3810	9906	149.7	5.2
2014	2955	13759	25.3	8.7



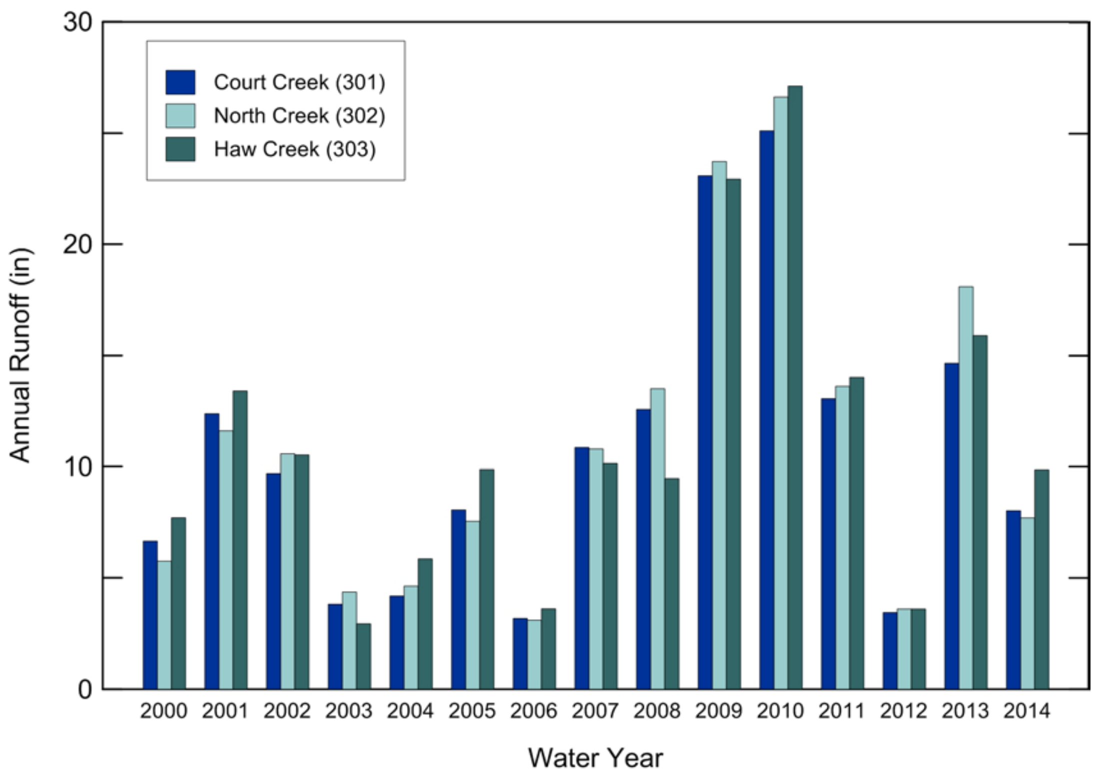


Figure 2-7. Annual runoff at the five CREP monitoring stations

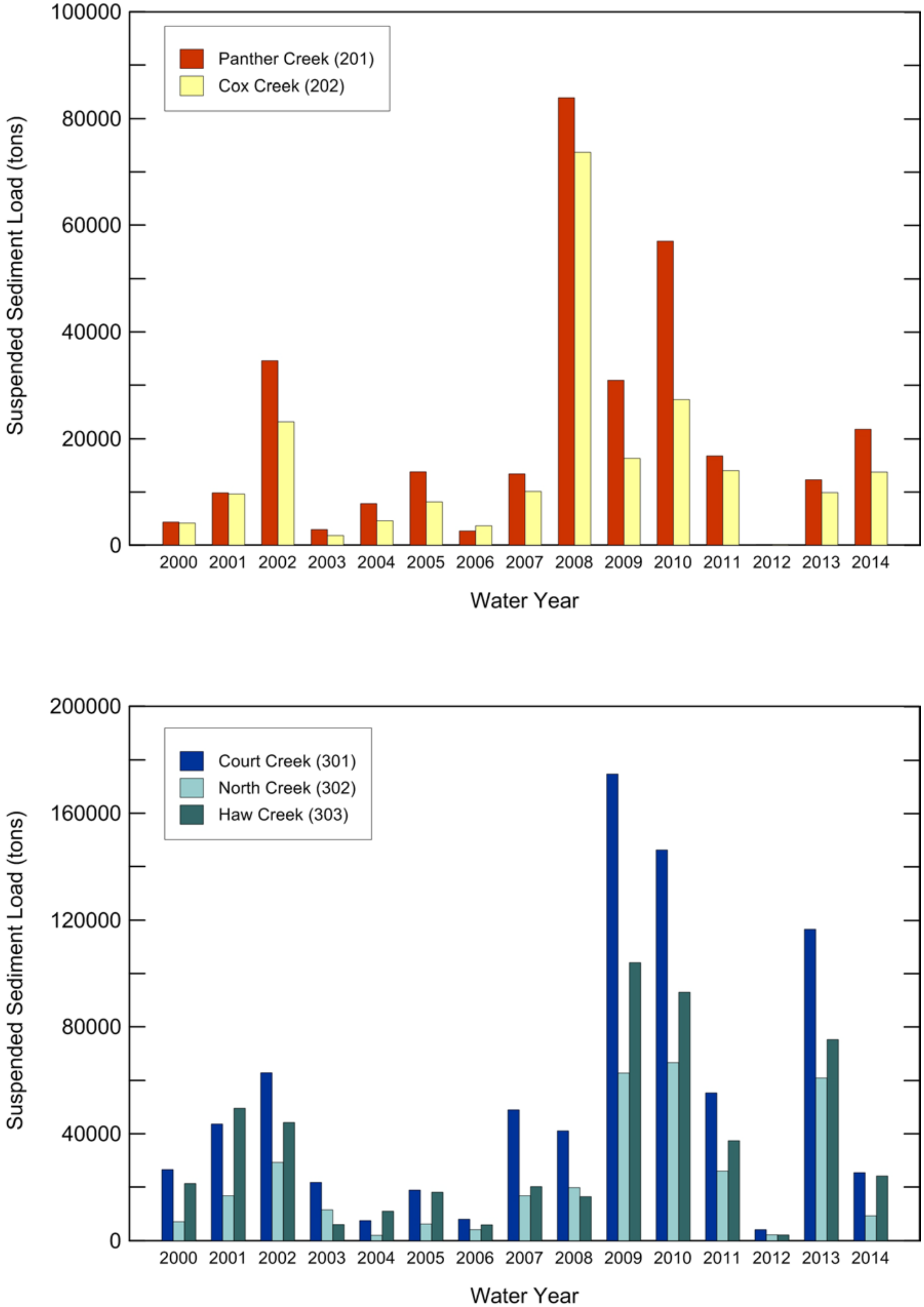


Figure 2-8. Annual suspended sediment loads at the five CREP monitoring stations

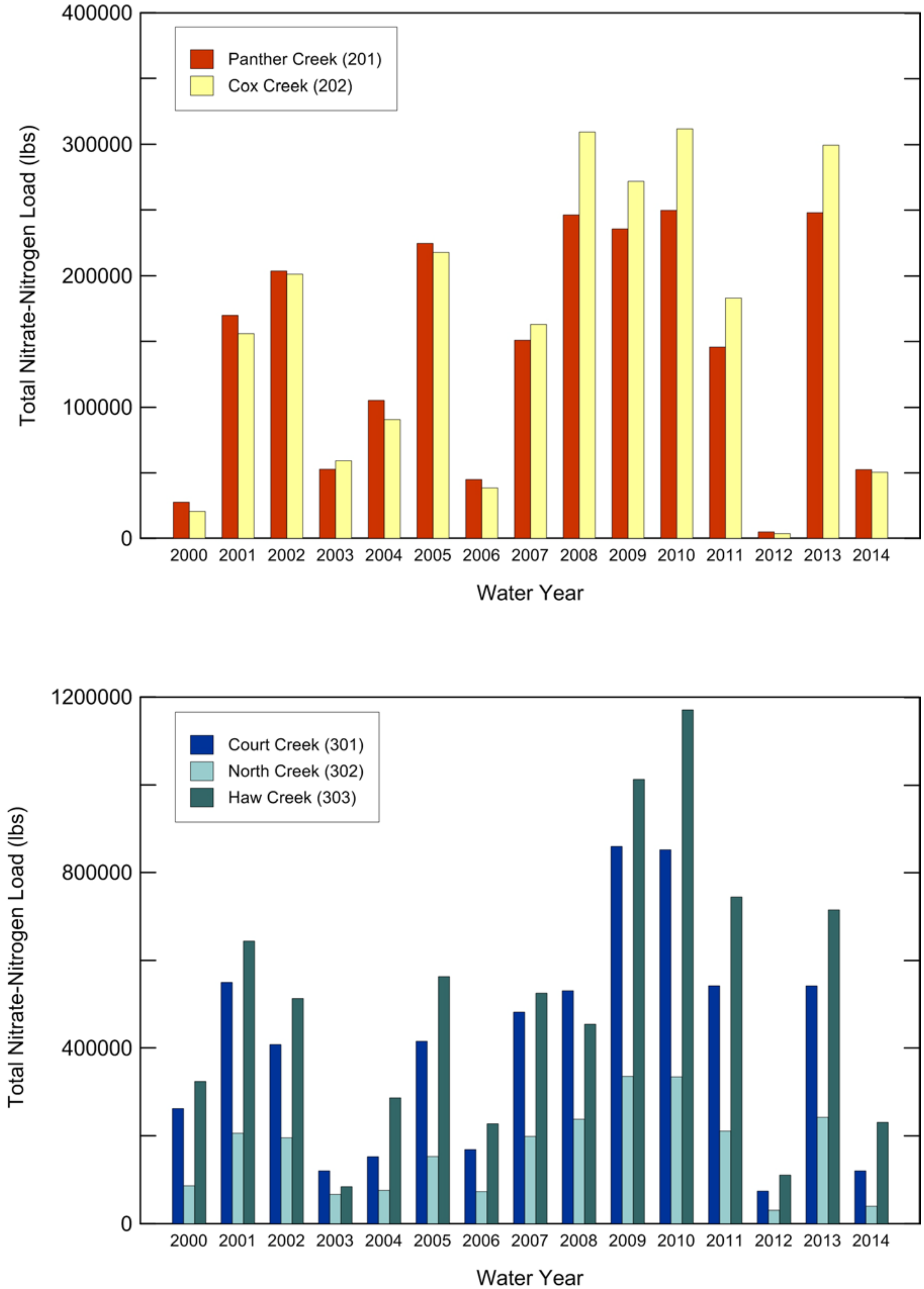


Figure 2-9. Annual nitrate-N loads at the five CREP monitoring stations

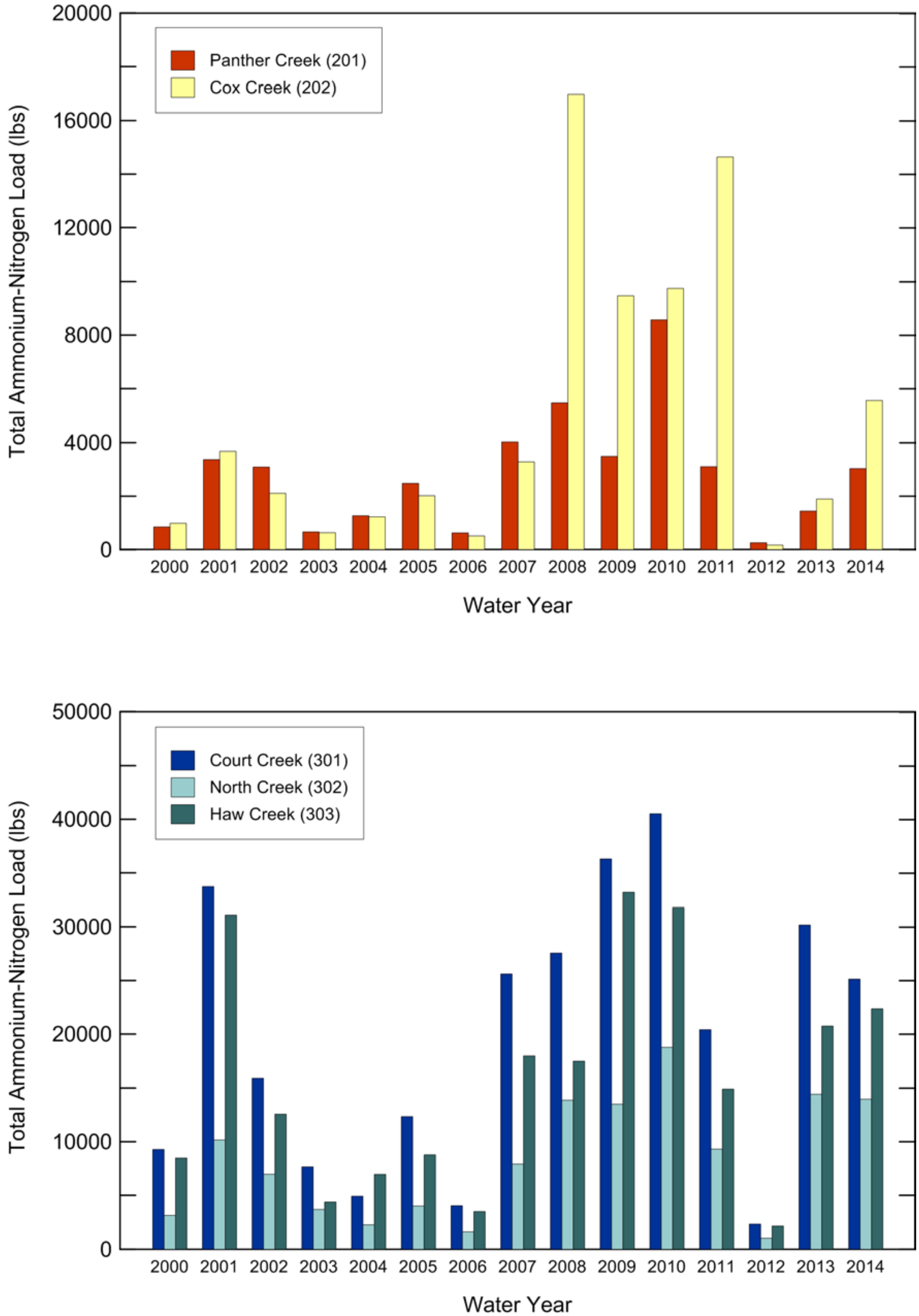


Figure 2-10. Annual ammonium-N loads at the five CREP monitoring stations

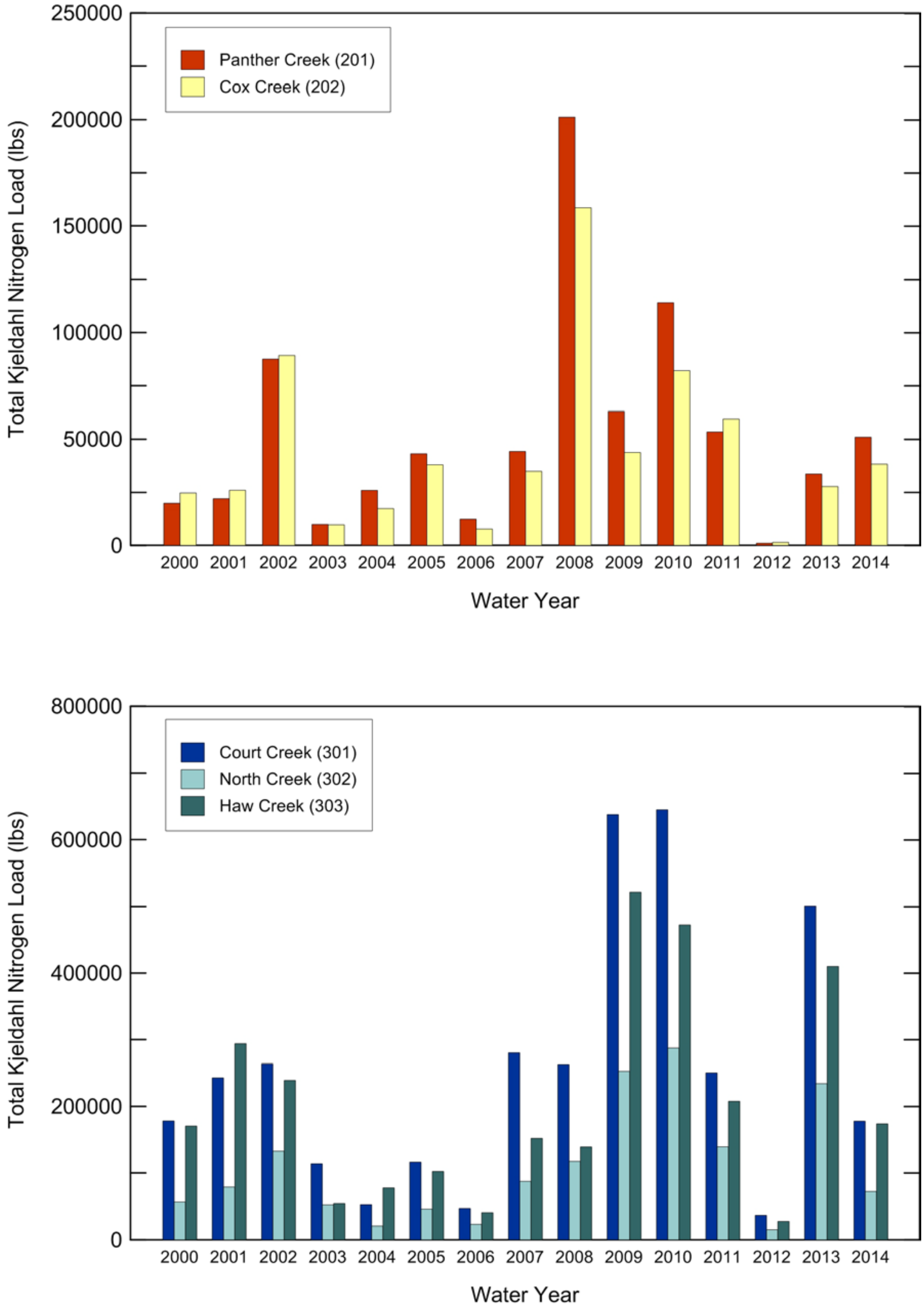
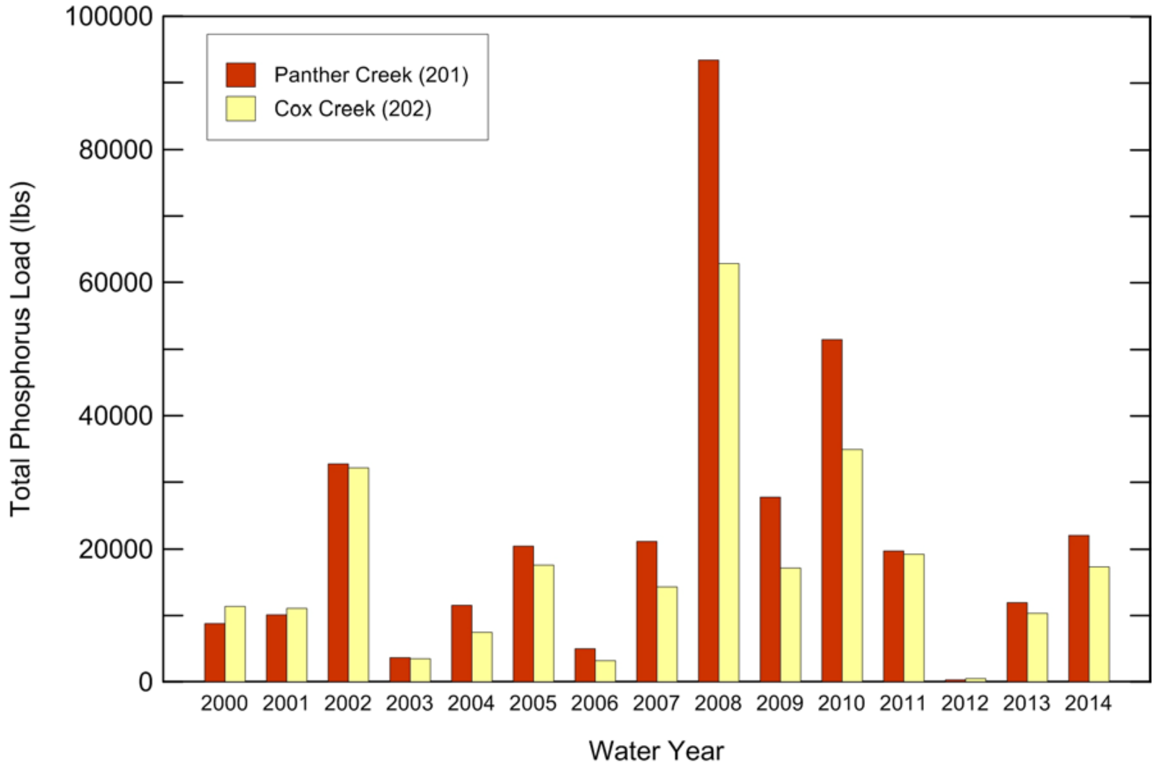


Figure 2-11. Annual Kjeldahl nitrogen loads at the five CREP monitoring stations



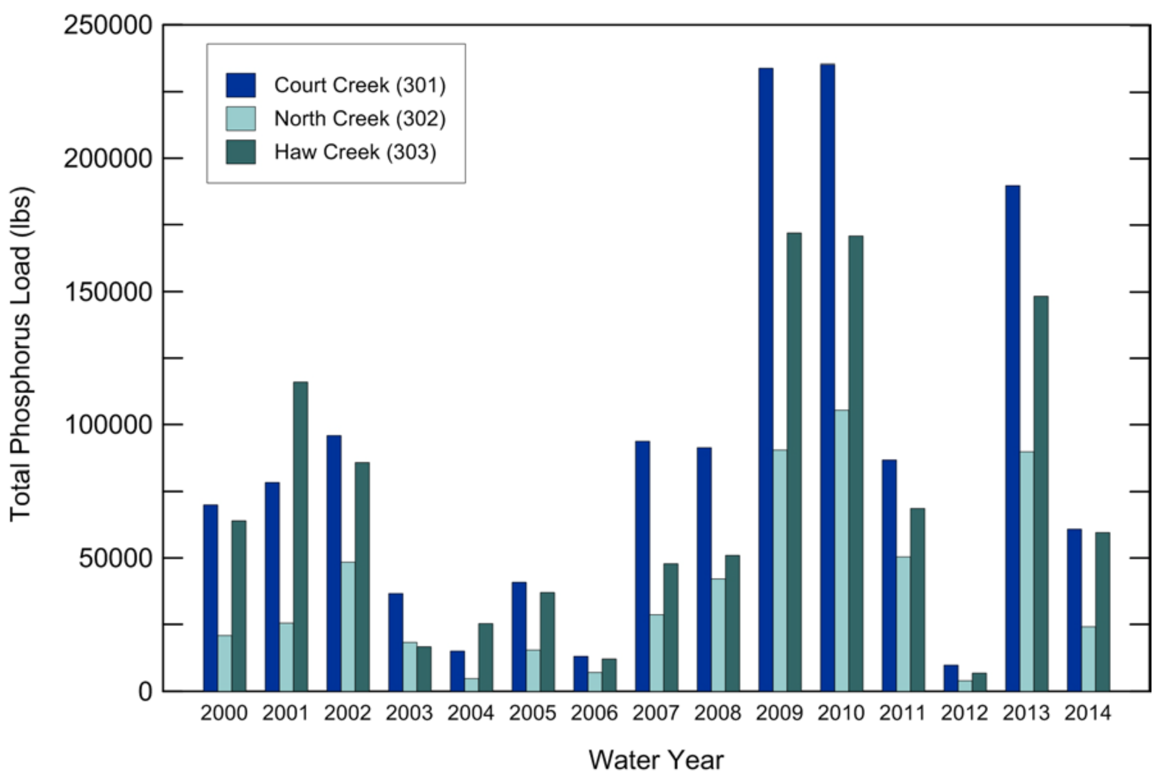


Figure 2-12. Annual phosphorus loads at the five CREP monitoring stations

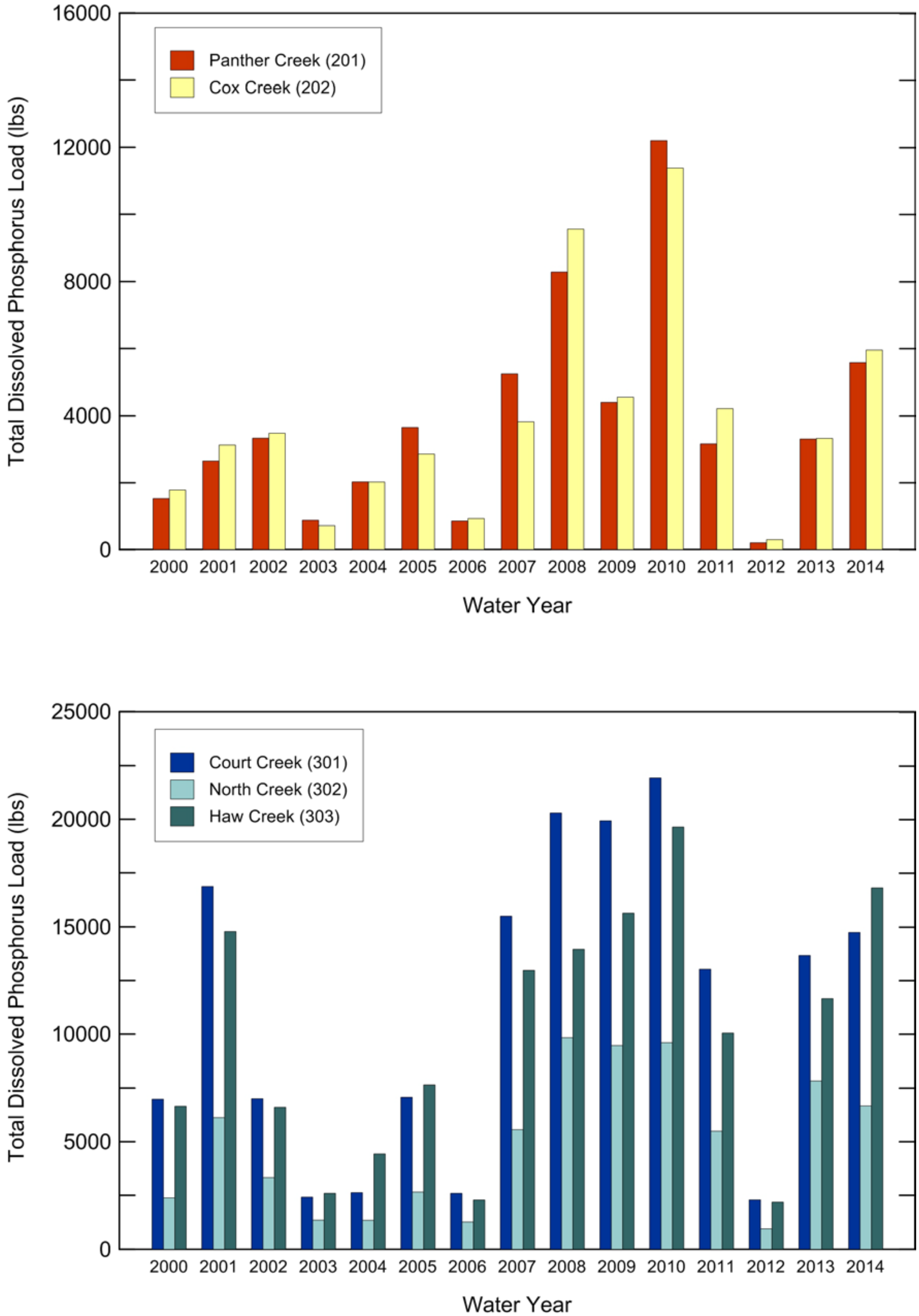
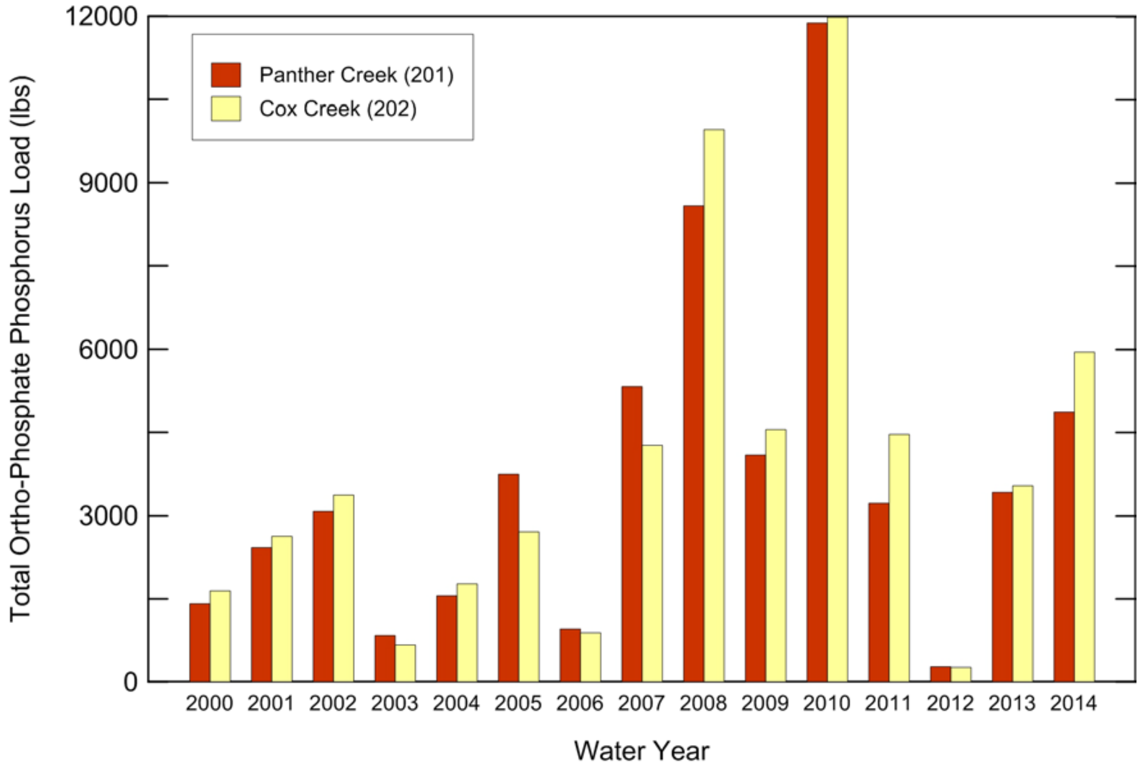


Figure 2-13. Annual dissolved phosphorus loads at the five CREP monitoring stations



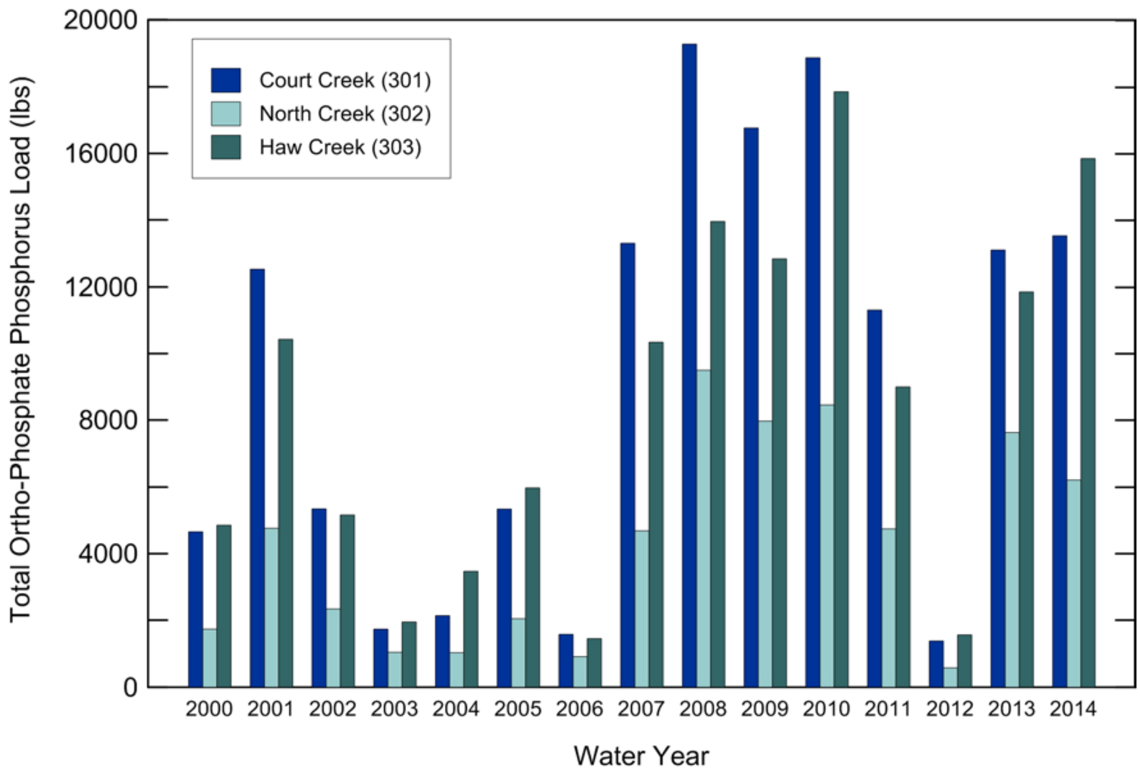


Figure 2-14. Annual ortho-phosphate phosphorous loads at the five CREP monitoring stations

Sediment and Nutrient Yields

To compare the different watersheds in terms of the amount of sediment and nutrient generated per unit area from each of the watersheds, the annual sediment and nutrient yields were computed by dividing the total annual load with the drainage area in acres for each of the monitoring stations. The results are provided in table 2-8 for sediment yield, table 2-9 for nitrate-N yield, and table 2-10 for total phosphorous. Sediment yields range from a low of 0.01 tons/acre for station 201 in WY2012 to a high of 9.57 tons/acre for station 202 in WY2008. Because of the high level of variability from year to year the average sediment yield for the 15 years of data collection are compared in figure 2-15. The stations are arranged in order of their drainage area, with the station with the smallest drainage area (202) on the left and the station with the largest area (301) on the right. As can be seen in the figure, on the average the stations with the smaller drainage areas (202 and 201) yield higher sediment (about 2.0 ton/acre) than the stations with the larger areas (302, 303, 301) that yield less than 1.5 tons/acre.

Nitrate-N yields vary from a low of 0.5 lbs/acre for stations 201 and 202 in WY2012 to a high of 40.5 lbs/acre for station 202 in WY2010. For comparison purposes the average annual nitrate-N yield for the five stations is shown in figure 2-16. In general the stations with smaller drainage areas generate more nitrate per unit area than those with larger drainage areas, except for station 303 that is generating similar amounts as station 201 that has a smaller area.

Total phosphorous yields vary from a low of 0.03 lbs/acre for station 201 in WY2012 to a high of 8.81 lbs/acre for station 201 in WY2008. For comparison purposes, the average annual total phosphorous yield for the five stations is shown in figure 2-17. Similar to the nitrate-N yield, the stations with the smaller drainage areas generally generate more total phosphorous per unit area than those with larger drainage areas but the difference is very small.

Table 2-8. Sediment Yield in tons/acre for the CREP Monitoring Stations

	CREP sediment yield (tons/ac)				
Water Year	*201*	*202*	*301*	*302*	*303*
2000	0.41	0.54	0.62	0.42	0.60
2001	0.93	1.25	1.03	1.01	1.40
2002	3.26	3.01	1.48	1.76	1.25
2003	0.28	0.24	0.51	0.69	0.17
2004	0.74	0.60	0.17	0.12	0.31
2005	1.30	1.06	0.44	0.37	0.51
2006	0.25	0.48	0.19	0.25	0.16
2007	1.27	1.31	1.15	1.01	0.57
2008	7.92	9.57	0.97	1.19	0.46
2009	2.92	2.12	4.11	3.78	2.95
2010	5.38	3.54	3.44	4.01	2.63
2011	1.58	1.82	1.3	1.57	1.06
2012	0.01	0.02	0.10	0.13	0.06
2013	1.16	1.29	2.74	3.67	2.13
2014	2.06	1.79	0.60	0.55	0.68
Avg.	1.97	1.91	1.25	1.37	1.0

Table 2-9. Nitrate-N Yield in lbs/acre for the CREP Monitoring Stations

CREP nitrate-nitrogen yield (lbs/ac)					
Water Year	*201*	*202*	*301*	*302*	*303*
2000	2.6	2.7	6.2	5.2	9.2
2001	16.0	20.2	12.9	12.4	18.2
2002	19.2	26.1	9.6	11.8	14.5
2003	5.0	7.7	2.8	4.0	2.4
2004	9.9	11.8	3.6	4.5	8.1
2005	21.2	28.3	9.8	9.2	15.9
2006	4.2	5.0	4.0	4.4	6.4
2007	14.2	21.2	11.3	12.0	14.9
2008	23.2	40.2	12.5	14.3	12.9
2009	22.2	35.3	20.2	20.2	28.7
2010	23.6	40.5	20.0	20.2	33.2
2011	13.7	23.8	12.8	12.7	21.1
2012	0.5	0.5	1.7	1.8	3.1
2013	23.4	38.9	12.7	14.6	20.3
2014	5.0	6.6	2.8	2.3	6.5
Avg.	13.6	20.6	9.5	10.0	14.3

Table 2-10. Total Phosphorus Yield in lbs/acre for the CREP Monitoring Stations

CREP total phosphorus yield (lbs/ac)					
Water Year	*201*	*202*	*301*	*302*	*303*
2000	0.83	1.48	1.65	1.25	1.81
2001	0.95	1.44	1.84	1.53	3.28
2002	3.09	4.17	2.25	2.92	2.43
2003	0.34	0.45	0.86	1.10	0.47
2004	1.09	0.97	0.35	0.29	0.72
2005	1.93	2.28	0.96	0.92	1.05
2006	0.47	0.42	0.31	0.41	0.34
2007	2.00	1.86	2.20	1.72	1.35
2008	8.81	8.16	2.15	2.53	1.44
2009	2.62	2.23	5.50	5.45	4.87
2010	4.86	4.53	5.54	6.35	4.84
2011	1.86	2.50	2.04	3.03	1.94
2012	0.03	0.06	0.23	0.24	0.19
2013	1.13	1.34	4.46	5.40	4.20
2014	2.08	2.25	1.43	1.45	1.69
Avg.	2.14	2.28	2.12	2.37	2.04

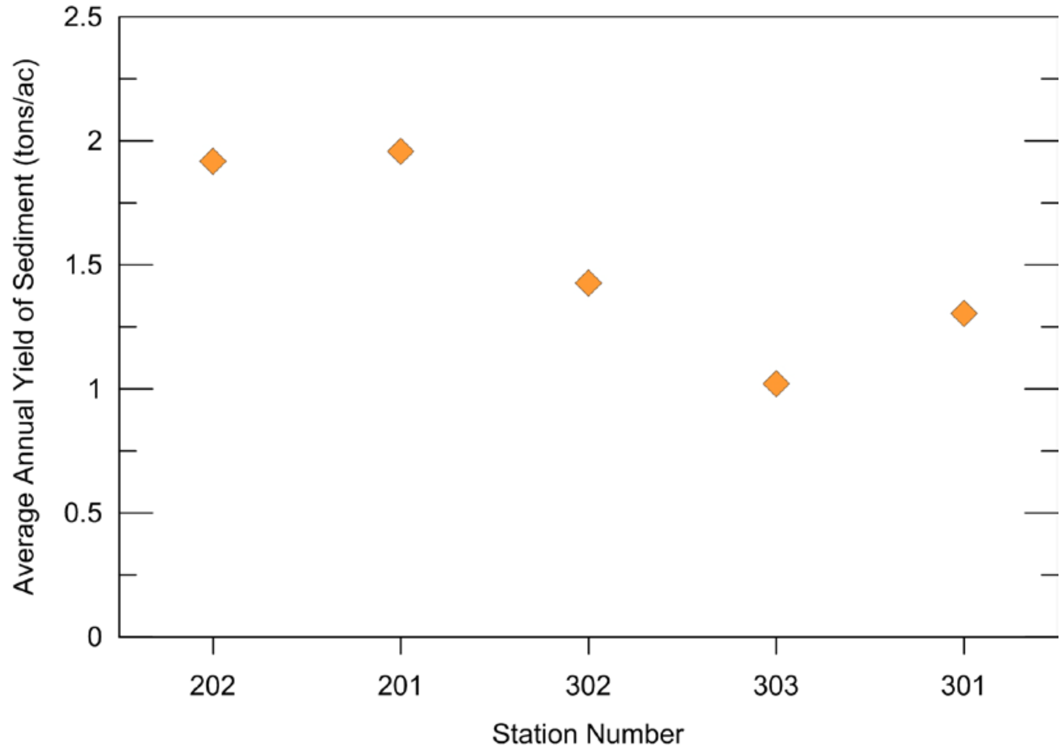


Figure 2-15. Average annual sediment yield in tons/acre for the CREP monitoring stations

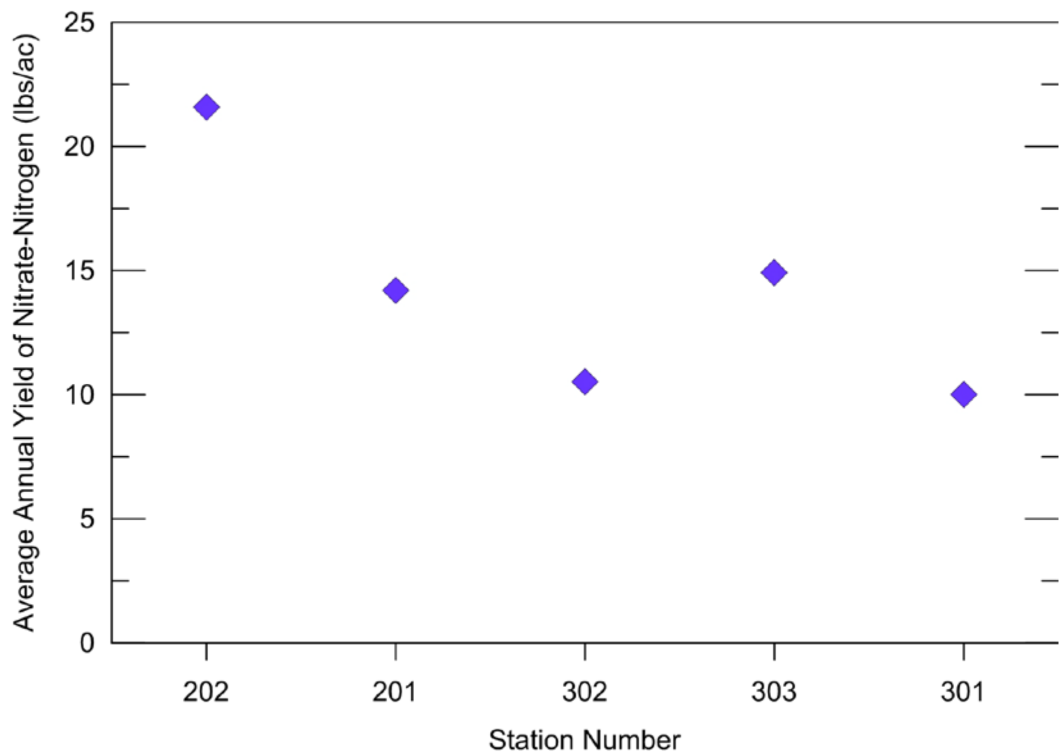


Figure 2-16. Average annual nitrate-N yield in lbs/acre for the CREP monitoring stations

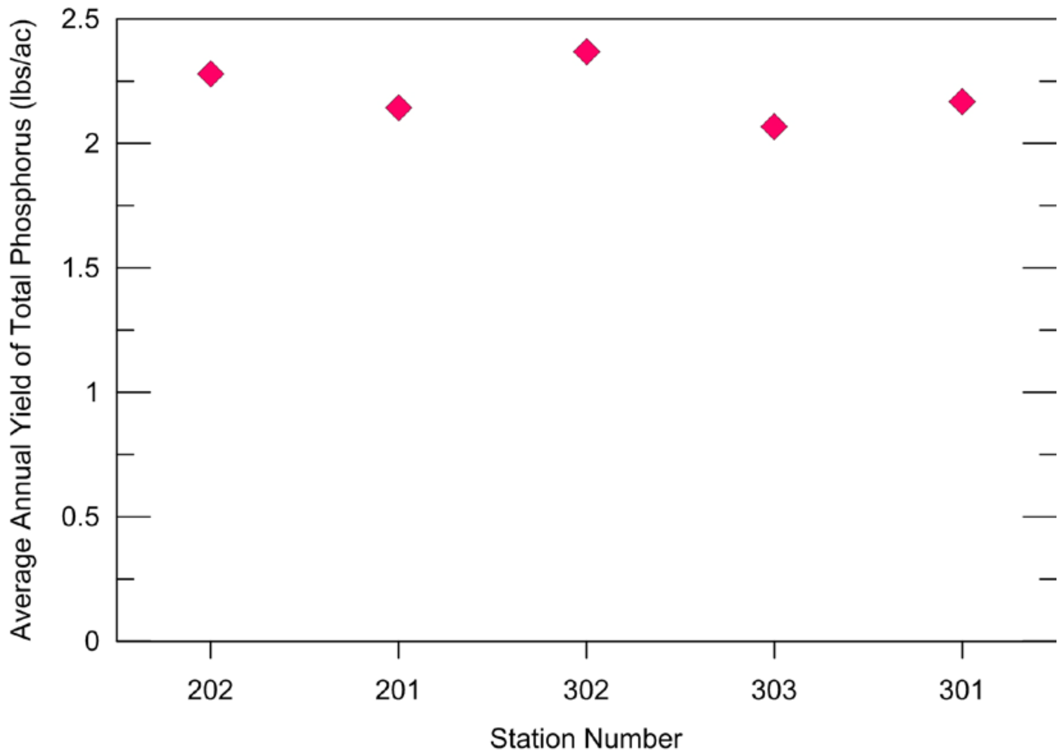


Figure 2-17. Average annual total phosphorous yield in lbs/acre for the CREP monitoring stations

Additional CREP Data Collection Efforts

In addition to the CREP monitoring in the Court/Haw and Panther/Cox watersheds, that was initiated in 1999, several additional monitoring efforts have been initiated by the ISWS through the CREP project in order to provide additional information on the role BMPs in reducing sediment and nutrient yields and to better define the context of existing CREP data on a larger watershed scale.

During September of 2006 in response to significant CREP enrollments and an intensive restoration effort by the Natural Resources Conservation Service (NRCS), two additional monitoring stations (table 2-11) were installed in the Cedar Creek watershed, located in the Spoon River basin (figure 2-18). Station 306 is located on the right descending bank of the mainstem of Cedar Creek where it intersects CR 000 E in Fulton County (border with Warren Co). The second gage, station 305, is located near the left descending bank of Swan Creek, a major tributary of Cedar, where it flows beneath CR 000 E Fulton County, approximately 2.1 miles south of the Cedar Creek (306) gage.

Table 2-11. Additional CREP Monitoring Stations in the Spoon River Watershed

Station ID	*Name*	*Drainage area*	*Location*	*Watershed*
305	Swan Creek	98.1 sq mi (254 sq km)	N 40.67700 W 090.44391	Spoon River
306	Cedar Creek	146.2 sq mi (379 sq km)	N 40.70847 W 090.44540	Spoon River
RG39	Rain Gage 39	NA	N40.79145 W090.49999	Spoon River

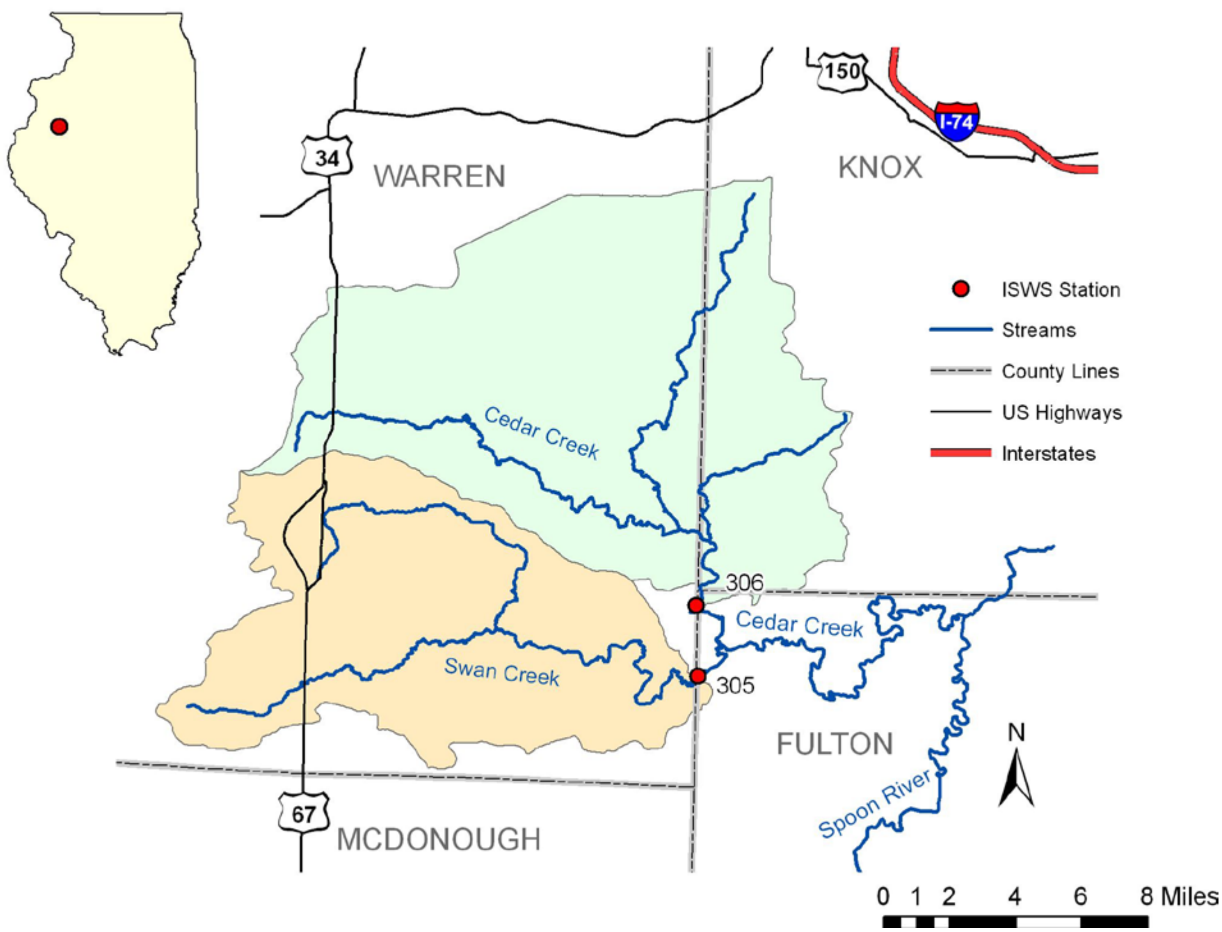


Figure 2-18. Locations of monitoring stations in the Cedar and Swan watersheds

Both watersheds are located in the Galesburg Plain physiographic region. The topography is flat to gently rolling and the soils are primarily loess. Stream channels and associated floodplains are heavily dissected with stream channels commonly being incised into the floodplain. Both watersheds are mostly rural with agriculture the predominant land use. Pasture and woodlands are also common due to the topography introduced by the dissected stream channels.

Both gages became operational near the end of WY2006 (9/15/2006) and are instrumented and operated as are all CREP gages, in accordance to the CREP QAPP (Appendix A). Both stations utilize a pressure transducer to determine stage, log data on a 15 minute time step and are equipped with an ISCO automated pump sampler slaved to the stage sensor in order to augment manual discrete sampling efforts. Thirty-eight and thirty-three discharge measurements have been collected at stations 305 and 306 respectively in an effort to establish a reliable rating in as short a time as possible. Based on provisional data, summary statistics for suspended sediment concentration data is provided in table 2-12.

In addition to the two streamgages the ISWS has installed a recording raingage immediately east of CR1500E and approximately 0.5 mi north of CR1100N in Warren Co. The raingage is a modified Belfort equipped with a linear potentiometer, in order to provide a digital output, and can be operated throughout the year. Raingage deployment and maintenance as well as the download and reduction of precipitation data can be found in the CREP QAPP (Appendix A).

ISWS field staff began suspended sediment sampling at two U.S. Geological Survey (USGS) gages located on the mainstem of the Spoon River on 3/29/2004. Samples are collected weekly at both sites with additional samples collected during runoff events. Sampling at London Mills (05569500) is done from the Route 116 bridge where the USGS gaging station is located. Sediment sampling at Seville (05570000) is done approximately 1 mile downstream of the current USGS gage location on State Route 95. Current USGS sediment data are also collected at this location. As of 9/30/12, 568 samples have been collected at London Mills while 521 samples have been collected at Seville. Summary statistics for suspended sediment concentration data collected through WY2012 are presented for each station in Table 2-13.

Table 2-12. Suspended Sediment Concentration Data (mg/L) for Swan and Cedar Creeks

	Swan (305)	*Cedar (306)*
Count (samples)	3515	3623
Mean	380.1	471.3
Max	7872.6	8101.8
Min	1.99	1.59
Median	137.1	132.6
25th Percentile	49.3	51.0
75th Percentile	416.3	462.7

Table 2-13. Suspended Sediment Concentration Data (mg/L) for Spoon River at London Mills and Seville

	London Mills (05569500)	*Seville (05570000)*
Count (samples)	568	521
Mean	296.1	293.1
Max	4952.7	4730.7
Min	1.91	3.93
Median	116.0	122.2
25th Percentile	49.9	58.8
75th Percentile	285.7	266.7

3. Land Use Cover and Conservation Practices

Land Cover

The Illinois River Basin (IRB) is nearly 16 million acres with a diverse range of land covers. The extent of these land covers is illustrated in figure 3-1 using the U.S. Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) 2014 land cover data. The database contains almost 150 land cover category types. For the purpose of this study those types have been grouped into 11 categories: corn, soybeans, small grains, other row crops, other crops, grass/pasture, developed, woodland, wetlands, water, and other. Figure 3-2 show in 2014 the Illinois River Basin was dominated by agricultural land, comprising of 63% of the basin. Corn and soybean acreage accounts for most of the agricultural land cover. Developed urban-type lands, woodlands, and grass/pasture lands are the next highest with 14%, 12%, and 8%, respectively. The Illinois River Basin is unique in that a large portion of the watershed contains the six-county developed areas surrounding the City of Chicago.

As seen in Figure 3-3, these are the same dominant land covers in the five monitored watersheds with some variations. The Panther (201) and Cox Creek (202) watersheds are located next to one another (Figure 2-3) but show marked differences in land cover between agriculture production and woodland. Cox Creek watershed has 78% land cover in corn/soybean acreage whereas Panther Creek watershed has 55%. Woodland acreage in Panther Creek watershed is 3 times more than Cox Creek due to the IDNR Jim Edgar Panther Creek State Fish and Wildlife Area. Both watersheds have similar acreages in grassland/pasture/open lands and developed urban areas. Court Creek (301) and Haw Creek (303) watersheds are also located next to each other. North Creek (302) is a subwatershed within the Court Creek (301) watershed. Percent area of agriculture is 47% and 59% in Court and Haw Creek watersheds, respectively, where difference is offset by the woodland and developed areas of 39% and 29%. The higher woodland land cover area in Court Creek watershed is due to the North Creek (302) subwatershed.

Outside of natural factors such as the physical settings and climate variability, land use is the main driving factors that affect a watershed's hydrology, erosion, sedimentation, and water quality. It is therefore important to document and analyze changes in land use for a given watershed to properly understand and explain changes in its hydrology, water quality, and the erosion and sedimentation process. The Illinois River basin has undergone significant changes in land use practices during the last century. These changes have been used to explain degradation in water quality and aquatic habitat along the Illinois River. In recent years, there have been significant efforts at the local, state, and federal level to improve land use practices by implementing conservation practices throughout the watershed. The Illinois River CREP is a course of major state and federal initiatives to significantly increase conservation and restoration practices in the Illinois River basin.

The USDA National Agriculture Statistics Service (NASS) land cover data has been available since 1999. In 2006 an evaluation of the usefulness of the crop data layers for annual land cover information in Illinois was undertaken by the Illinois State Geological Survey (ISGS) and NASS. Based on inherent errors associated with satellite data, irreparable mechanical problems with older multispectral imagery satellites and land cover classification methods used to interpret that imagery, new enhanced CDL protocols were established in 2007 for Illinois.

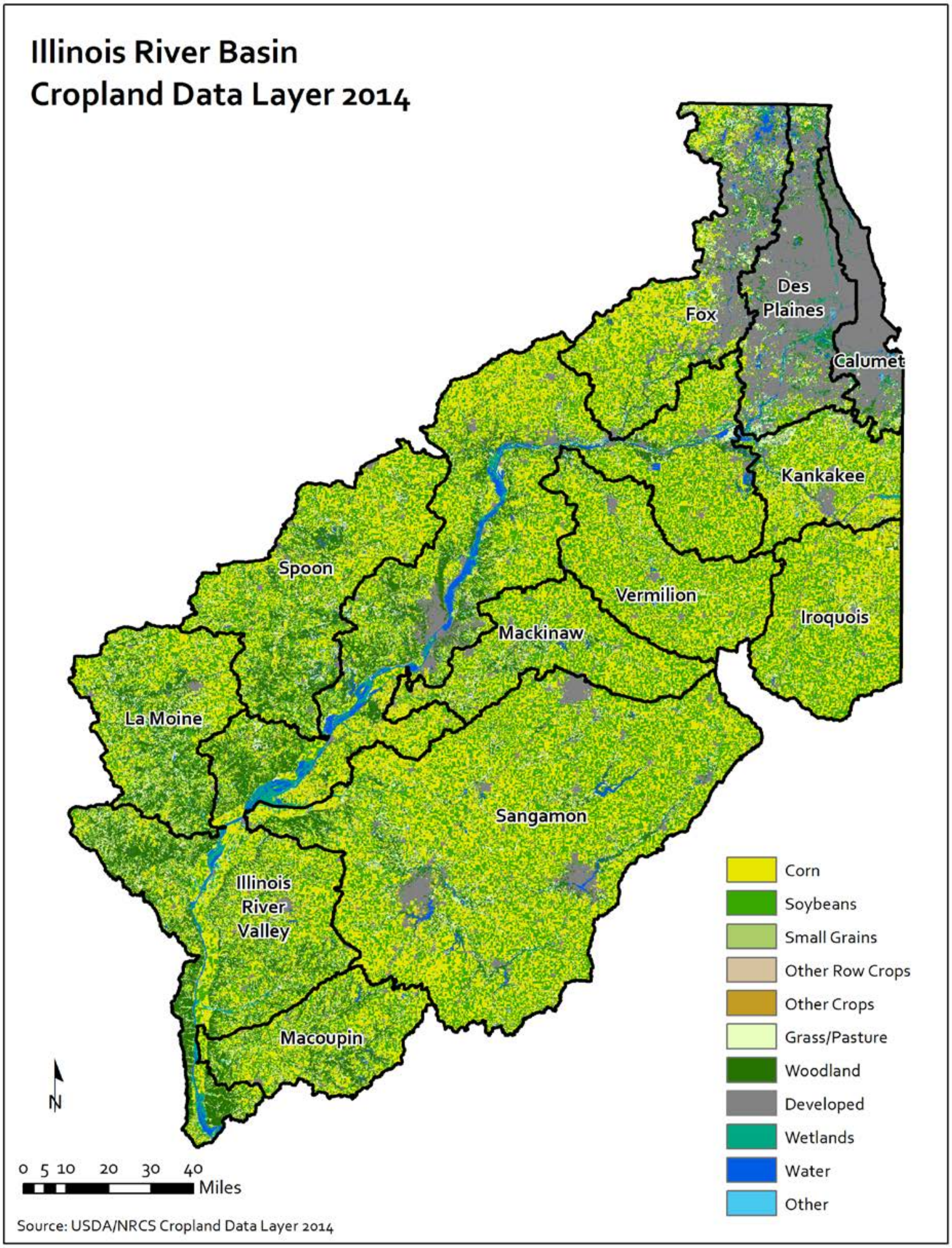


Figure 3-1. Land cover of the Illinois River Basin (NASS, 2010)

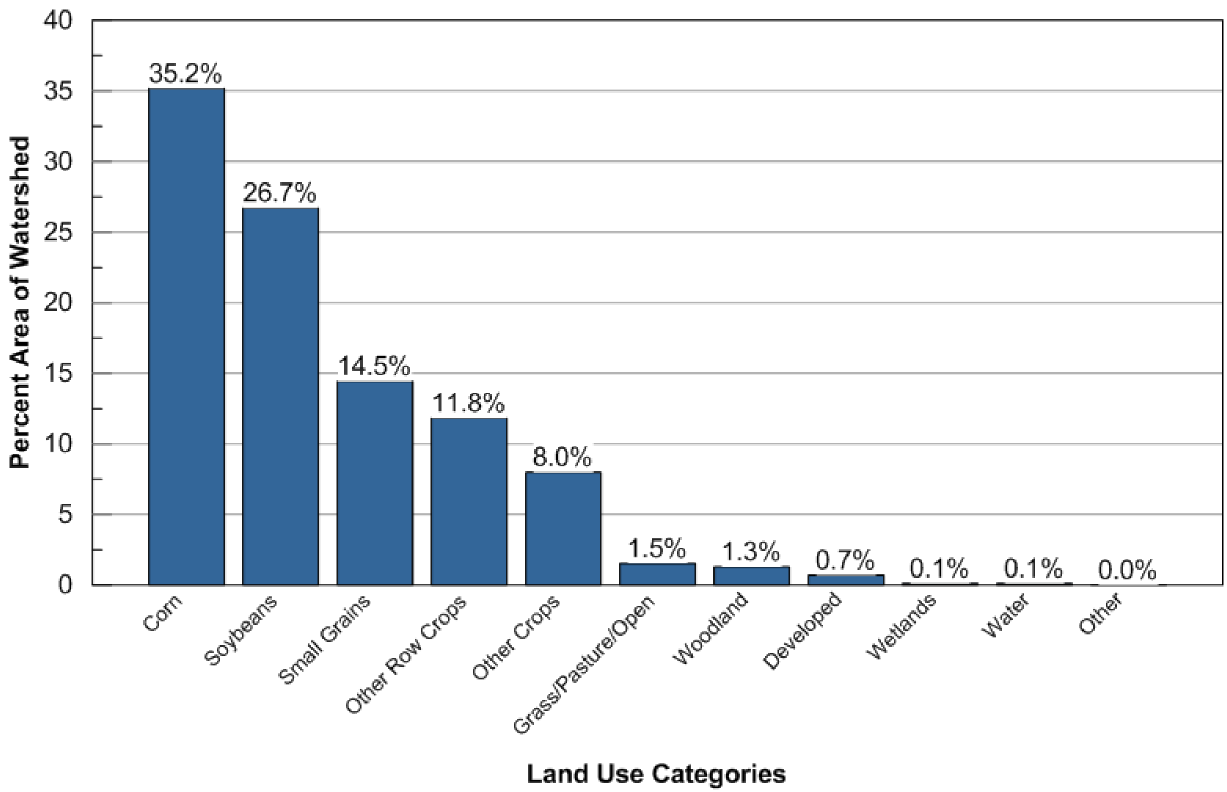


Figure 3-2. Percent watershed area of types of land cover in Illinois River Basin (NASS, 2014)

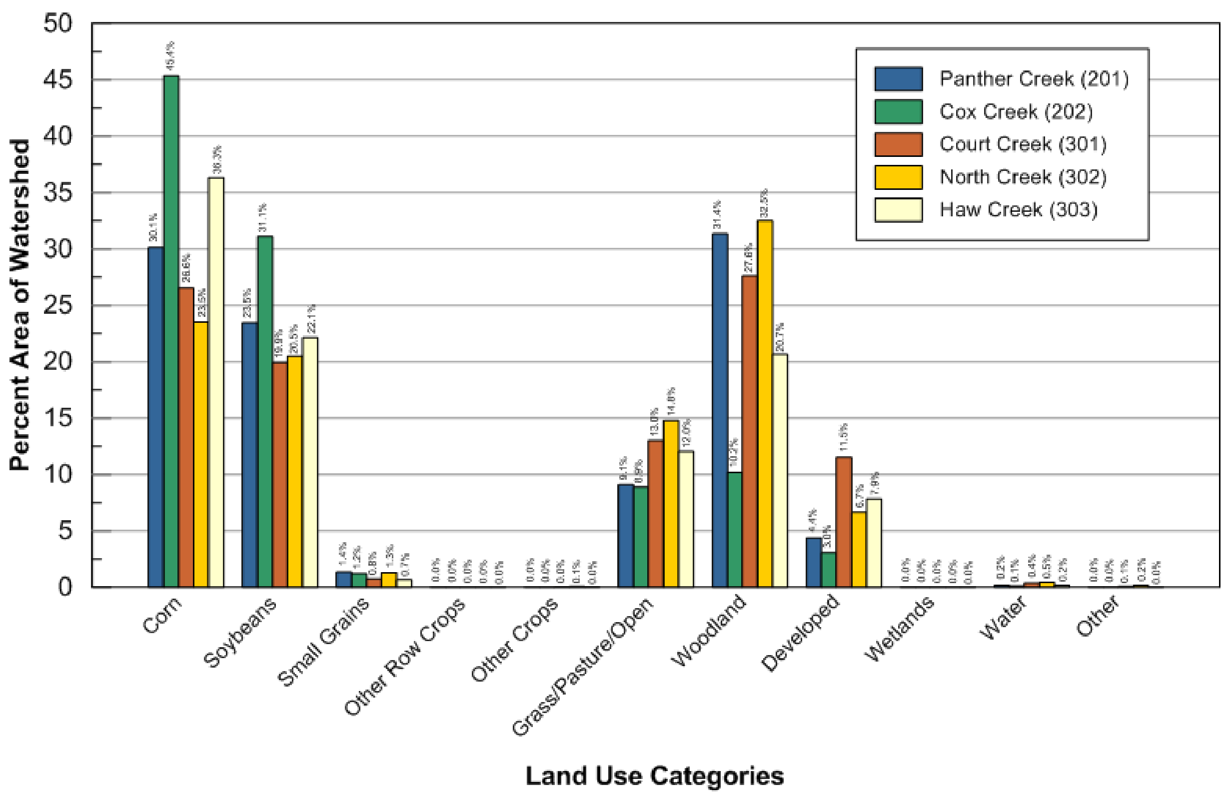


Figure 3-3. Percent watershed area of types of land cover in five monitored watersheds in the Illinois River Basin (NASS, 2014)

Consequently, land cover misclassifications were identified prior to the new protocol, which became more apparent when evaluating the land cover in the monitored watersheds (figure 3-4): Panther Creek (201), Cox Creek (202), Court Creek (301), North Creek (302), and Haw Creek (303). Therefore, any changes in land cover will be evaluated for this study beginning in 2007 through 2013 which is the most currently available NASS CDL data.

The five monitored watersheds have somewhat different ratios of land cover types. The Panther and Cox Creek watersheds in the Spoon River watershed have 53 and 73 percent area in agriculture and 47 and 27 percent in non-agriculture land covers, respectively (table 3-1). The main difference is Panther Creek has over 20 percent more land in forest/shrubland than Cox Creek, due to a large portion of the watershed lies in the Panther Creek State Conservation Area. Agriculture land cover is 44 and 56 percent in Court and Haw Creeks, respectively, while the non-agriculture area is the inverse. North Creek watershed, a tributary of Court Creek, has a larger portion of land area in forest/shrubland than Haw Creek. Figure 3-5 illustrates the percent change in total watershed acres between 2007 and 2013 for six generalized land cover categories in each of the five monitored tributary watersheds in the Illinois River Basin. Agriculture land covers were categorized into Corn, Soybeans, Double Crop with Soybeans and Other Cropland, as well as summed in one category identified as Agriculture. Non-agriculture land covers were categorized into Grassland and Forest/Shrubland, and summed as Non-Agriculture. All five watersheds had a 5 percent reduction in non-agricultural land cover area (Grasslands and Forest/Shrubland) between 2007 and 2013. An increase in agricultural land cover area (Corn, Soybeans, Double Crop with Soybeans and Other Cropland) ranged from 2 to nearly 11 percent occurred on all five watersheds. The three Spoon River tributary watersheds (Court, North, and Haw Creeks) had marked percent increases in soybean acres and decreased percent of corn acres. The two Sangamon River watersheds (Panther and Cox Creeks) had an increase percent of corn acres, with Panther having an increase percentage of soybean acres and Cox with an increase in other cropland acres.

Figures 3-6 to 3-10 show the changes in each land cover for each year between 2007 and 2013. For this report, NASS Cropland Data Layer (CDL) categories for the monitored watersheds were combined into 6 general land cover categories: 1) corn, 2) soybean, 3) other cultivated crops, 4) grassland, 5) forest/shrubland and 6) developed, barren, open space, water and wetlands. Land cover area changes between years is represented in acres. Therefore, some watersheds may appear to have greater changes in acreage from year to year but may only represent a small percentage of the watershed depending on the total watershed acres. Panther Creek watershed (figure 3-6) acres remained constant for move land covers when comparing 2007 and 2013. Corn and soybean acres shifted between years and inversely as reflected by normal corn and soybean rotation practices. Forest/shrubland saw a minor shift in 2010. Cox Creek watershed (figure 3-7) saw similar variability as Panther Creek watershed in most land cover acreage. Only minor increases in acres for cultivated crops and developed, barren, open space, water and wetlands. Court Creek (figure 3-8) appeared to have corn and Grasslands trade acres each year, with Corn increasing to a high in 2011 and then returning to near 2007 acreage. Soybean acres increased every other year for a seven year increase. Forest/Scrubland acres decreased slightly with little variability. North Creek watershed (figure 3-9) is a subwatershed within Court Creek watershed explaining the significant reduction in total watershed acres. The same patterns and variability as Court Creek watershed appear here. Finally, Haw Creek watershed (Figure 3-10) land cover patterns and variability in acreages were similar to Court/North Creek watersheds.

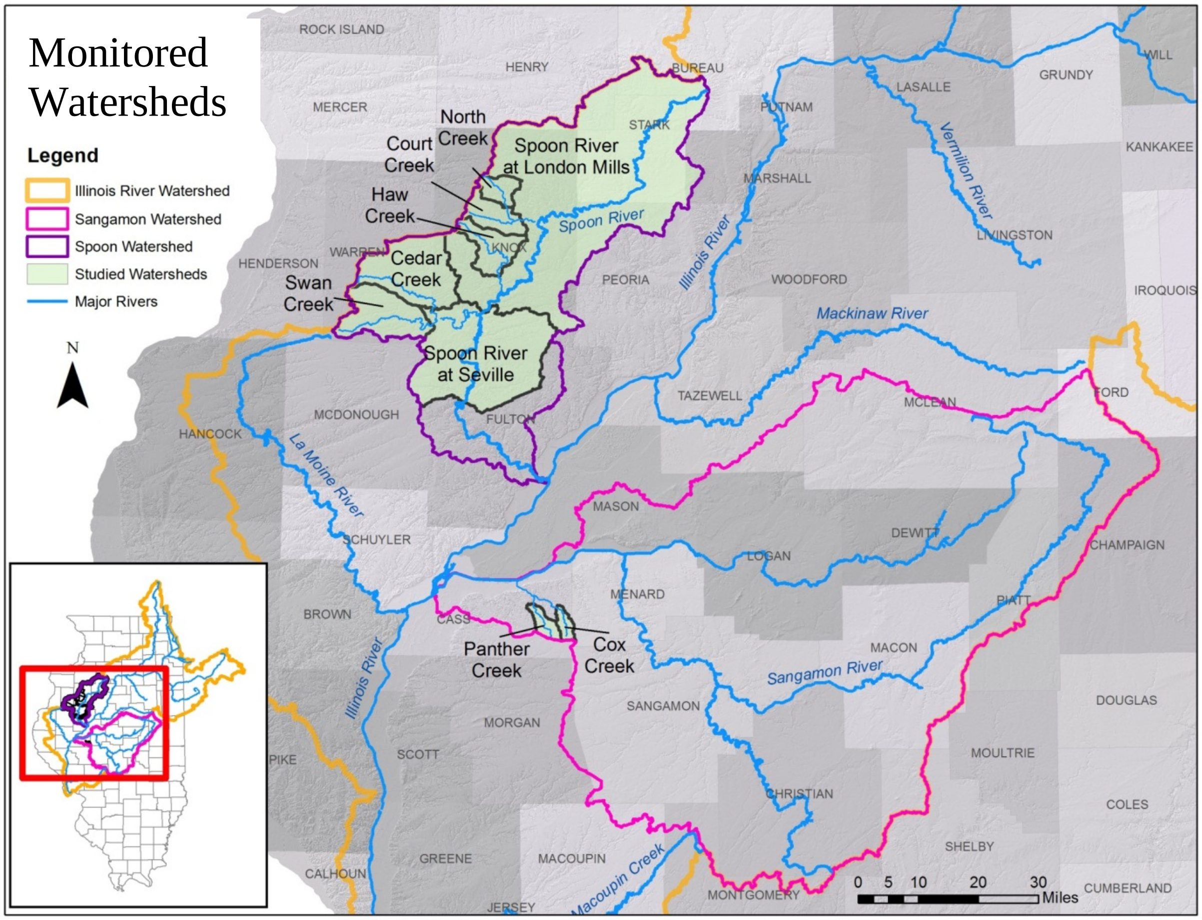


Figure 3-4. Watersheds being monitored for hydrology, sediment and nutrients.

Table 3-1. 7-year average (2007-2013) percent acres of land cover area by watershed

	ISWS Station Number				
	201	*202*	*301*	*302*	*303*
Corn	31	46	28	26	36
Soybeans	21	26	16	16	20
Other Crops	1	2	0	0	0
Grasslands	11	13	20	20	17
Forest/Shrubland	32	11	29	34	21
Developed, Barren, Open Space, Water, Wetlands	4	3	7	4	6
AGRICULTURE	53	73	44	42	56
NON-AGRICULTURE	47	27	56	58	44

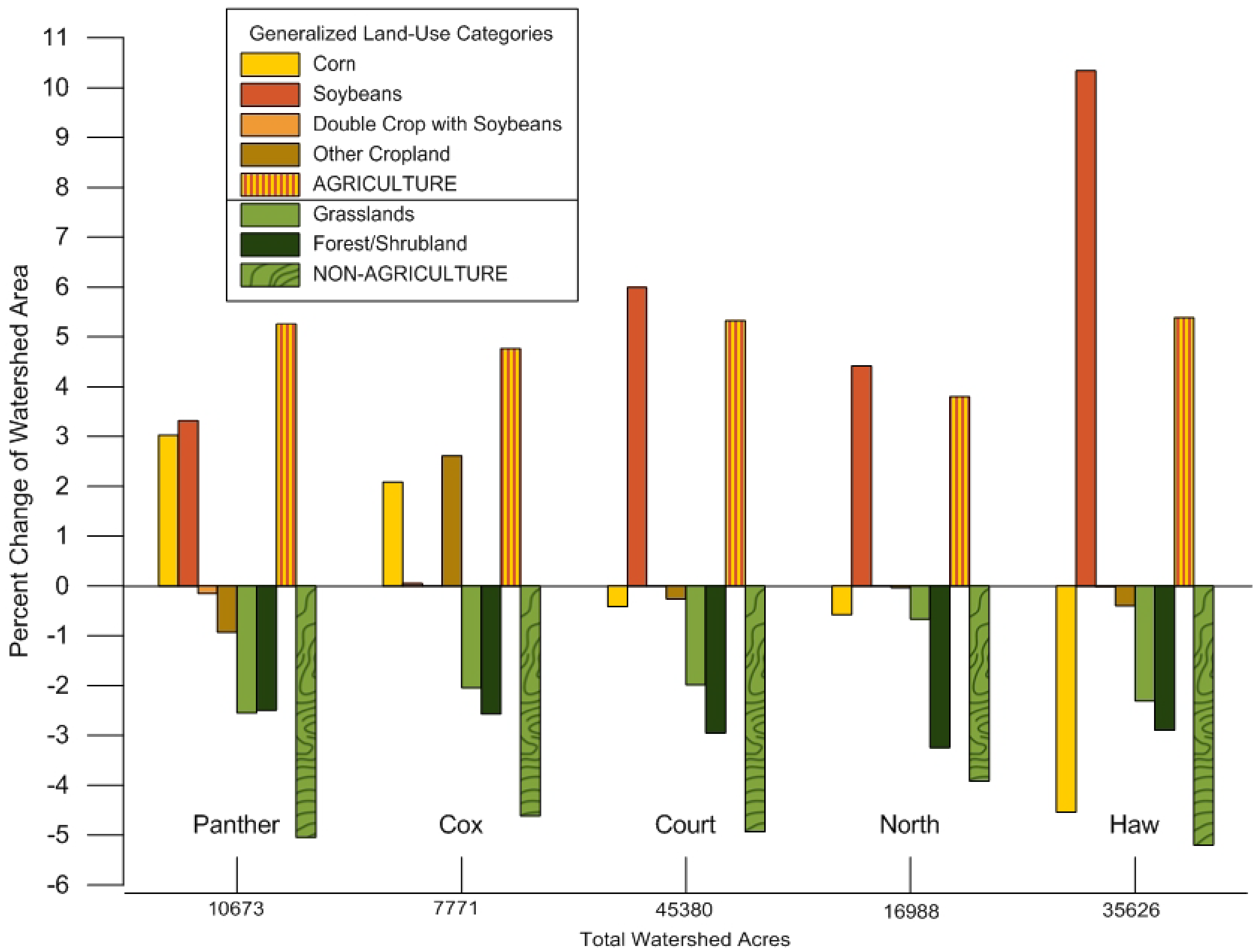


Figure 3-5. Illinois River Basin Watersheds: Percent Change in Generalized NASS Land-Use from 2007-2013.

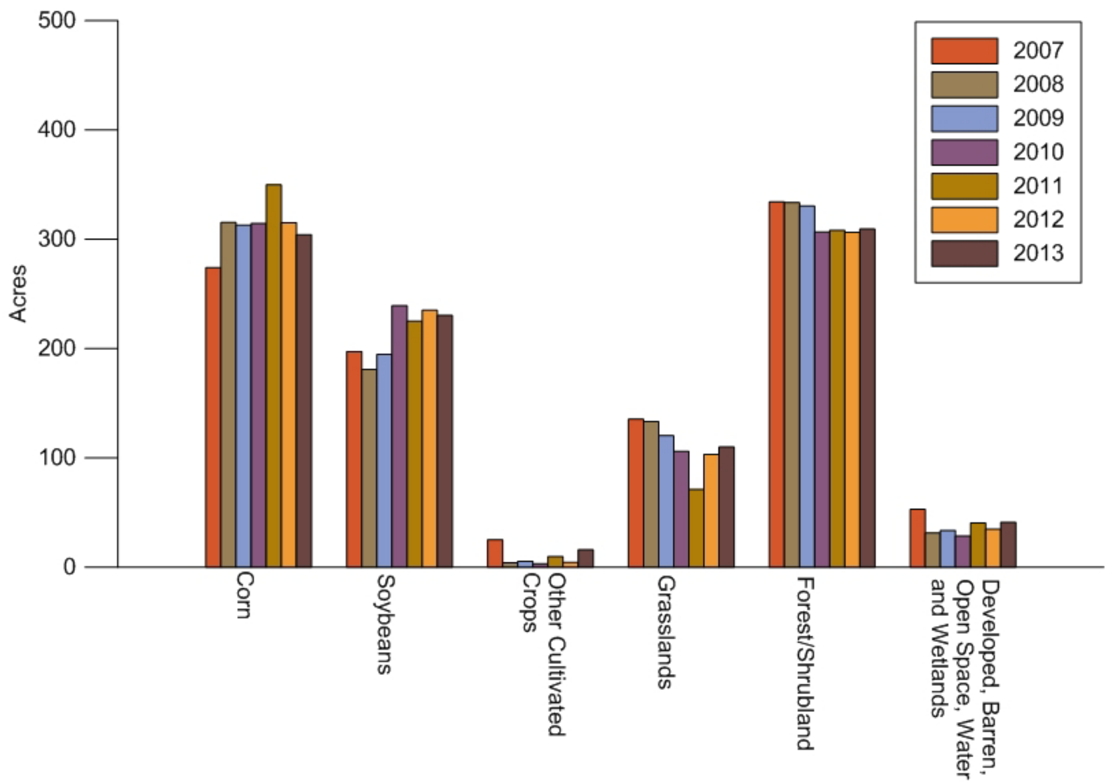


Figure 3-6. Panther Creek Watershed from ISWS Station 201: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

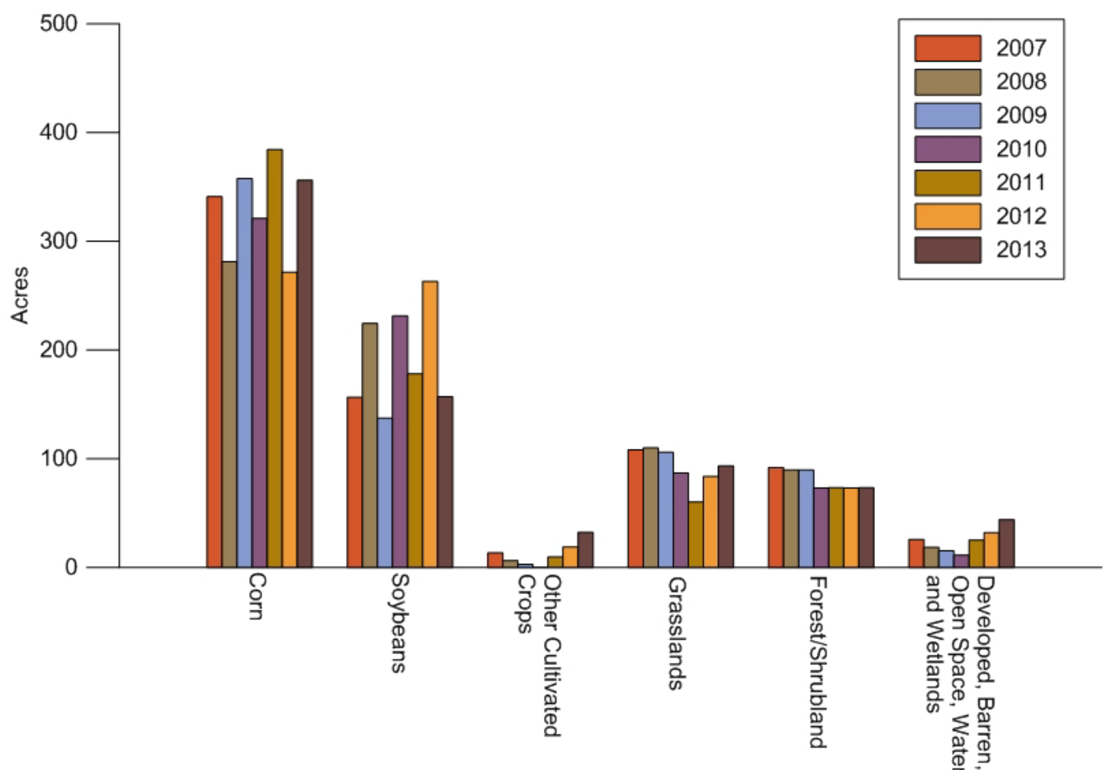


Figure 3-7. Cox Creek Watershed from ISWS Station 202: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

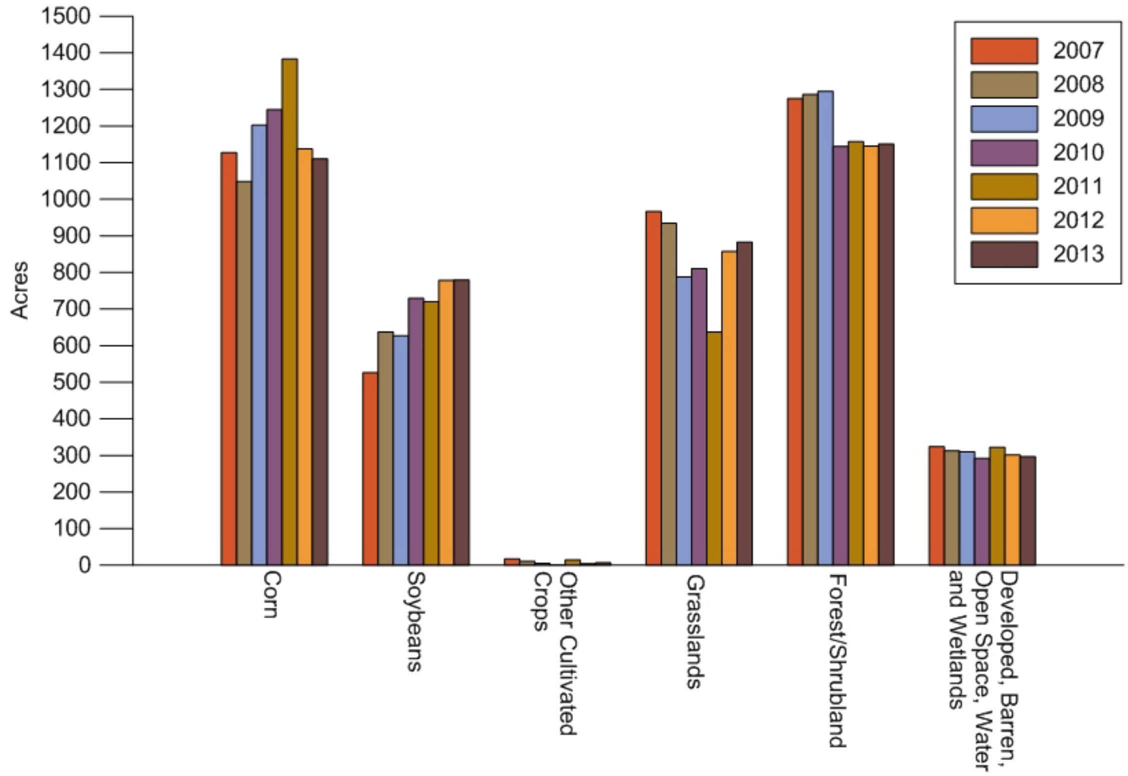


Figure 3-8. Court Creek Watershed from ISWS Station 301: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

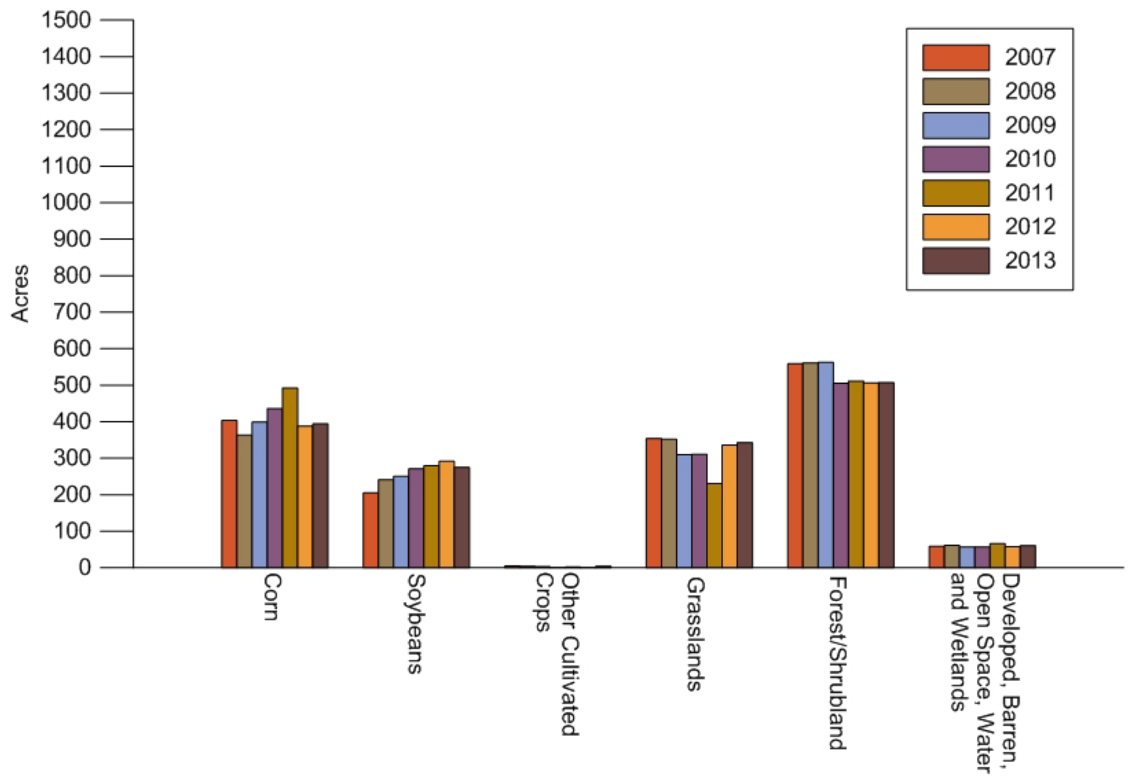


Figure 3-9. North Creek Watershed from ISWS Station 302: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

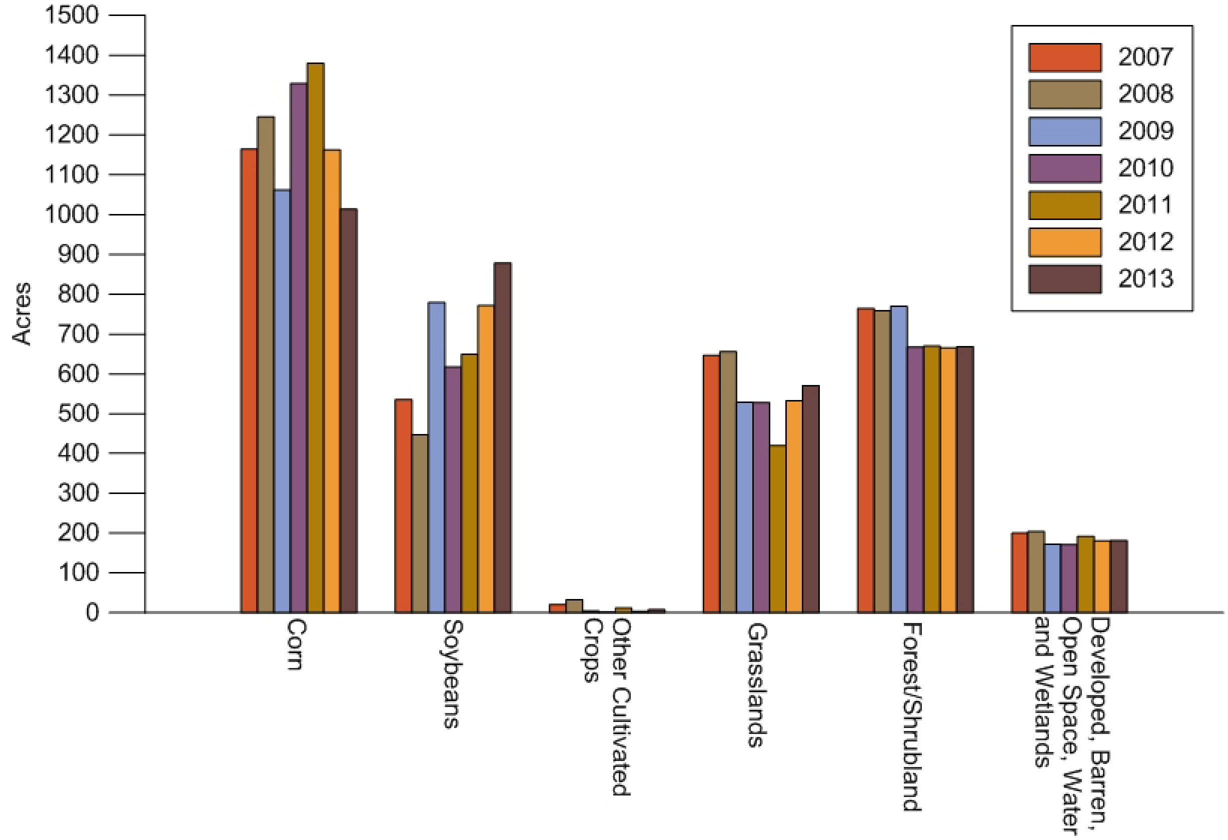


Figure 3-10. Haw Creek Watershed from ISWS Station 303: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

Conservation Practices

There has been a significant increase in the implementation of conservation practices in Illinois in recent years with CREP making a major contribution. Figure 3-11 shows the location of approved Illinois CREP contracts from the State of Illinois as of 2014. With this type of information it will be possible to identify areas where there has been significant participation in the CREP program and where changes in sediment and nutrient delivery should be expected. The information will provide important input data to the watershed models that are being developed to evaluate the impact of CREP practices.

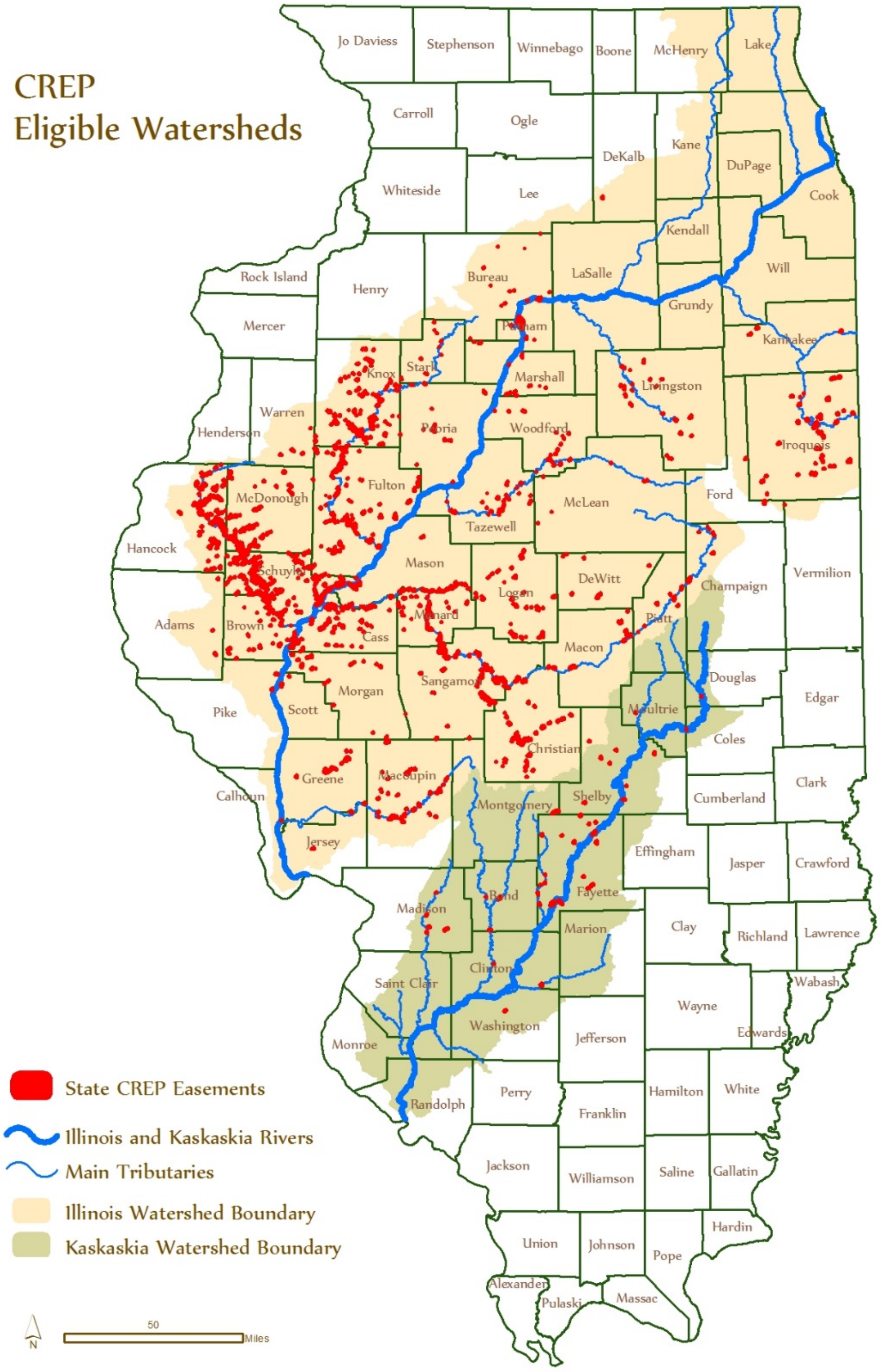


Figure 3-11. State of Illinois CREP contract locations (IDNR, 2015).

There are many conservation practices implemented through the watersheds as a result of federal and state conservation reserve programs. In order to evaluate watershed monitoring efforts, knowing when and what conservation practices are implemented in the watershed is important. Figures 3-12 to 3-13 are examples of cumulative acres of conservation practices installed in a couple of the monitored watersheds from 1999 through 2015. The order by which the practices are listed in the legend represent, from the largest to smallest, the sum of the acres by practice from 1999-2015. Riparian buffers, wetland restoration, filter strips and SAFE habitat are the most installed conservation practice in Court Creek (301) watershed with most of the acres occurring prior to 2009. Whereas, permanent wildlife habitat (Additional Acres) was the most installed practice installed prior to 2005 in the Haw Creek (303) watershed. Existing grasses and trees, filter strips and grass waterways are the next most installed.

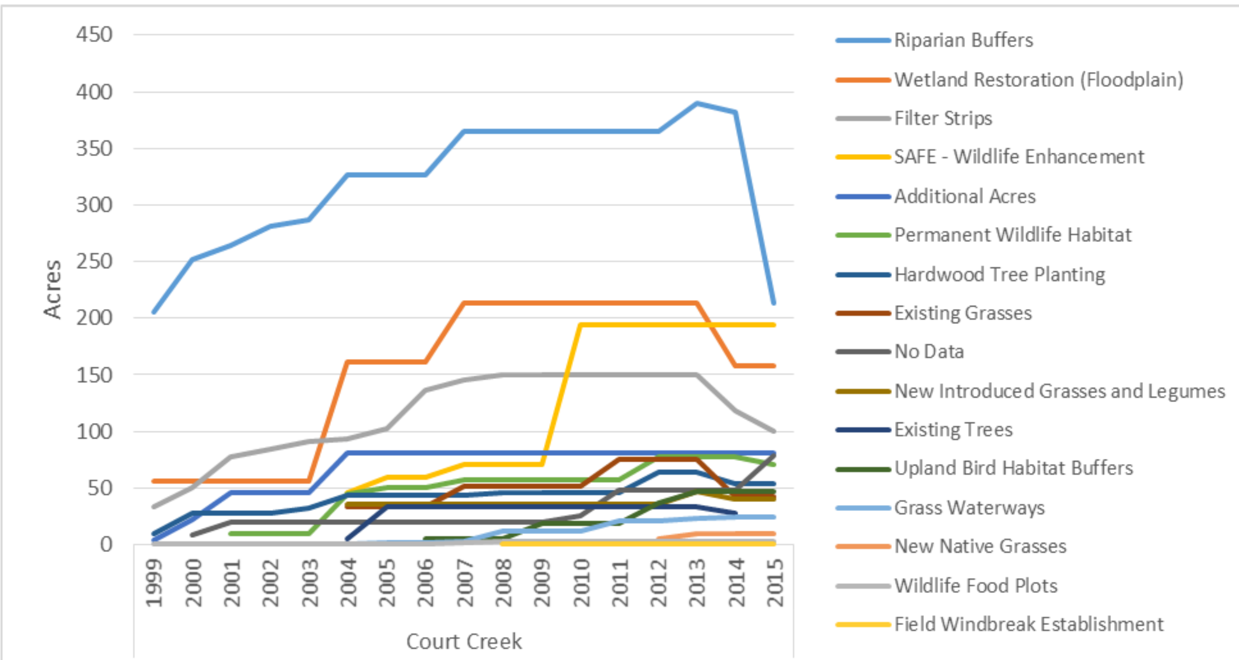


Figure 3-12. Cumulative acres of conservation practices installed in Court Creek watershed at monitoring station ISWS #301 from 1999-2015.

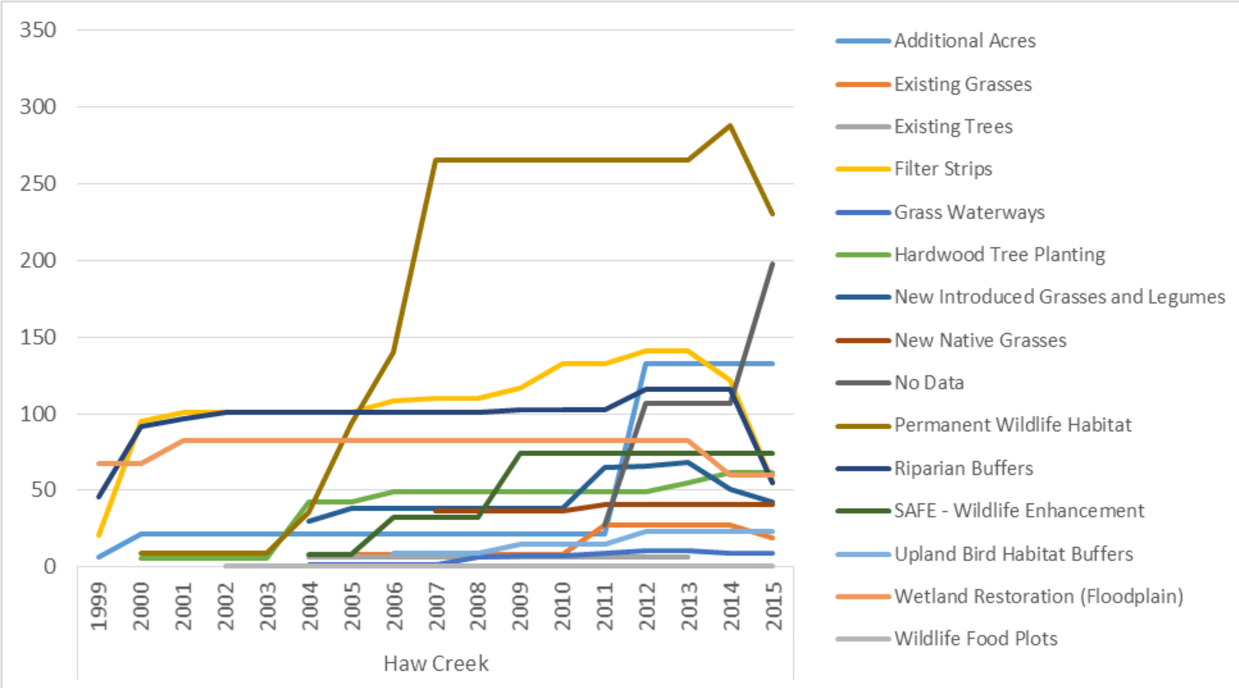


Figure 3-13. Cumulative acres of conservation practices installed in Haw Creek watershed at monitoring station ISWS #303 from 1999-2015.

4. Variability and Trends in Precipitation and Streamflow

Results of a short-term monitoring program have to be viewed with respect to the climatic and hydrologic conditions under which the data was collected. Under ideal conditions, which rarely happen, the monitoring period would include a combination of wet, dry, and normal climatic conditions that represent the range of variability in climatic and hydrologic conditions in the watershed. The influence of climatic and hydrologic conditions on the data collected has been taken into consideration, especially when different datasets collected at different times and conditions are combined or compared. The Illinois River basin, as any major watershed, has experienced significant variability in precipitation and streamflow over the last century and recent periods. Data collection for the CREP program started in 1999 to provide a perspective as to how the current monitoring period compares to the long-term variability of precipitation and stramflows within the Illinois River basin. Historical precipitation and streamflow data are analyzed and presented in this segment of the report.

Climate and hydrologic records from the past 100 years in Illinois show considerable long-term variability. These variabilities and trends were analyzed for two stations on the Illinois River and six tributary stations in the Illinois River basin (figure 4-1). Figure 4-2 compares average precipitation and streamflow for the Upper Illinois River watershed since the 1880s, as expressed in moving 10-year average values. Similar comparisons are shown in figures 4-3 to 4-8 for the Fox, Kankakee, Spoon, Sangamon, LaMoine, and Macoupin subwatersheds, respectively, but for shorter time periods as limited by the available gaging records. Figure 4-9 for the entire Illinois River Basin (at the Valley City streamgage) is nearly identical to figure 1 except for the period of record. The 10-year average precipitation and streamflow values plotted in figures 4-2 to 4-9 represent the approximate midpoint of the 10 years; for example, the value for 1995 represents the average for 10 years from 1990-1999, the value for 1996 represents the average for the 10 years 1991-2000, and so forth. Streamflow values are expressed in inches of water spread uniformly over the entire watershed such that average streamflow can be compared directly with precipitation for the concurrent period. Streamflow values in figure 4-2 are computed from flow and stage records at Peoria prior to 1940 and at Kingston Mines since 1940.

Figure 4-2 shows that precipitation and streamflow in the Upper Illinois River watershed from 1970 to 1995 were considerably higher than at any other time in the 20^{th} Century. Prior to 1895, precipitation for the Illinois River watershed is estimated from a small set of gaging records dating back to 1870. These precipitation records show that there was a decade of high precipitation in the late 1870s and early 1880s similar in magnitude to high precipitation amounts during 1970-1995. A comparison of 10-year average precipitation and streamflow amounts clearly shows that streamflow has been very closely related to concurrent precipitation throughout the past 125 years, with a correlation coefficient (r) of 0.958.

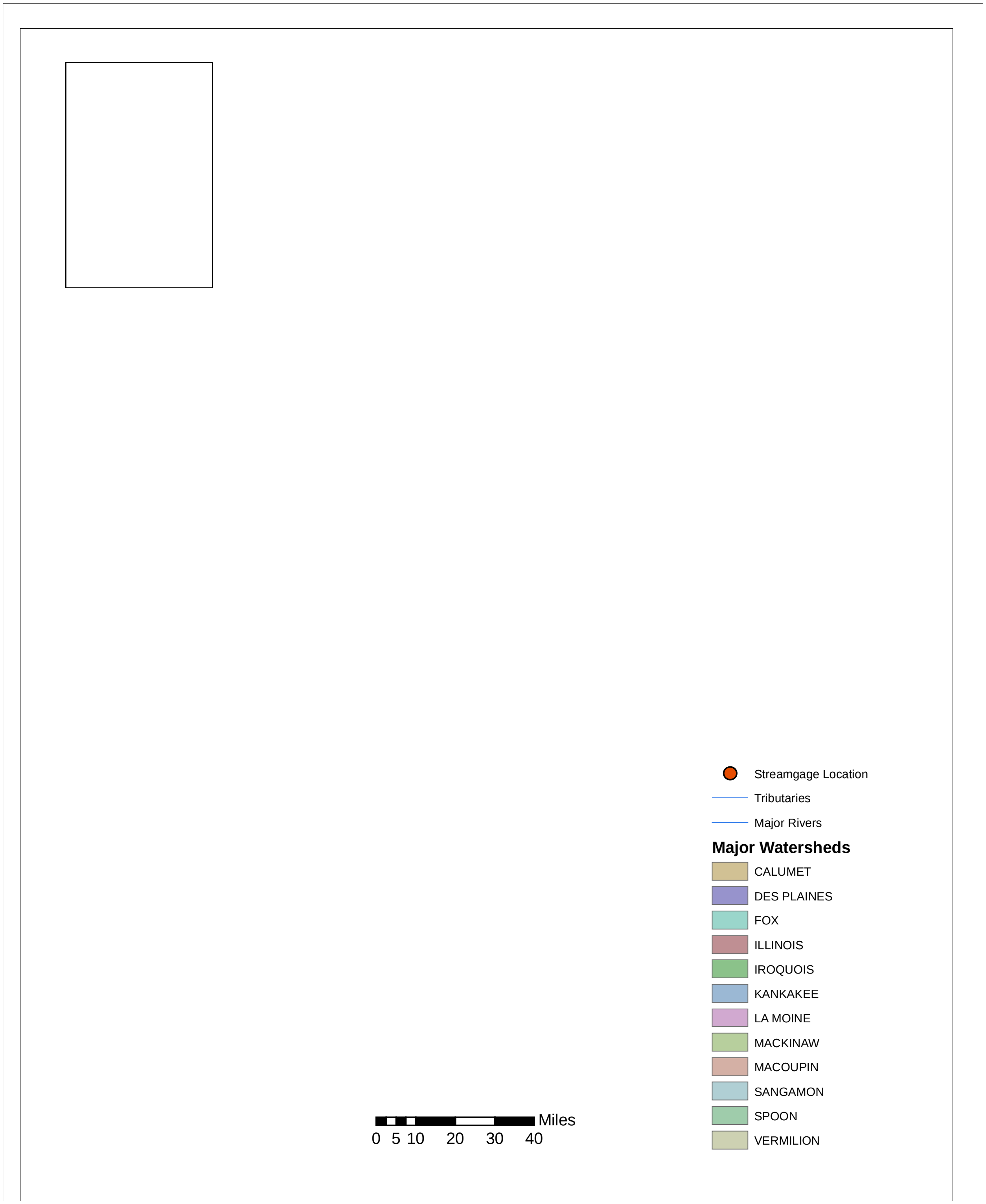


Figure 4-1. Location of streamgaging stations with long-term data used in the analysis of variability and trends

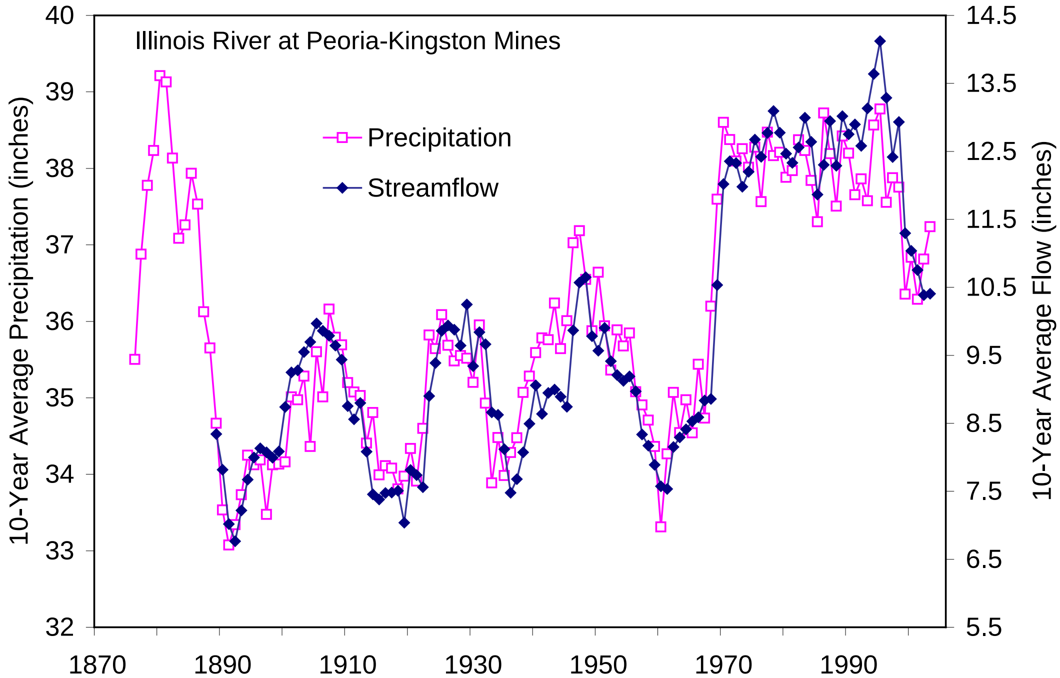


Figure 4-2. Ten-year average precipitation and streamflow, Illinois River at Peoria-Kingston Mines

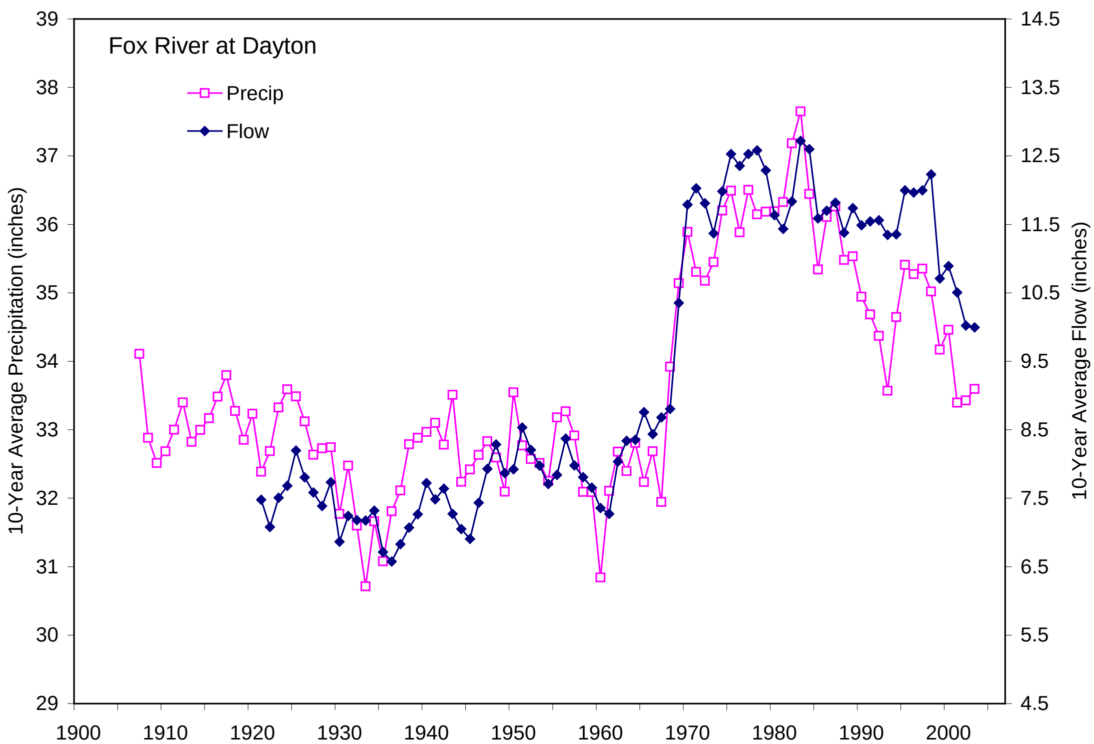


Figure 4-3. Ten-year average precipitation and streamflow, Fox River at Dayton

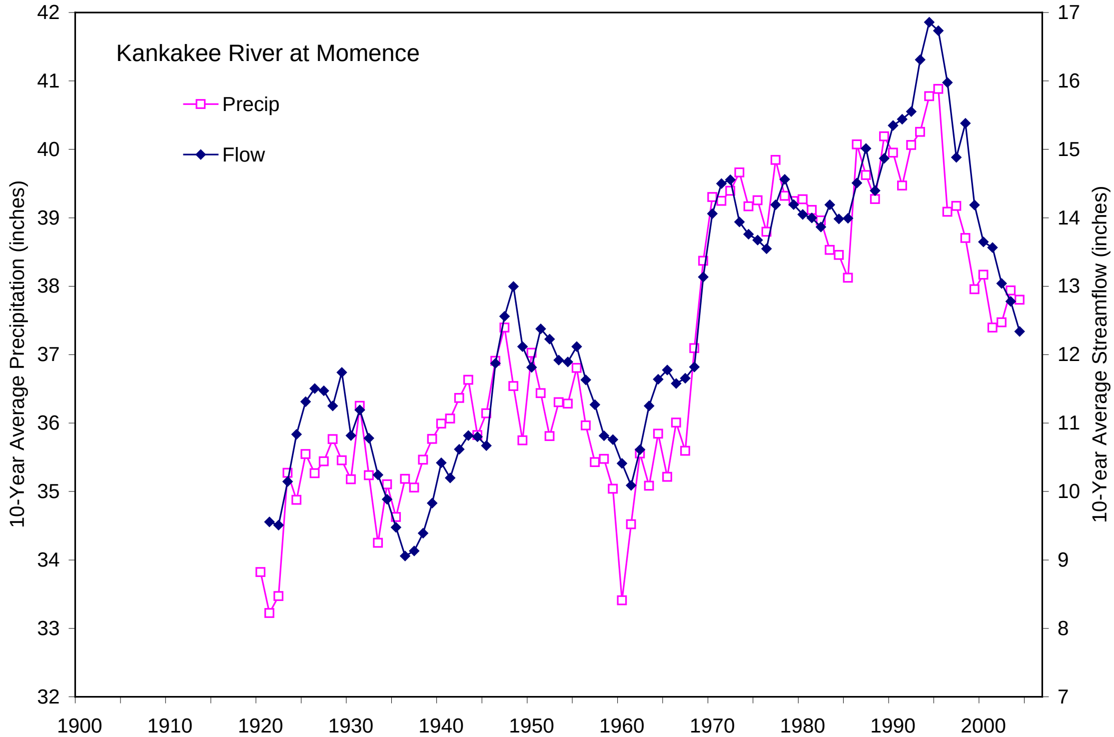


Figure 4-4. Ten-year average precipitation and streamflow, Kankakee River at Momence

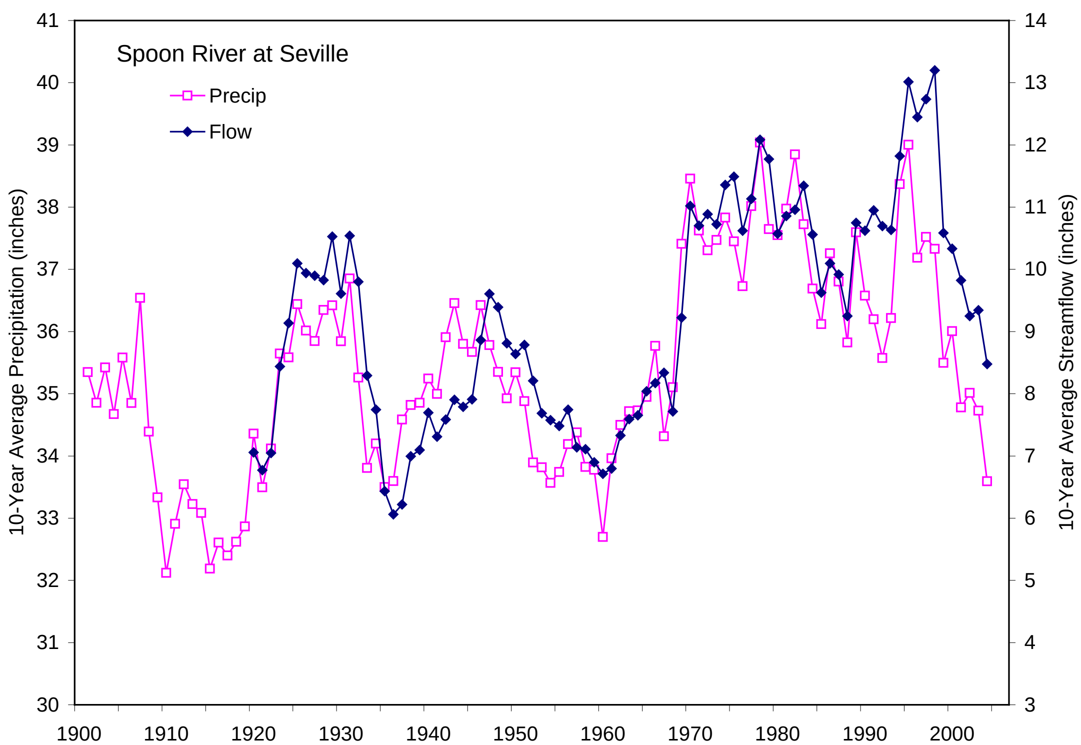


Figure 4-5. Ten-year average precipitation and streamflow, Spoon River at Seville

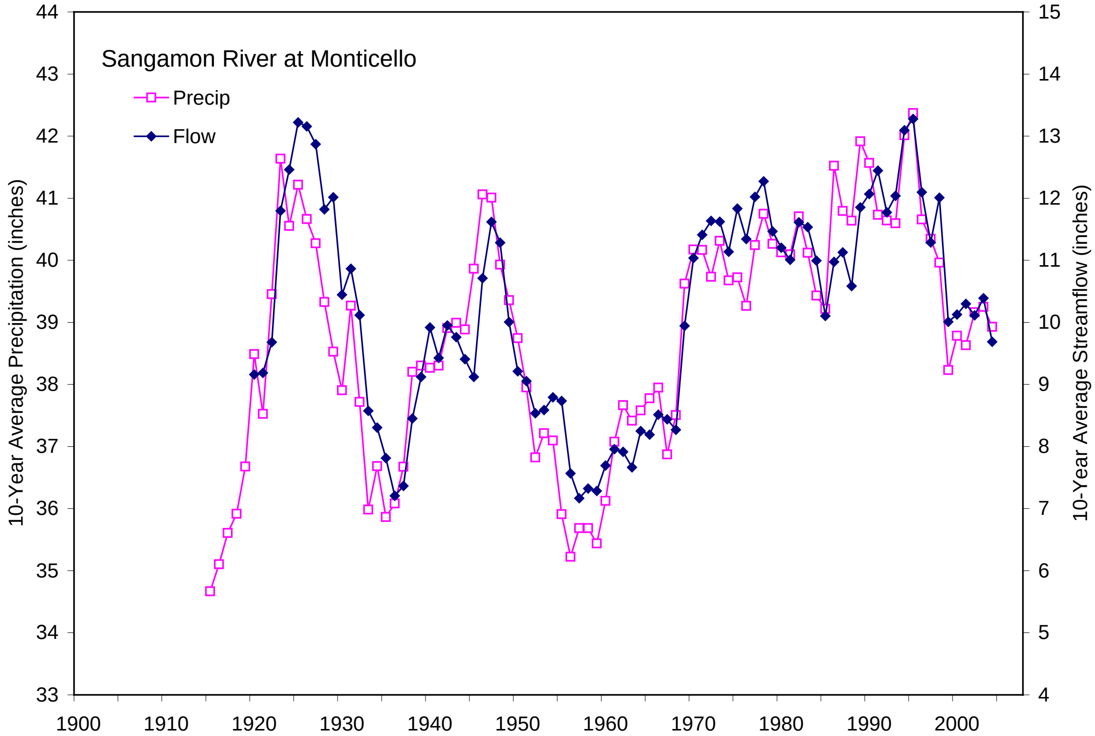


Figure 4-6. Ten-year average precipitation and streamflow, Sangamon River at Monticello

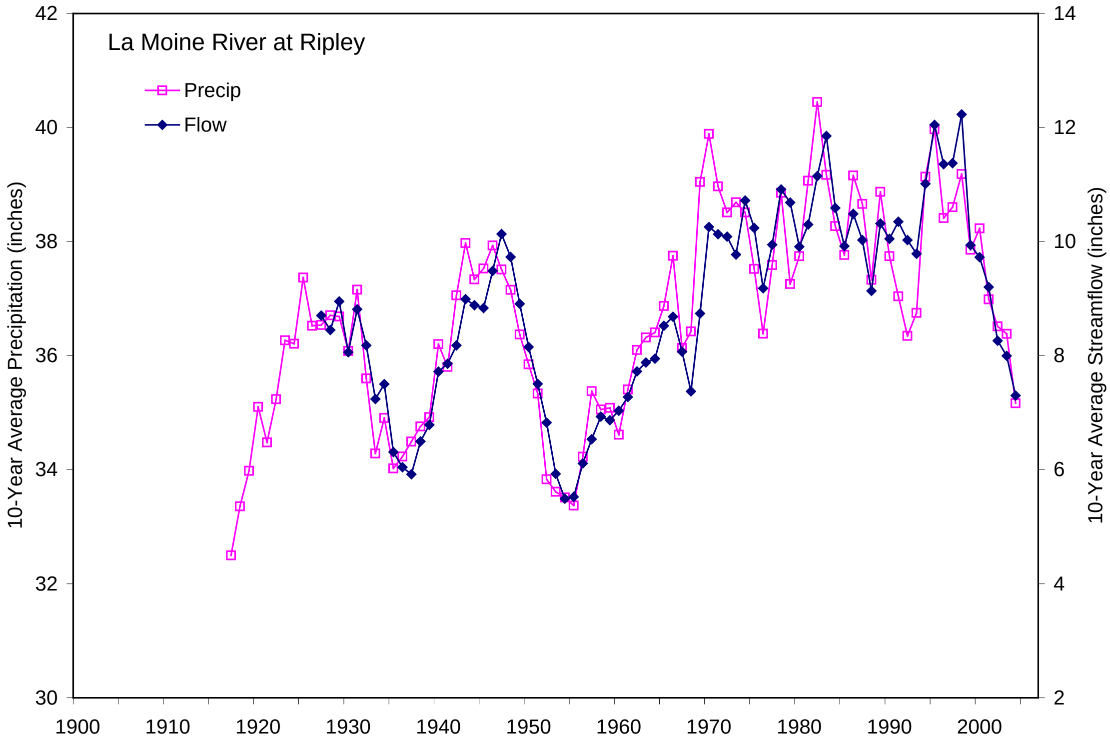


Figure 4-7. Ten-year average precipitation and streamflow, LaMoine River at Ripley

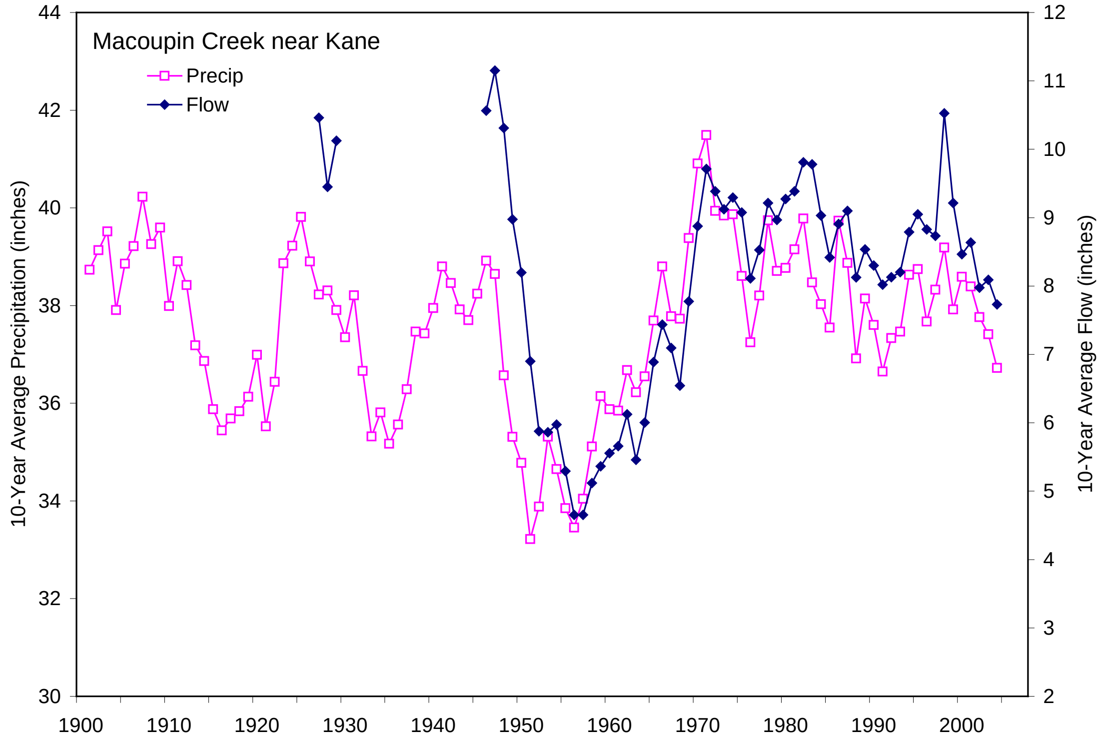


Figure 4-8. Ten-year average precipitation and streamflow, Macoupin Creek near Kane

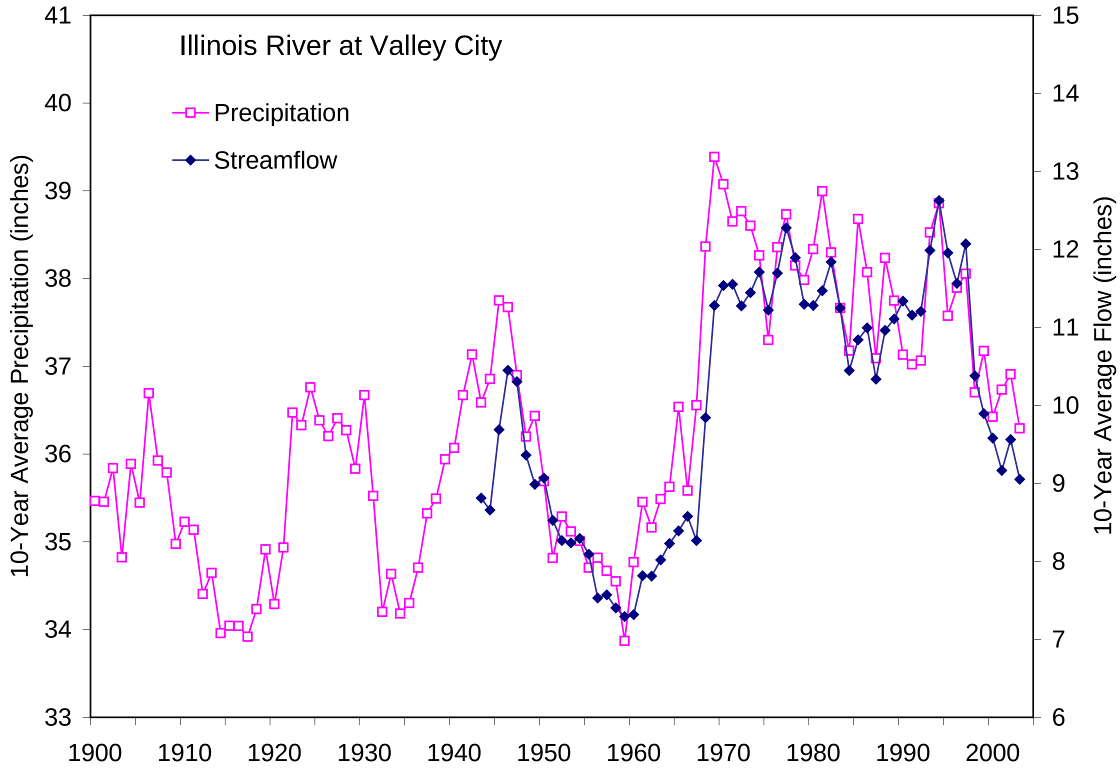


Figure 4-9. Ten-year average precipitation and streamflow, Illinois River at Valley City

Precipitation and streamflow trends shown in figure 4-2 are consistent with regional trends that have affected northern Illinois and much of the upper Midwest (Knapp, 2005). Statistical analyses of long-term streamflow records by Knapp (2005) using the Kendall tau-b trend statistic indicate that streamgage records in northern Illinois, eastern Iowa, and Minnesota all exhibit increasing trends in average streamflow (figure 4-10). Conversely, long-term flow records in the southern two-thirds of Illinois generally do not show significant increases in streamflow.

Figures 4-2 to 4-9 illustrate that trends in precipitation and streamflow vary across the Illinois River watershed. Increasing trends are particularly evident in the Upper Illinois River watershed and its two primary tributaries, the Fox and Kankakee River (figures 4-3 and 4-4). In contrast, the Macoupin, LaMoine, and Sangamon River subwatersheds, in the southern portion of the Illinois River basin, show much less or no overall trend in precipitation or streamflow — even though these records show considerable variation in precipitation and streamflow from decade to decade. The Spoon River watershed, having an intermediate location, shows an increasing trend in flow amount, but to a lesser degree than the Fox and Kankakee River watersheds located farther to the north. In all cases, there is a strong correlation between average precipitation and streamflow.

The significance of the trends is identified using the Kendall tau-b statistic. The Kendall tau-b statistical test provides a quantitative measure of trend, with a coefficient value of 0 indicating no trend and a value of 1 indicating an absolute increasing trend. For the 93-year flow records dating back to 1915, a coefficient value greater than or equal to 0.115 indicates an increasing trend at a 90 percent confidence level, and a value greater than or equal to 0.162 indicates an increasing trend at a 98 percent confidence level. Table 3-2 shows the Kendall Tau-b trend coefficients computed for two time periods, 1915-2007 and 1970-2007. The 1915-2007 trend analyses for the Fox, Kankakee, and Upper Illinois (Peoria-Kingston Mines) flow records show increasing trends with very high levels of confidence. The 1915-2007 trend analysis for the Spoon River record shows an increasing trend, with roughly a 94 percent level of confidence. The flow records for the tributaries located farther south in the watershed do not show a significant trend (having less than an 80 percent level of confidence). The 1915-2007 trend coefficient for the Illinois River at Valley City is not shown because the flow record does not date back to 1915.

Although flow records from the northern half of the Illinois River watershed display an general increasing trend over their full period of record, a closer look indicates: 1) there was a geographically widespread and sizable jump in average flow amount between the 1960s and 1970s (this jump also occurred in the southern part of the basin to a lesser extent); and 2) for most locations there has been little or no additional increase since the 1970s. In fact, for most locations, the average flows since 1995 have declined from the high flow levels that occurred from 1970 to 1995. Table 3-3 presents the average annual precipitation and streamflow amounts for the Illinois River and its major tributaries over the past 12 years (1996-2007) and compares these amounts to those for earlier periods (1915-1969 and 1970-1995) and to the overall long-term record. Except for the Kankakee River, the average flow from 1996-2007 for these rivers is much closer to the long-term average than it is to the higher flow amounts that were experienced

Figure 4-10. Locations of long-term streamflow gages (at least 89 years of record) showing statistically significant trends in mean annual flow in the eastern United States (from Knapp, 2005)

from 1970 to 1995. Thus, with the exception of the Kankakee River watershed, it is reasonable to conclude that other flow records collected throughout the Illinois River watershed over the 1996-2007 timeframe may represent conditions similar to their expected long-term average condition.

Although it is not possible to predict how these trends will progress in the future, concerns expressed in previous decades regarding the potential for continued increases in flows throughout the Illinois River watershed (for example by Ramamurthy et al., 1989) for the time being may no longer be an issue. If anything, there may be growing concerns that the occurrence of drought periods such as existed prior to 1970 may become more frequent. This analysis does not specifically look at trends of flooding or low flows. However, for long-term gaging records in the Illinois River watershed, Knapp (2005) found that trends in high flows and low flows tended to be coincident and proportional to trends in average flow.

Table 4-1. Kendall Tau-b Trend Statistics for Flow Records on the Illinois River and Major Tributaries

	Kendall Tau-b coefficient value period-of-record used in the analysis	
Streamgage record	*1915-2007*	*1970-2007*
Fox River at Dayton	0.294	-0.135
Kankakee River at Momence	0.316	-0.007
Illinois River at Peoria-Kingston Mines	0.315	-0.144
Spoon River at Seville	0.127	-0.127
Sangamon River at Monticello	0.087	-0.081
LaMoine River at Ripley	0.075	-0.166
Macoupin Creek near Kane*	-0.009	-0.081
Illinois River at Valley City**	------	-0.112

Notes:
* The periods of record for the Macoupin Creek gage near Kane are 1921-1933 and 1941-2007.
** The flow record at Valley City only extends back to 1939. The trend coefficient for the 1939-2007 period at Valley City, 0.162, is somewhat less than the trend coefficient for Peoria-Kingston Mines for the same time period (0.192).

Table 4-2. Average Annual Precipitation and Streamflow (inches) for Different Periods of Record

Precipitation

Watershed	*1915-2007*	*1915-1969*	*1970-1995*	*1996-2007*
Fox	33.7	32.6	35.9	34.4
Kankakee	37.0	35.5	39.5	38.4
Upper Illinois (Peoria)	36.3	35.2	38.3	37.1
Spoon	35.7	34.9	37.7	34.8
Sangamon	38.9	38.1	40.7	38.9
LaMoine	36.6	35.8	38.6	35.9
Macoupin	37.4	37.0	38.6	36.9
Entire Illinois (Valley City)	36.5	35.6	38.3	36.6

Streamflow

Watershed	*1915-2007*	*1915-1969*	*1970-1995*	*1996-2007*
Fox	9.3	7.7	12.1	10.0
Kankakee	12.3	10.9	14.7	13.5
Upper Illinois (Peoria)	10.2	8.8	12.9	10.8
Spoon	9.1	8.0	11.3	9.2
Sangamon	10.4	9.5	12.4	10.1
LaMoine	8.7	7.7	10.7	8.2
Macoupin	8.4	8.1	9.1	7.8
Entire Illinois (Valley City)	9.8	8.4	11.7	9.5

5. Model Development and Application

The Illinois State Water Survey has been developing a watershed model for the Illinois River basin in support of the Illinois River Ecosystem project. In the initial phase, a hydrologic model of the entire Illinois basin has been developed and used to evaluate potential impacts of land use changes and climate variability on streamflow in the Illinois River basin. The model is based on the U.S. Environmental Protection Agency's BASINS 3.0 modeling system. The Hydrologic Simulation Program – FORTRAN or HSPF (Bicknell et al., 2001) which is part of BASINS was used to simulate the hydrology of the Illinois River basin. The HSPF is a comprehensive and dynamic watershed model that also has the capability to simulate water quality and sediment transport.

To make the model applicable for assessing and evaluating the impact of CREP and other land use changes on water quality and sediment transport, the Water Survey has been developing the sediment transport and water quality capabilities of the HSPF model for the Illinois River basin. The initial effort has focused on the Spoon River watershed (figure 5-1) where two of the four intensively monitored watersheds, Court and Haw Creek, are located. Streamflow, sediment, and water quality data being collected at three monitoring stations are being used to calibrate and test the model for the Spoon River watershed. Once the calibration and validation process are completed for the Spoon River watershed, the model parameters can be used to develop models for other similar watersheds to simulate the hydrology, sediment transport and water quality under different climatic and land use scenarios. Over time, as land use practices change significantly as a result of CREP and other conservation practices, the models being developed will provide the tools to evaluate and quantify changes in water quality and sediment delivery to the Illinois River.

The progress in model development for the Spoon River watershed is discussed in the following sections.

HSPF Model

The HSPF model is a conceptual, comprehensive, long term continuous simulation watershed scale model which simulates non-point source hydrology and water quality, combines it with point source contributions, and performs flow and water quality routing in the watershed and its streams. The HSPF model simulates land-surface portion of the hydrologic cycle by a series of interconnected storages – an upper zone, a lower zone, and a ground-water zone. The fluxes of water between these storages and to the stream or atmosphere are controlled by model parameters. The model uses a storage routing technique to route water from one reach to the next during stream processes.

For sediment simulation, the surface erosion component of the HSPF model performs processes such as sediment detachment from the soil matrix in the pervious land segments during rainfall event, washoff of this detached sediment, scour of the soil matrix, and reattachment or compaction of the sediment. Storage and washoff of sediments from the impervious surfaces is

Figure 5-1. Location of the Spoon River watershed

also considered. The sediment load and transport in the stream channel is dependent on the particle diameter, density, fall velocity, shear stress for deposition and scour, and erodibility. The noncohesive (sand) and cohesive (silt and clay) sediment transport is simulated in the model using different subroutines.

Nutrients in the watershed soil in the HSPF model are simulated either as attached to organic or inorganic solids, dissolved in the overland flow, or as concentrations in the subsurface flow reaching the streams laterally. For both nitrogen and phosphorous compounds, the processes simulated include immobilization, mineralization, nitrification/denitrification (nitrogen only), plant uptake, and adsorption/desorption. The nutrient loads from the watershed undergo further transformation in the stream reaches.

Model Input Data

The HSPF model requires spatial information about watershed topography, river/stream reaches, land use, soils, and climate. The hourly time-series of climate data required for hydrologic simulations using HSPF include precipitation, potential evapotranspiration (ET), potential surface evaporation, air temperature, dew-point temperature, wind speed, and solar radiation. The hourly precipitation data from the two ISWS gages, one each in Court Creek (ISWS31) and Haw Creek (ISWS32) watersheds, were used (figures 5-2 and 5-3). Daily precipitation data from the MRCC (Midwestern Regional Climate Center) gaging station at Galesburg (ID 113320) was also used after it was disaggregated into hourly data based on the hourly precipitation data from an ICN (Illinois Climate Network) station located in Monmouth (MON). The other time series of the climate inputs for the above three precipitation stations were obtained from the ICN station at Monmouth. Daily data from nine additional MRCC stations (figure 5-4) in or near the Spoon River watershed were also disaggregated into hourly data based on the hourly data from three stations at Peoria, Moline, and Augusta, as found in the BASINS database. These additional stations were used for the Spoon River watershed model.

For topographic inputs, the 30-meter Digital Elevation Model (DEM) raster dataset produced by the Illinois State Geological Survey (ISGS) and the United States Geological Survey (USGS) was used. The high resolution National Hydrography Dataset (NHD) developed by the USGS was used to provide stream/river reach information to the model. The land use data were obtained from the Illinois Department of Agriculture which is based on the satellite imagery of the State of Illinois acquired from three dates during the spring, summer, and fall seasons of 1999 and 2000. Land use in the study watersheds was classified as corn, soybean, rural grassland, forest, urban, wetland and other (figures 5-5, 5-6, and 5-7). The soils data were based on digitized County Soil Association Maps of the Knox County and the STATSGO dataset (figure 5-8). The soil type for various parts of the study watersheds were determined spatially from the digitized soils maps, but the parameters corresponding to the soil type were manually entered during development of the HSPF model.

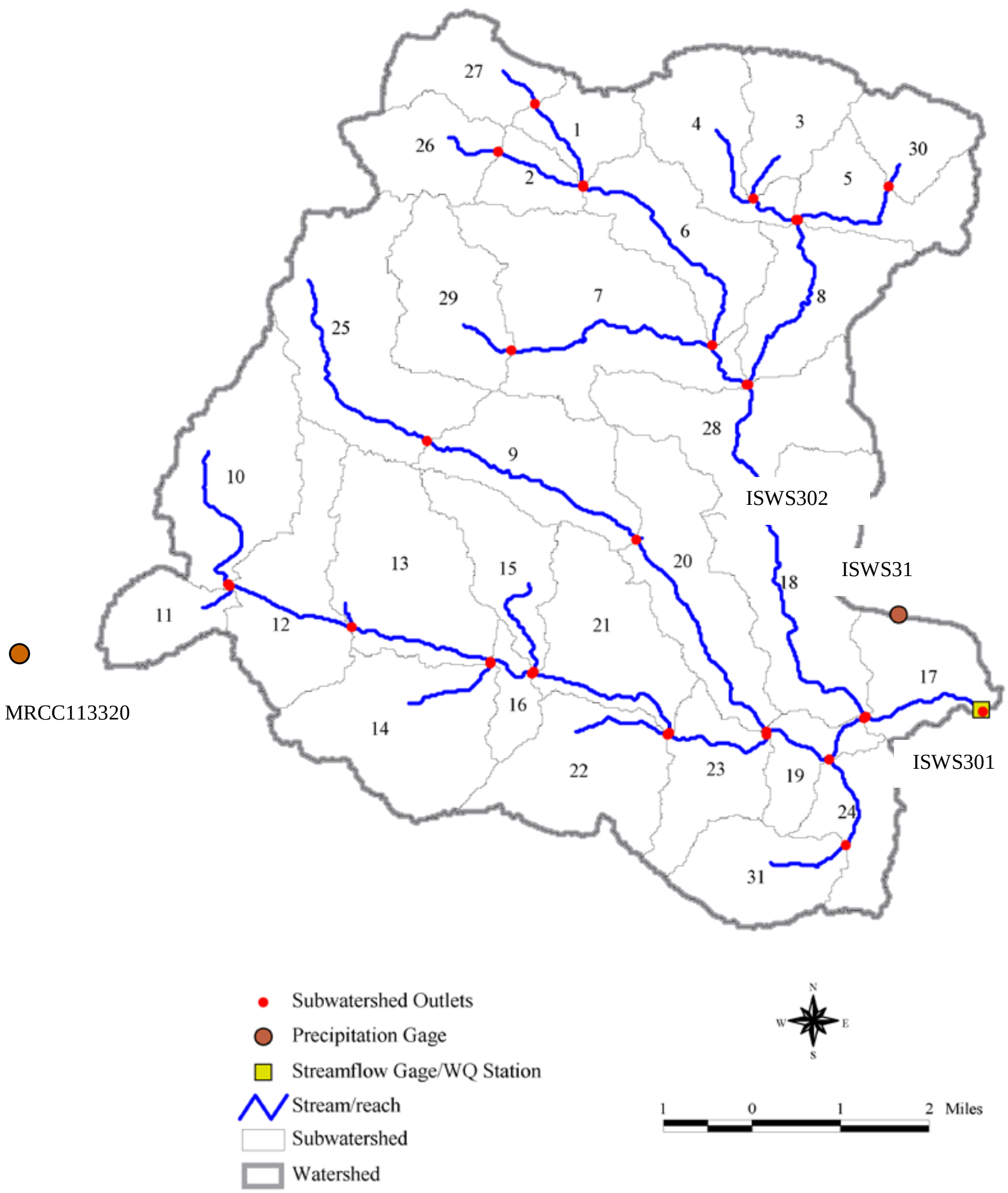


Figure 5-2. Schematic of the subwatershed and stream delineation, and precipitation gages used for the Haw Creek model

Figure 5-3. Schematic of the subwatershed and stream delineation, and precipitation gages used for the Haw Creek model

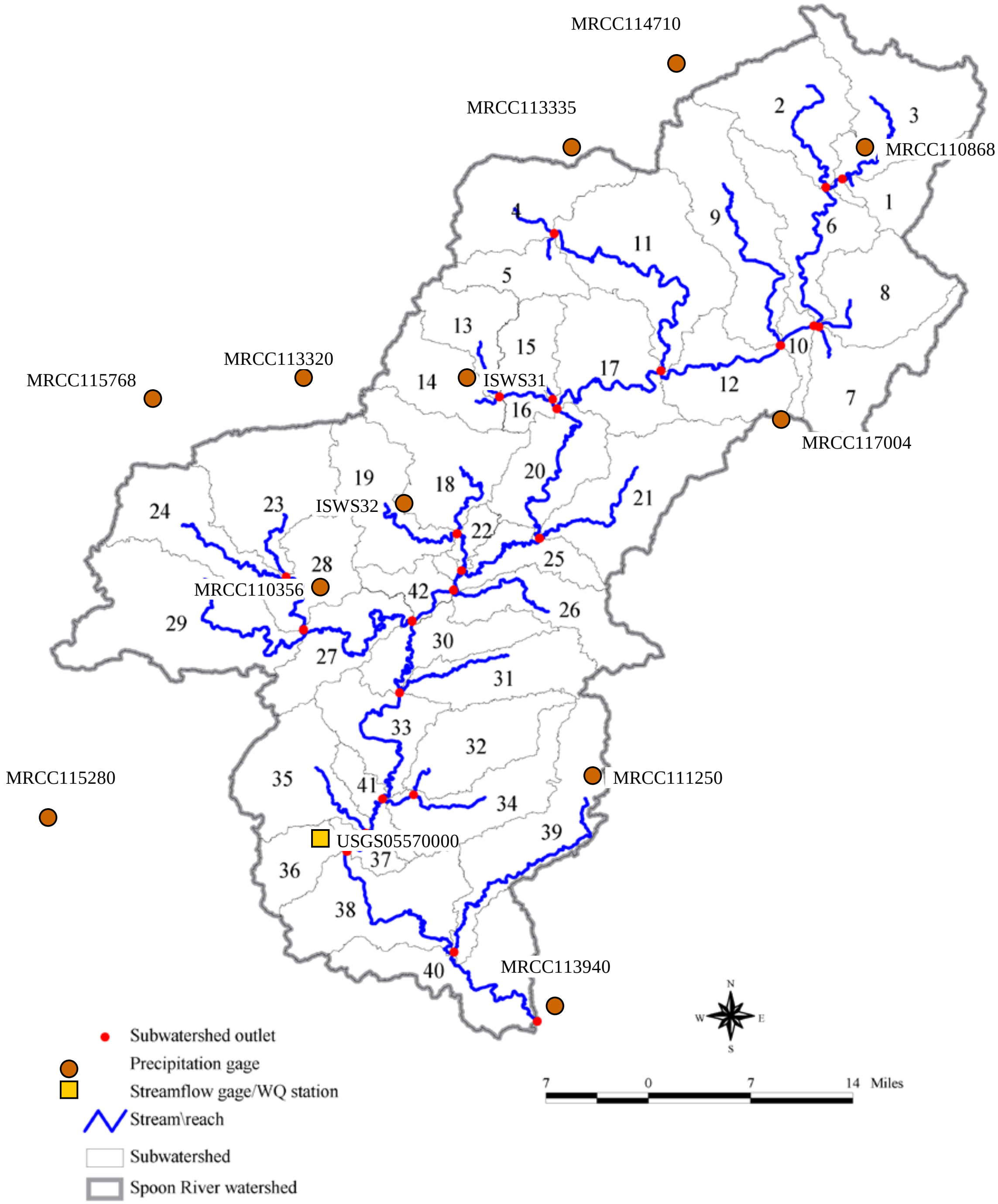


Figure 5-4. Schematic of the subwatershed and stream delineation, and precipitation gages used for the Spoon River watershed model

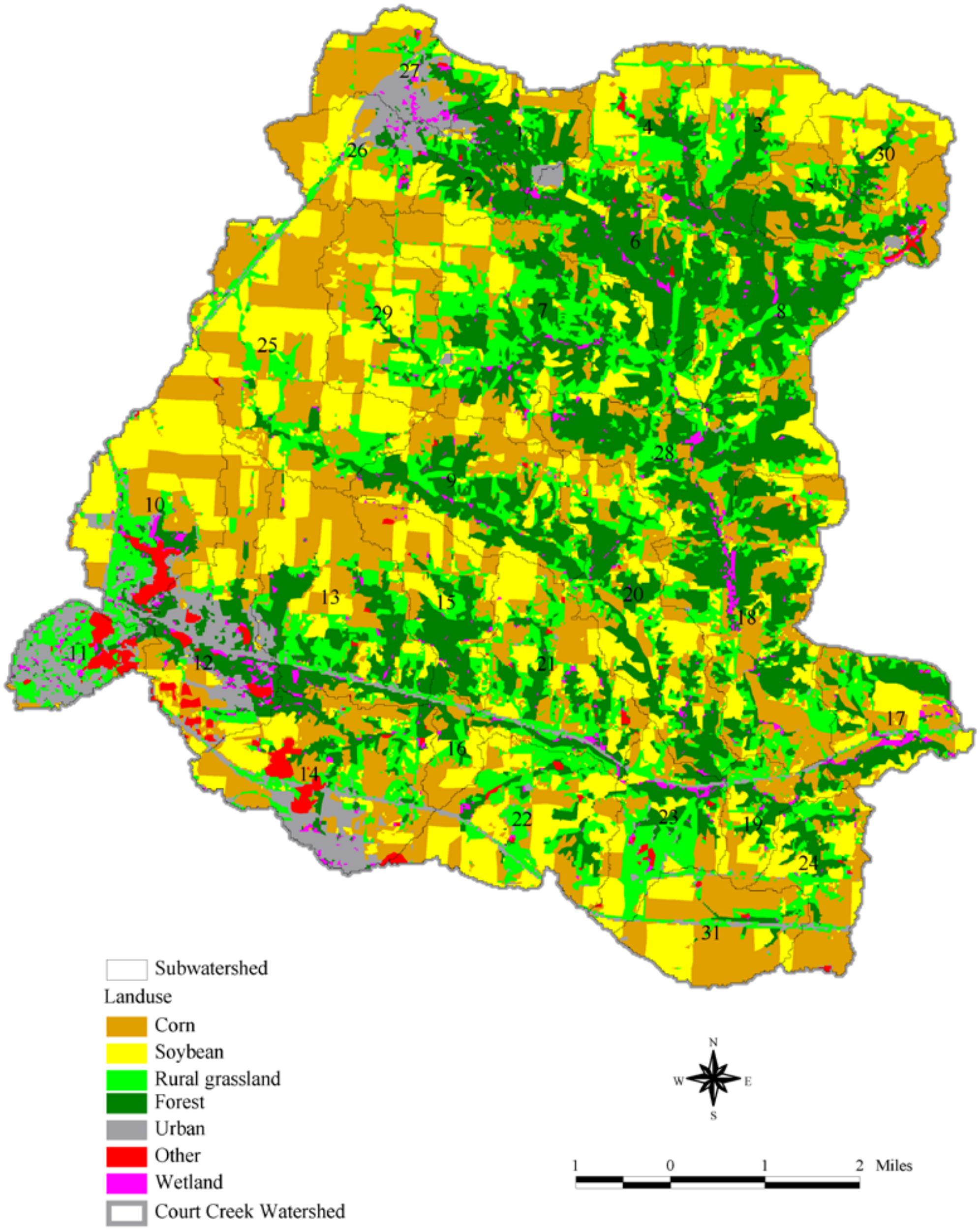


Figure 5-5. Land use in the Court Creek watershed

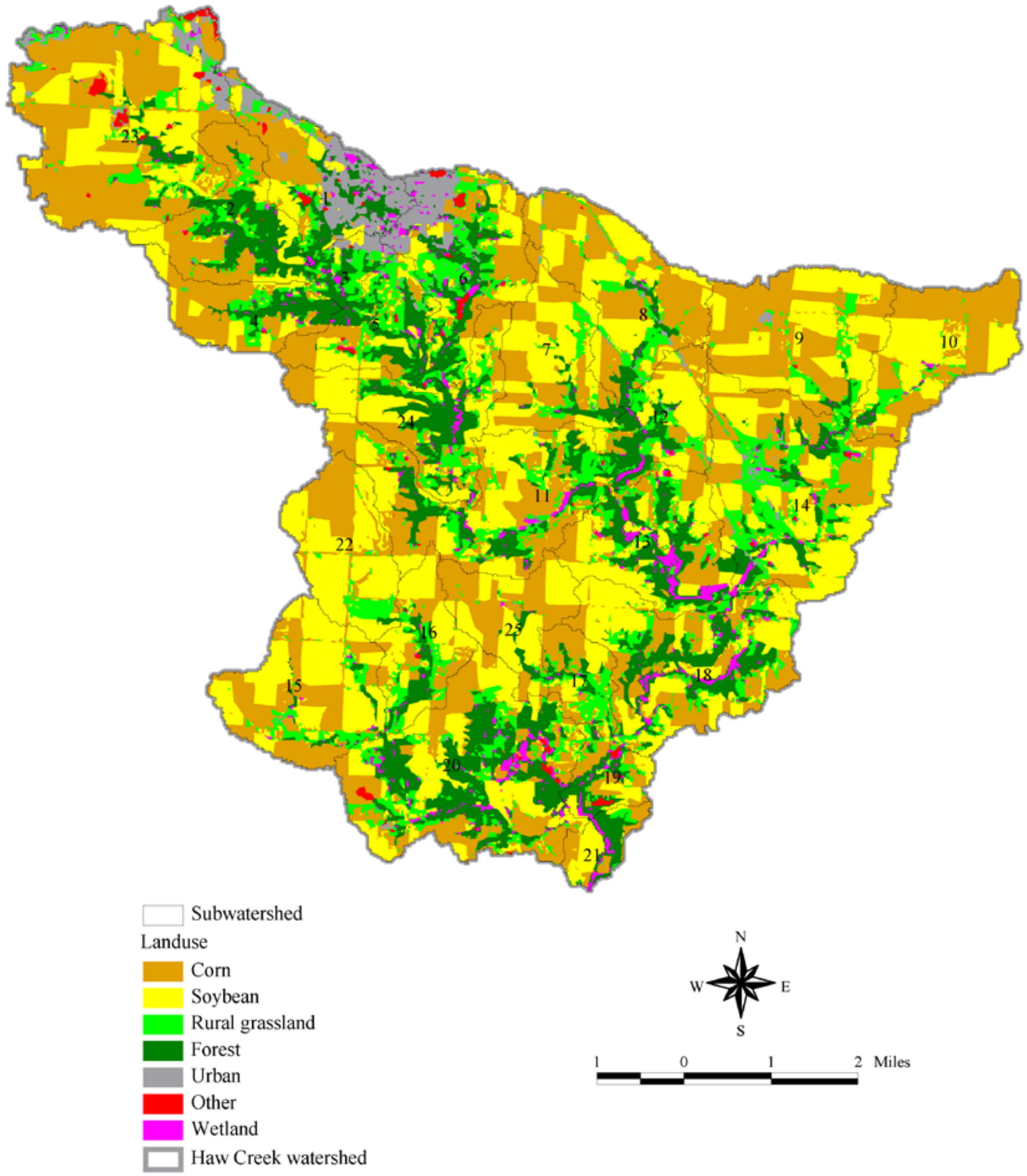


Figure 5-6. Land use in the Haw Creek watershed

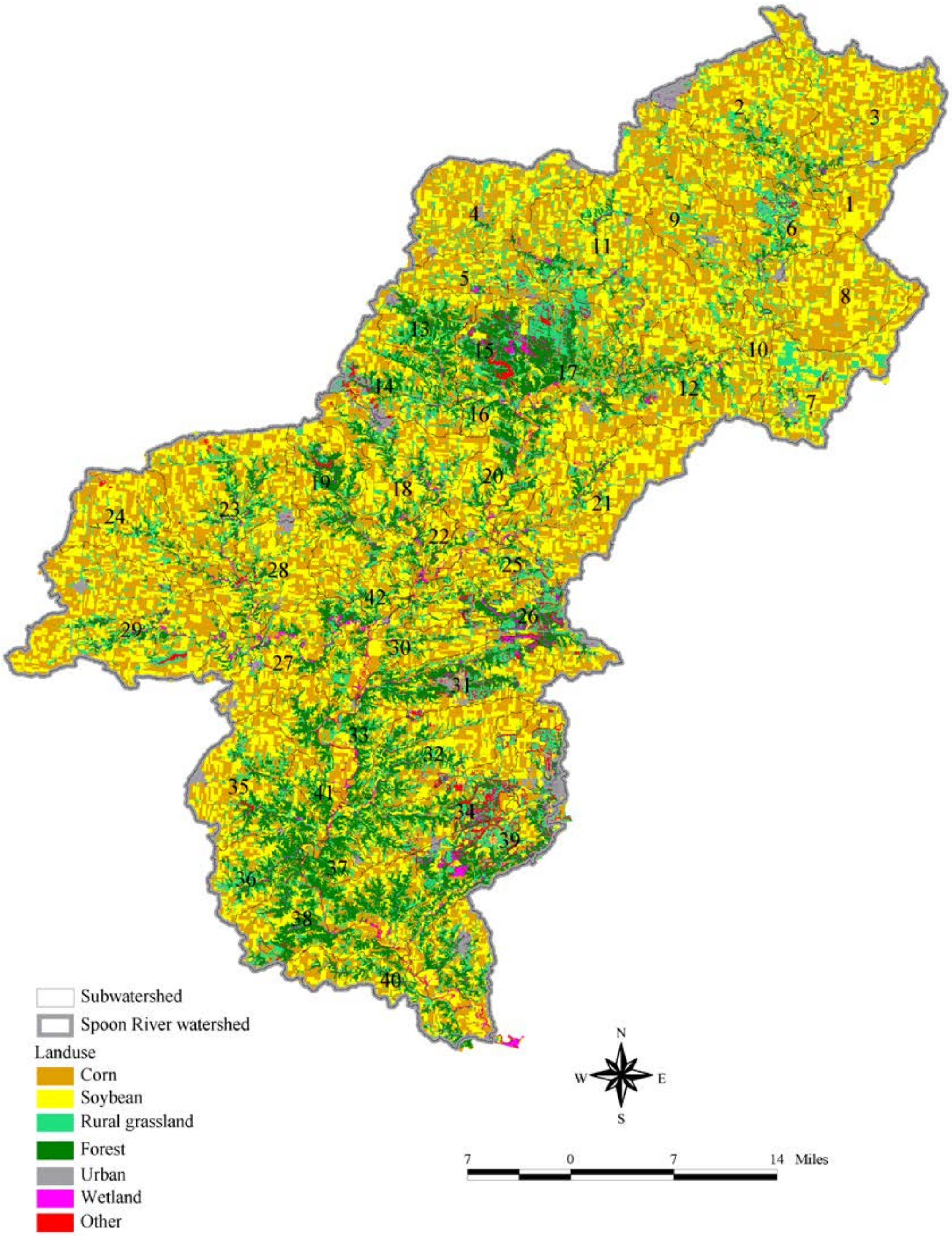


Figure 5-7. Land use in the Spoon River watershed

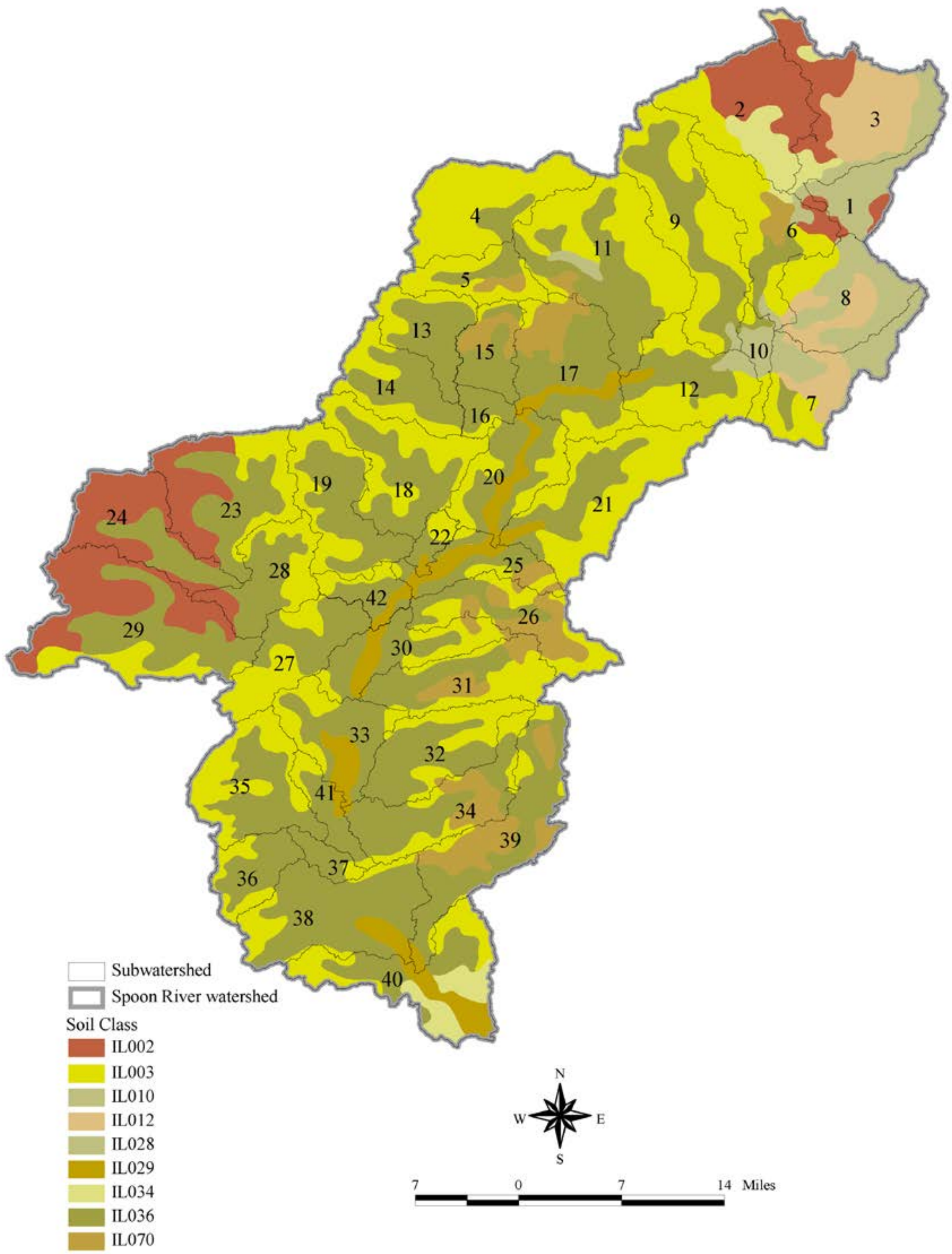


Figure 5-8. Soil types in the Spoon River watershed

Model Development

Based on the topographic and hydrographic data, the watersheds were subdelineated into smaller hydrologically-connected subwatersheds and stream reaches, and respective outlets. The Automatic Delineation procedure in BASINS with an option of 'burning in' existing streams was used. Subdelineation was done for representing spatially variable physical and other characteristics of a watershed in the HSPF model. The Court, Haw, and Spoon River watersheds were subdivided into 31, 25, and 42 subwatersheds, respectively (figures 5-2, 5-3, and 5-4). During subdelineation, outlets were specified in the models corresponding to the streamflow gaging/water quality monitoring stations on the North Creek (ISWS302), Court Creek (ISWS301), Haw Creek (ISWS303), and the USGS streamflow gaging station at Seville (USGS05570000) in the Spoon River watershed (figures 5-2, 5-3, and 5-4). The subwatersheds were further subdivided into Hydrologic Response Units (HRUs) based on land use, soil, and climate to account for the spatial variability of a basin's physical and hydrologic characteristics at a finer scale. An HRU is an area within a watershed that is expected to have a similar hydrologic response to input of precipitation and evapotranspiration. Each HRU has a set of parameter values that must be determined through the calibration process to define runoff characteristics as well as loading of various constituents from that HRU. In the Court Creek watershed HSPF model, climate data from the Court Creek and Galesburg precipitation gages were input to different subwatersheds based on the proximity. Similarly, in the Haw Creek HSPF model data from the Haw Creek and Galesburg gages were input to various subwatersheds. In case of Spoon River watershed HSPF model, data from all ten MRCC stations were specified for different subwatersheds based on their proximity to the gages.

Model of the Court Creek watershed was developed first using two years (WY2001-WY2002) streamflow and sediment concentration data from the ISWS301 streamflow gage/WQ station on the Court Creek. Calibrated model parameters from this model were then used to populate the models of the Haw Creek and Spoon River watersheds. No further calibration of these two models was performed. Haw Creek watershed model was run for the same two year period as Court Creek watershed model and the model results were compared with the observed data from the ISWS303 gage on the Haw Creek. Since long-term climate and streamflow data were available for the Spoon River watershed, this model was run for 1972-1995 period using data from the USGS05570000 at Seville.

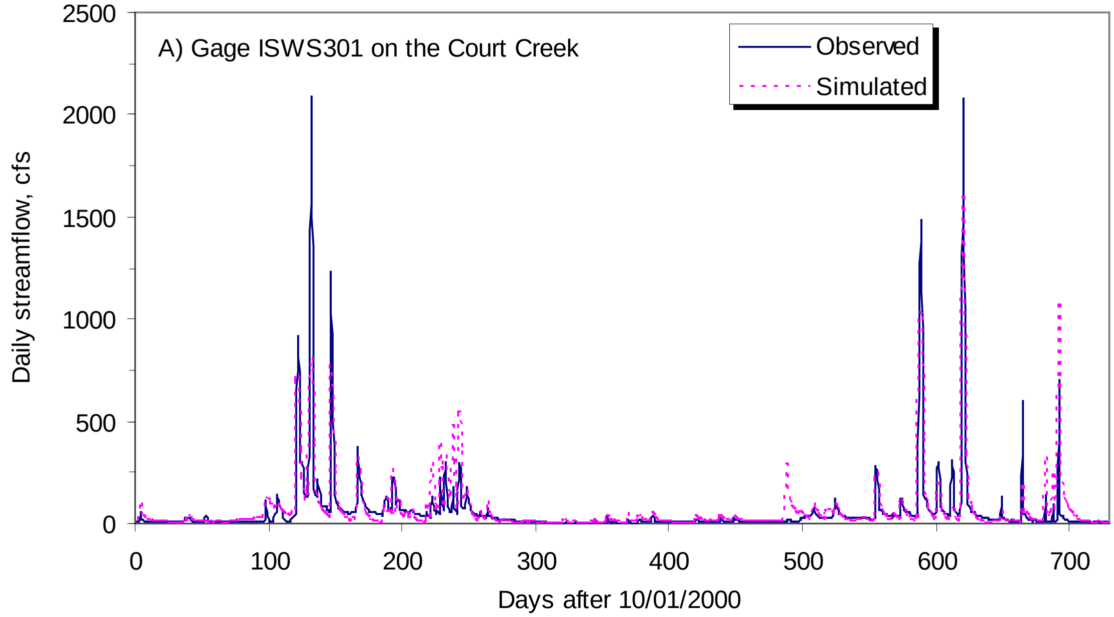
Modeling Results

Values of a large number of HSPF model parameters can not be obtained from field data and need to be determined through model calibration exercise. The Court Creek watershed model was calibrated to assign best possible parameter values to each HRU and stream reach so that the model simulated daily streamflows and pollutant concentrations similar to the values observed at the gaging/monitoring stations. Calibration of the hydrologic component of the model was followed by the calibration of the water quality component for the sediment concentration. Model was run for hourly time step. For the two year calibration period of WY2001-WY2002, percent volume error between the model simulated and observed streamflows at gages ISWS301 on the Court Creek and ISWS302 on the North Creek were 1.2% overestimation, and 3.5%

underestimation, respectively. Comparisons of the daily streamflows simulated by the model for WY2001-WY2002 period with those observed at gages ISWS301 and ISWS302 are shown in figures 5-9a and 5-9b. The performance of this preliminary model is promising and overall the simulated streamflows follow the similar trend as the observed values. The timings and shape of the simulated streamflow hydrographs resemble the observed ones but some peak flows were underestimated by the model. In this study the model was not calibrated to match the individual stormflow events, rather it was calibrated to fit the long-term and daily data over the two year calibration period. Also, data from only two precipitation gaging stations, both near the boundary of the watershed (figure 5-2), were used to spatially represent the precipitation over the entire watershed. It is possible that rainfall measured for a particular event at one of the gages did not represent the rainfall that actually occurred in different parts of the watershed, thereby resulting in discrepancies between the observed and simulated streamflow hydrographs. Thus, more precipitation gaging stations will help improve the performance of the hydrologic model by more accurately simulating the stormflow hydrographs.

For sediment simulation by the model in the Court Creek watershed, parameters controlling soil erosion on the surface and sediment transport in the stream channel were calibrated. Comparison of sediment concentration simulated by the model and those observed at gages ISWS301 and ISWS302 are shown in figure 5-10 for the WY2001-WY2002 period. The simulated values generally followed the same trend as the observed sediment concentration values at both gages. Since most soil erosion occurs during extreme runoff events, some high sediment concentrations were underestimated by the model as a result of poor estimation of the stormflow peaks by the model during hydrologic simulations.

Streamflow and sediment concentration simulation results from the Haw Creek watershed model are compared with the observed data as shown in figures 5-11 and 5-12, respectively. Similar results from the Spoon River watershed model are shown in figures 5-13 and 5-14. In this preliminary phase, the performances of these two models were similar to the calibrated model of the Court Creek watershed. Performance of these models can be improved in the future if climate, streamflow, and water quality data are available for more stations and longer time period to improve the model calibration.



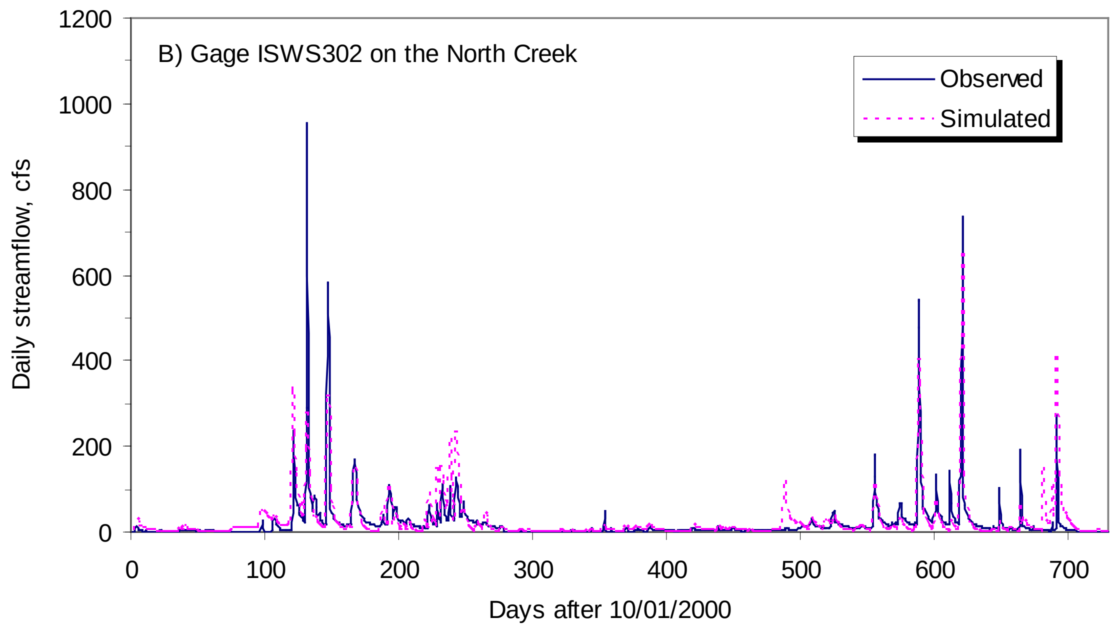
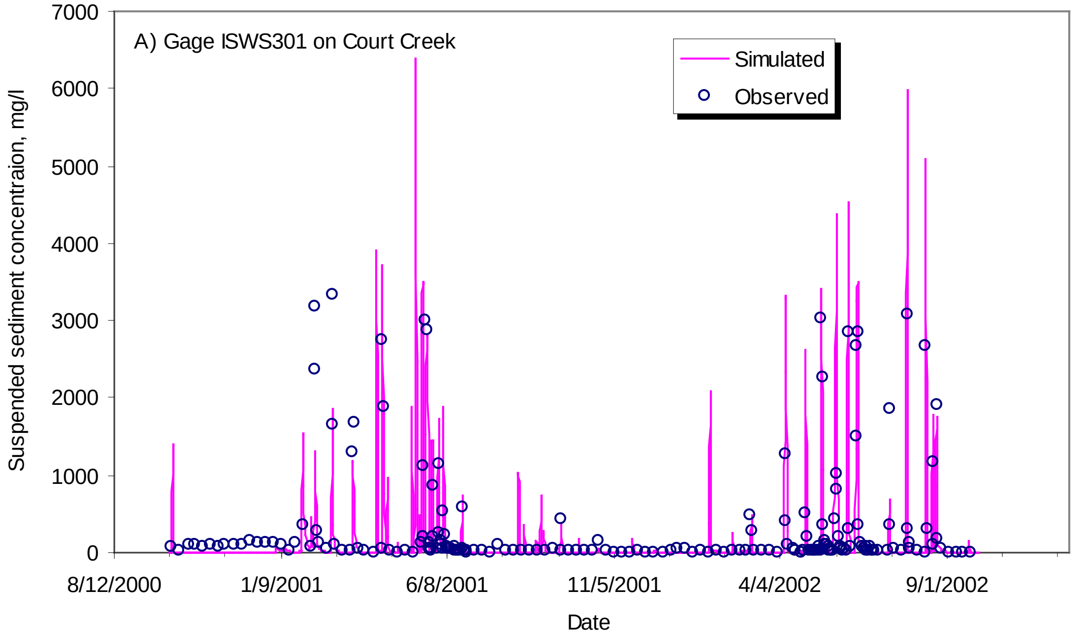


Figure 5-9. Results of model calibration for streamflow simulation for the Court Creek watershed



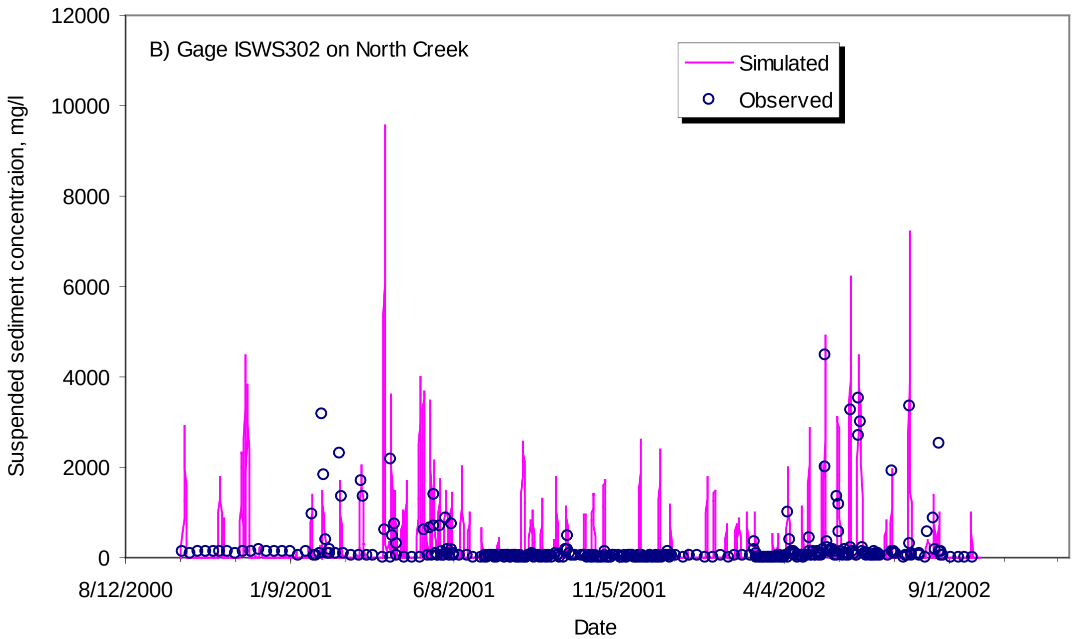


Figure 5-10. Preliminary results of model calibration for suspended sediment concentration simulation for the Court Creek watershed

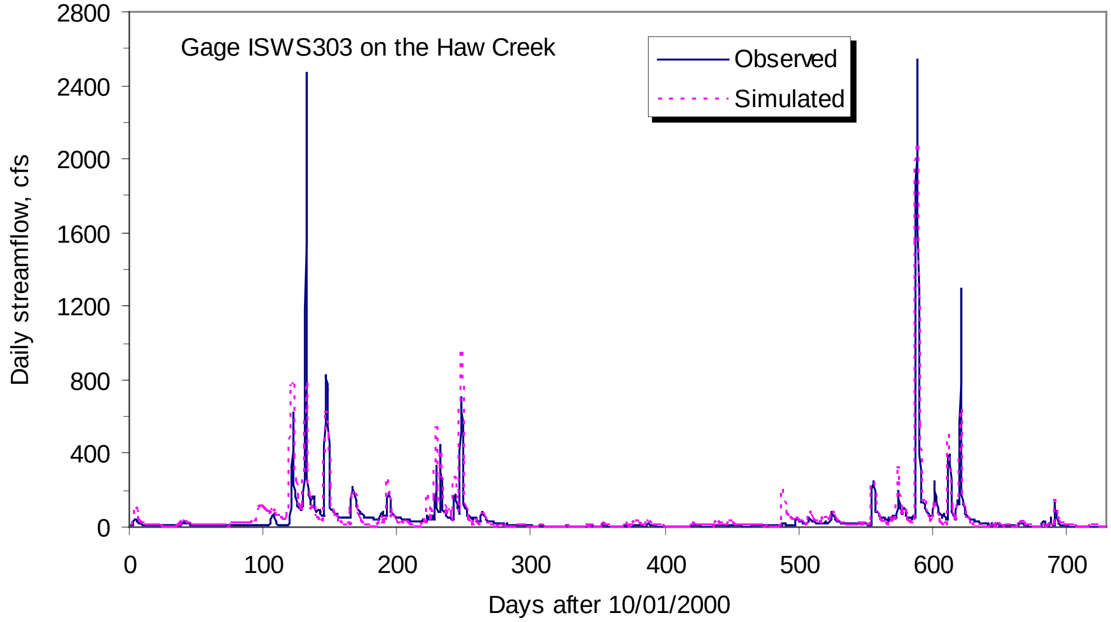


Figure 5-11. Comparison of observed and simulated streamflow by the Haw Creek watershed model developed using the calibrated parameters from the Court Creek watershed model

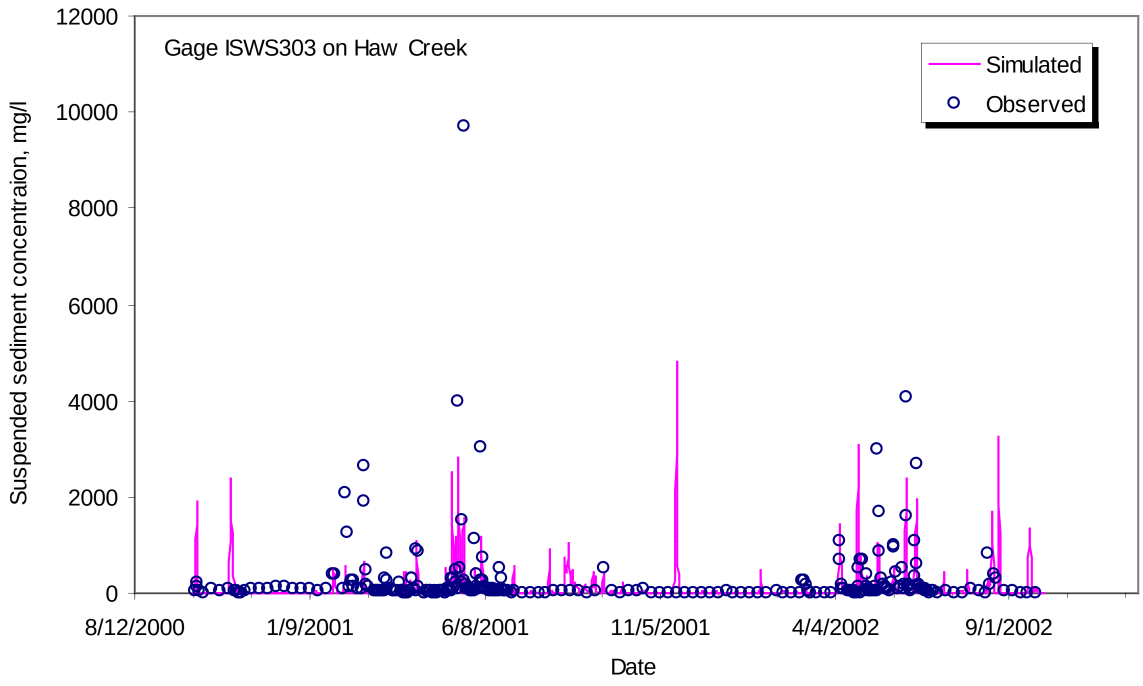


Figure 5-12. Preliminary results for suspended sediment concentration from the Haw Creek watershed model developed using the calibrated parameters from the Court Creek watershed model

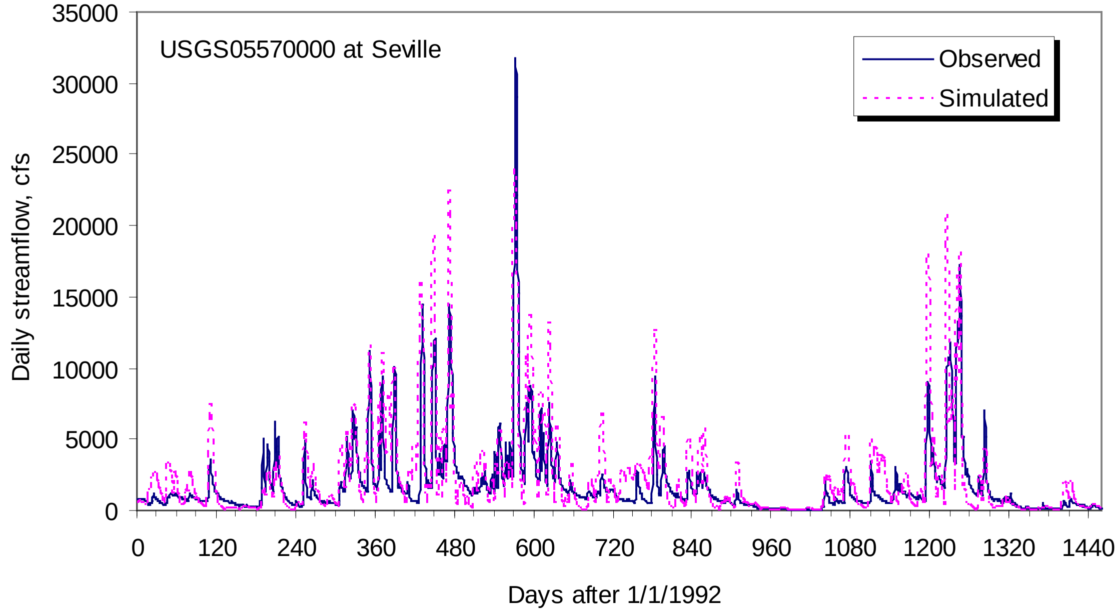


Figure 5-13. Comparison of observed and simulated streamflow simulation by the Spoon River watershed model developed using the calibrated parameters from the Court Creek watershed model

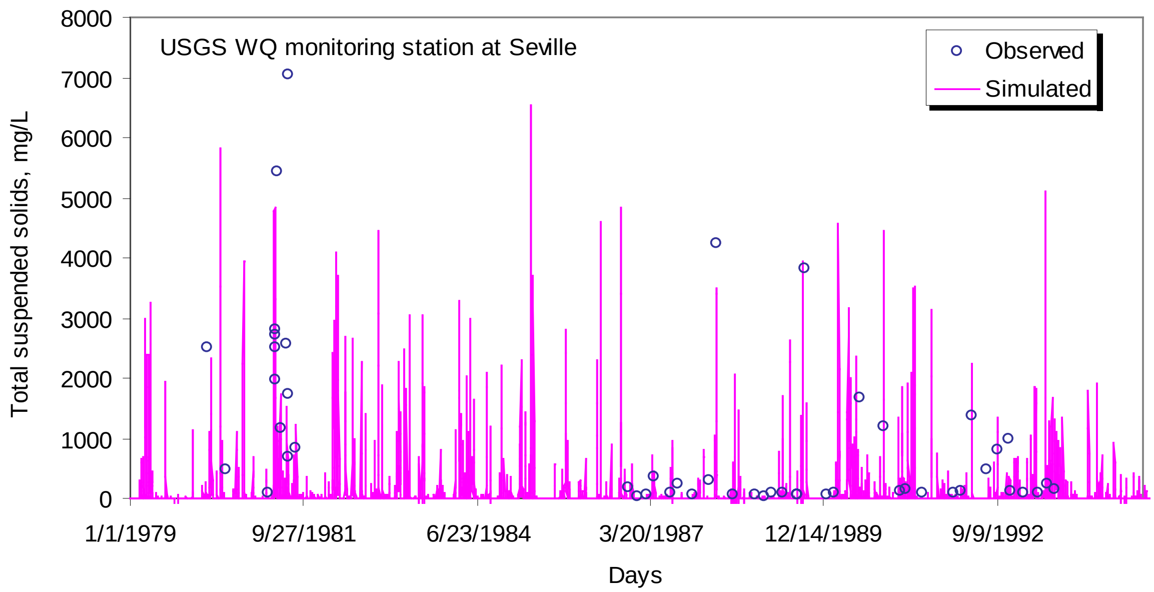


Figure 5-14. Preliminary results for suspended sediment concentration from the Spoon River watershed model developed using the calibrated parameters from the Court Creek watershed model

6. Analyses and Discussion

Sediment Loadings

Based on sediment records since 1980, the Illinois River on the average receives approximately 12 million tons of sediment annually from tributary streams (Demissie et al., 2004). About 55 percent of the sediment delivered to the river (6.7 million tons) is deposited in the river, backwater lakes, and side channels along the river. Most of this sediment is generated in the tributary watersheds to the Lower Illinois River, with the Spoon and LaMoine River watersheds as the highest per unit area generators of sediment among the major tributaries. The smaller tributaries draining directly to the river also contribute significant sediment. Controlling the erosion processes that are producing excessive sediment and reducing sediment delivery to the Illinois River will be a long-term effort, since sediment storage and mobilization along major rivers is a slow process. It will take some time to flush the sediment already in the system. In the initial phase of a restoration project, the major goal is to stabilize the system so that the erosion process is not accelerating and generating more sediment. The readjustment processes will take a number of years to reach a dynamic equilibrium condition where the natural processes of erosion and sedimentation are in balance. The long-term goal of the Illinois River restoration projects is to reach such a state where continued excessive sedimentation is eliminated.

To assess these processes, long-term monitoring is needed. The CREP program has been collecting sediment data at selected watersheds to supplement other monitoring programs. The data collection for the CREP program started in 1999 and has generated fourteen years of data. The annual sediment load data for each of the five CREP monitoring stations have been presented in chapter 2. Because of the short duration of data collection program, this data cannot yet be used to assess long-term trends. However, the short-term trends are shown in figure 6-1, where the sediment load per unit area was normalized by the runoff in inches to account for the variability of runoff from year to year. Even though the extreme wet year 2008 stands out as the year with the highest yield (for Panther and Cox Creeks), the general trend for the other stations is a gradual decrease or no trend. Again, these are short term trends and any major climatic or hydrologic variability in the coming year could change the trends, as illustrated with the influence of 2008 on Panther and Cox Creeks. As we continue the monitoring program, the trends will be more clear and reliable as the duration of the monitoring period increases.

The data were also compared with historical data collected by the USGS for small watersheds in the Illinois River basin as shown in figure 6-2. As shown in the figure, the CREP dataset is consistent with the older dataset and will be used to develop improved sediment delivery estimates for small watersheds in the Illinois River basin and improve our assessment and evaluation capability.

To assess long-term trends, data collected by the USGS and ISWS since 1980 were used to compute sediment delivery for the major tributaries to the Lower Illinois River. For the USGS data, sediment delivery from the three major tributary watersheds to the Lower Illinois River was computed for the downstream gaging stations near the outlet of the watersheds using the same methods developed by Demissie et al. (2004). The outflow of sediment from the Illinois River basin is measured at Valley City. The sediment loads and the corresponding water discharges for

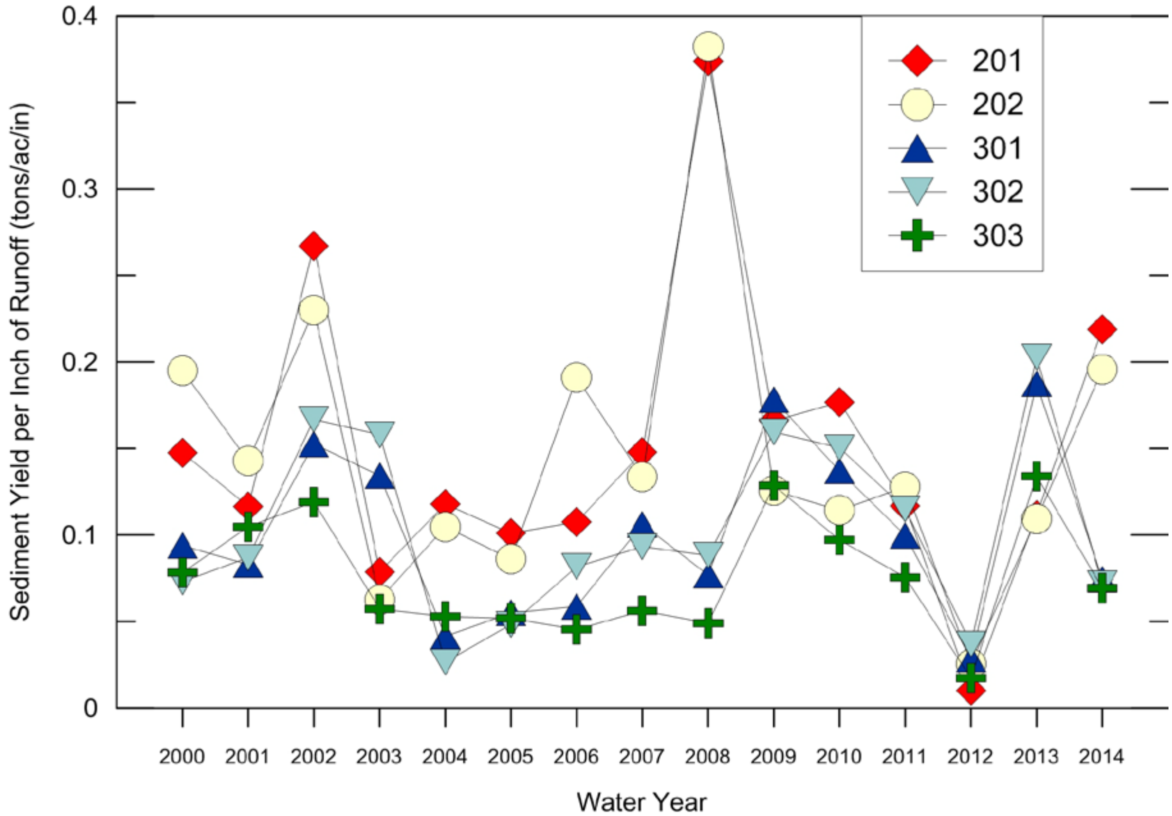


Figure 6-1. Variability of sediment yield per inch of runoff for CREP monitoring stations

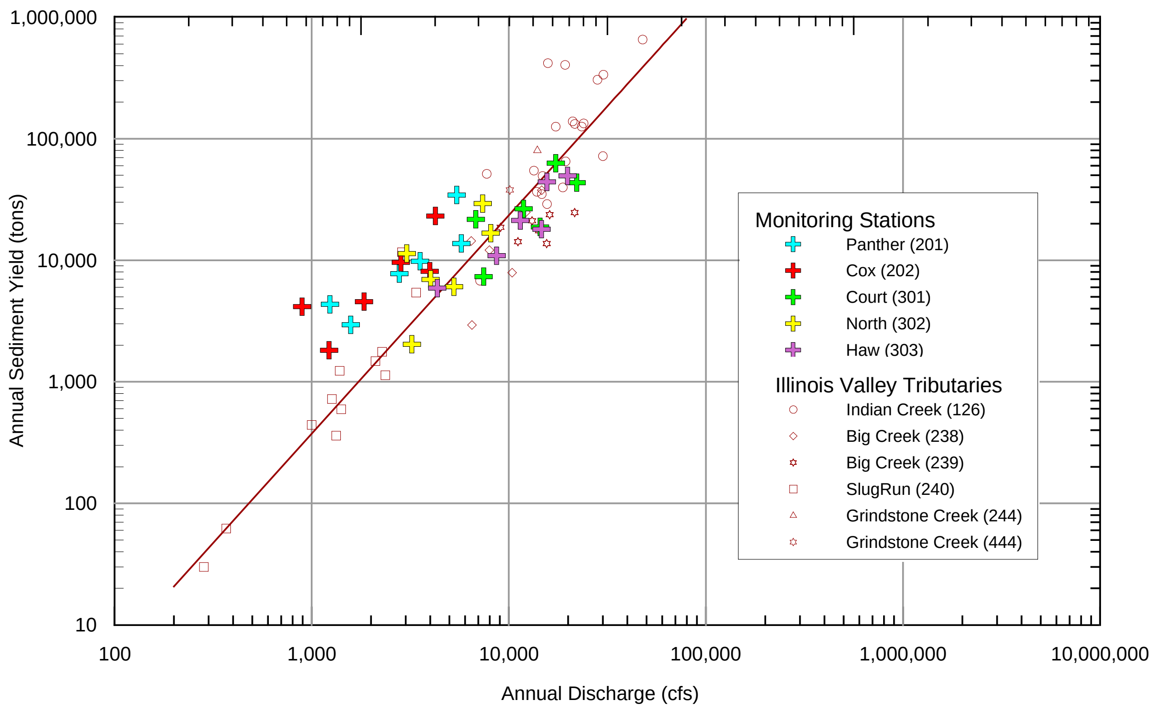


Figure 6-2. Comparison of sediment load from CREP monitoring stations with historical sediment data for small watersheds by the USGS

five-year increments since 1980 are shown in figure 6-3. The period 1991-1995 generally shows the highest sediment delivery to the Illinois River and the highest outflow from the Illinois River for the period under consideration, primarily because of the 1993 major floods. Since that period, sediment delivery from the tributaries and outflow from the Illinois River have generally been decreasing. If these trends continue into the future, there would be significant reduction in sediment delivery to the Illinois River.

Similar trends are also observed from the analyses of sediment data collected by the ISWS for the Benchmark Sediment Monitoring Program for Illinois Streams. The Benchmark Sediment Monitoring Program has been collecting weekly sediment data at selected monitoring stations throughout the state since 1980 (Allgire and Demissie, 1995). The data collected over that last 30 years have been processed and analyzed to observe trends in sediment concentrations and loads. Figures 6-4 to 6-6 show the trend in sediment load since 1980 for the Spoon River at Long Mills, LaMoine River at Ripley, and Sangamon River at Monticello, respectively. All three stations show a decreasing trend since 1980 even though the 2009 and 2010 annual loads are higher than the mean annual loads.

Nutrient Loadings

To assess long-term trends in nutrient loadings as conservation practices are implemented, the state has been collecting nutrient data at the five CREP monitoring stations where sediment data have been collected since 1999. Even though there are some low and high nutrient load years, the dataset is not long enough to assess long-term trends in nutrient loading. However, the short-term trends based on the data collected so far are shown in figures 6-7 and 6-8 for nitrate-N and total phosphorous yields per inch of runoff respectively. The nutrient yield values were divided by the inches of runoff to partly remove the effect of the variability of runoff from year to year. As shown in figure 6-7, the nitrate-N yields show a gradual decline since 2006 for all stations except for a spike in 2013 for stations 201 and 202 following a major drought in 2012. Figure 6-8 shows no significant trend for total phosphorous over the whole monitoring period except for the jump in yield in 2000 and 2008 for stations 201 and 202 and a significant drop for all the stations in 2012 due to the drought.

Long-term data collected by the Illinois EPA as part of their Ambient Water Quality Monitoring Network can, however, provide a fair indication of the general long-term trend in nutrient delivery to the Illinois River. Figure 6-9 shows annual nitrate-N yields in tons per square mile from the three major tributaries of the Lower Illinois River (Spoon, Sangamon, and LaMoine Rivers). Nitrate-N represents about 70 percent of the total nitrogen load in most of Illinois' agricultural watershed, and thus is a good surrogate for total nitrogen load. As can be seen in the figure, the nitrate yields can range from almost zero during a drought year like 1989 to a high of about 11 tons per square mile during a major wet period like the 1993 flood year. Therefore, climatic factors do play a major role in nutrient transport and delivery. The most important observation that can be made for the figure is the slow decreasing trend of nitrate-N yield from the major tributary watersheds. Even though it is very difficult to measure how much of the change is due to the CREP program, it is obvious that conservation practices in these watersheds, where most of the CREP lands are located, are making a difference in nitrogen delivery to the Illinois River.

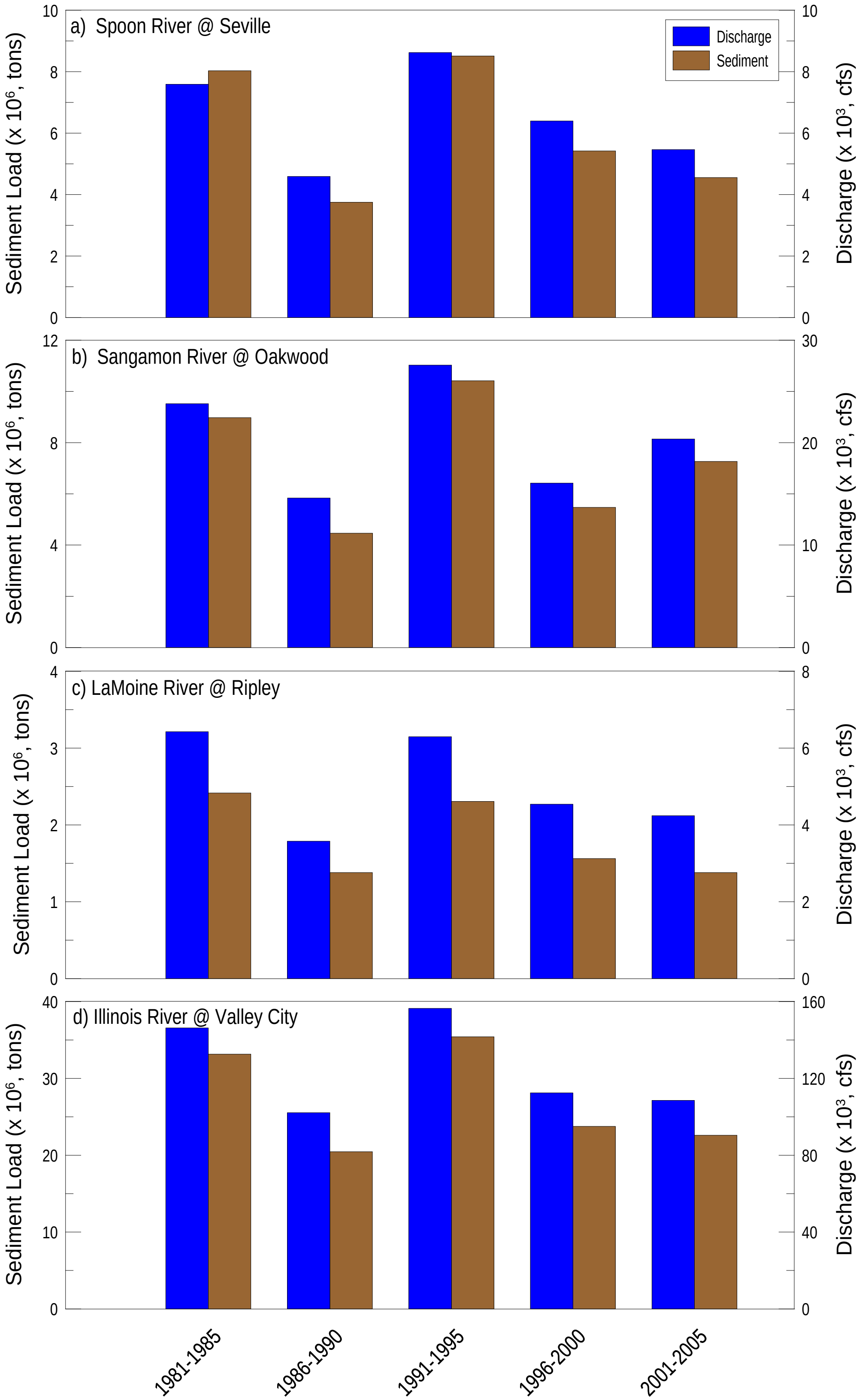


Figure 6-3. Sediment delivery from the three major tributary watersheds to the Illinois River and sediment outflow from the Illinois River at Valley City

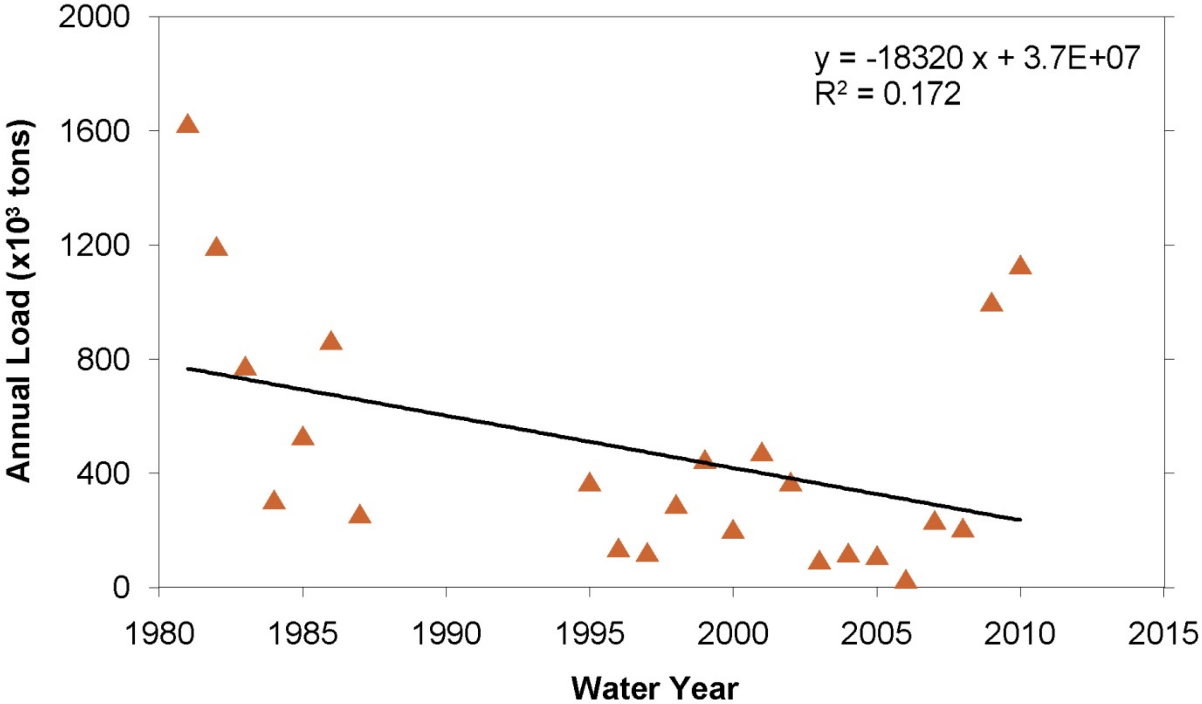


Figure 6-4. Trends in sediment load at Spoon River at London Mills (after Crowder et al., 2008)

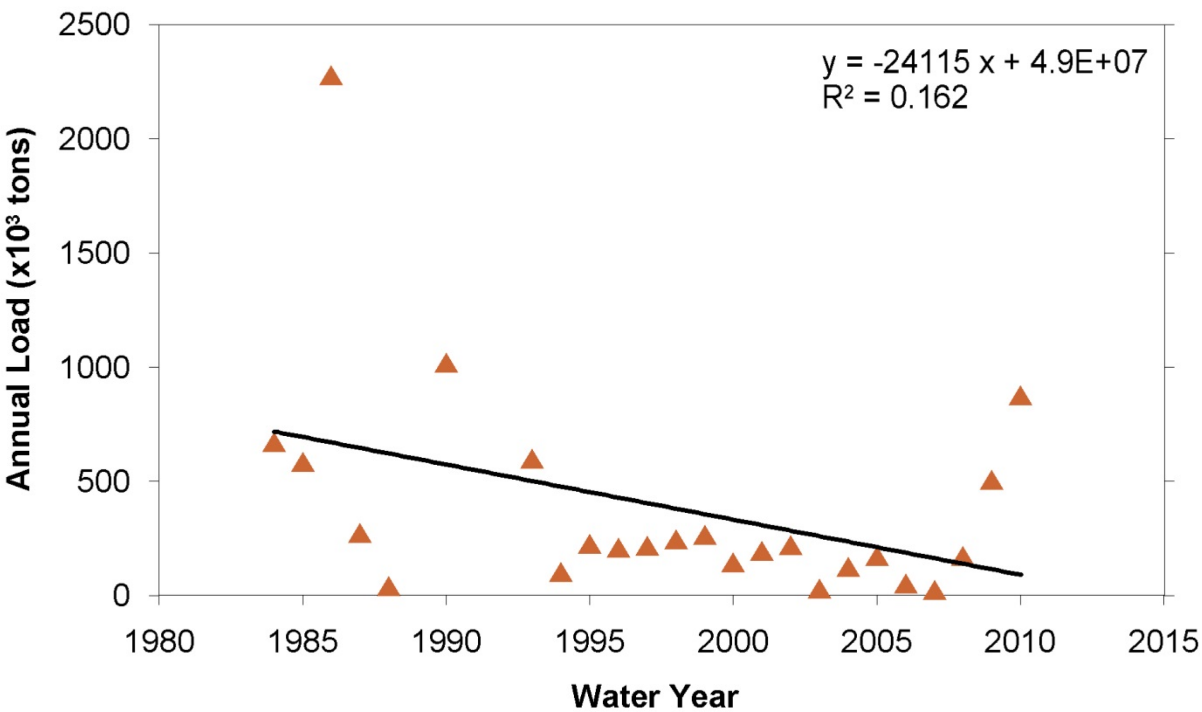


Figure 6-5. Trends in sediment load at LaMoine River at Ripley, IL (after Crowder et al., 2008)

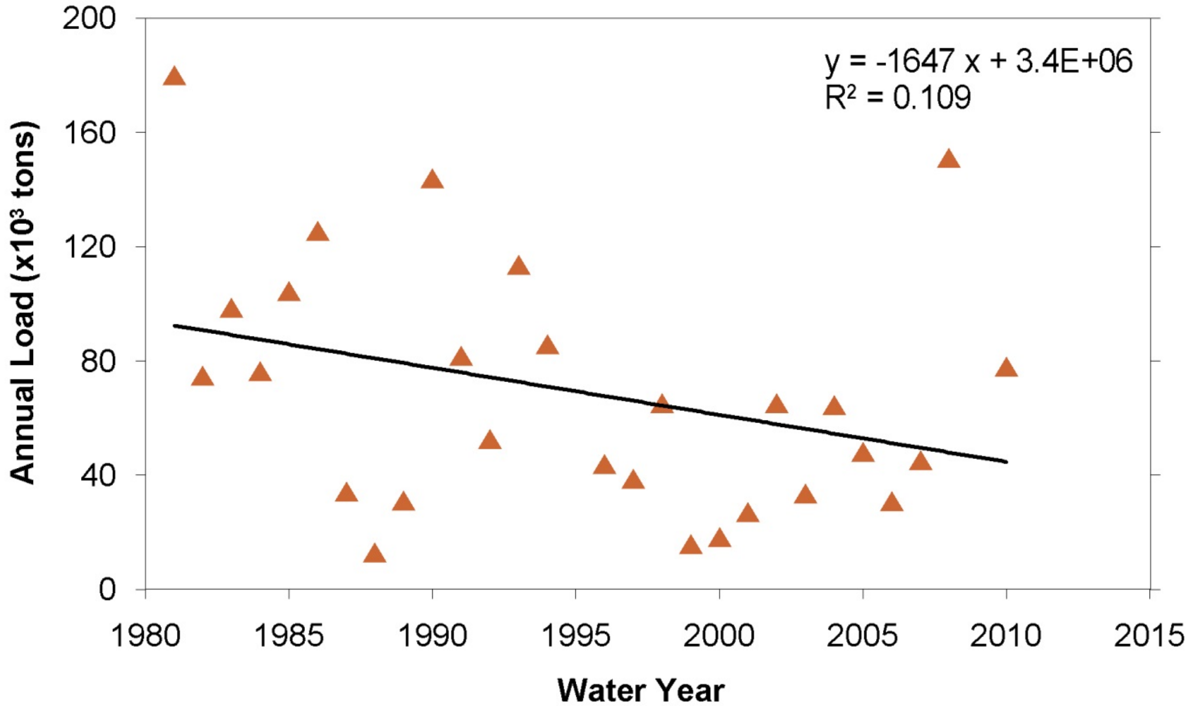


Figure 6-6. Trends in sediment load at Sangamon River at Monticello, IL
(after Crowder et al., 2008)

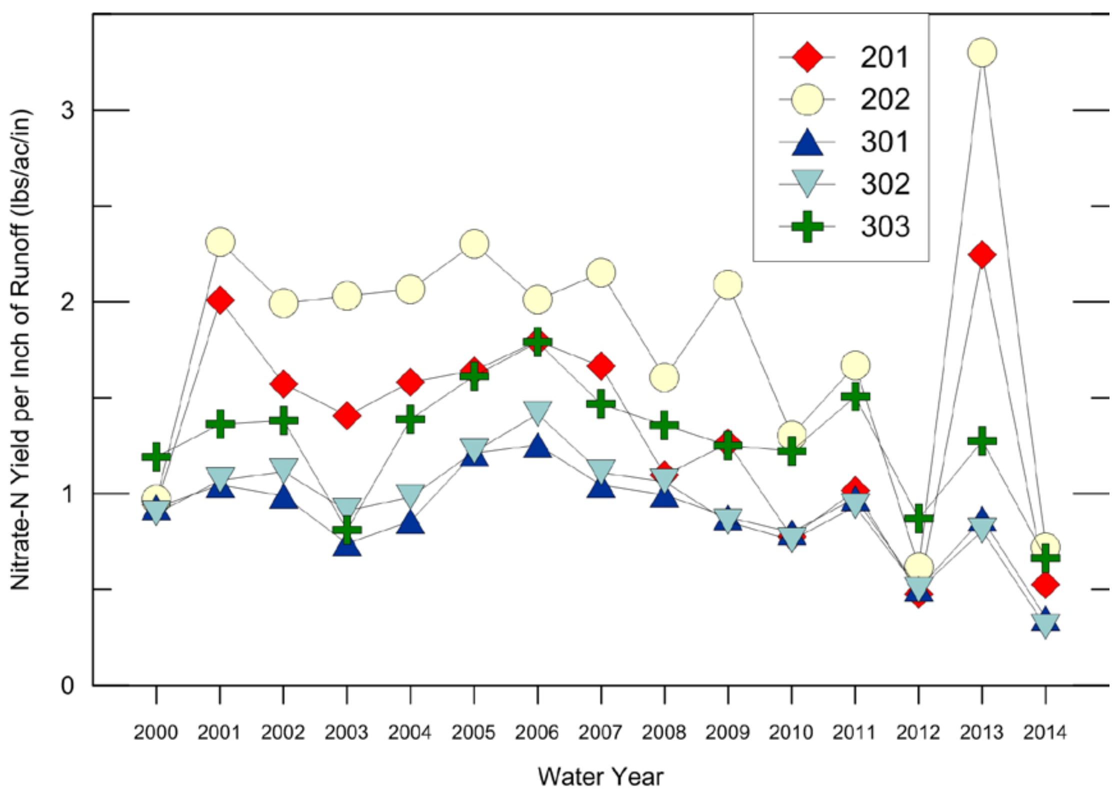


Figure 6-7. Variability of nitrate-N yield per inch of runoff for CREP monitoring stations

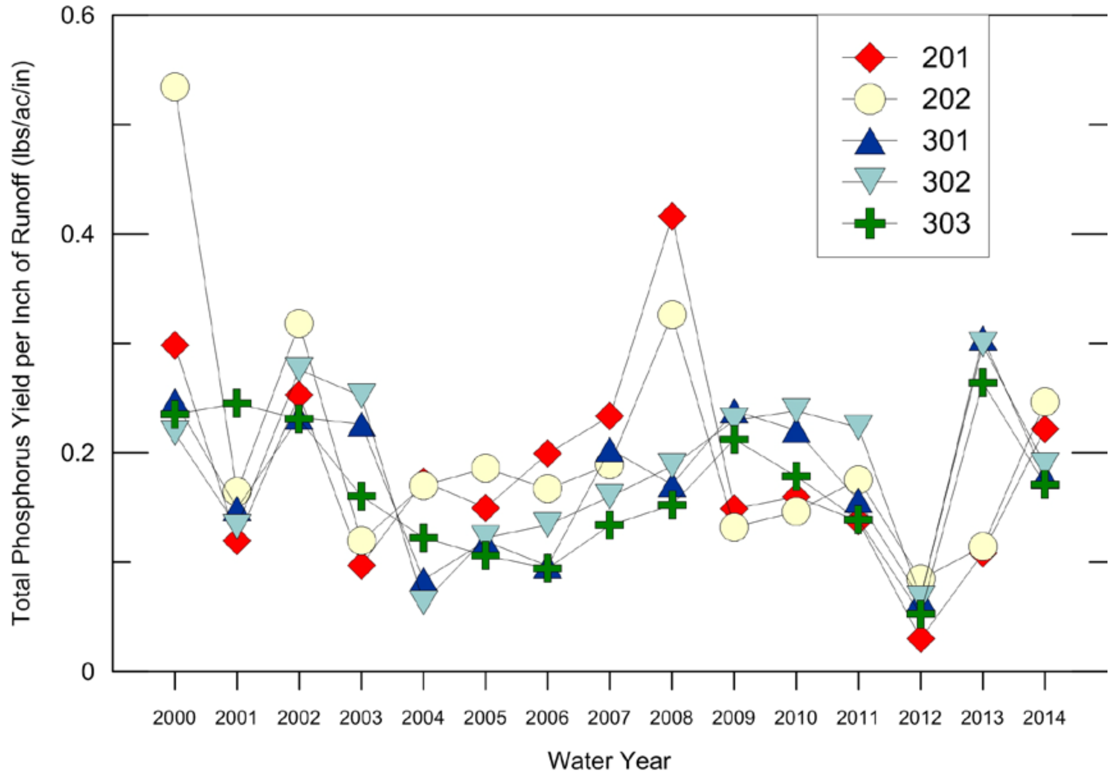


Figure 6-8. Variability of total phosphorous yield per inch of runoff for CREP monitoring stations

Figure 6-10 shows the total phosphorous yield from the same three major tributary watersheds discussed in the previous figure. Annual phosphorous delivery ranges from a low of almost zero during the drought years 1989, 2006, and 2012 to a high of almost 1.7 tons per square mile for the extreme wet year of 1993. The data also show how extremely dependent phosphorous delivery is on climatic variability. Similar to the trends to the nitrate delivery, there was a slow but gradual decreasing trend in phosphorous yield from the Spoon and LaMoine Rivers until 2007 and an increase since then except for the drought year 2012. Overall, there is a gradual increase in phosphorous primarily driven by increases in dissolved phosphorous starting in 2007.

The trends in nutrient loads from the major tributaries are reflected in nutrients transported by the Illinois River. Analyses of the data from the two downstream monitoring stations, Havana and Valley City, are shown in figure 6-11 for nitrate-N and total phosphorous. In general, the trend is a gradual decrease for Nitrate-N for the whole period and a decreasing trend from 1975 to 2006 for phosphorous, but has increased starting in 2007 primarily due to an increase in dissolved phosphorous loading. The cause for a sudden increase in dissolved phosphorous starting in 2007 disrupting a long-term decreasing trend from 1975 to 2006 is being studied closely to find the primarily cause. These observations are extremely important as to nutrient delivery from Illinois streams to the Mississippi River and eventually to the Gulf of Mexico. Illinois had been identified as one of the major sources of nutrients to the Gulf of Mexico, and the fact that nitrate delivery from Illinois has not increased and is gradually decreasing is good news not only to Illinois but to the Gulf of Mexico, too.

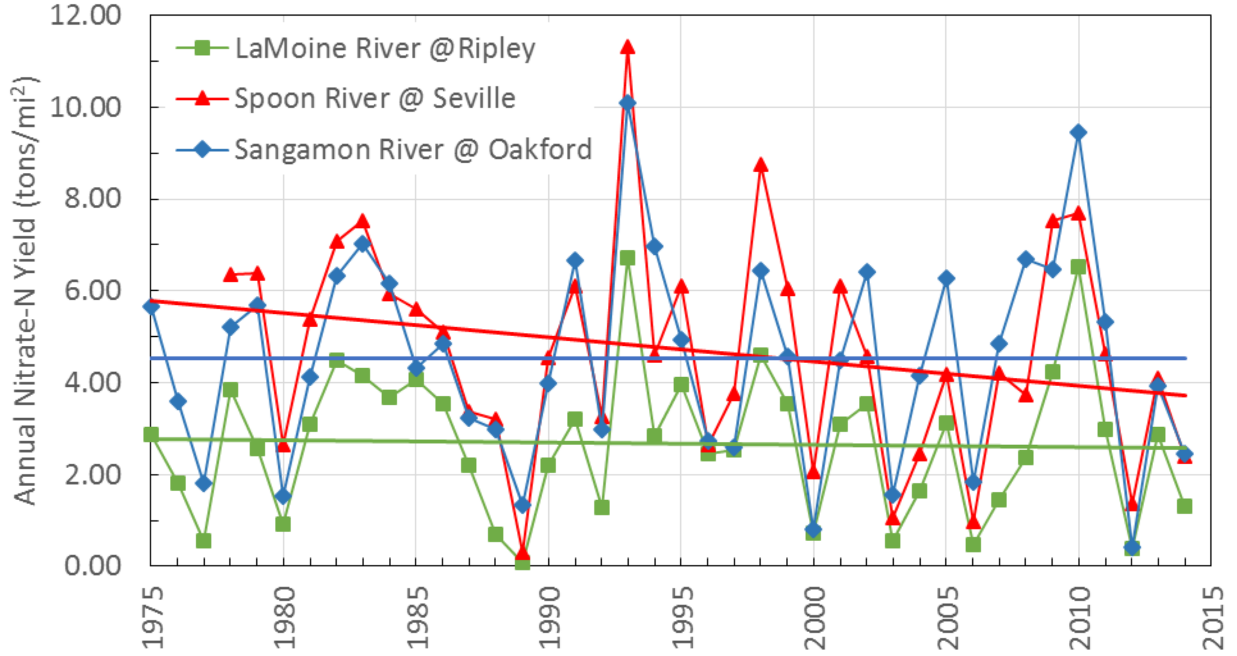


Figure 6-9. Annual nitrate-N loads for the three major tributary watersheds to the Lower Illinois River

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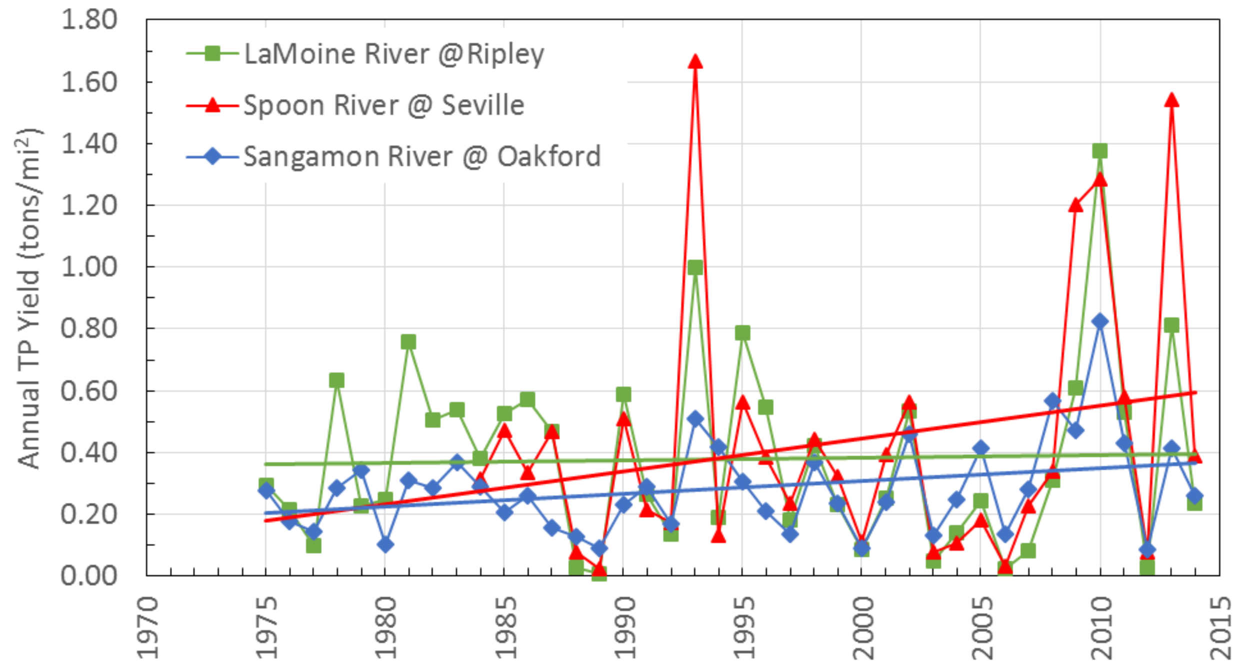

Figure 6-10. Annual total phosphorous loads for the three major tributary watersheds to the Lower Illinois River

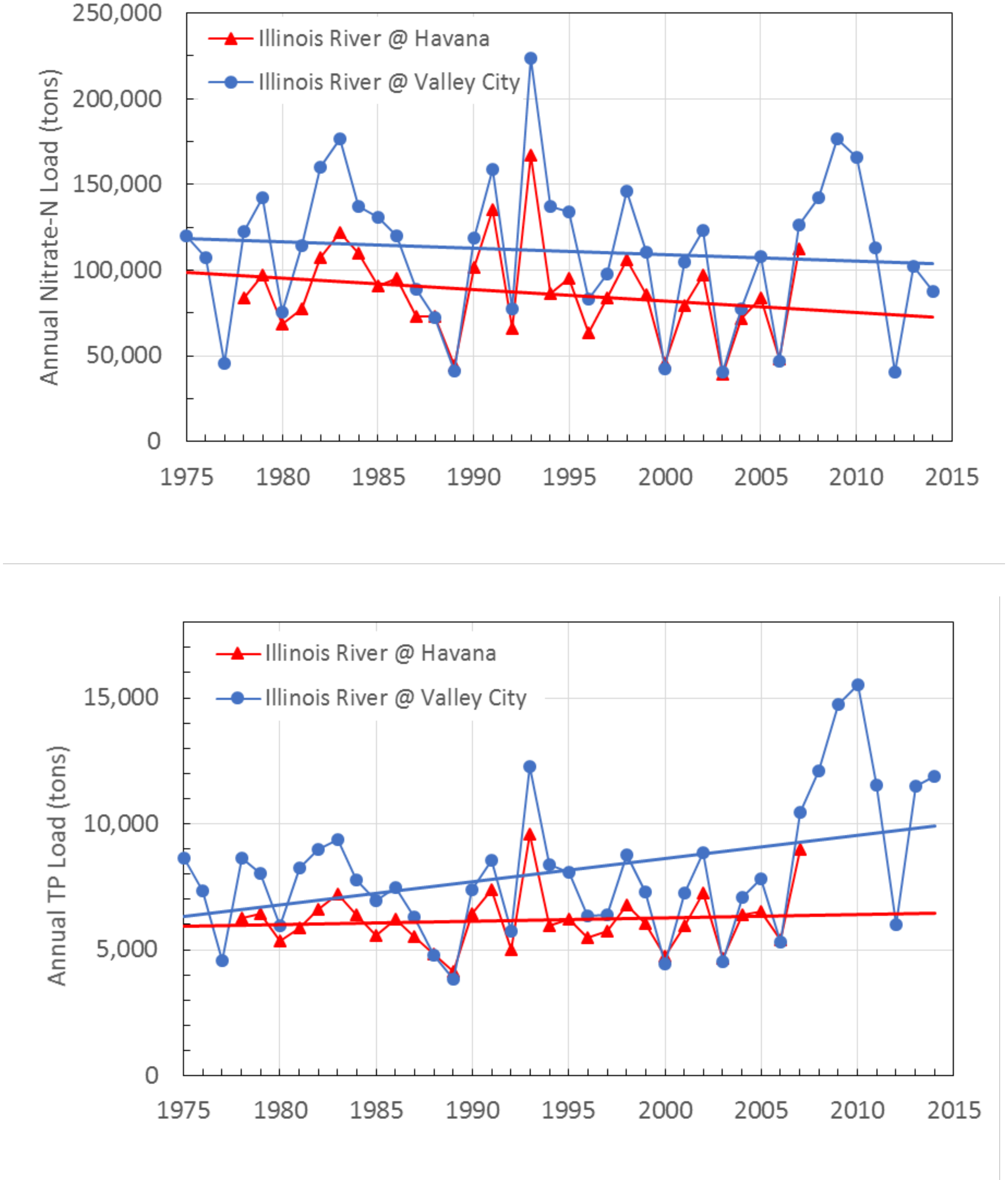

Figure 6-11. Nitrate-N and total phosphorous loads along the Lower Illinois River

7. Summary and Conclusions

The Illinois River Conservation Reserve Enhancement Program (CREP) was initiated as a joint federal/state program with the goal of improving water quality and wildlife habitat in the Illinois River basin. Based on numerous research and long-term data, the two main causes of water quality and habitat degradations in the Illinois River were known to be related to sedimentation and nutrient loads. Based on this understanding, the two main objectives of the Illinois River CREP were to reduce the amount of silt and sediment entering the main stem of the Illinois River by 20 percent; and to reduce the amount of phosphorous and nitrogen loadings to the Illinois River by 10 percent. To assess the progress of the program towards meeting the two goals, the Illinois Department of Natural Resources (IDNR) and the Illinois State Water Survey (ISWS) are developing a scientific process for evaluating the effectiveness of the program. The process includes data collection, modeling, and evaluation.

The monitoring and data collection component consist of a watershed monitoring program to monitor sediment and nutrient for selected watersheds within the Illinois River basin and also to collect and analyze land use data throughout the river basin. Historically, there are a limited number of sediment and nutrient monitoring stations within the Illinois River basin, and most of the available records are of short duration. To fill the data gap and to generate reliable data for small watersheds, the Illinois Department of Natural Resources funded the Illinois State Water Survey to initiate a monitoring program that will collect precipitation, hydrologic, sediment, and nutrient data for selected small watersheds in the Illinois River basin that will assist in making a more accurate assessment of sediment and nutrient delivery to the Illinois River. Five small watersheds located within the Spoon and Sangamon River watersheds were selected for intensively monitoring sediment and nutrient within the Illinois River basin. The Spoon River watershed generates the highest sediment per unit area in the Illinois River basin, while the Sangamon River watershed is the largest tributary watershed to the Illinois River and delivers the largest total amount of sediment to the Illinois River.

As outlined in the Illinois River Basin Restoration Plan, the alternative of no-action in the Illinois River watershed would have resulted in increased sediment delivery to the Illinois River and habitats and ecosystem would continue to degrade. However, analysis of the available long term data from different sources and the most recent data from the CREP monitoring program, indicate that sediment and nutrient loads from the tributary watersheds are gradually decreasing or stabilizing as a result of implementation of conservation practices in the watershed. We have also observed a recent rise in phosphorous delivery from the major tributaries since 2007 primarily driven by dissolved phosphorous. These increases are not observed from the CREP monitoring sites. With the knowledge that reduction in sediment delivery from large watersheds takes time to move through the system, the indication of stabilized sediment delivery shows progress is being made in restoring the Illinois River watershed. If the present trends continue for the next 10 to 15 years, sediment and nutrient delivery to the Illinois River will be significantly reduced, and lead to improved ecosystem in the river and tributary watersheds in the long-term.

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APPENDIX D

Sediment and Nutrient Monitoring at Selected Watersheds within the Kaskaskia River Watershed for Evaluating the Effectiveness of the Illinois River Conservation Reserve Enhancement Program (CREP)

by
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Prepared for the
Office of Resource Conservation,
Illinois Department of Natural Resources
Springfield, Illinois

November 2015

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Monitoring and Evaluation of Sediment and Nutrient Delivery to the Illinois River: Illinois River Conservation Reserve Enhancement Program (CREP)

by
Illinois State Water Survey
Prairie Research Institute, University of Illinois

1. Introduction

The Conservation Reserve Enhancement Program (CREP) was initiated as a joint federal/state program with the goal of improving water quality and wildlife habitat in the Illinois and Kaskaskia River basins. Based on numerous research and long-term data, the two main causes of water quality and habitat degradations in the rivers of Illinois were known to be related to sedimentation and nutrient loads. Based on this understanding, the two main objectives of the Illinois CREP were stated as follows:

1) Reduce the amount of silt and sediment entering the main stem of the Illinois and Kaskaskia River by 20 percent.
2) Reduce the amount of phosphorous and nitrogen loadings to the Illinois and Kaskaskia River by 10 percent.

To assess the progress of the program towards meeting the two goals, the Illinois Department of Natural Resources (IDNR) and the Illinois State Water Survey (ISWS) are developing a scientific process for evaluating the effectiveness of the program. The process includes data collection, modeling, and evaluation. Progress made so far in each of these efforts is presented in this report.

Acknowledgments

The work upon which this progress report is based is supported by funds provided by the Office of Resource Conservation, Illinois Department of Natural Resources, under the guidance of Luke Garver, IDNR CREP Program Coordinator. The project is also supported as part of Laura Keefer's regular duties at the Illinois State Water Survey under the guidance of Mike Demissie, Director, Illinois State Water Survey and ISWS Principal Investigator for the CREP studies.

Several Illinois State Water Survey staff worked diligently to meet project objectives and their tireless dedication is much appreciated. Erin Bauer developed and implemented the data collection computer programming and protocols for the field instrumentation. John Beardsley and Jim Osborne designed, fabricated, and installed the instrument shelters. Erin Bauer designed, developed and manages the project databases, software programming for data processing and computations, and performs quality control. Yao Hu, University of Illinois Ph.D. candidate, wrote the MatLab code for the project data processing. Lara Seek, John Beardsley and Erin Bauer perform the field data collection efforts that amount to many long, wet, and tiring days.

Joyce Wyse performs data entry as well as track and organize project records. Erin Bauer compiled, investigated and analyzed the land cover data (Illinois and Kaskaskia Basins). Phil Graff, ISWS, and Lisa Beja, IDNR, compiled the CREP contract conservation practices database (Illinois and Kaskaskia Basins). Erin Bauer, Lara Seek and Joyce Wyse produced the tables and figures. Laura Keefer is responsible for the overall investigation, implementation, management and analyses of the ISWS Kaskaskia monitoring activities, as well as writing the progress report. Leon Hinz, Illinois Natural History Survey (INHS), collaborated in the ISWS/INHS co-location site selection of intensive monitoring stations and his assistance was most appreciated.

2. Watershed Characteristics

The Kaskaskia River watershed has a drainage area of 5,810 mi^2, is generally located in the southwest region of the State of Illinois, and occupies all or portions of 15 counties (Figure 1). The headwaters begin in Champaign and Piatt Counties in east-central Illinois and flows in a southwesterly direction to join the Mississippi River in Randolph County. Table 1 lists the tributary watersheds and associated drainage areas. Figure 2-1 illustrates approximately 22 tributary watersheds in the basin that range in drainage area from 53 to 917 mi^2. The two largest tributary watersheds are Shoal Creek (917 mi^2) and Silver Creek (480 mi^2) and together occupy nearly 25 percent of the Kaskaskia River watershed drainage area. In general, the Kaskaskia River watershed is divided into four sub-watersheds (Upper, Middle, Lower, and Shoal Creek) that are associated with the outlets at the two main reservoirs, Lake Shelbyville and Carlyle Reservoir, and confluence with the Mississippi River. The Shoal Creek tributary watershed is distinguished due to its large drainage area. See (Illinois Department of Natural Resources 2000) for further information.

Hydrology

Knapp and others (2012) describe the Kaskaskia River as one of the more highly managed rivers in Illinois. The streamflow on the main stem of the Kaskaskia River is controlled by two federal reservoirs (Shelbyville and Carlyle Reservoirs) and the navigation pools in the lower reaches of the river are maintained by a lock and dam. Water is withdrawn for industry and public water supplies from several reservoirs constructed throughout the watershed. Other inflows come from effluent discharges throughout the drainage system by municipal systems and industries, as well as power plant cooling water returns. A detailed water supply assessment of the Kaskaskia River watershed can be found in (Knapp, Roadcap et al. 2012).

Geology

The surficial geology plays a role in the types of land cover in the Kaskaskia River watershed. Figure 2-2 illustrates the boundaries of the physiographic regions, loess (windblown silt) thicknesses, and shaded relief for the Kaskaskia River watershed. The watershed is predominantly in the Bloomington Ridged Plain and Springfield Plain of the Till Plains Section.

The Upper sub-watershed is entirely in the Bloomington Ridged Plain and characterized by low, broad ridges with intervening wide stretches of relatively flat or gently undulatory ground (Leighton, Ekblaw et al. (1948). These alternating ridges with flat ground are indicative of the most recent glacial period, referred to as the Wisconsin. Therefore, the drainage system is more recent than the Springfield Plain which is older and more developed.

The Middle, Shoal Creek, and most of the Lower sub-watersheds are in the Springfield Plain which is part of the Illinoian glacial drift period that occurred before the Wisconsin. The Illinoisan is characteristically flat with low and broad ridges (moraines) but some areas in the Kaskaskia watershed have ridges and hills with irregular assemblages of gravel with small intervening plains. The drainage system is characterized by major rivers in low gradient and broad terraced valleys and tributaries in wide v-shaped valleys with headwaters originating from the low gradient, broad shallow valleys of the till plains. Basically, the Springfield Plain occupies the older Illinoisan glacial drift with older drainage development, whereas the

Bloomington Ridge Plain occupies the Wisconsin, which overlies the Illinoisan, and is flat with sequences of ridges and initial stages of drainage.

Another geologic characteristic that controls drainage development and is a factor in erosion is the thickness of the windblown silt (loess) that overlies the glacial drift, similar to frosting on a layer cake (Illinoisan and Wisconsin glacial drift), somewhat smoothing out imperfections on the surface. As seen in Figure 2-2, the loess in the Upper sub-watershed is between 0-5 feet thick and lies in the ridged and wide flat valleys of the Bloomington Ridged Plain. Most of the Middle sub-watershed and upper reaches of the Shoal Creek sub-watershed the loess is 0-5 feet thick and lies in the more developed drainage landscape of the Springfield Plain. The lower reaches of Shoal Creek and most of the Lower sub-watersheds have thicknesses that can range from 5 to greater than 20 feet proceeding from east to west toward the Mississippi River. However, many of the stream valleys in these areas do not have loess present and is considered to have been eroded. Areas with thick loess are considered prone to erosion under steep conditions which can result in unstable stream channels. A more extensive discussion on the geology and surficial materials in the Kaskaskia River watershed can be found in (Illinois Department of Natural Resources 2000).

In summary, the four sub-watersheds of the Kaskaskia River watershed are fairly distinct from each other based on geology and land cover features. These features have an influence on water quality, erosion, and aquatic habitat. Agriculture production is dominant in the Upper sub-watershed due to the consistent, relatively flat and wide valleys between gentle ridges, as well as the highly productive soil developed in the loess cap. Large areas dominated by highly productive soil and agriculture tend to have elevated nutrient levels in the stream system. The Middle and upper-Shoal sub-watersheds have a mix of agriculture and woodlands/grasses, where the agriculture is in the flatter uplands and woodlands in the deeper valleys. Nutrients may be slightly more elevated in the drainage system but some erosion issues may play a factor in the valleys. The lower-Shoal and Lower sub-watersheds are similar in land use to the Middle sub-watershed, slightly more agriculture but the loess thicknesses in combination with higher relief result in erosion being more of an issue in these areas.

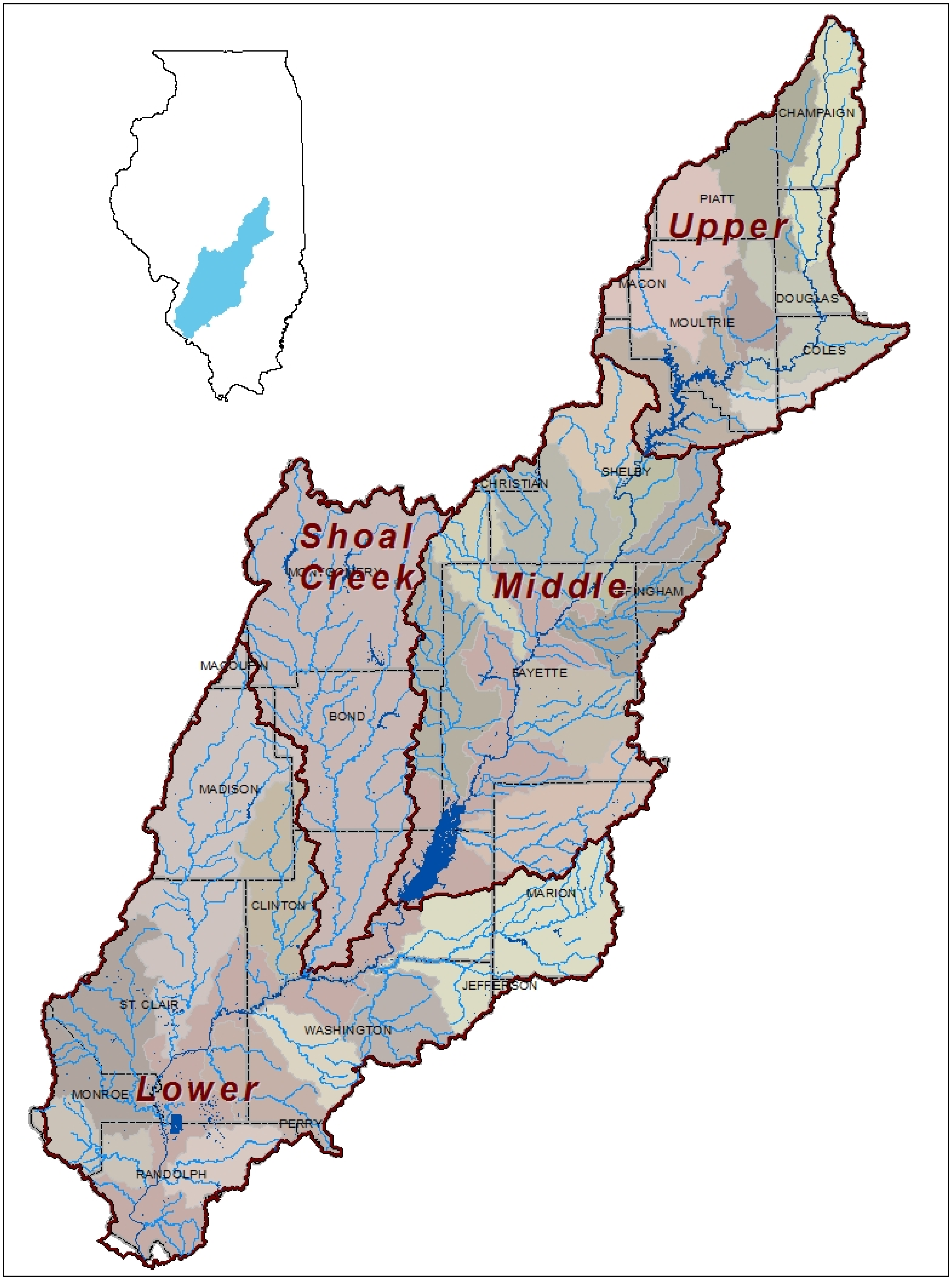


Figure 2-1. Kaskaskia River Basin, sub-basins, and major tributary watersheds

Table 2-1. Kaskaskia tributary watersheds and drainage areas

Tributary Name	*Drainage Area (acres)*	*(mi²)*
Ash Creek	89,610	140
Beck Creek	130,771	204
Crooked Creek	224,663	351
East Fork Kaskaskia River	132,477	207
Elkhorn Creek	56,760	89
Hickory Creek	92,224	144
Hoffman Creek	67,428	105
Horse Creek	60,175	94
Hurricane Creek	128,822	201
Johnathan Creek	36,896	58
Kaskaskia-L. Shelbyville	**122,705**	**192**
Kaskaskia Ditch	103,474	162
Kaskaskia River	**658,183**	**1,028**
Lake Fork	109,537	171
Little Crooked Creek	73,254	114
Mud Creek	87,207	136
Plum Creek	57,399	90
Richland Creek	213,431	333
Robinson Creek	79,112	124
Shoal Creek	586,584	917
Silver Creek	307,171	480
Sugar Creek	112,775	176
West Okaw River	154,219	241
Whitley Creek	33,687	53
Total	*3,718,563*	*5,810*

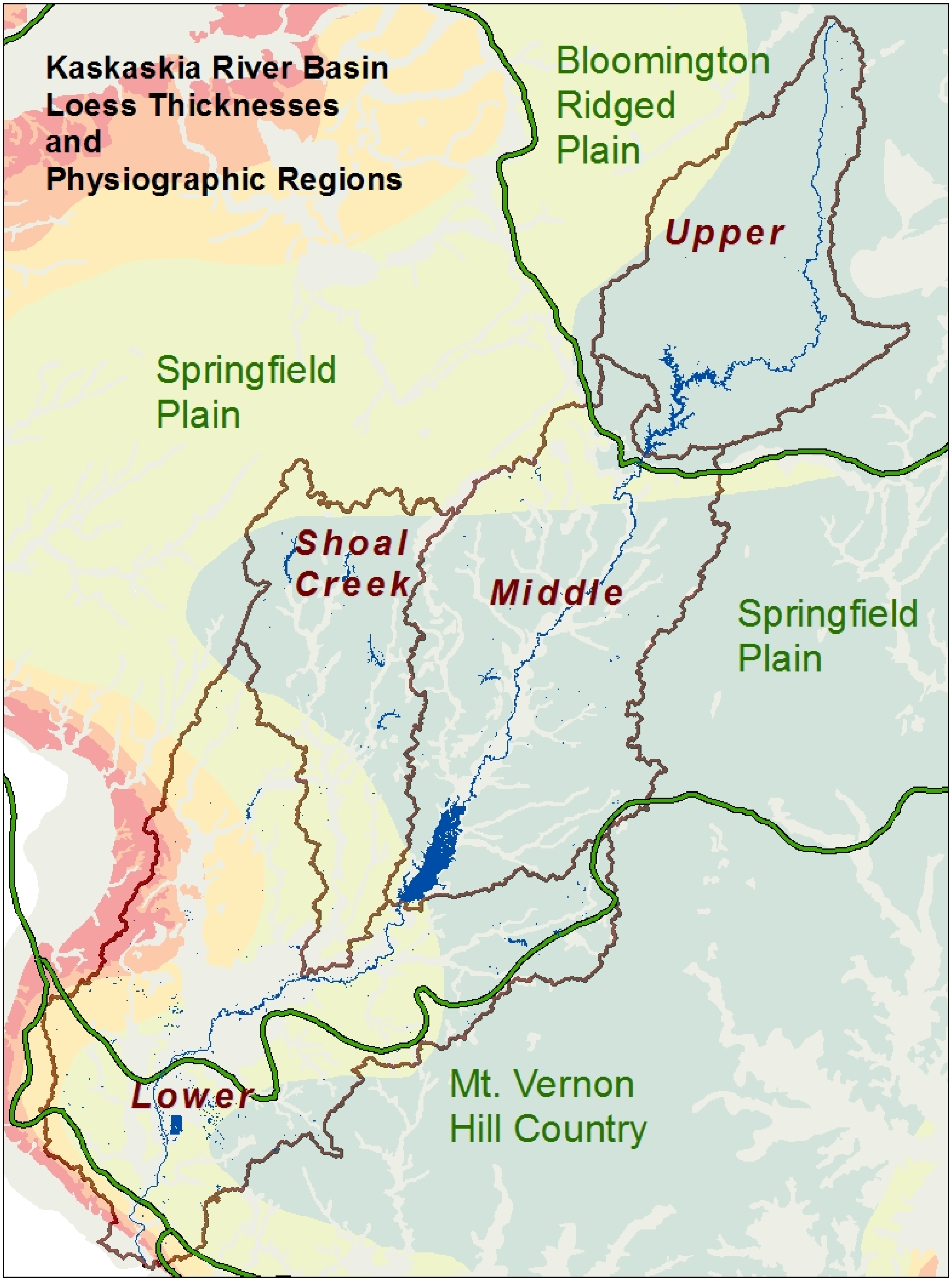


Figure 2-2.Physiographic regions and loess thicknesses in Kaskaskia Basin

3. Monitoring and Data Collection

The monitoring and data collection component consists of a watershed monitoring program to monitor sediment and nutrient for selected sub-watersheds within the Kaskaskia River basin and also to collect and analyze land use data throughout the river basin. Currently available data is insufficient to monitor long-term trends especially in small watersheds where changes can be observed and quantified more easily than in larger watersheds. To fill the data gap and to generate reliable data for small watersheds, the Illinois Department of Natural Resources funded the Illinois State Water Survey to initiate a monitoring program that will collect precipitation, hydrologic, sediment, and nutrient data for selected small watersheds in the Kaskaskia River basin that will assist in making a more accurate assessment of sediment and nutrient delivery.

The monitoring strategy for the project was to select small Kaskaskia River tributary watersheds to establish an intensive monitoring program to detect any changes in sediment and nutrient transport characteristics that could be attributed to changes in land use or other factors. The project is designed to measure the cumulative impact within the watershed on sediment and nutrient yield and is not designed to measure the impact of specific BMPs on water quality or sediment yield. Several factors were evaluated to determine the final locations of the intensive monitoring sites, such as artificial inflow and outflow of water due to water supply, industrial, and recreation needs, geology, land use, currently available water quality data for more prescriptive monitoring plans, areas likely to have appreciable CREP sign-ups, and co-location with other physical, biological, and water quality program stations. Co-locating and/or supplementing monitoring stations with other water quality and aquatic sampling stations in the watershed is an integrated approach that contributes to understanding the mechanisms that link hydrologic, sediment, nutrient, biological, and physical information for application in other watersheds in Illinois.

Due to the highly managed nature of the Kaskaskia River watershed hydrology, this project assessed locations of water inflows and outflows that could mask monitoring results by affecting the normal balance of the sediment and nutrient loading character. For example, the streamflow in the main stem of the Kaskaskia River and several tributaries are significantly controlled by the periodic releases from reservoirs. Also, the water from those releases are more of a reflection of the water quality from lake processes rather than the transport of water and nutrients from the upper portions of the drainage system. Also assessed were locations of waste water treatment plant (WWTP) effluent, NPDES discharges, and other smaller reservoirs in the tributary watersheds. This project capitalized on a recently completed water supply assessment for the Kaskaskia River watershed, which assembled existing water availability and supply information mentioned above by Knapp, Roadcap et al. (2012).

To effectively monitor any changes in sediment and nutrient loading due to CREP, small-scale intensive monitoring in several places improves the ability to monitor changes over time. Ideally, these small-scale study watersheds should be in areas that will have the highest likelihood of CREP sign-ups. The ISWS contacted several local stakeholder groups, county Soil and Water Conservation Districts and CREP program staff to estimate areas likely to have appreciable CREP sign-ups within the Kaskaskia River watershed. This assessment period overlapped with the 2012 drought which appeared to have appreciably reduced CREP sign-ups for the first year of the project. Consequently, in collaboration with Illinois Natural History Survey (INHS) investigators, an analysis was made based on land cover, geology, hydrology, biology and conservation reserve programs (CRP) already in the watershed. This allowed for comparing and contrasting watershed land uses with physical character for selection of watersheds estimated to be likely and unlikely for CREP signups. Four watersheds were then selected to represent combinations of physical watershed character and land cover.

Monitoring Stations

The four small watersheds selected for intensively monitoring sediment and nutrient within the Kaskaskia River basin are located within the Crooked Creek, North Fork Kaskaskia River, Hurricane Creek and Shoal Creek watersheds. In addition, two continuous recording raingages were established near the monitored watersheds. The general locations of the watersheds, monitoring stations and raingages are shown in figure 3-1 and more detailed station maps are shown in figures 3-2 through 3-4. Information about the stations is provided in table 3-1. Lost Creek (402) is a tributary of Crooked Creek which, in turn is a direct tributary to the Kaskaskia River with its confluence downstream of Carlyle Reservoir. The Carlyle Reservoir is a U.S. Army Corps of Engineers impoundment on the Kaskaskia River. The North Fork Kaskaskia River (403) and Hurricane Creek (404) are a direct tributaries to the Kaskaskia River at the upstream end of Carlyle Reservoir. East Fork Shoal Creek (405) is a tributary of Shoal Creek, the largest tributary of the Kaskaskia River, with its confluence downstream of Carlyle Reservoir. The type of data collected and the data collection methods have been presented in detail in the first progress report for the CREP monitoring program (Demissie et al., 2001) and in the Quality Assurance Project Plan (QAPP) given in Appendix A. The data collected at each of the monitoring stations follows these protocols.

Table 3-1. Sediment and Nutrient Monitoring Stations and Raingages Established for the Kaskaskia River CREP

Station ID	*Name*	*Drainage area*	*Watershed*
402	Lost Creek	38.0 sq mi (24,320 acres)	Crooked Creek
403	North Fork Kaskaskia River	35.5 sq mi (22,701 acres)	North Fork Kaskaskia River
404	Hurricane Creek	27.7 sq mi (17,753 acres)	Hurricane Creek
405	East Fork Shoal Creek	30.9 sq mi (19,820 acres)	Shoal Creek
43	Witt, IL	--	East Fork Shoal & Hurricane Creeks
44	Shattuc, IL	--	Lost Creek

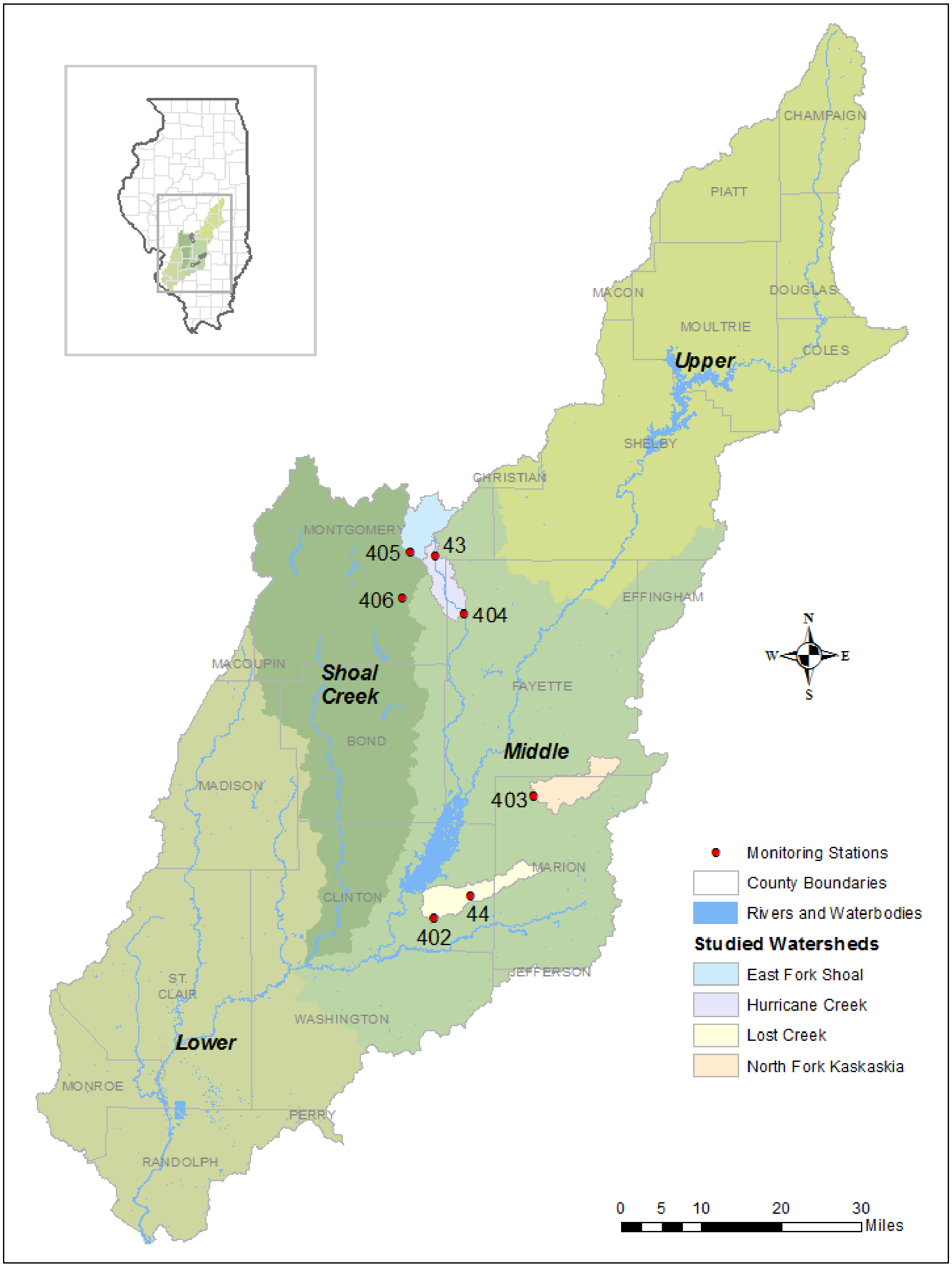


Figure 3-1. General location of monitoring stations in the Kaskaskia River watershed

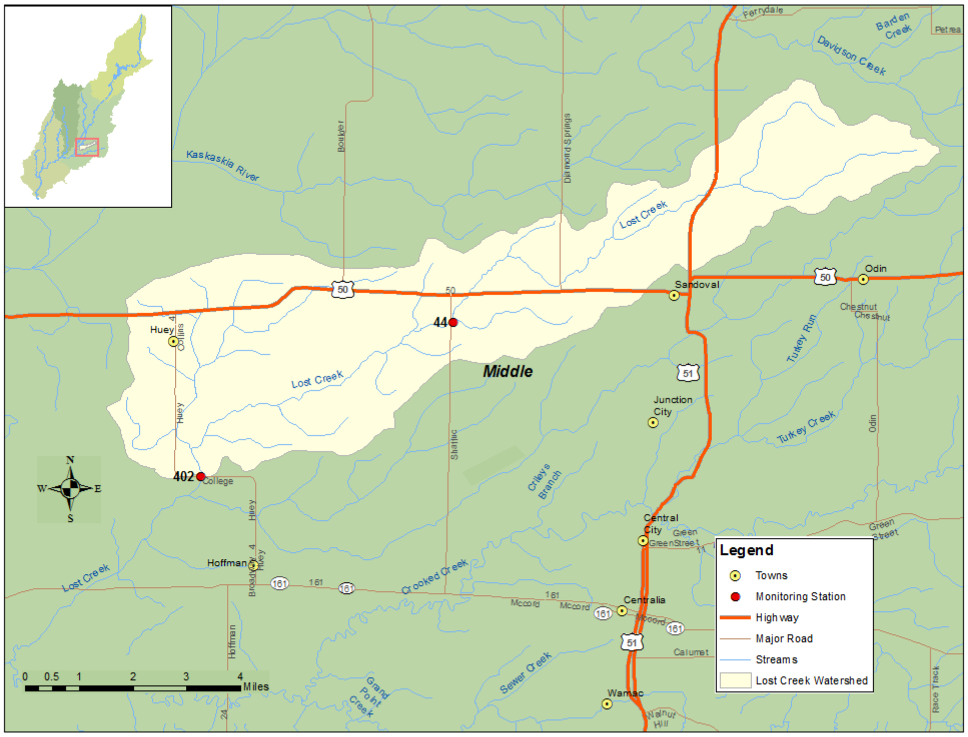


Figure 3-2. Detailed location of monitoring stations in Lost Creek (402) watershed

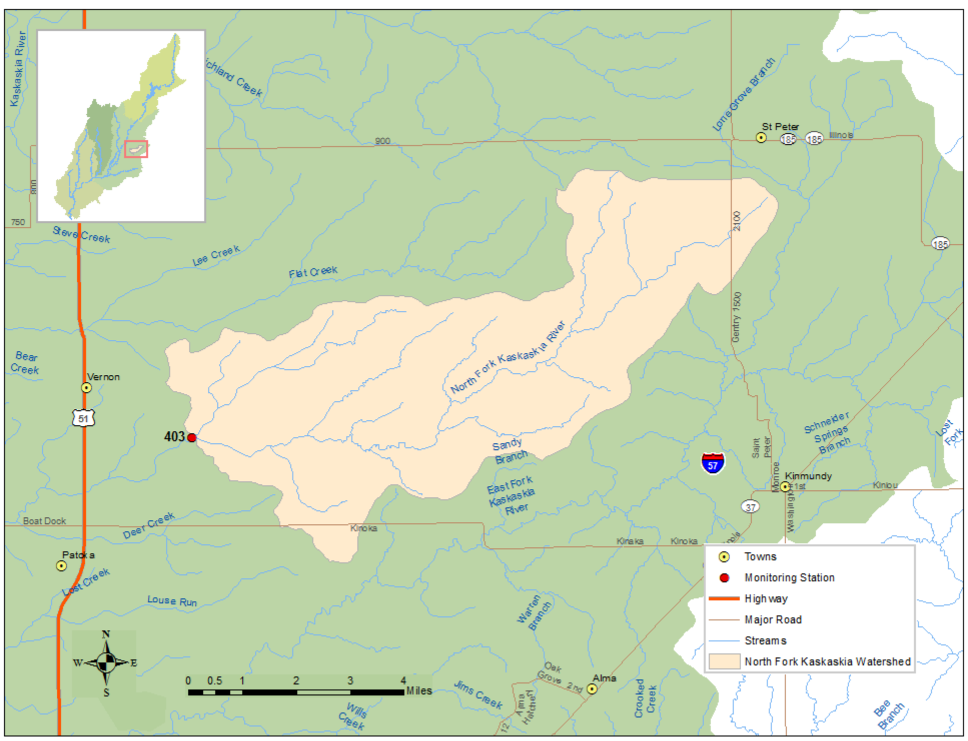


Figure 3-3. Detailed location of monitoring station in North Fork Kaskaskia River (403) watershed

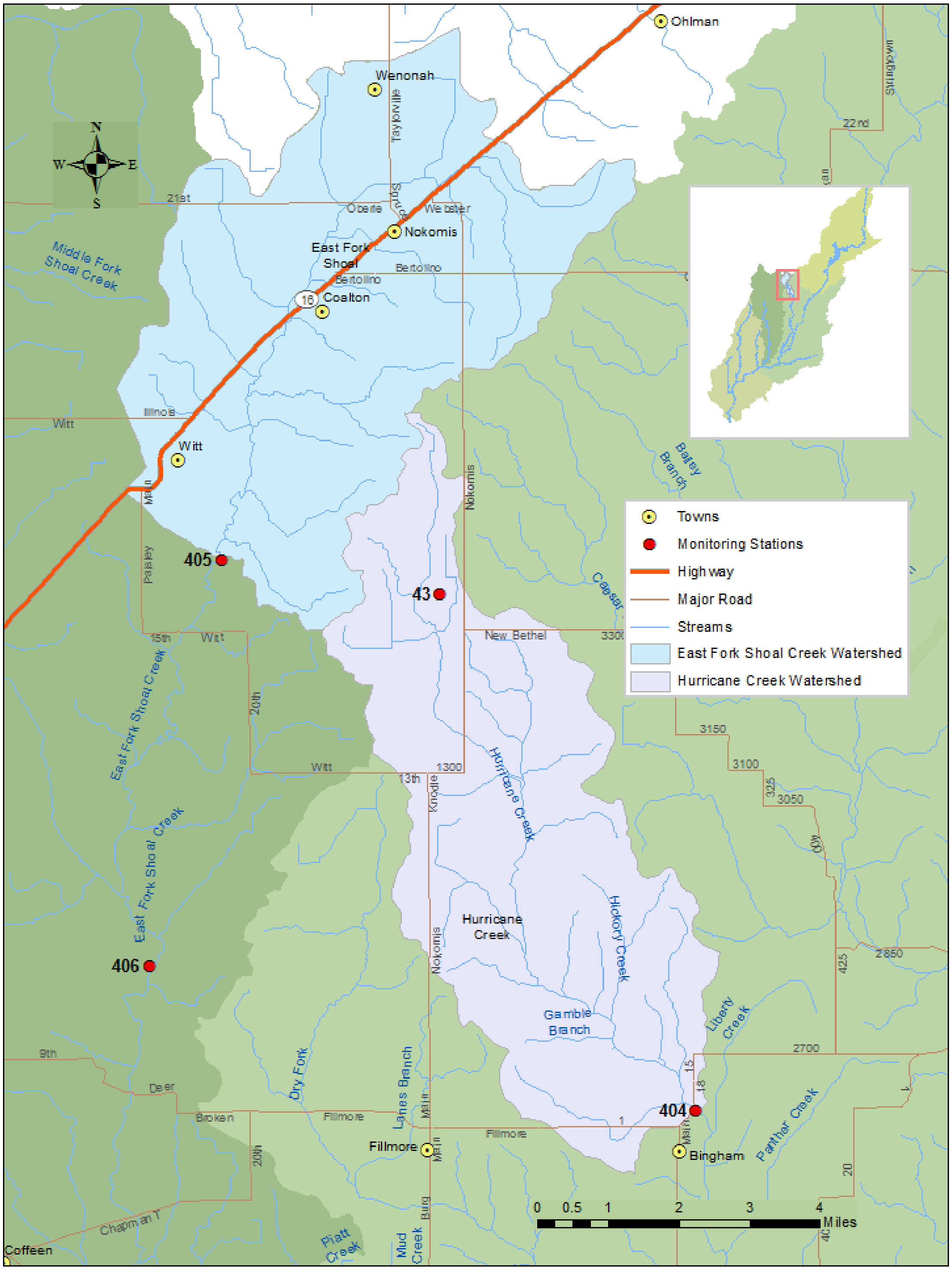


Figure 3-4. Detailed location of monitoring stations in Hurricane (404) and East Fork Shoal Creek (405) watersheds

Each of the four monitoring stations are instrumented with a Campbell Scientific CR850 datalogger, CS476 radar water level sensor, ISCO automatic water sampler, cell modem, antenna, solar panel, and batteries. All instruments, except the ISCO sampler, are housed in a stainless steel shelter to protect them from weather and vandalism. The ISCO sampler is housed in a modified 55-gallon steel drum with a hinged lid for access. The two raingages are instrumented with a modified Belfort weighing-bucket raingage, Campbell Scientific CR200 datalogger, cell modem, antenna, solar panel, and battery. The shelter and instrument configurations of the four streamgage monitoring stations are shown in Figure 3-5 and raingage stations in Figure 3-6. All data is retrieved from the station dataloggers via cell modem every hour to ISWS computer databases.

Figure 3-5. Streamgage monitoring stations in Kaskaskia River Basin: a) Lost Creek, b) North Fork Kaskaskia River, c) Hurricane Creek, and d) East Fork Shoal Creek

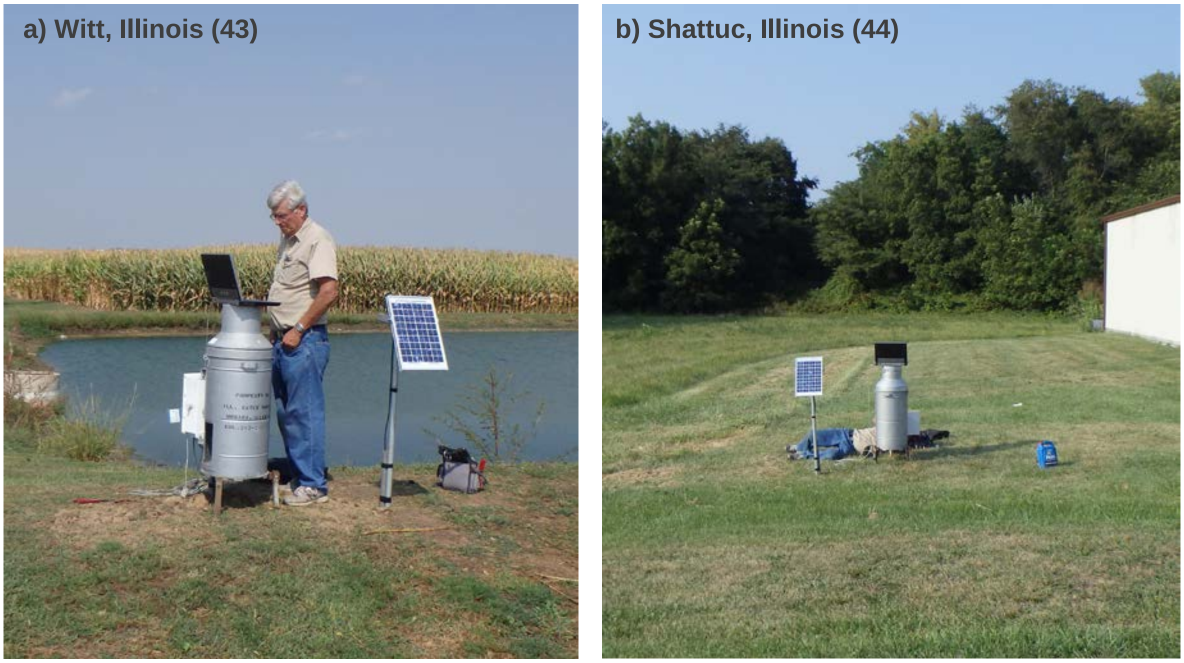


Figure 3-6. Raingage stations in Kaskaskia River Basin: a) Witt, Illinois (43) and b) Shattuc, Illinois (44)

<u>Stream Stage and Flow</u>

The "stage" of a stream is the measurement of the water surface of a stream from an arbitrary datum. The stage record is collected continuously and makes it possible to determine the volume of water carried by a stream past a streamgaging station. Through the application of a stage discharge rating curve, the continuous stage is converted to streamflow. Streamflow data are generated from the 15-minute stage record at a streamgaging station. The stage data are converted to discharge (streamflow) by applying a stage-discharge calibration curve. The calibration is developed by taking several detailed field measurements of the streamflow at known stages.

Methods used in this study for determining stream discharge follow established USGS procedures as outlined by Rantz (1982a, 1982b). Stream discharge is determined by measuring the mean velocity along a stream cross section. Each vertical represents the velocity of a flow area (substation), which is defined as the sum of half the distance between verticals by the water depth at the vertical. At each vertical the velocity is sampled at 20 and 80 percent of the total depth (for total depths ≥ 2.5 feet) or at 60 percent of the total depth (for total depths < 2.5 feet). The average of the 20 and 80 measurements or the single 60 percent measurement is assumed to be the mean velocity for that subsection. Each subsection discharge is calculated by multiplying the average velocity by the flow area, and then the sum of all the subsections equals the total discharge of the stream cross section. Every discharge is then plotted against the corresponding stage at which the discharge measurement occurred. After sufficient measurements have been collected, a curve is developed to express the relationship between stage and discharge. Using this stage-discharge curve, the stage data files are then converted to discharge. The discharge data can then be used to develop nutrient and sediment load data.

All data are compiled in to what is referred to as "water years", which begins on October 1st and ends September 30th of the following year. The year is associated with the close of the period. For example, water year 2014 (WY2014) begins October 1, 2013 and ends September 30, 2014.

The process of collecting a sufficient number of streamflow measurements to adequately develop a stage-discharge calibration takes time. This usually takes 1-2 water years into a monitoring study. Therefore, stream discharge values are not available at this time, as well as sediment and nutrient load calculations. It is anticipated that calibration curves will be sufficient for producing preliminary data at the next annual progress report.

Sediment and Nutrient Data

Sediment Data

Suspended sediment samples are collected either manually or by ISCO automated pump sampler. The suspended sediment sampling methods used in this study followed established USGS procedures as outlined by Edwards and Glysson (1999) and FISP (1952). The manual sampling method used depth-integrating samplers for all but the shallowest conditions. The second method used to collect suspended sediment samples was the ISCO automated pump sampler. The programming of the CR850 datalogger controls the ISCO sampling schedule. This program allows automated sampling during high-flow events and is triggered by changes in stage over time. Manual suspended sediment samples were taken at all four stations during weekly station visits and during storms when possible.

Suspended sediment concentration (SSC) data and stream stage for all stations are shown in figures 3-7 through 3-10 for WY2014-15. Summary statistics for SSC samples can be found in table 3-2. As can be seen in the figures, suspended sediment concentrations are highly variable throughout a year depending on the climatic conditions and location of the stations in the watershed. The distance between monitoring stations ranges from 10 to 45 miles and subject to rainfall and storm variability and tracking through the region. It is also evident that sediment concentrations are the highest during storm events resulting in the transport of most of the sediment during storm events. Therefore, it is extremely important that samples are collected frequently during storm events to accurately measure sediment loads at monitoring stations. Approximately 1121 SSC samples were collected at all stations. The highest maximum SSC occurred at Lost Creek (402) at 15,704 mg/L and lowest maximum at North Fork Kaskaskia (403) with 3,456 mg/L. The mean SSC for all stations ranged from 428 to 1036 mg/L. All stations had minimum SSC below 5 mg/L.

Nutrient Data

The nutrient data are organized into two groups: nitrogen species and phosphorous species. The nitrogen species include nitrate-nitrogen (NO_3-N), ammonium-nitrogen (NH_4-N), and total Kjedahl nitrogen (TKN). The phosphorous species include total phosphorous (TP), total dissolved phosphorous (TDP), and orthophosphate (P-ortho). Approximately 3,124 samples have been collected for nitrogen and 2,529 for phosphorus. Nitrogen and phosphorus sample results with stream stage are shown in figures 3-11 to 3-14 and 3-15 to 3-18, respectively. A summary statistics for all stations showing the sample count, mean, median, minimum, maximum, 25^{th} percentile, and 75^{th} percentile are given in table 3-2.

Data for the nitrogen species at all four monitoring stations show that the dominant form of nitrogen transported by the streams is total Kjeldahl nitrogen (TKN). During storm events, the concentration of TKN rises significantly, exceeding the nitrate-N concentration (NO_3-N). TKN is highly correlated to suspended sediment concentrations. Ammonium-nitrogen (NH_4-N) concentrations are low at all stations except East Fork Shoal Creek (405) where maximum concentrations were nearly equal with nitrate-N concentrations. TKN maximum concentration of 21.28 mg/L was at Lost Creek (402).

As can be seen in figures 3-11 and 3-12 phosphorous species at all monitoring stations show that most of the phosphorous load is transported during storm events. Total phosphorous (t-P) concentrations are the highest during storm events and relatively low most of the time. This is very similar to that shown by sediment and thus implies high correlations between sediment and phosphorous concentrations and loads. The highest maximum t-P concentration for WY2014-15 was 6.23 mg/L at Lost Creek (402). Ortho-phosphate (oPO4-P) and total dissolved phosphorus (t-P-diss) maximum and mean concentrations at all stations are similar (table 3-2).

Figures 3-19 to 3-22 illustrate the distribution of sediment, nitrogen and phosphorus concentrations for a typical storm event on April 8-11, 2015. Note the two y-axes on the left of the plot showing concentrations for sediment (green diamonds) and the other for nitrogen/phosphorus. The right y-axis shows water discharge. The first observation is the variation in streamflow between the stations which is expected due to the spatial variation between the stations (see map in figure 3-1) and rainfall intensities. As seen in Figures 3-19 and 3-21 Hurricane (404) and East Fork Shoal (405) creeks share a watershed boundary but rainfall intensity, slope, and land cover can produced different stream discharge characteristics. This in turn can affect the carrying capacity of the streamflow resulting in variations in concentrations. All the figures support the concentration summary statistics which informed that TKN and t-P are the dominant nitrogen and phosphorus species at all stations and is similar in pattern with suspended sediment concentrations.

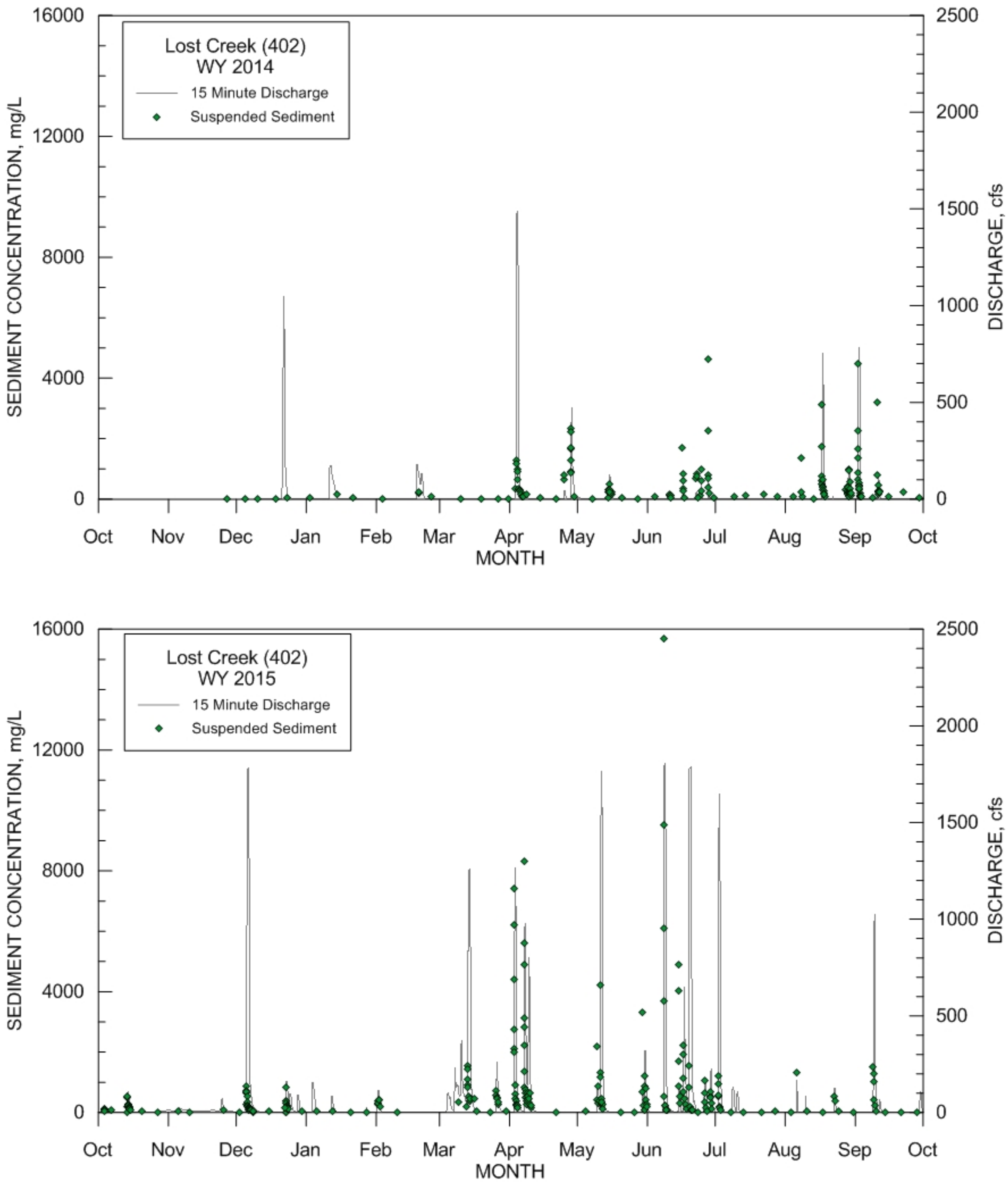


Figure 3-7. Suspended sediment concentrations and water stage at Lost Creek (402):
Water Year 2014 and Water Year 2015

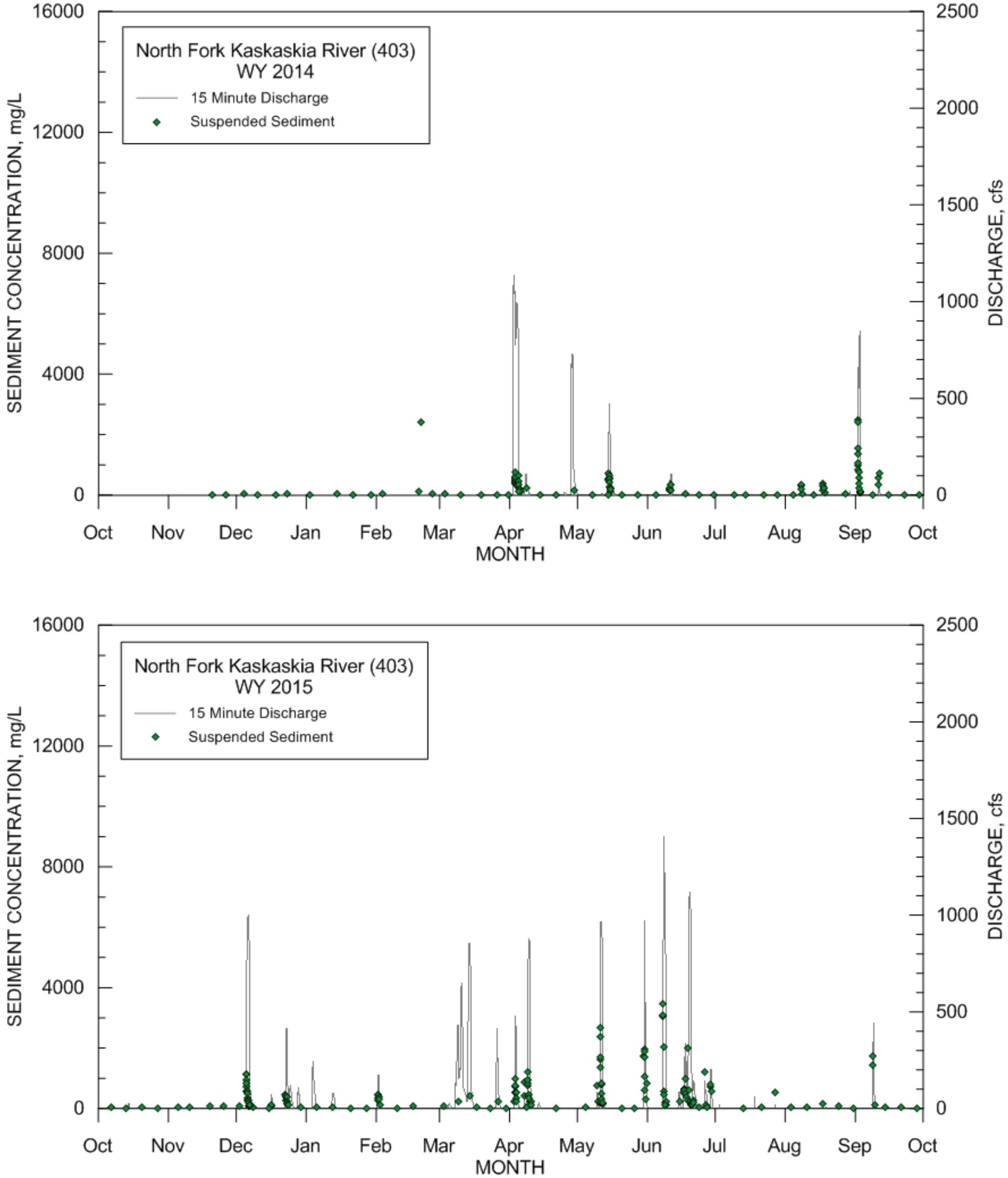


Figure 3-8. Suspended sediment concentrations and water stage at North Fork Kaskaskia River (403): Water Year 2014 and Water Year 2015

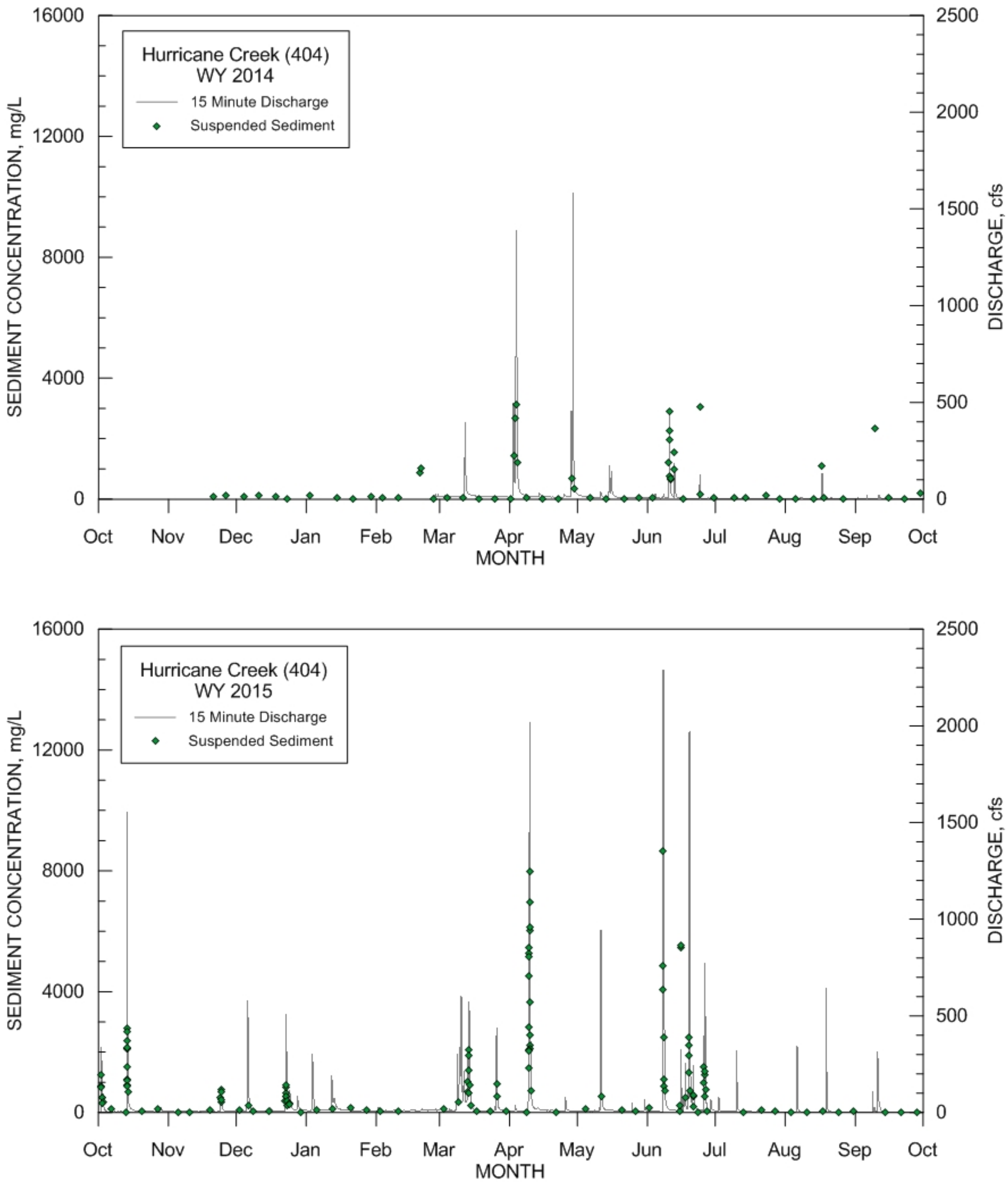
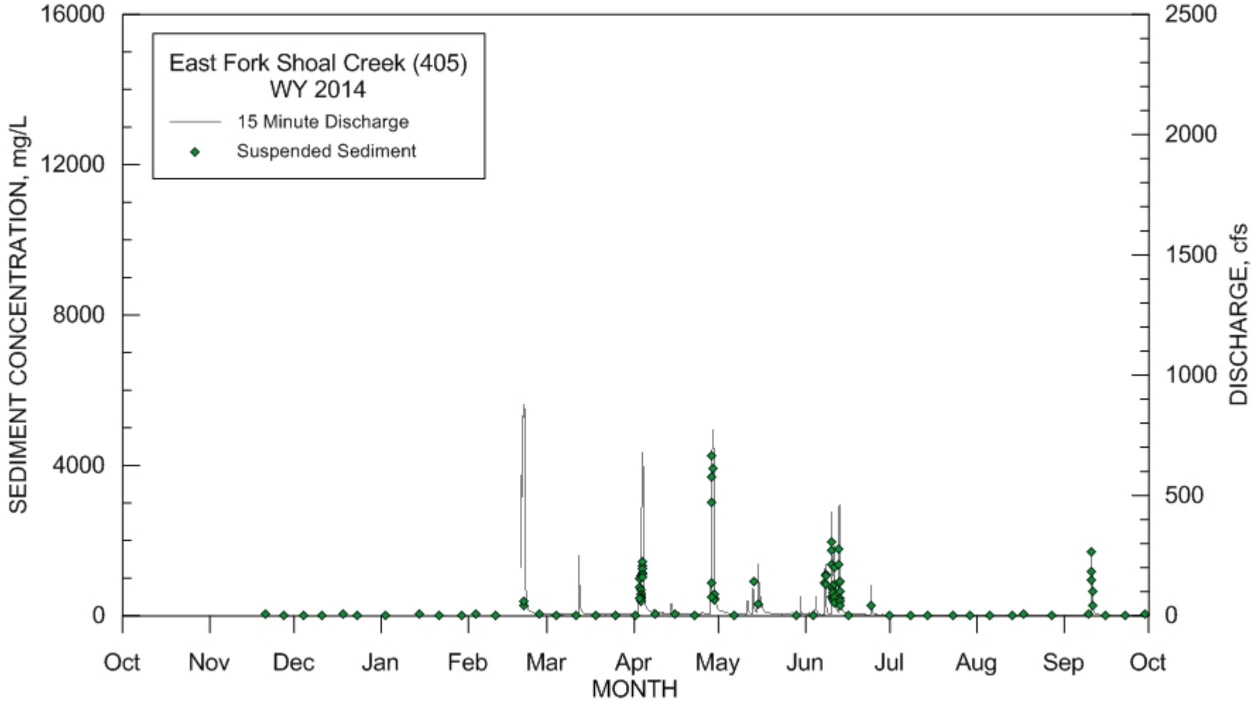


Figure 3-9. Suspended sediment concentrations and water stage at Hurricane Creek (404): Water Year 2014 and Water Year 2015



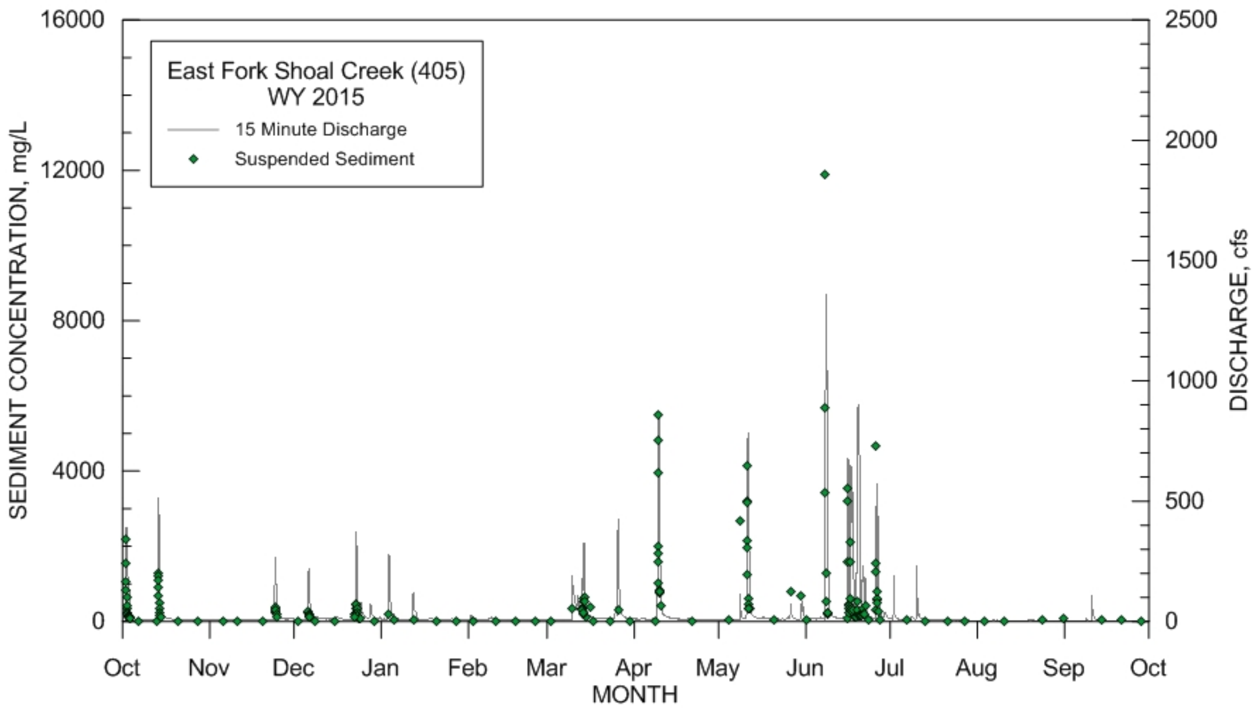


Figure 3-10. Suspended sediment concentrations and water stage at East Fork Shoal Creek (405): Water Year 2014 and Water Year 2015

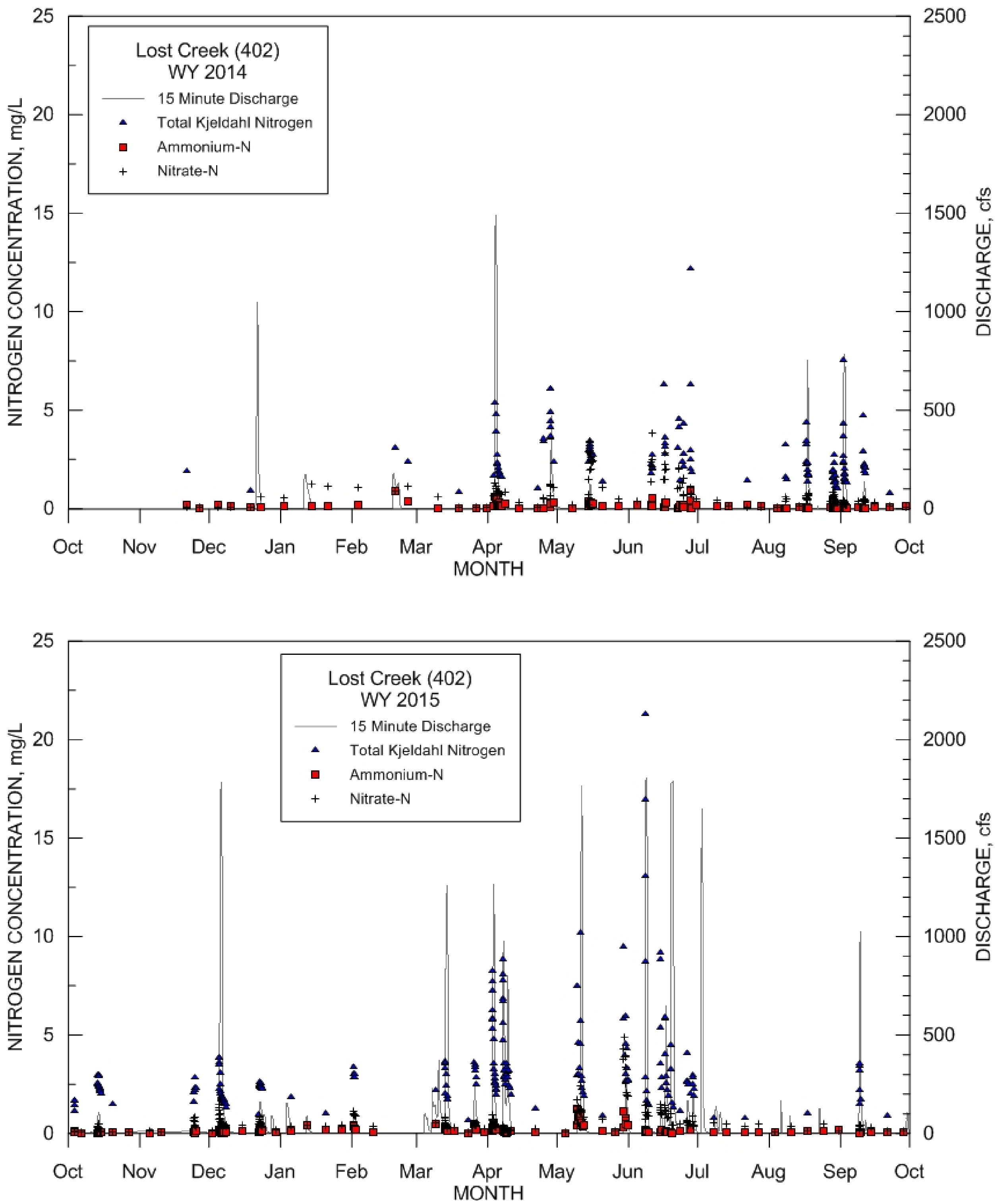
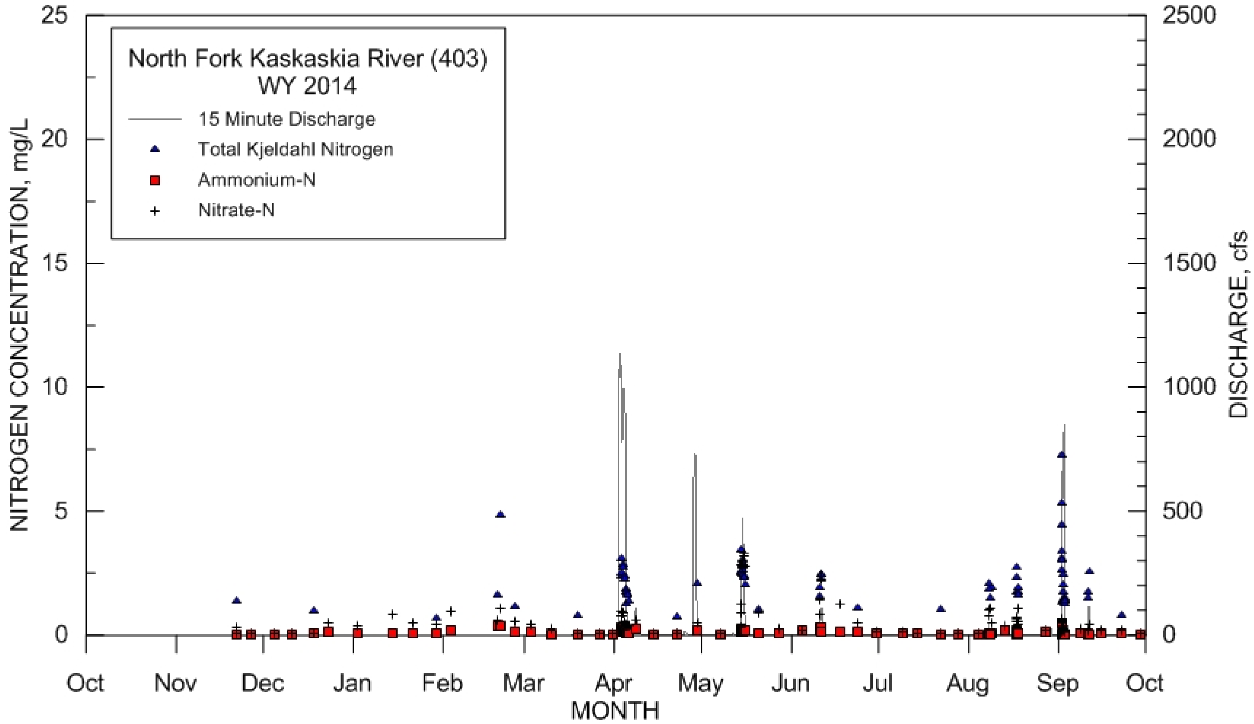


Figure 3-11. Nitrogen concentrations and water stage at Lost Creek (402):
Water Year 2014 and Water Year 2015



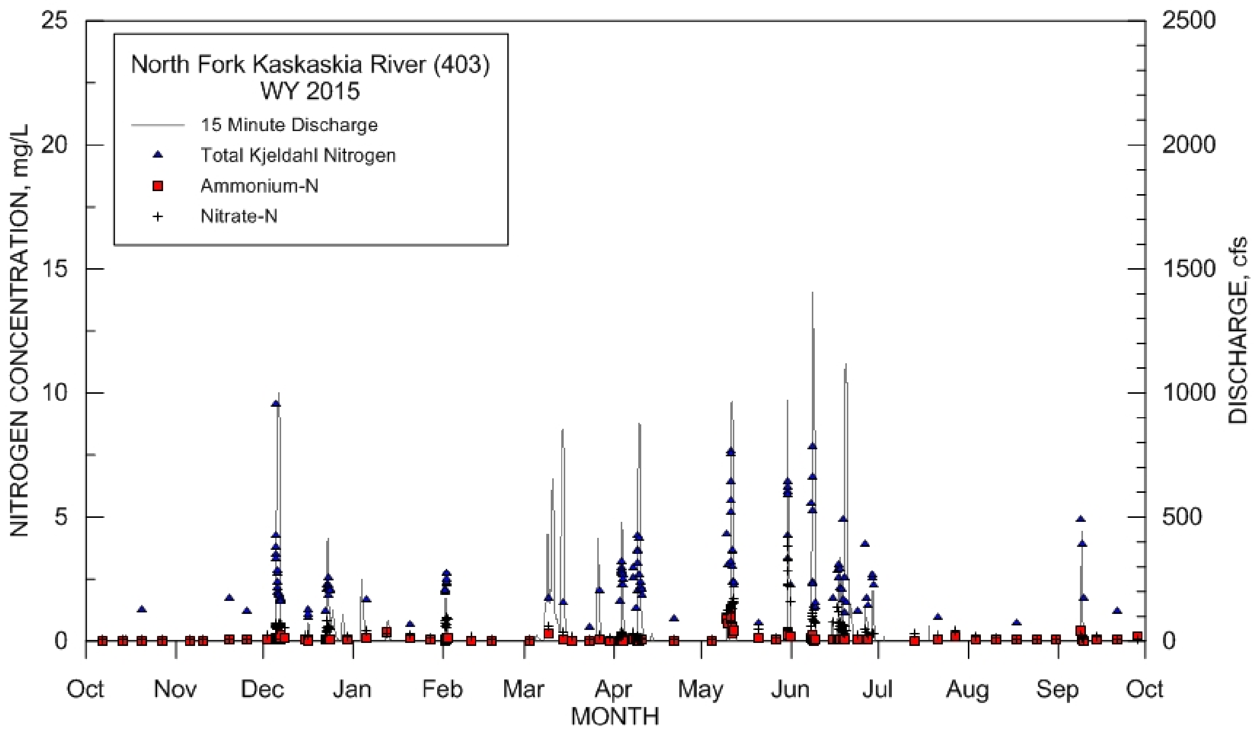


Figure 3-12. Nitrogen concentrations and water stage at North Fork Kaskaskia River (403): Water Year 2014 and Water Year 2015

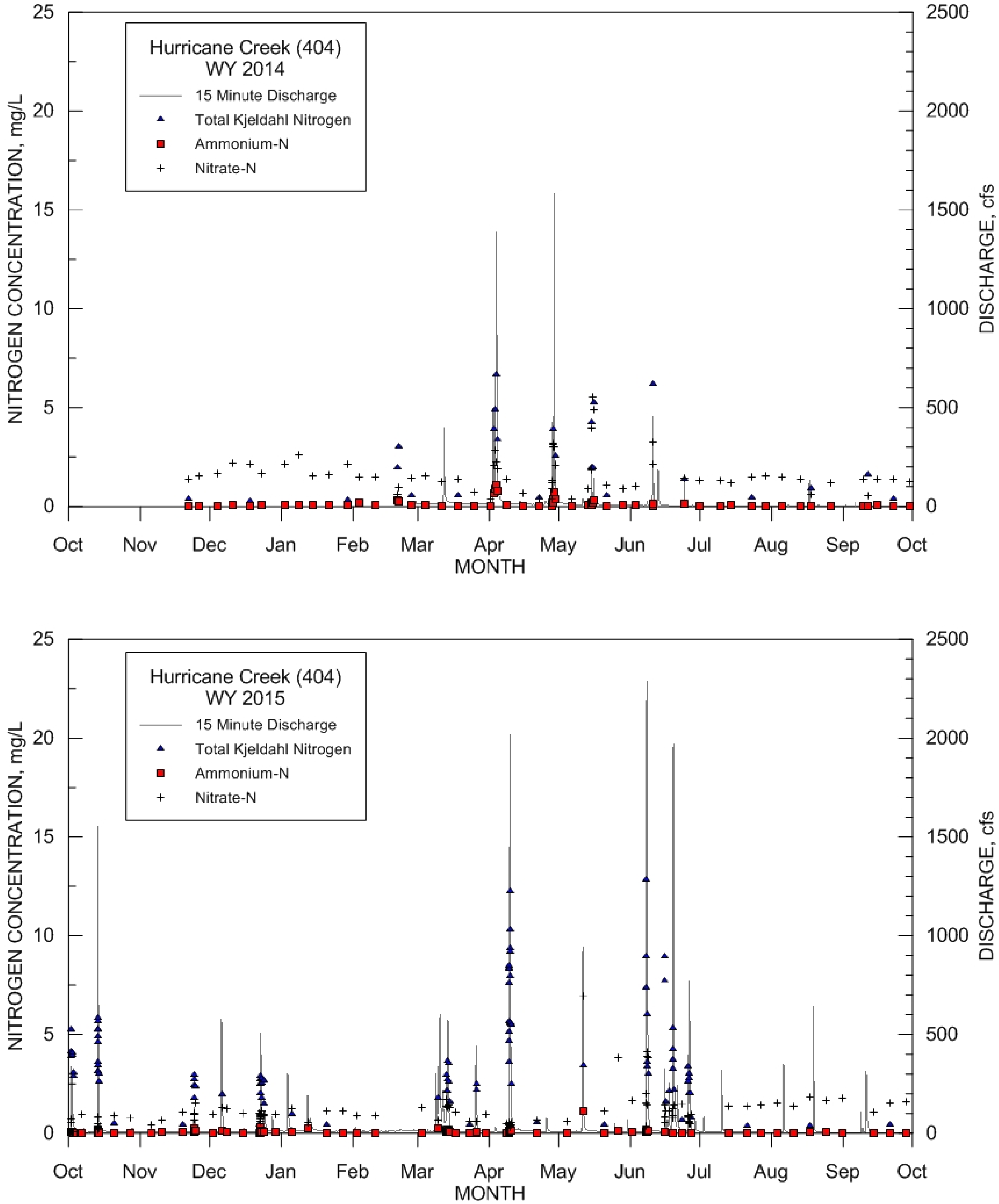
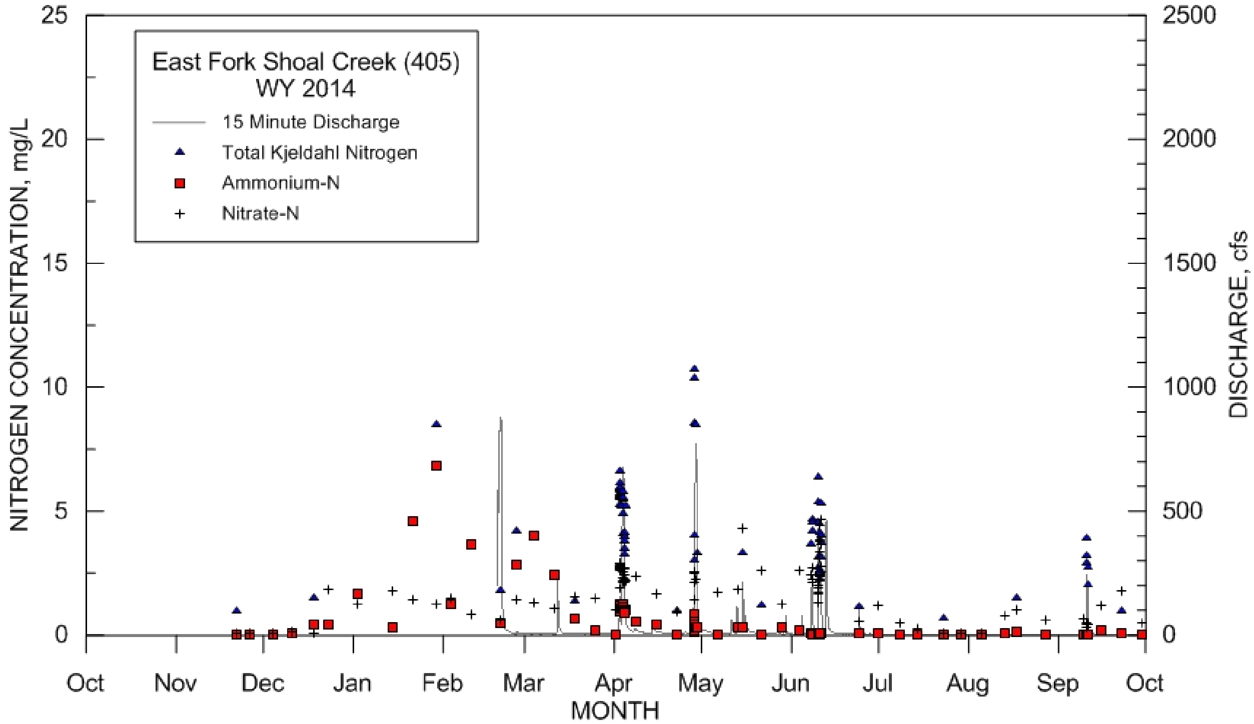


Figure 3-13. Nitrogen concentrations and water stage at Hurricane Creek (404): Water Year 2014 and Water Year 2015



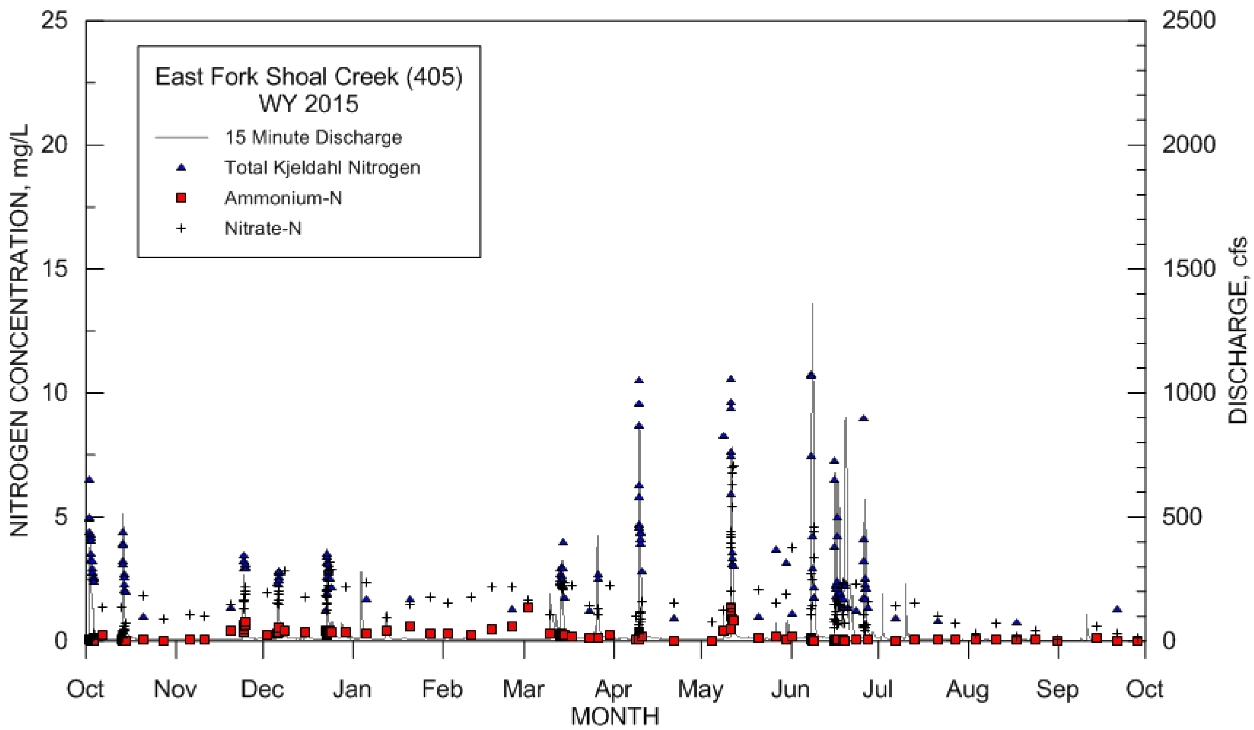
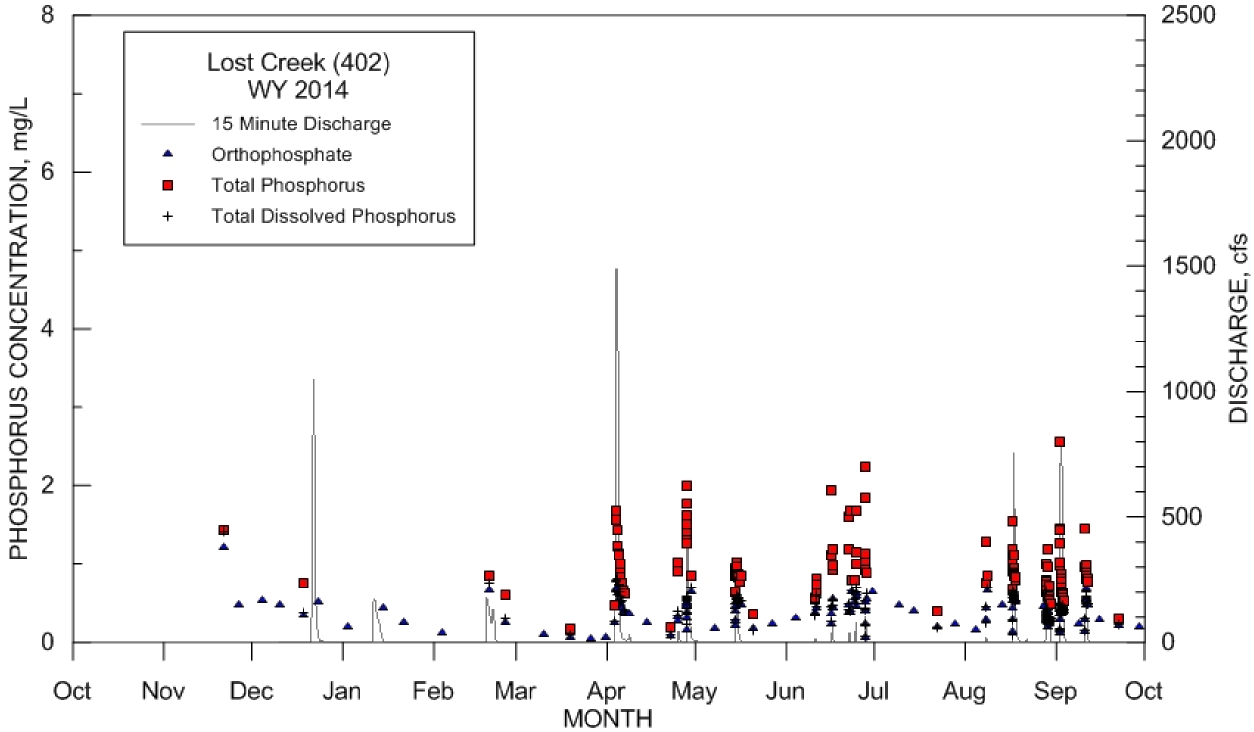


Figure 3-14. Nitrogen concentrations and water stage at East Fork Shoal Creek (405): Water Year 2014 and Water Year 2015



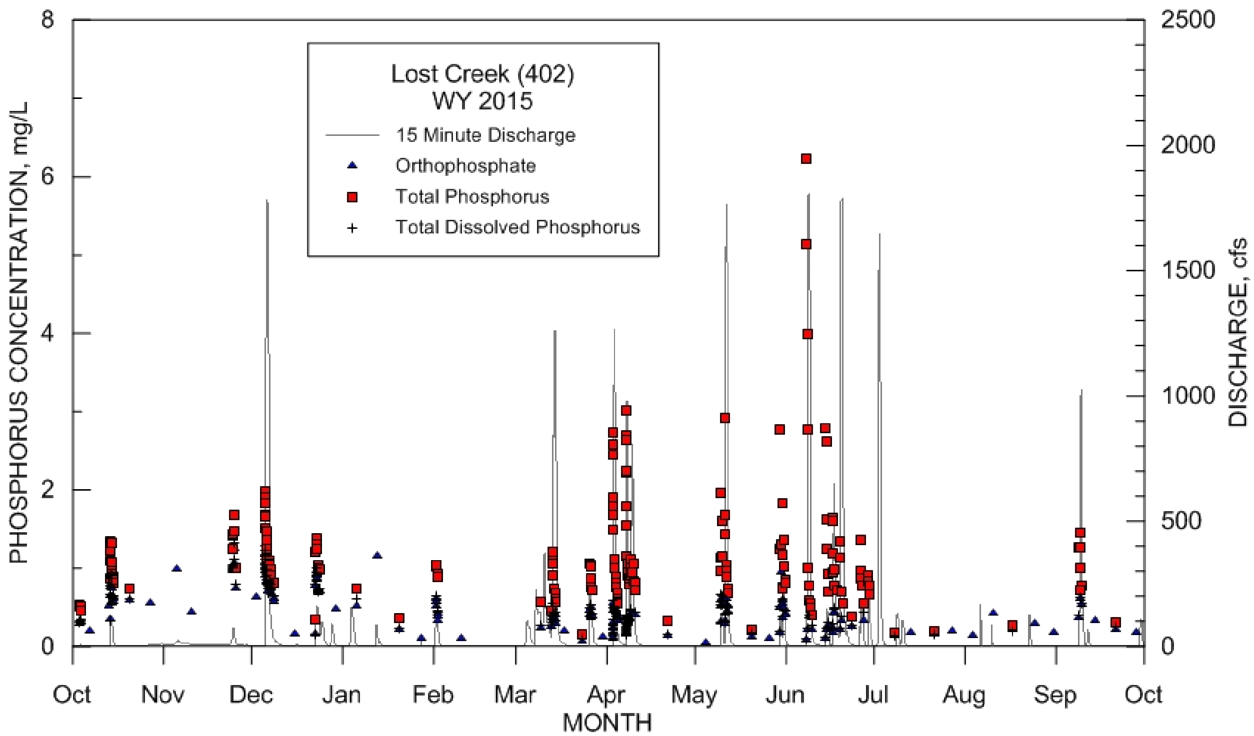


Figure 3-15. Phosphorus concentrations and water stage at Lost Creek (402): Water Year 2014 and Water Year 2015

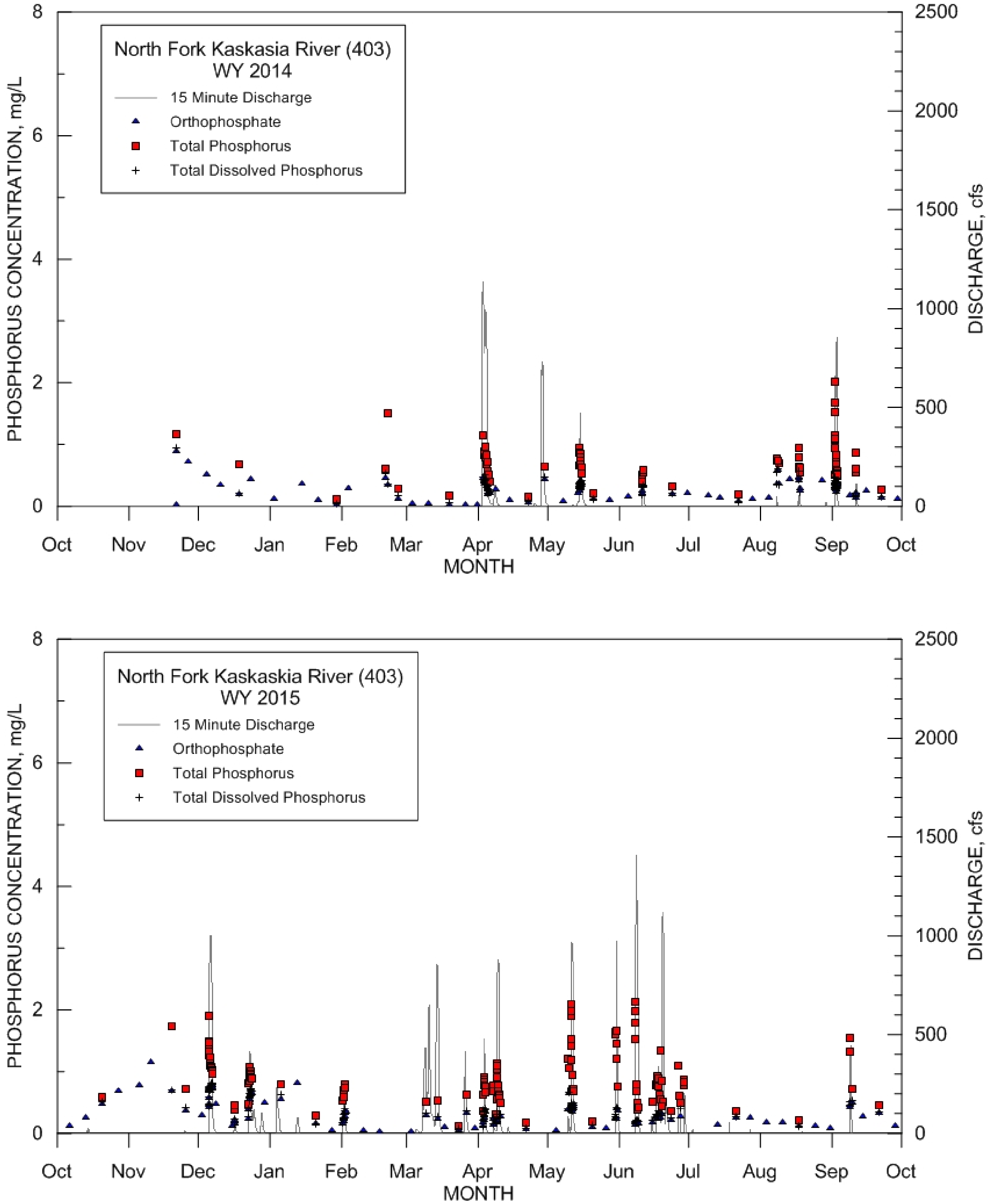


Figure 3-16. Phosphorus concentrations and water stage at North Fork Kaskaskia River (403): Water Year 2014 and Water Year 2015

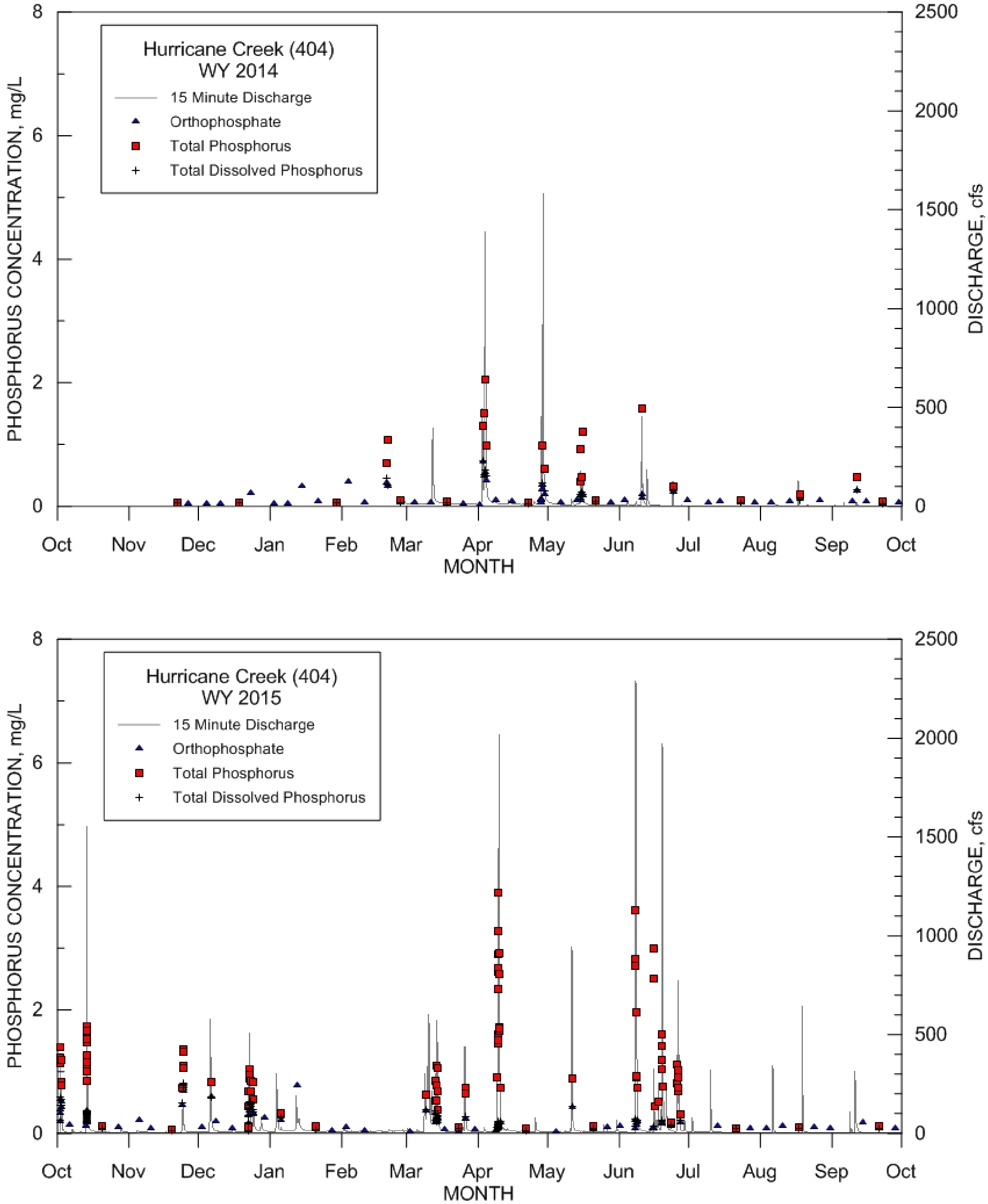
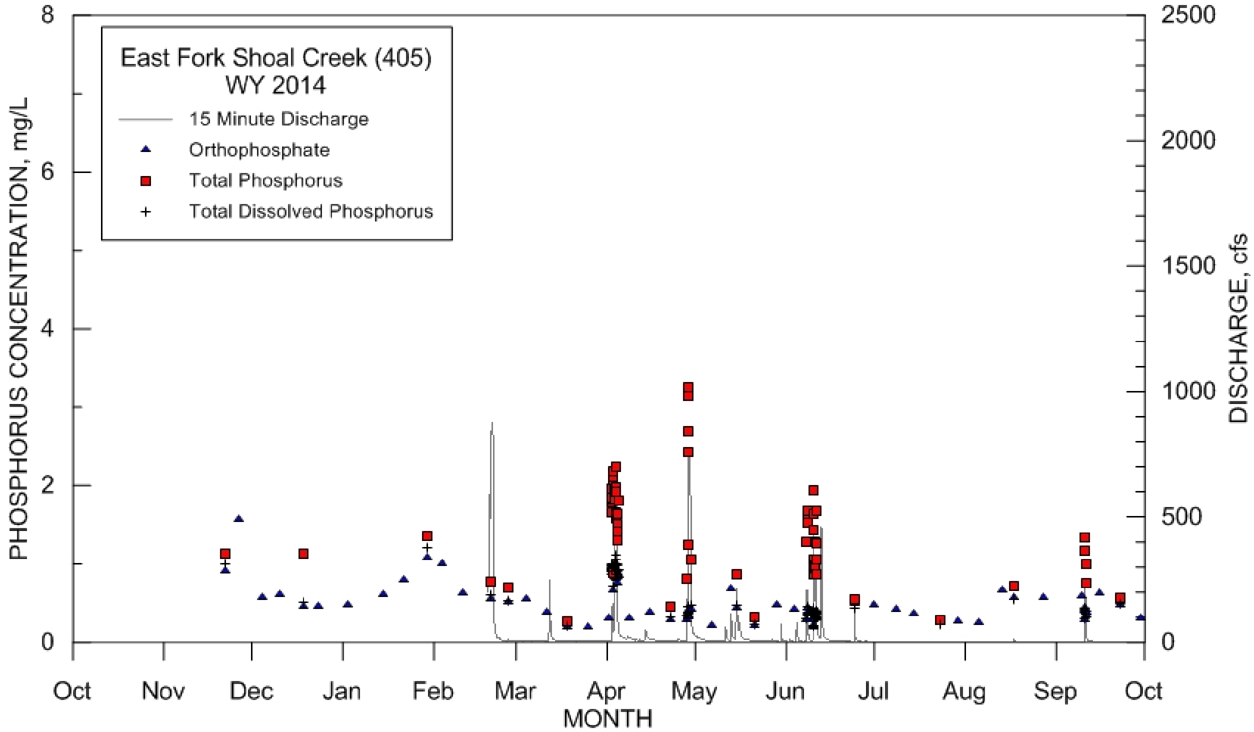


Figure 3-17. Phosphorus concentrations and water stage at Hurricane Creek (404): Water Year 2014 and Water Year 2015



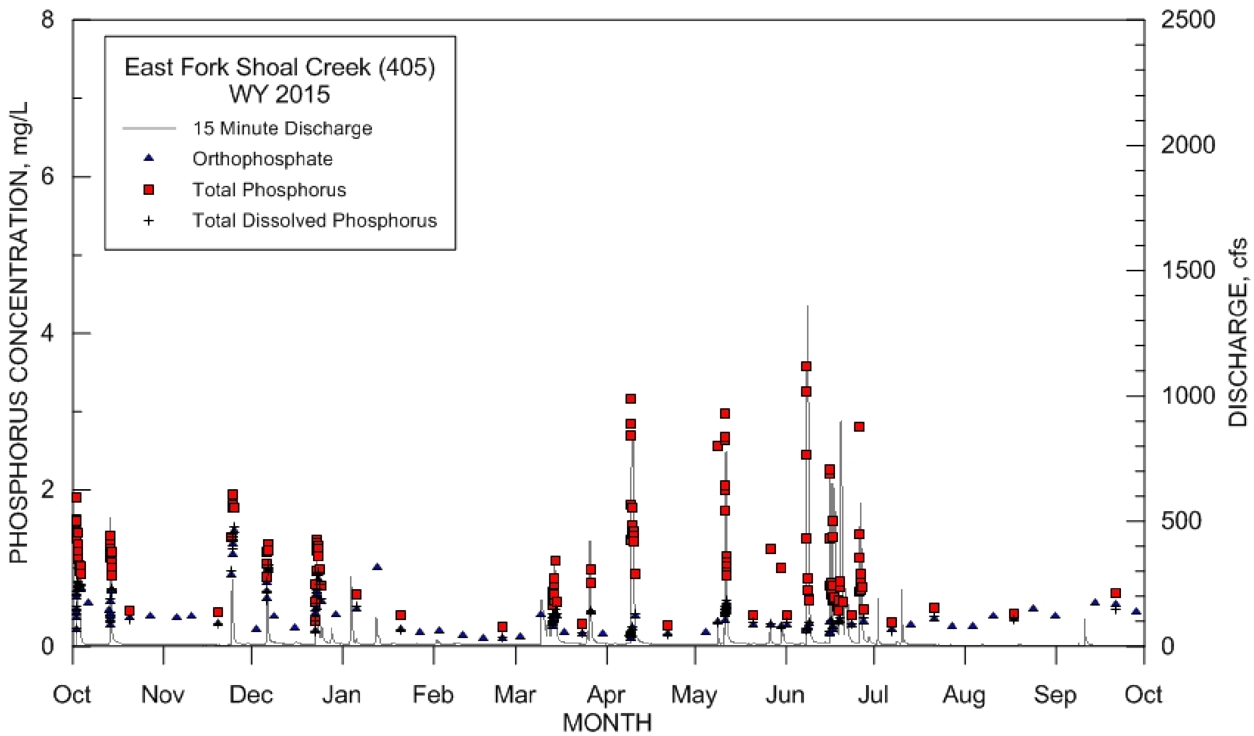
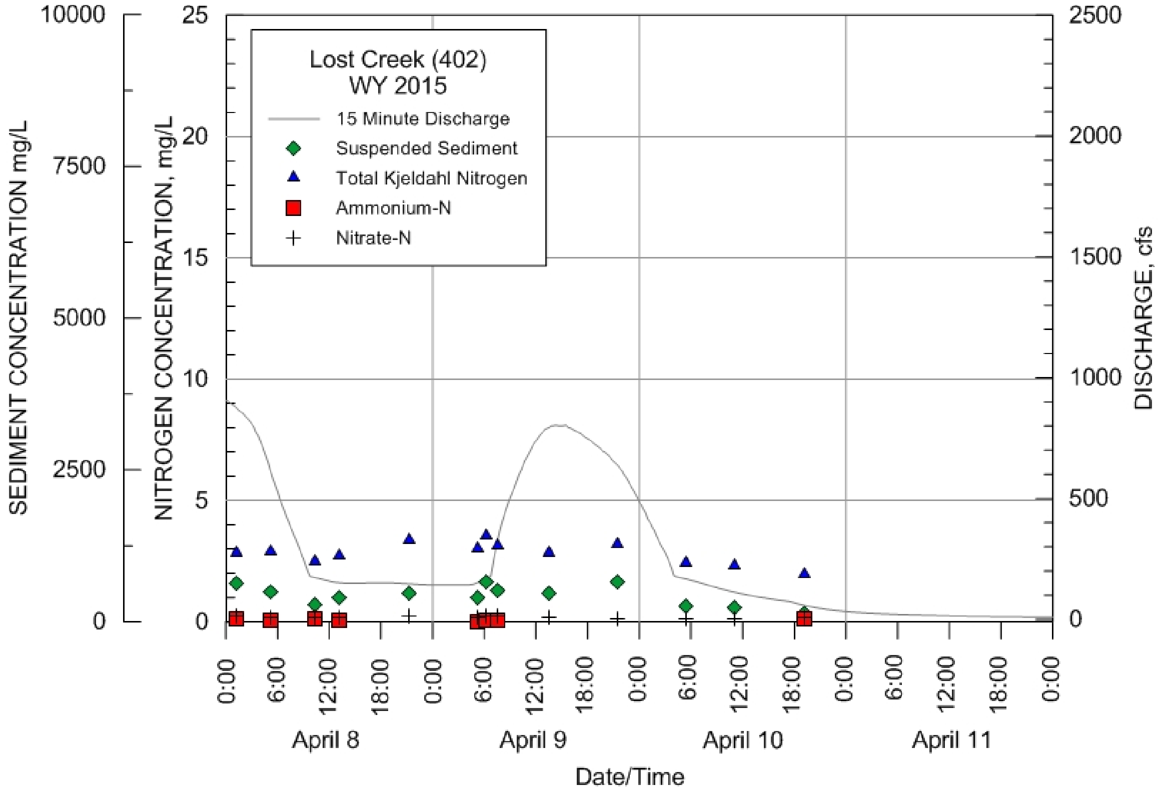


Figure 3-18. Phosphorus concentrations and water stage at East Fork Shoal Creek (405): Water Year 2014 and Water Year 2015

Table 3-2. Summary Statistics for Water Years 2014 and 2015 (all concentrations in mg/L).

	NO3-N	*NH4-N*	*TKN*	*t-P*	*t-P-dissolved*	*oPO4-P*	*SSC*
Lost Creek (402)							
Count	381	346	327	327	292	347	383
Mean	0.73	0.16	3.03	1.09	0.50	0.45	688
Median	0.49	0.10	2.44	0.96	0.46	0.42	265
Min	< 0.04	< 0.03	0.68	0.16	0.07	0.05	4
Max	4.90	1.24	21.28	6.23	1.41	1.30	15,704
25th Percentile	0.32	0.04	1.80	0.76	0.33	0.28	100
75th Percentile	0.91	0.21	3.36	1.24	0.62	0.56	657
North Fork Kaskaskia River (403)							
Count	266	243	208	208	185	243	275
Mean	0.64	0.13	2.52	0.84	0.38	0.33	427
Median	0.44	0.06	2.24	0.77	0.36	0.30	221
Min	< 0.04	< 0.03	0.56	0.11	< 0.04	0.01	4
Max	4.18	1.31	9.55	2.14	0.93	1.16	3,456
25th Percentile	0.17	0.03	1.62	0.56	0.26	0.18	58
75th Percentile	0.77	0.14	2.85	1.01	0.45	0.42	541
Hurricane Creek (404)							
Count	191	169	124	124	102	169	190
Mean	1.21	0.10	3.47	1.07	0.27	0.19	1,036
Median	1.04	0.05	2.92	0.92	0.22	0.12	391
Min	< 0.04	< 0.03	< 0.26	< 0.05	< 0.04	0.02	5
Max	6.96	1.12	12.80	3.90	0.81	0.78	8,649
25th Percentile	0.56	0.03	1.89	0.52	0.13	0.07	43
75th Percentile	1.45	0.09	4.68	1.43	0.37	0.26	1,258
East Fork Shoal Creek (405)							
Count	269	250	221	221	190	250	273
Mean	1.63	0.40	3.62	1.25	0.55	0.50	679
Median	1.50	0.11	3.02	1.13	0.43	0.40	312
Min	< 0.04	< 0.03	0.68	0.25	0.11	0.09	3
Max	7.08	6.81	10.71	3.59	1.53	1.55	11,897
25th Percentile	0.66	0.04	2.26	0.79	0.33	0.30	33
75th Percentile	2.24	0.45	4.34	1.60	0.78	0.68	782



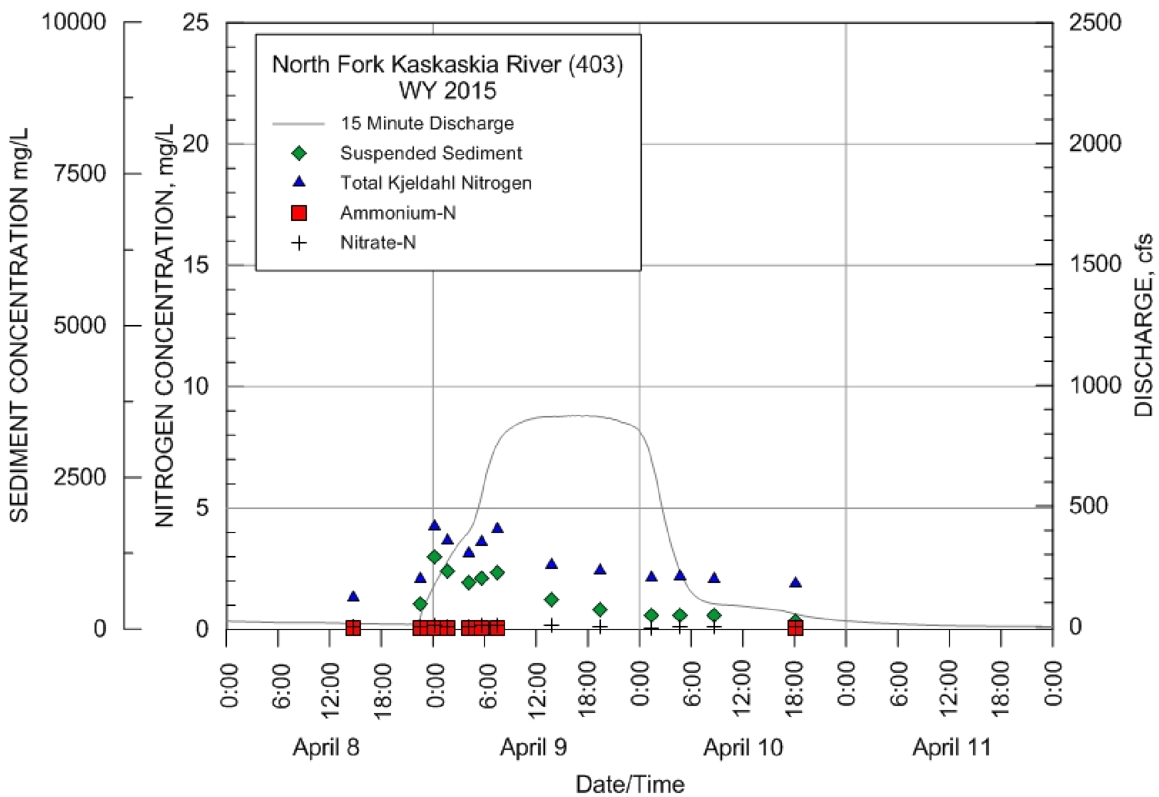
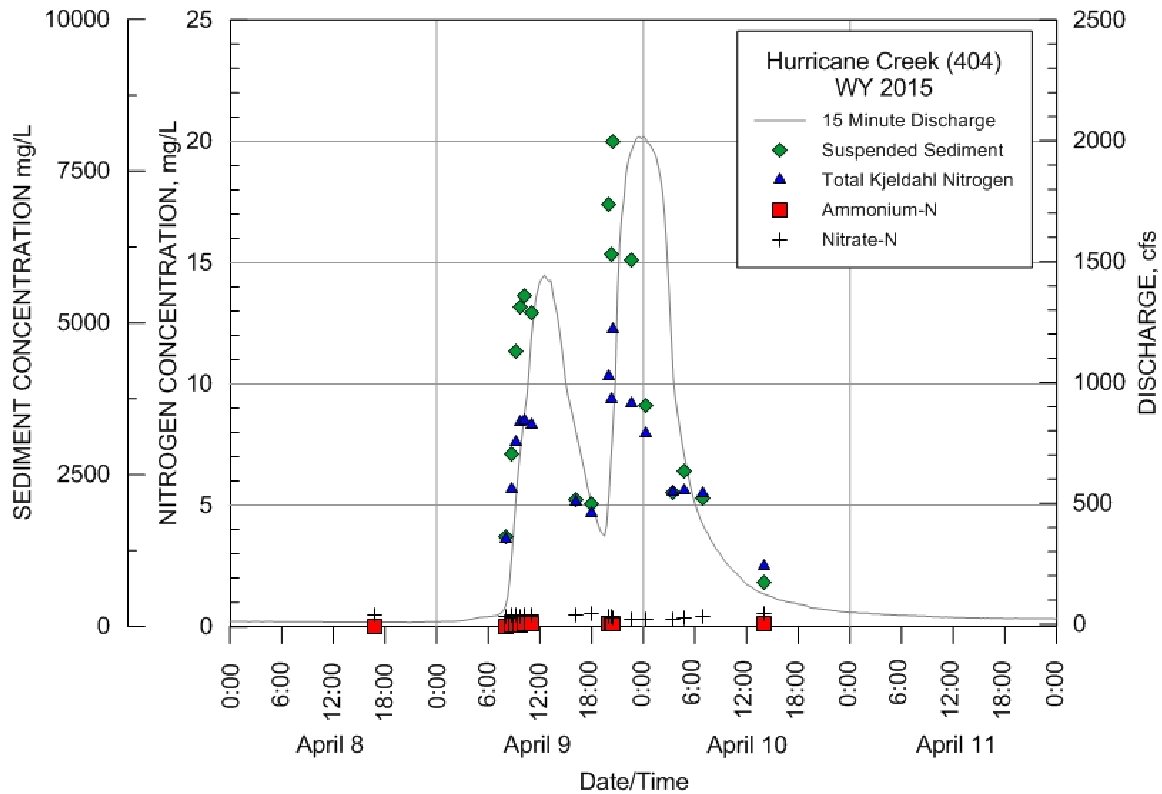


Figure 3-19. Sediment and nitrogen concentrations during April 8-11, 2015 event at Lost Creek (402) and North Fork Kaskaskia River (403).



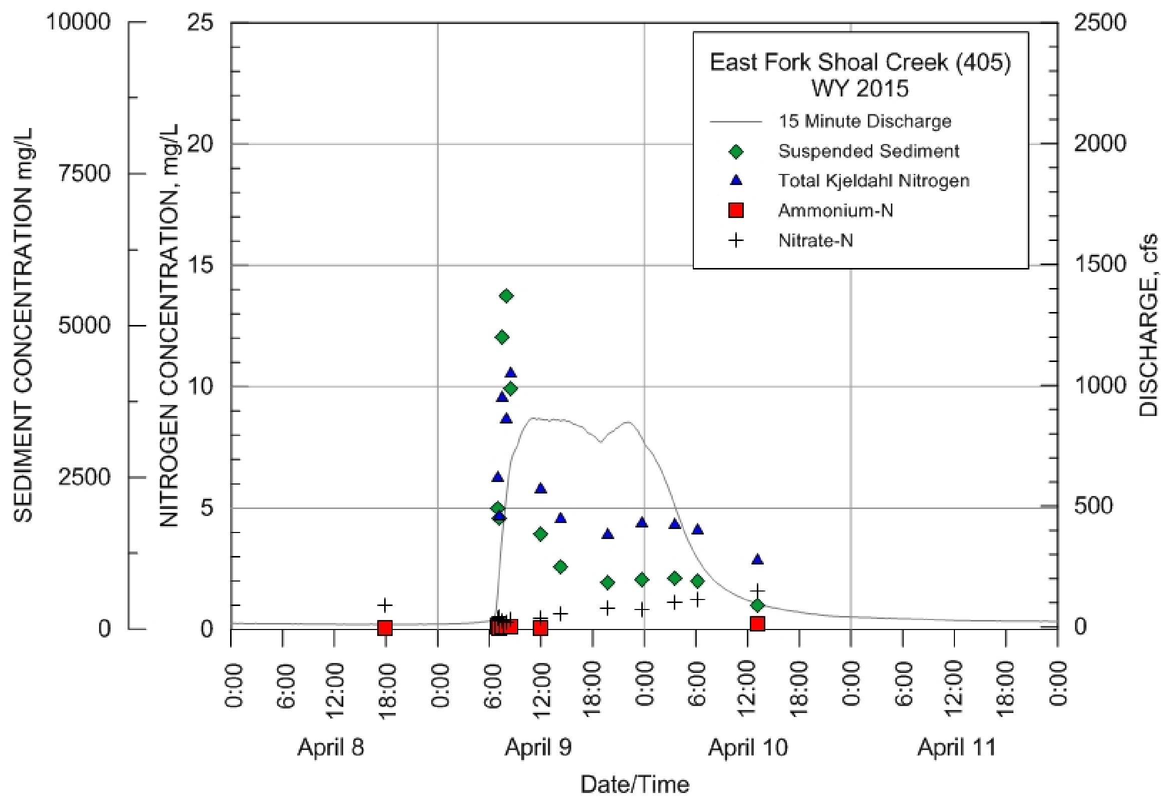
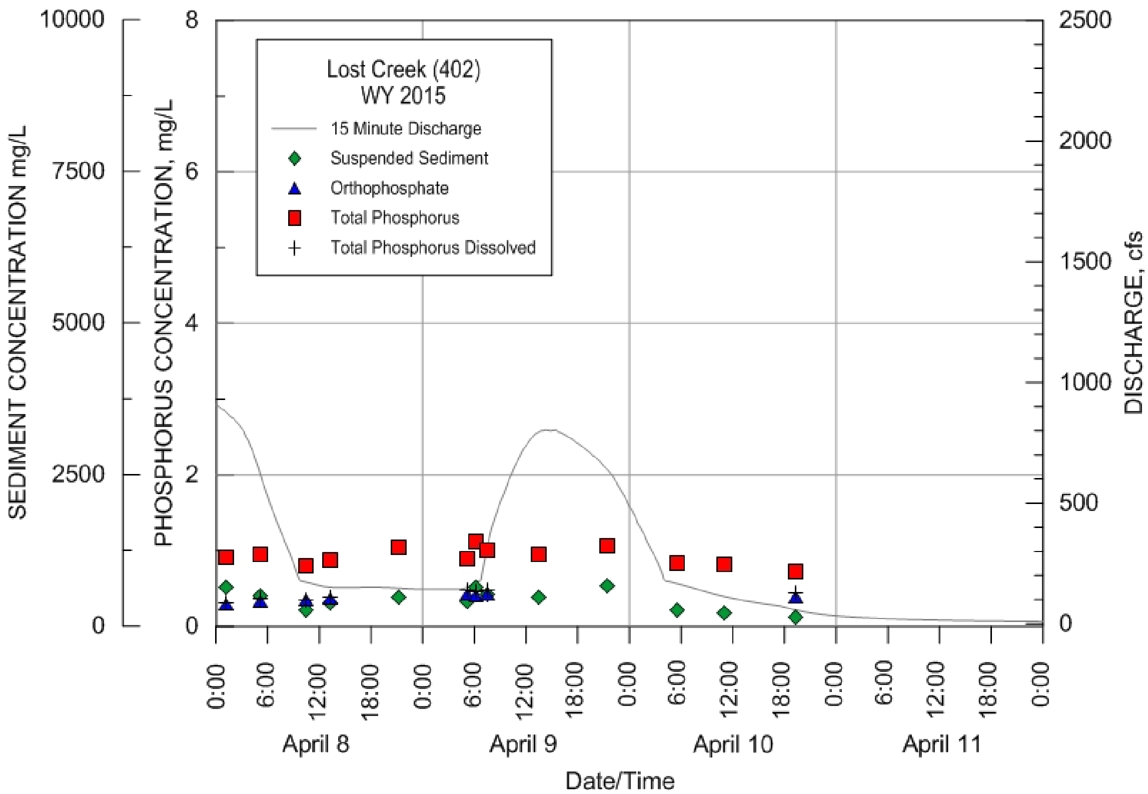


Figure 3-20. Sediment and nitrogen concentrations during April 8-11, 2015 event at Hurricane Creek (404) and East Fork Shoal Creek (405).



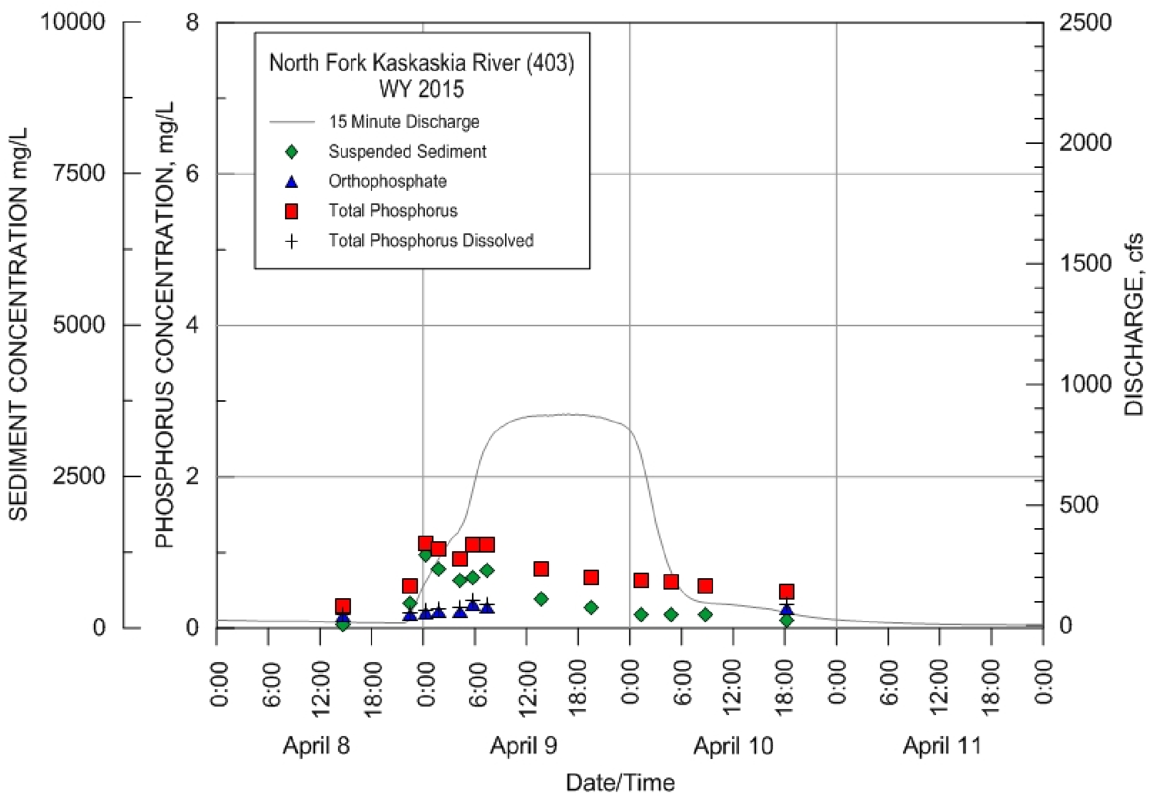


Figure 3-21. Sediment and phosphorus concentrations during April 8-11, 2015 event at Lost Creek (402) and North Fork Kaskaskia River (403).

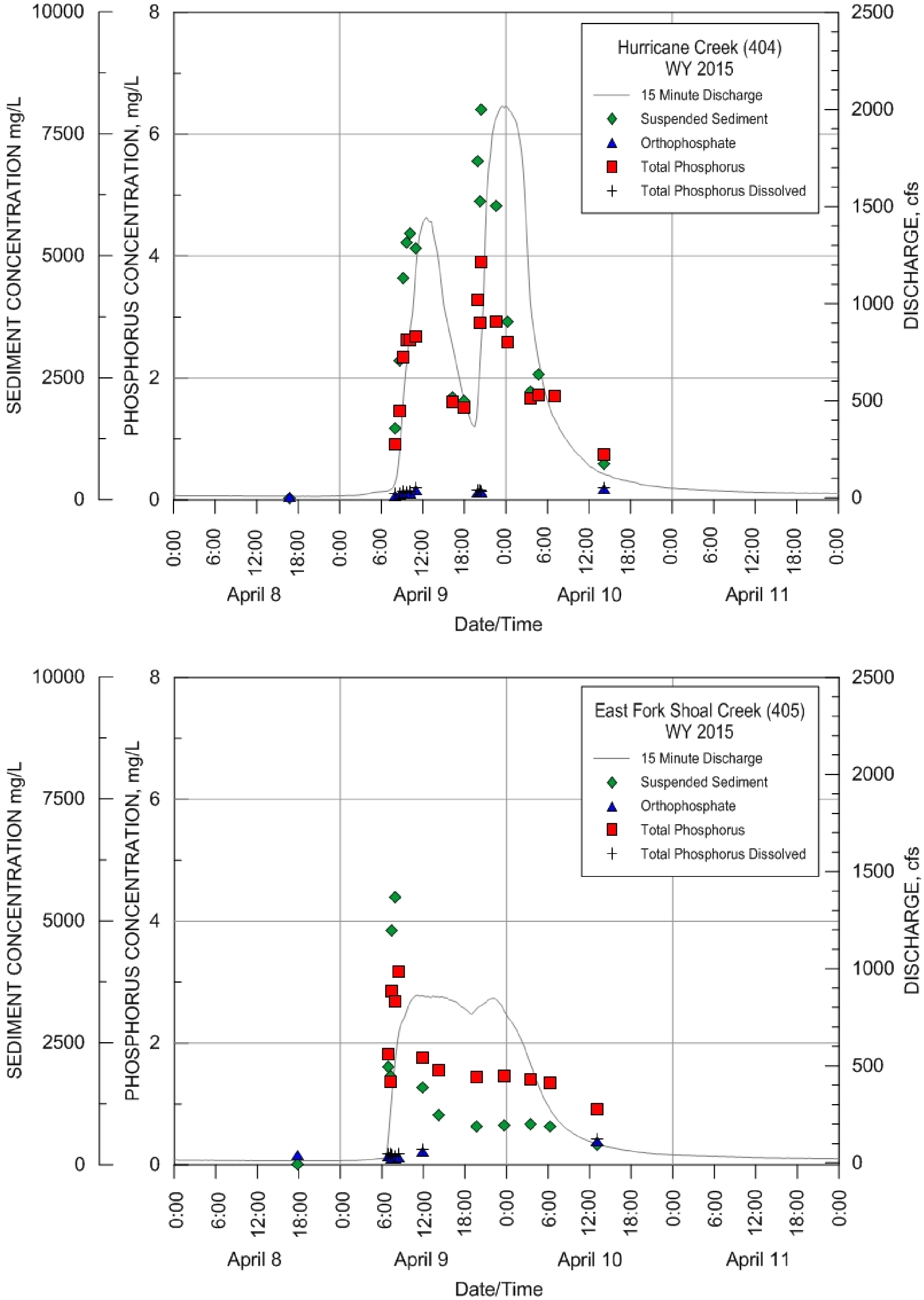


Figure 3-22. Sediment and phosphorus concentrations during April 8-11, 2015 event at Hurricane Creek (404) and East Fork Shoal Creek (405).

Sediment and Nutrient Yields

The collection of sediment and nutrient concentrations, as well as stream discharges, makes it possible to compute the load of sediment of nutrients being transported out of a watershed as measured at a monitoring station. The load is the mass of sediment or nutrients over a determined period of time. However, to compare loads between watersheds in terms of the mass per unit area, the monthly sediment and nutrient yields were computed by dividing the total annual load with the drainage area in acres for each of the monitoring stations. The yield results are provided in tables 3-3 through 3-6 for suspended sediment, nitrate-n, TKN, and total phosphorus, respectively, and illustrated in figures 3-23 through 3-26. Suspended sediment yields are presented in tons per acre (tons/ac) and nitrate-N, TKN, and total phosphorus are presented in pounds per acre (lbs/ac).

Monthly sediment yields forWY2014-15 range from a low of 0.0 to 1.26 tons/acre where Hurricane Creek (404) had the highest yield. Hurricane Creek (404) had the highest annual yield, whereas the other three monitoring stations were much lower and similar in magnitude. As presented earlier, Lost Creek (402) had the highest recorded suspended sediment concentration, however, Hurricane Creek (404) had the highest mean and 75th quartile concentrations of all the stations. For Water Year 2015, Hurricane Creek (404) is transporting the equivalent of nearly 3 tons of suspended sediment per acre.

During WY2014-2105 monthly nitrate-N yields vary from a low of 0.01 lbs/acre at several stations to a high of 1.95 lbs/acre for East Fork Shoal Creek (405) in June 2015. The highest annual nitrate-N yield for WY2015 is 5.21 lbs/ac also at East Fork Shoal Creek (405) with with Lost Creek (402) next at 3.21 lb/acre. Hurricane Creek (404) had the lowest annual nitrate-N yield. Monthly TKN yields during WY2014-15 were higher than nitrate-N yields with Hurricane Creek (404) and Lost Creek (402) near the same with 12.13 and 11.75 lbs/acre, respectively. East Fork Shoal Creek (405) and North Fork Kaskaskia River (403) also similar but lower with 7.37 and 6.19 lbs/acre, respectively. This pairing of yields is similar to suspended sediment yields.

Monthly total phosphorous yields vary from near zero lbs/acre to a high of 3.87 lbs/acre for East Fork Shoal Creek (405) in June 2015. East Fork Shoal Creek (405) had the highest monthly yields for all but only a few months during WY2014-15. This station has a WY2015 annual total phosphorus yield of 11.53 lbs/acre, almost 3 times the annual load of the other stations.

Table 3-3. Suspended Sediment Yield in tons/acre for Kaskaskia Monitoring Stations

		SEDIMENT YIELD (tons/ac)			
	Month	*402*	*403*	*404*	*405*
WY2014					
	Jan 2014	0.003			
	Feb 2014	0.005	0.000	0.009	0.054
	Mar 2014	0.009	0.000	0.061	0.001
	Apr 2014	0.000	0.133	0.757	0.241
	May 2014	0.138	0.019	0.006	0.024
	June 2014	0.003	0.003	0.134	0.074
	July 2014	0.007	0.000	0.001	0.000
	Aug 2014	0.000	0.002	0.006	0.000
	Sept 2014	0.026	0.046	0.009	0.008
WY2015					
	Oct 2014	0.030	0.000	0.237	0.039
	Nov 2014	0.003	0.000	0.016	0.007
	Dec 2014	0.001	0.053	0.081	0.016
	Jan 2015	0.050	0.002	0.017	0.005
	Feb 2015	0.002	0.005	0.006	0.000
	Mar 2015	0.004	0.093	0.264	0.046
	Apr 2015	0.124	0.075	1.262	0.140
	May 2015	0.172	0.113	0.066	0.107
	June 2015	0.091	0.190	1.022	0.287
	July 2015	0.238	0.001	0.002	0.001
	Aug 2015	0.032	0.000	0.002	0.000
	Sept 2015	0.001	0.016	0.001	0.000
***WY 2014**	(April - Sept)	0.19	0.20	0.98	0.40
WY 2015	(Oct - Sept)	0.75	0.55	2.98	0.65

[*-partial water year]

Table 3-4. Nitrate-N Yield in lbs/acre for Kaskaskia Monitoring Stations

		NITRATE-N YIELD (lbs/ac)			
	Month	*402*	*403*	*404*	*405*
WY2014					
	Jan 2014	0.10	0.00		
	Feb 2014	0.10	0.00	0.00	0.25
	Mar 2014	0.00	0.00	0.01	0.09
	Apr 2014	0.48	0.59	0.27	1.05
	May 2014	0.08	0.34	0.01	0.39
	June 2014	0.04	0.07	0.02	0.72
	July 2014	0.00	0.00	0.00	0.00
	Aug 2014	0.10	0.01	0.00	0.00
	Sept 2014	0.06	0.07	0.00	0.01
WY2015					
	Oct 2014	0.01	0.00	0.08	0.11
	Nov 2014	0.03	0.00	0.03	0.17
	Dec 2014	0.37	0.32	0.12	0.49
	Jan 2015	0.03	0.04	0.08	0.25
	Feb 2015	0.03	0.04	0.00	0.11
	Mar 2015	0.31	0.34	0.14	0.54
	Apr 2015	0.25	0.07	0.07	0.30
	May 2015	0.72	0.85	0.07	1.17
	June 2015	1.16	0.65	0.16	1.95
	July 2015	0.19	0.00	0.01	0.12
	Aug 2015	0.01	0.00	0.01	0.00
	Sept 2015	0.09	0.01	0.01	0.01
*WY 2014	(April - Sept)	0.98	1.09	0.31	2.52
WY 2015	(Oct - Sept)	3.21	2.31	0.79	5.21

[*-partial water year]

Table 3-5. TKN Yield in tons/acre for Kaskaskia Monitoring Stations

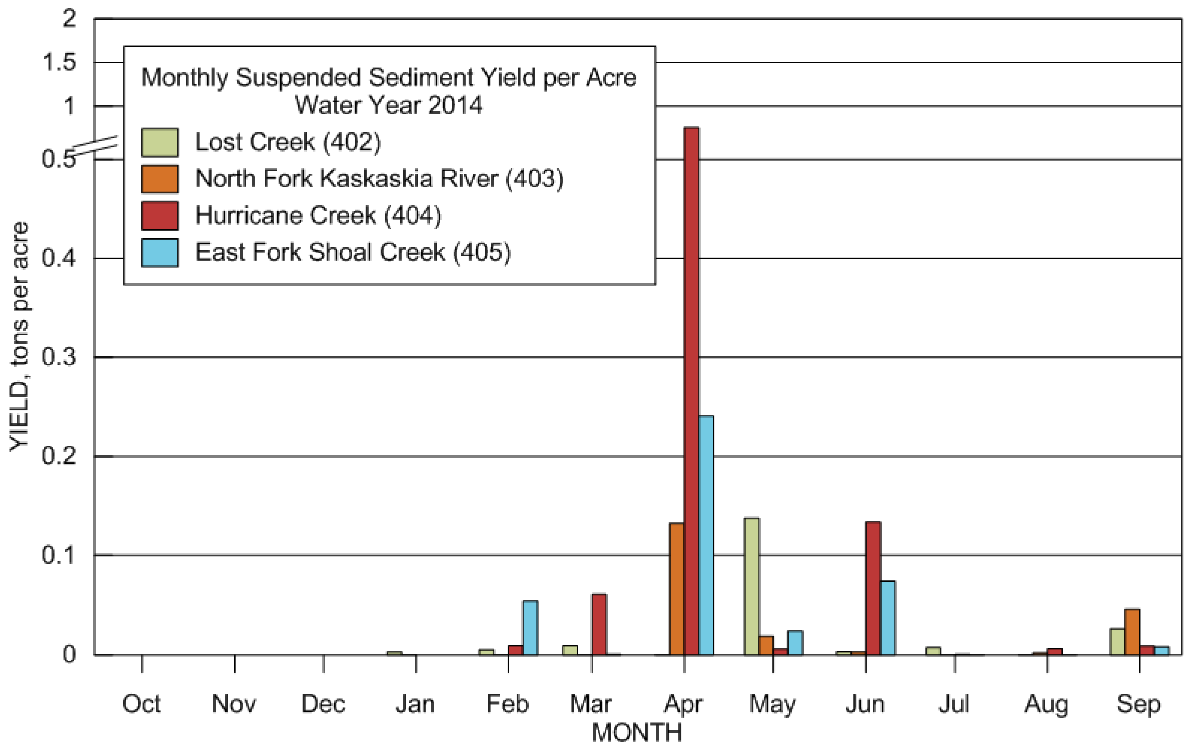
		TKN YIELD (lbs/ac)			
	Month	*402*	*403*	*404*	*405*
WY2014					
	Jan 2014	0.17	0.00		
	Feb 2014	0.34	0.00	0.01	0.73
	Mar 2014	0.00	0.00	0.20	0.15
	Apr 2014	1.72	1.82	3.12	1.93
	May 2014	0.10	0.28	0.42	0.38
	June 2014	0.10	0.06	0.74	0.70
	July 2014	0.00	0.00	0.01	0.00
	Aug 2014	0.33	0.03	0.02	0.00
	Sept 2014	0.36	0.40	0.03	0.06
WY2015					
	Oct 2014	0.10	0.01	1.07	0.65
	Nov 2014	0.16	0.01	0.13	0.24
	Dec 2014	1.39	0.91	0.74	0.51
	Jan 2015	0.14	0.13	0.21	0.23
	Feb 2015	0.10	0.10	0.13	0.08
	Mar 2015	1.69	1.01	1.30	0.75
	Apr 2015	2.27	0.87	3.32	1.29
	May 2015	1.62	1.29	0.70	1.07
	June 2015	3.27	1.75	4.41	2.45
	July 2015	0.55	0.01	0.05	0.08
	Aug 2015	0.06	0.00	0.04	0.01
	Sept 2015	0.39	0.10	0.03	0.02
WY 2014	(April - Sept)	3.12	2.59	4.54	3.96
WY 2015	(Oct - Sept)	11.75	6.19	12.13	7.37

[*-partial water year]

Table 3-6. Total Phosphorus Yield in tons/acre for Kaskaskia Monitoring Stations

		TOTAL P YIELD (lbs/ac)			
	Month	*402*	*403*	*404*	*405*
WY2014					
	Jan 2014	0.08	0.00		
	Feb 2014	0.09	0.00	0.00	1.24
	Mar 2014	0.00	0.00	0.05	0.12
	Apr 2014	0.63	0.82	0.90	2.96
	May 2014	0.03	0.10	0.09	0.47
	June 2014	0.04	0.02	0.19	1.00
	July 2014	0.00	0.00	0.00	0.00
	Aug 2014	0.16	0.02	0.01	0.00
	Sept 2014	0.16	0.17	0.01	0.11
WY2015					
	Oct 2014	0.04	0.01	0.34	1.14
	Nov 2014	0.10	0.01	0.06	0.58
	Dec 2014	0.79	0.61	0.28	0.98
	Jan 2015	0.06	0.08	0.07	0.35
	Feb 2015	0.03	0.04	0.04	0.08
	Mar 2015	0.51	0.43	0.39	0.95
	Apr 2015	0.72	0.32	1.04	1.88
	May 2015	0.56	0.51	0.19	1.48
	June 2015	1.20	0.72	1.38	3.87
	July 2015	0.18	0.01	0.02	0.15
	Aug 2015	0.02	0.00	0.01	0.01
	Sept 2015	0.18	0.05	0.01	0.04
WY 2014	(April - Sept)	1.19	1.13	1.25	5.91
WY 2015	(Oct - Sept)	4.39	2.78	3.83	11.53

[*-partial water year]



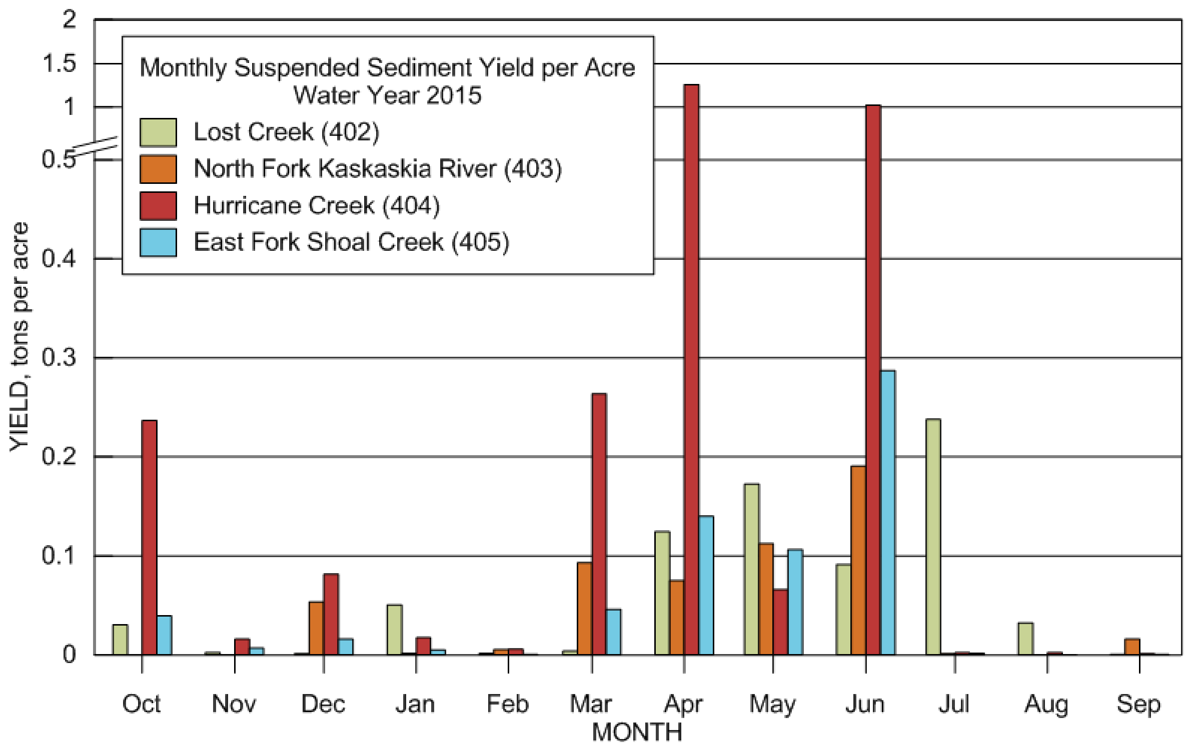


Figure 3-23. Monthly sediment yield (tons/acre) for all stations during WY2014-2015

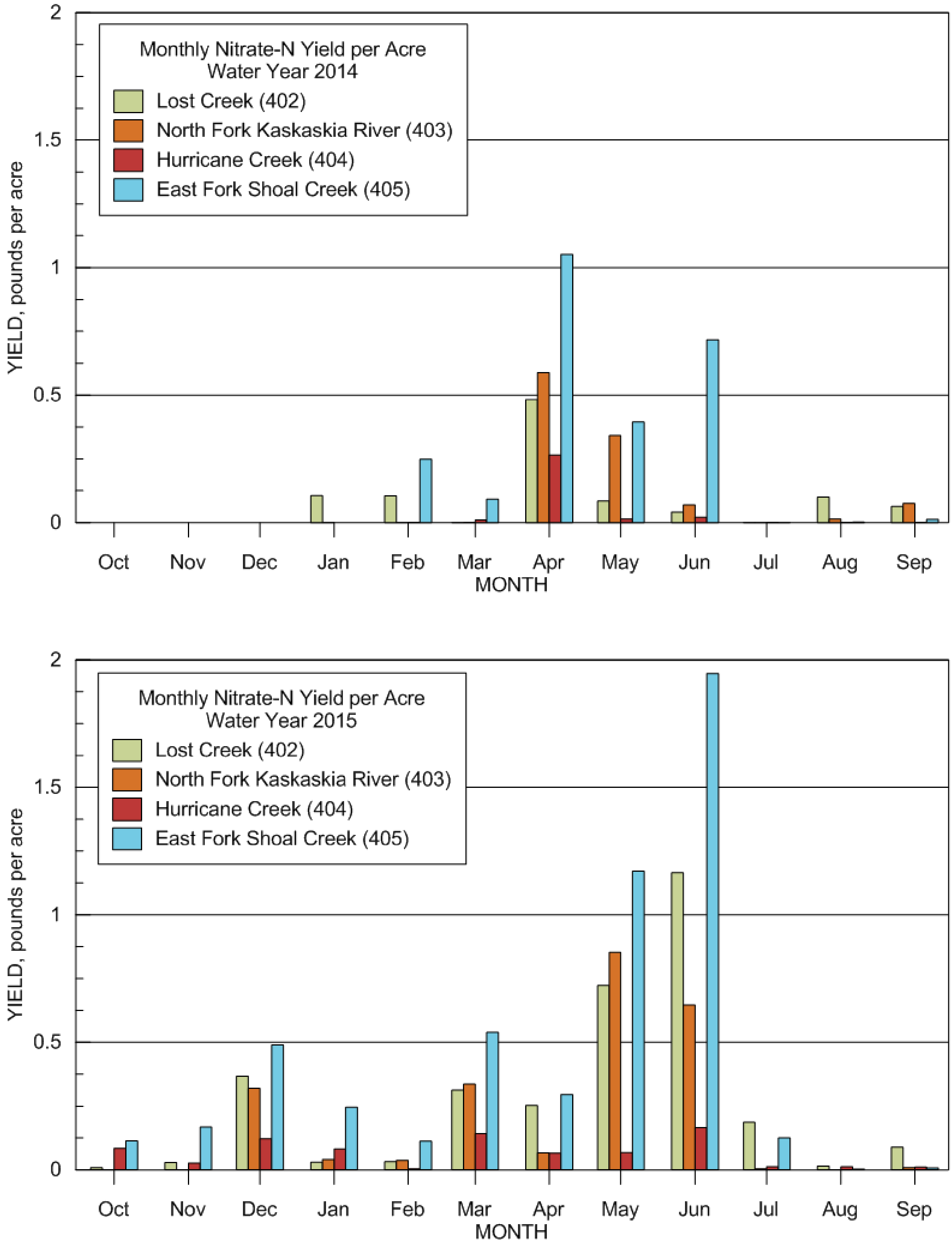


Figure 3-24. Monthly nitrate-N yield (tons/acre) for all stations during WY2014-2015

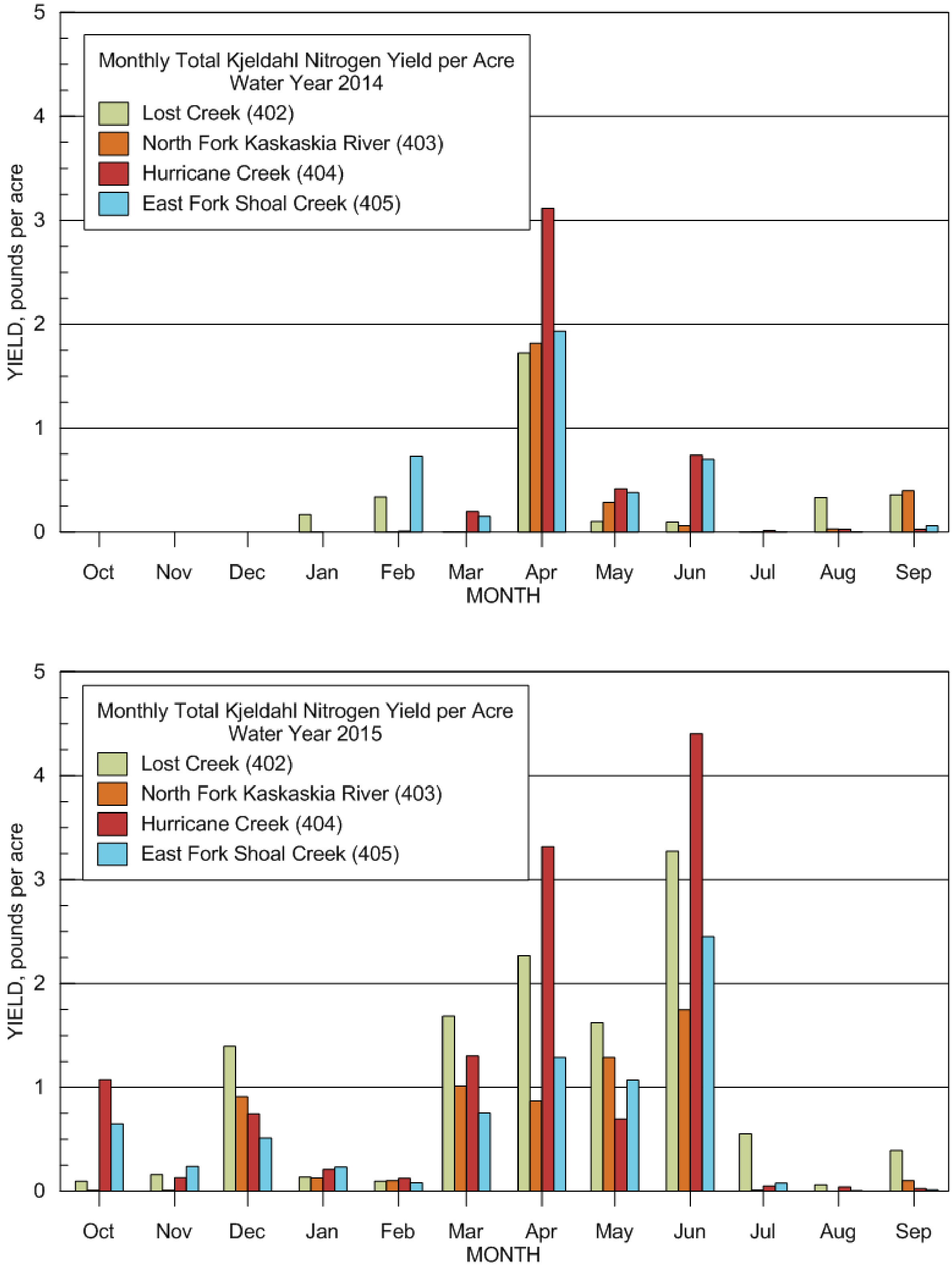
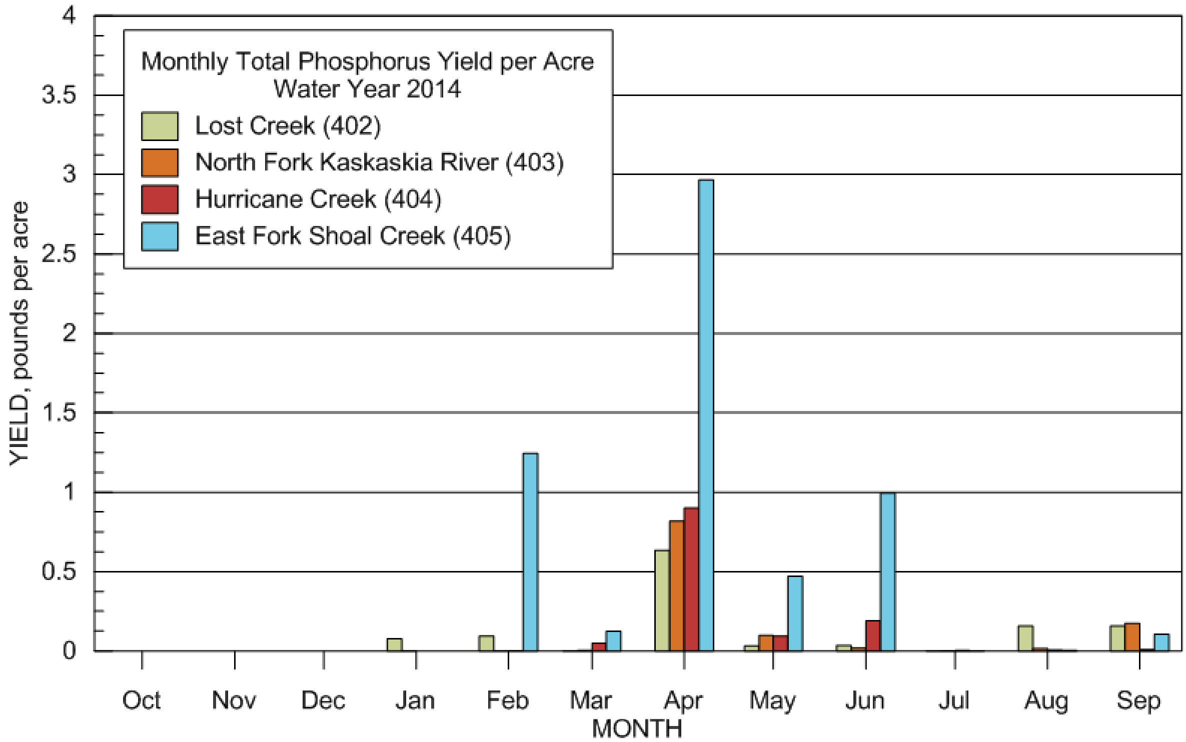


Figure 3-25. Monthly TKN yield (tons/acre) for all stations during WY2014-2015



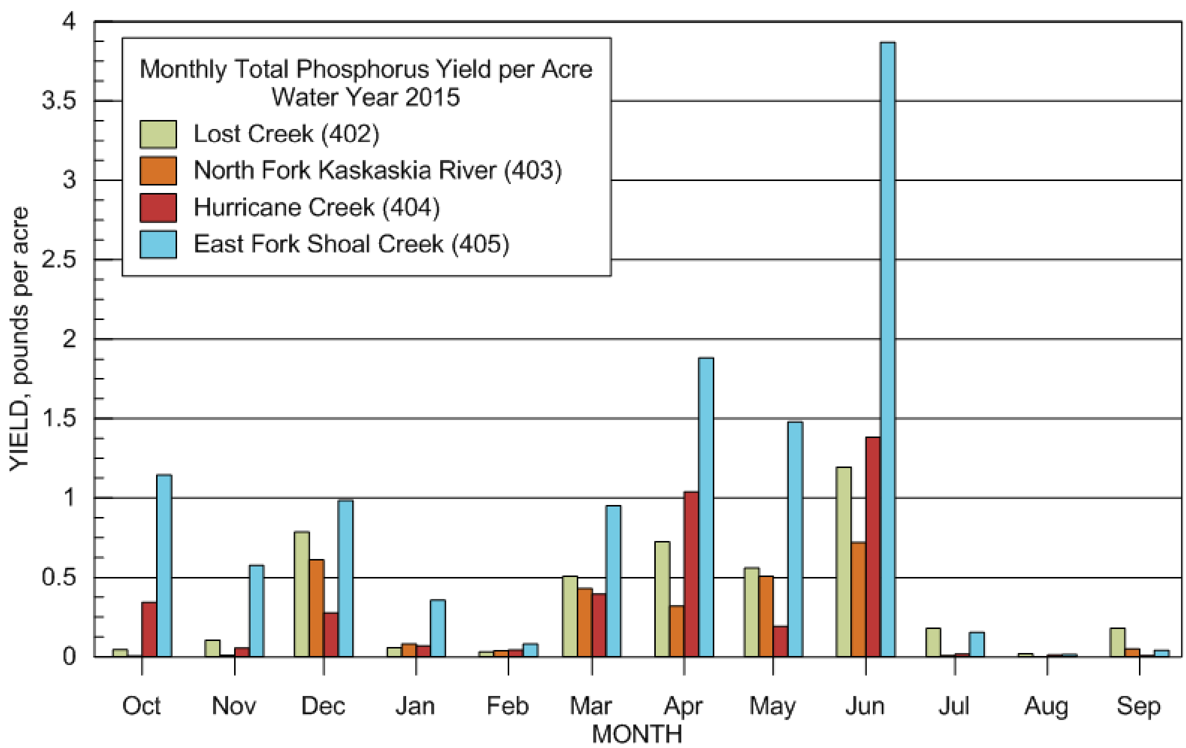


Figure 3-26. Monthly total phosphorus yield (tons/acre) for all stations during WY2014-2015

4. Land Cover and Conservation Practices

Land Cover

The distribution of 2014 land cover and croplands in the Kaskaskia River Basin are illustrated in Figure 4-1 and graphically summarized in Figure 4-2. The data is provided by the National Agricultural Statistics Service (NASS). In general, Figure 4-1 illustrates areas in agriculture production as represented by bright yellow and green colors, whereas woodlands, grassland, and wetlands in lighter greens and blues. Developed, urban types of areas are in gray. The Upper sub-watershed is dominated by agriculture production, the Middle sub-watershed is relatively equal between agriculture and all other land covers, and Shoal Creek and Lower sub-watersheds have agriculture in the flat upland areas and woodland, grassland, and wetlands predominantly in the stream valleys. Figure 4-2 shows land cover in decreasing order of percent area of the Illinois River Basin. Approximately 61 percent of the Kaskaskia River watershed area is in agriculture production, 16, 11 and 9 percent in woodlands, grassland, and developed areas, respectively.

As seen in Figure 4-3, these are the same dominant land covers in the four monitored watersheds with some variations. For many of these land covers the monitored watersheds appear to pair up. Lost Creek (402) and East Fork Shoal Creek (405) watersheds have agriculture production ranging from 74-78 percent while North Fork Kaskaskia (403) and Hurricane Creek (404) watersheds have lower agriculture percent areas (62-63%). This pattern is similar to developed urban-type land areas. The relationship reverses between the paired watersheds for grass/pasture/open lands and woodlands where North Fork Kaskaskia (403) and Hurricane Creek (404) watersheds have 13-14 and 17-20 percent, respectively. Lost Creek (402) and East Fork Shoal Creek (405) watersheds have 8 and 4-6 percent area in grass/pasture/open lands and woodlands, respectively.

Figure 4-4 illustrates the distribution of Conservation Reserve Program (CRP) areas throughout the Kaskaskia River watershed and counties. Based on a visual inspection, a few observations can be made. A majority of CRP areas are in close proximity to streams and waterbodies. Middle and Shoal Creek sub-watersheds appear to have higher concentrations of CRP acres than the other two sub-watersheds. The Upper sub-watershed is less dense but CRP seems to be evenly distributed. The Lower sub-watershed is similar to the Upper except Clinton and Marion Counties are denser.

The USDA National Agriculture Statistics Service (NASS) land cover data has been available since 1999. In 2006 an evaluation of the usefulness of the crop data layers for annual land cover information in Illinois was undertaken by the Illinois State Geological Survey (ISGS) and NASS. Based on inherent errors associated with satellite data, irreparable mechanical problems with older multispectral imagery satellites and land cover classification methods used to interpret that imagery, new enhanced CDL protocols were established in 2007 for Illinois. Consequently, land cover misclassifications were identified prior to the new protocol, which became more apparent when evaluating the land cover in the monitored watersheds (figure 4-5): Lost Creek (402), North Fork Kaskaskia River (403), Hurricane Creek (404), and East Fork Shoal Creek (405). Therefore, any changes in land cover will be evaluated for this report beginning in 2007 through 2013 which is the most currently available NASS CDL data.

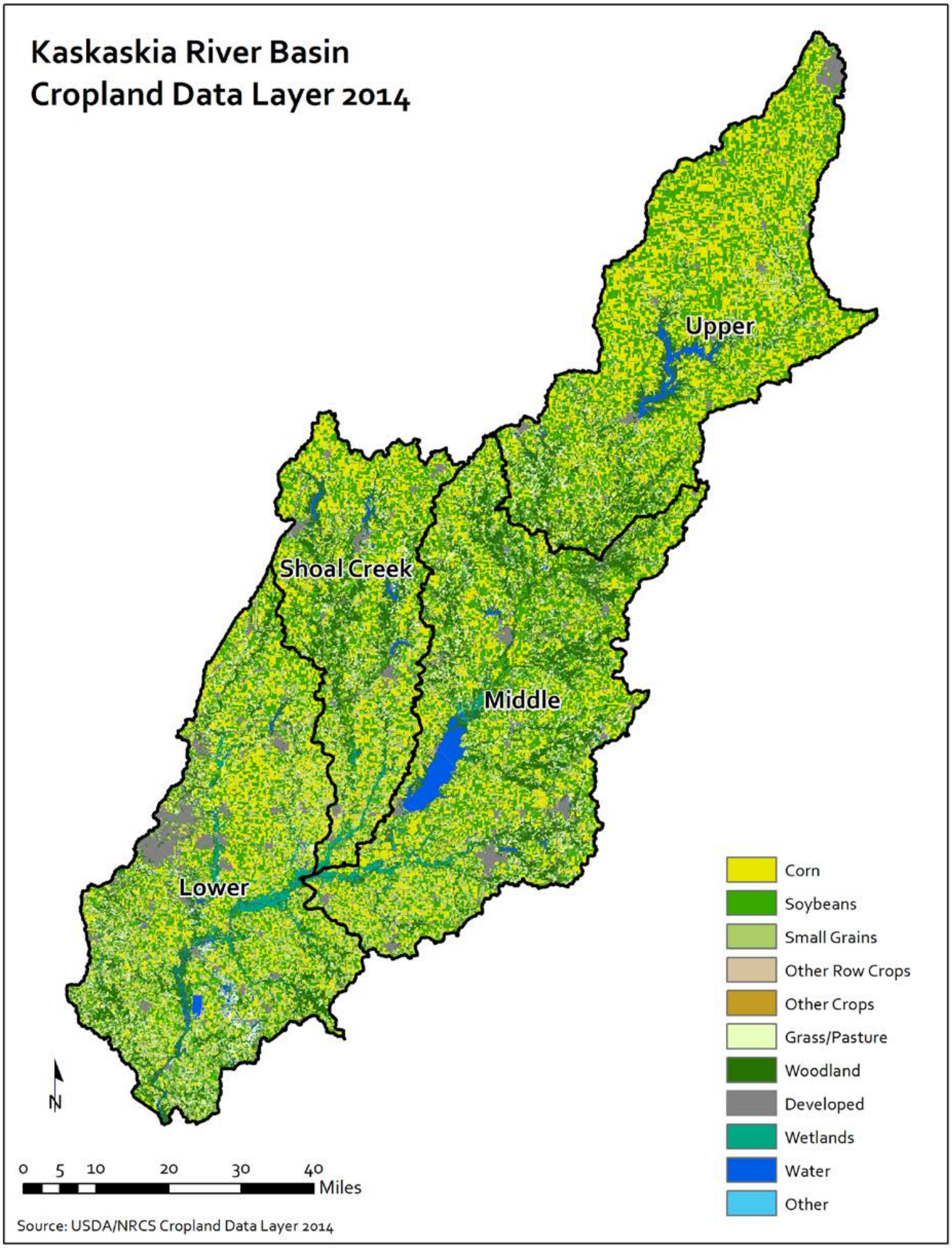


Figure 4-1. Types of land cover in Kaskaskia River Basin

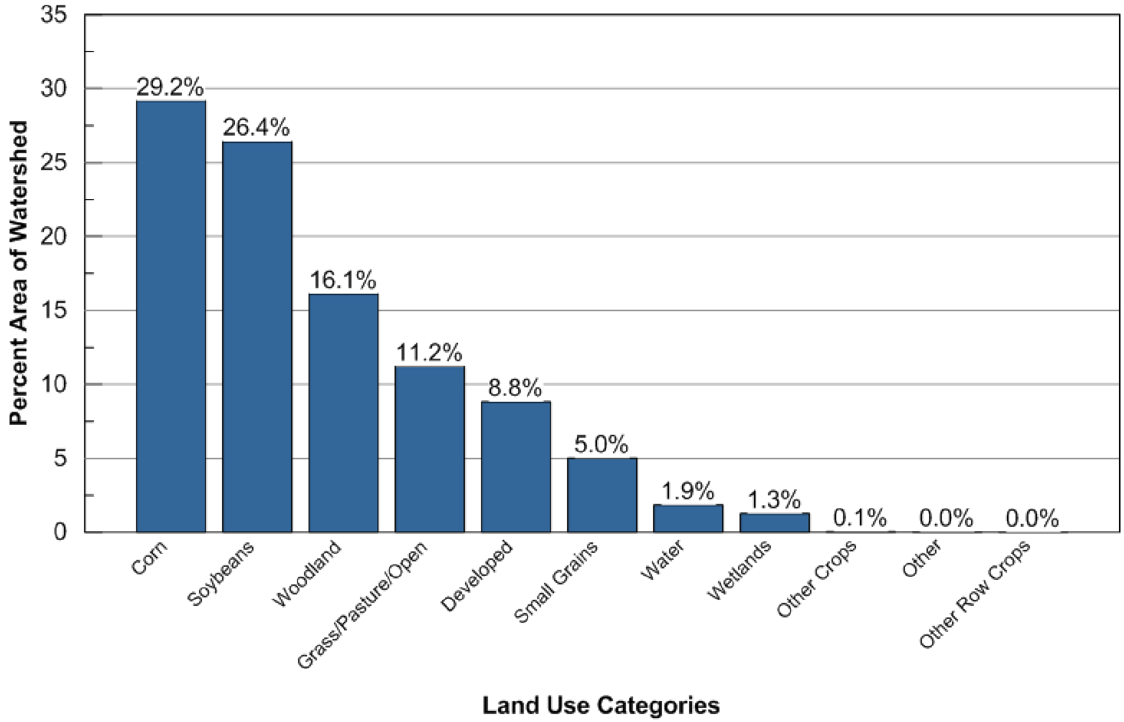


Figure 4-2. Percent watershed area of types of land cover in Kaskaskia River Basin (NASS, 2014)

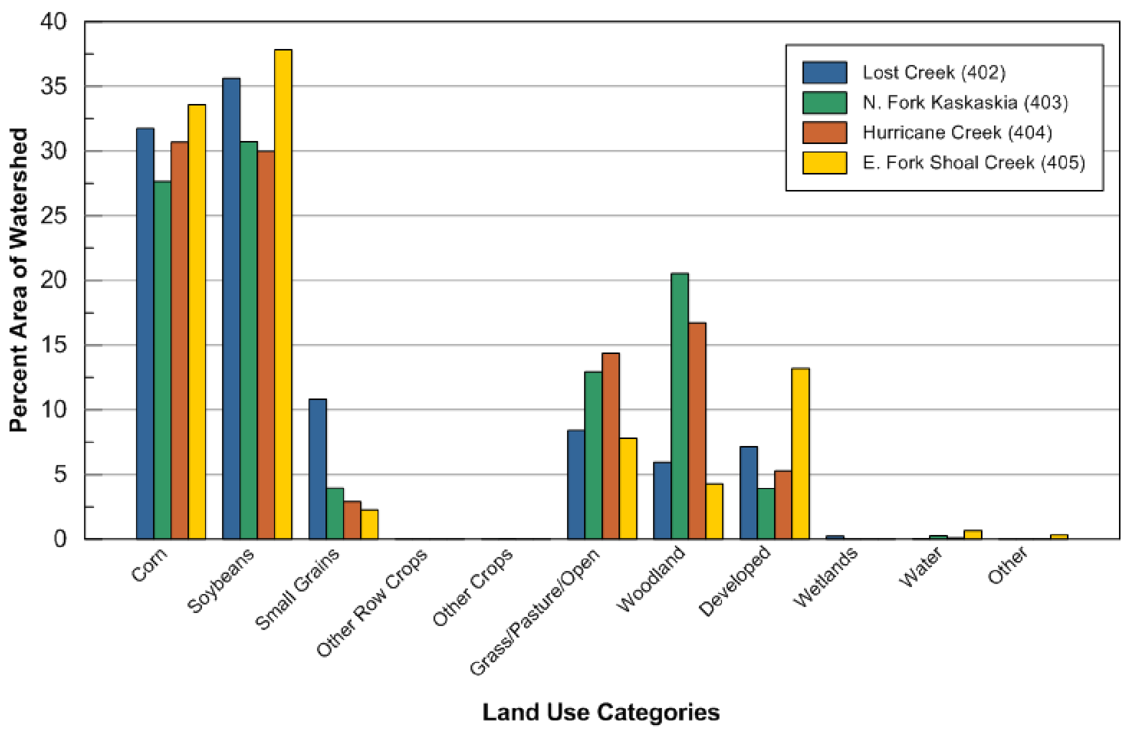


Figure 4-3. Percent watershed area of types of land cover in four monitored watersheds in Kaskaskia River Basin (NASS, 2014)

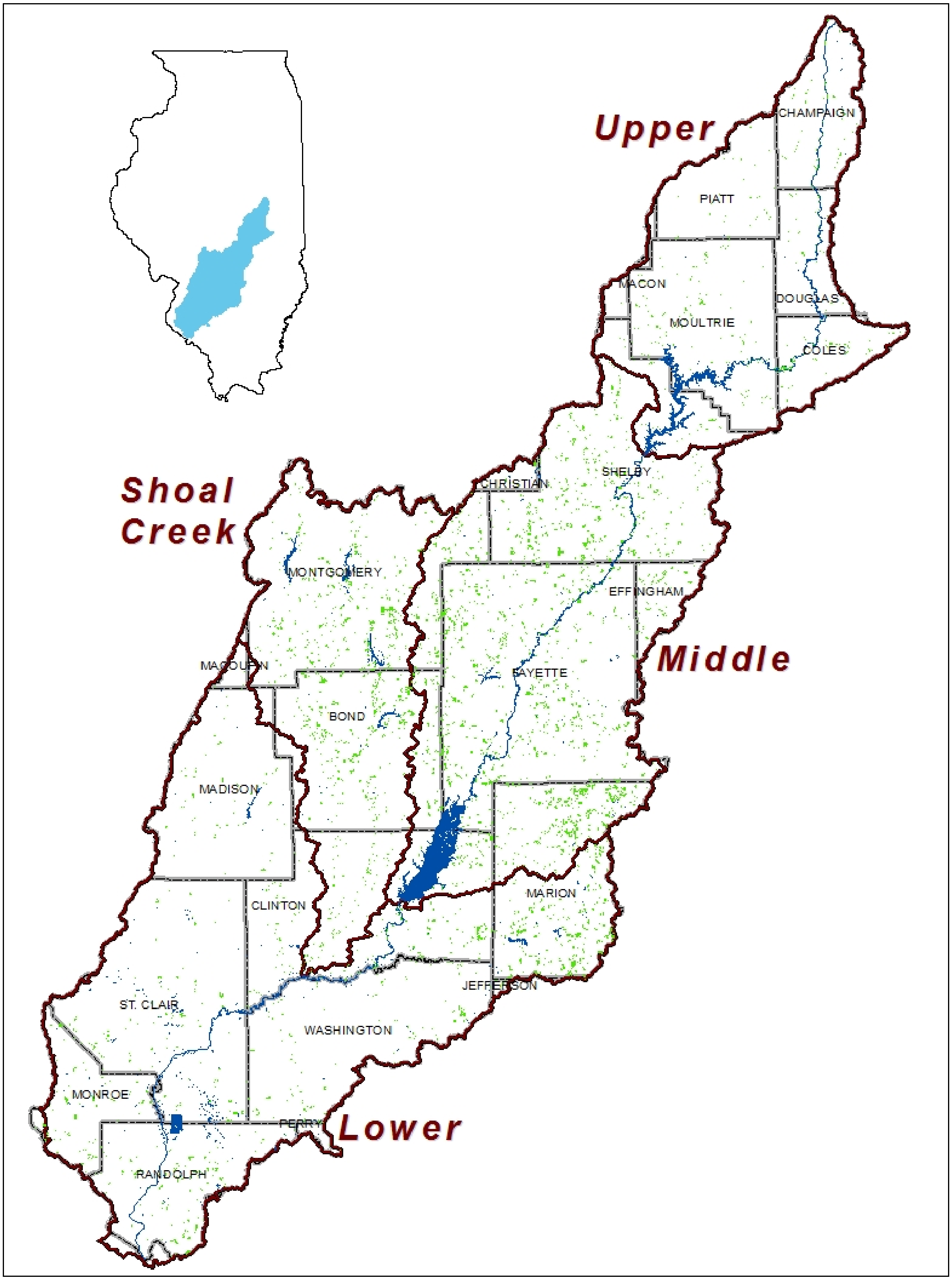


Figure 4-4.Conservation Reserve Program (CRP) in Kaskaskia Basin

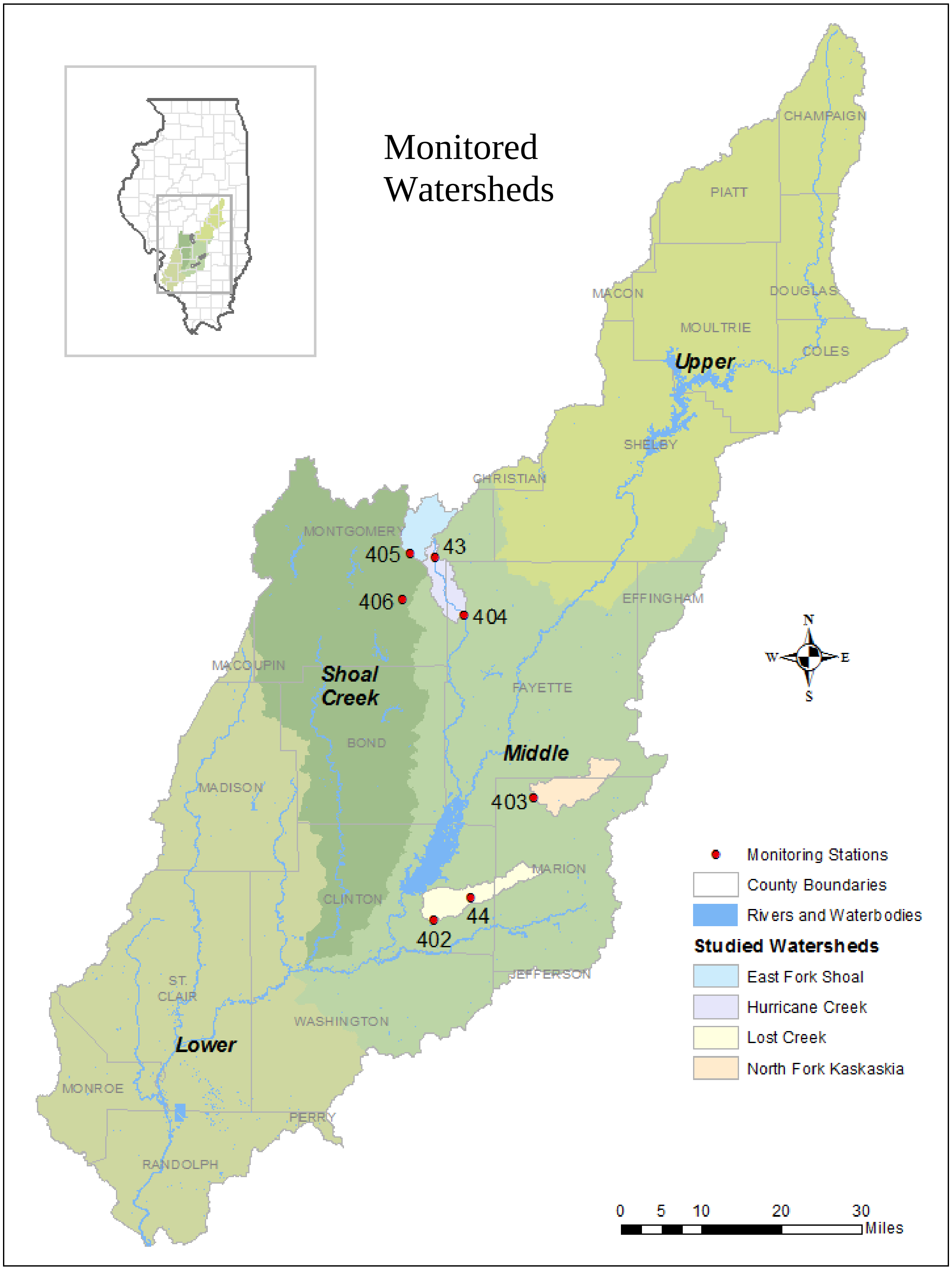


Figure 4-5. Locations of watersheds being monitored for hydrology, sediment and nutrients.

The four monitored watersheds have somewhat different ratios of land cover types. The Panther and Cox Creek watersheds in the Spoon River watershed have 53 and 73 percent area in agriculture and 47 and 27 percent in non-agriculture land covers, respectively (table 4-1). The main difference is Panther Creek has over 20 percent more land in forest/shrubland than Cox Creek, due to a large portion of the watershed lies in the Panther Creek State Conservation Area. Agriculture land cover is 44 and 56 percent in Court and Haw Creeks, respectively, while the non-agriculture area is the inverse. North Creek watershed, a tributary of Court Creek, has a larger portion of land area in forest/shrubland than Haw Creek. Figure 4-6 illustrates the percent change in total watershed acres between 2007 and 2013 for six generalized land cover categories

Table 4-1. 7-year average (2007-2013) percent acres of land cover area by watershed

	ISWS Station Number			
	402	*403*	*404*	*405*
Corn	33	26	30	31
Soybeans	38	30	28	32
Other Crops	1	1	1	1
Grasslands	16	20	22	18
Forest/Shrubland	8	22	18	14
Developed, Barren, Open Space, Water, Wetlands	4	1	2	4
AGRICULTURE	72	57	59	64
NON-AGRICULTURE	28	43	41	36

in each of the four monitored tributary watersheds in the Kaskaskia River Basin. Agriculture land covers were categorized into Corn, Soybeans, Double Crop with Soybeans and Other Cropland, as well as summed in one category identified as Agriculture. Non-agriculture land covers were categorized into Grassland and Forest/Shrubland, and summed as Non-Agriculture. All four watersheds had a 5 percent reduction in Double Crop with Soybeans and non-agricultural land cover area (Grasslands and Forest/Shrubland) between 2007 and 2013. An increase in agricultural land cover area (Corn and Soybeans) ranged from 2 to nearly 7 percent occurred on all four watersheds. Lost, Hurricane, and East Fork Shoal Creek watersheds had marked percent increases in soybean acres and North Fork Kaskaskia watershed had an increase of corn greater than soybeans. The Hurricane Creek watershed experiences the largest decrease in non-agriculture land cover mostly occurring with losses in grasslands. Grasslands decreased on the average of 3.5 percent over all four monitored watersheds.

Figures 4-7 to 4-10 show the changes in each land cover for each year between 2007 and 2013. For this report, NASS Cropland Data Layer (CDL) categories for the monitored watersheds were combined into 6 general land cover categories: 1) corn, 2) soybean, 3) other cultivated crops, 4) grassland, 5) forest/shrubland and 6) developed, barren, open space, water

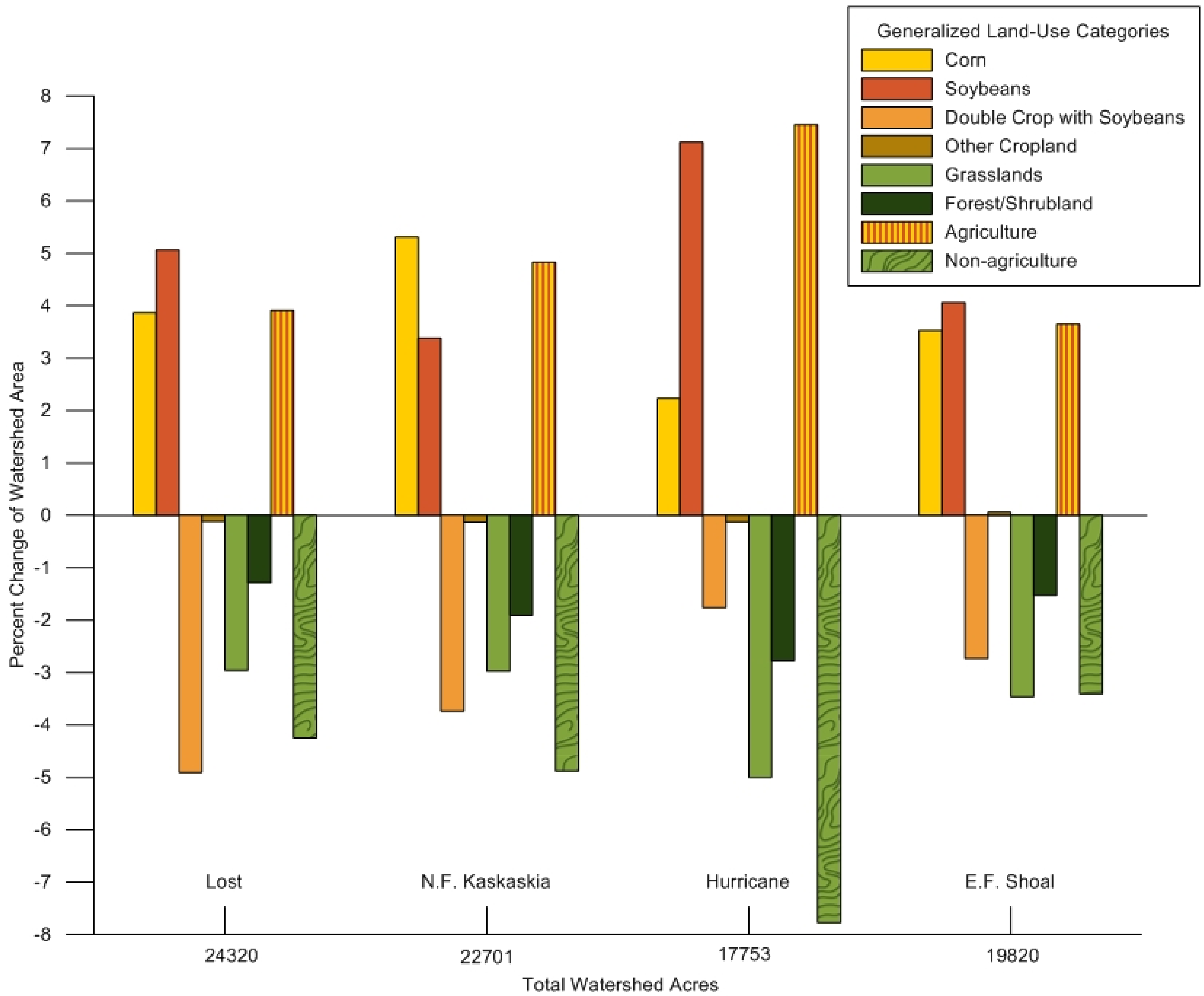


Figure 4-6. Kaskaskia River Basin Watersheds: Percent Change in Generalized NASS Land-Use from 2007-2013.

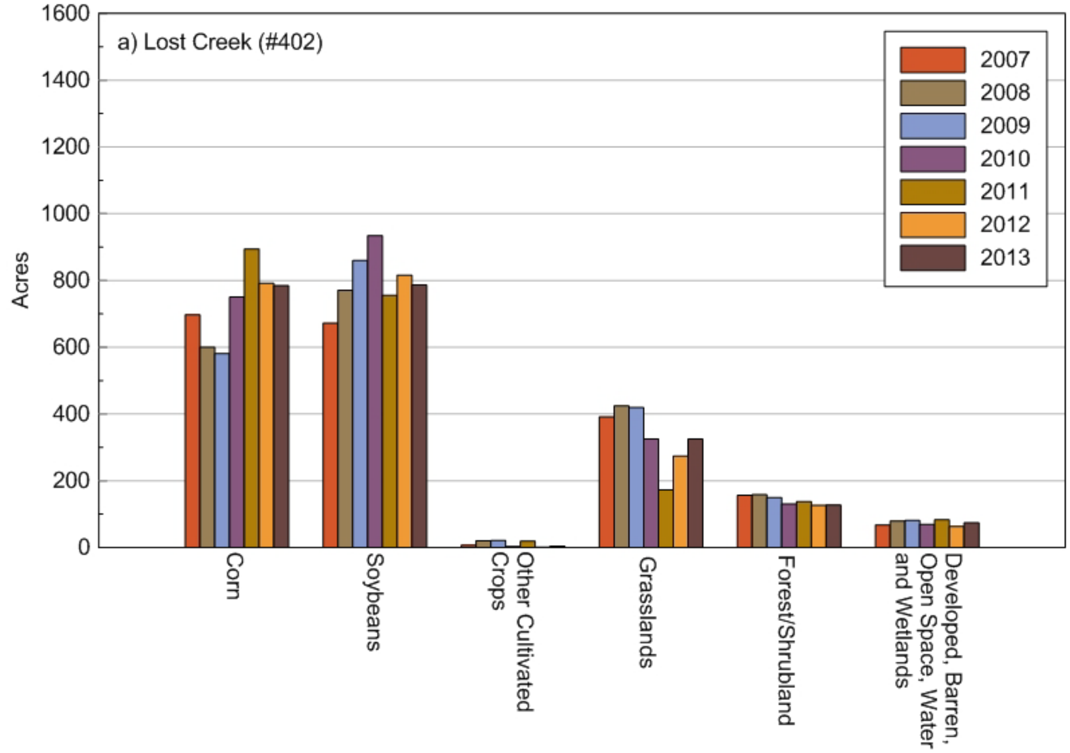


Figure 4-7. Lost Creek watershed from ISWS Station 402: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

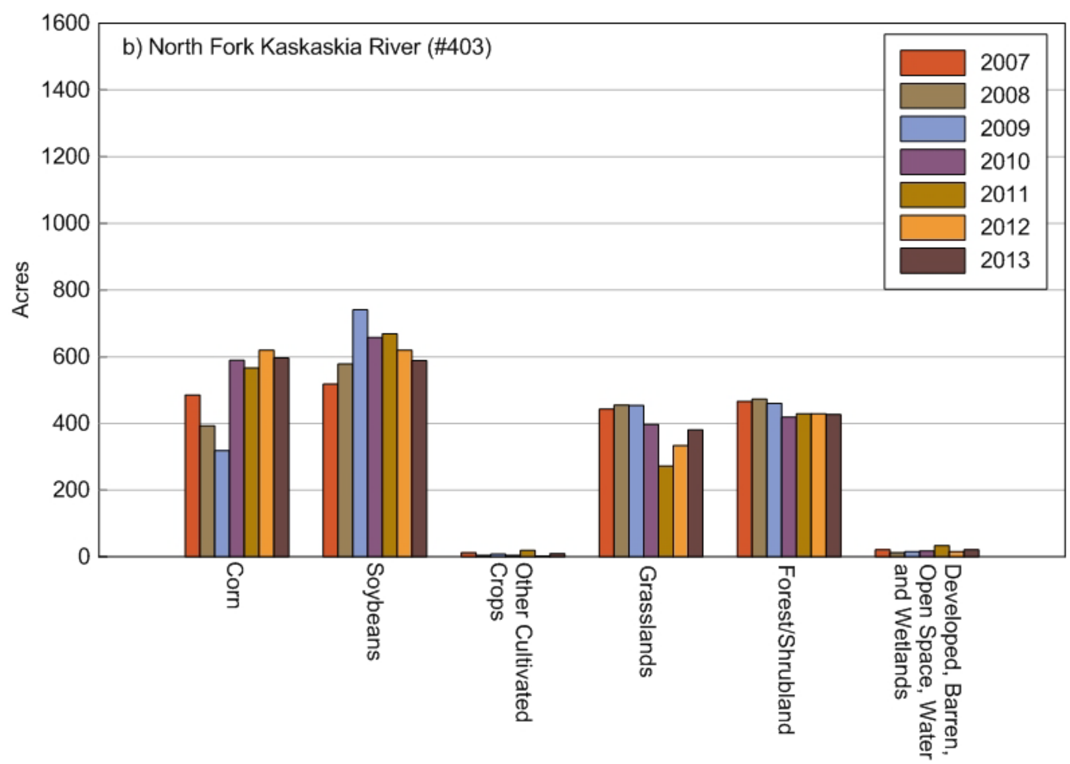


Figure 4-8. North Fork Kaskaskia River watershed from ISWS Station 403: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

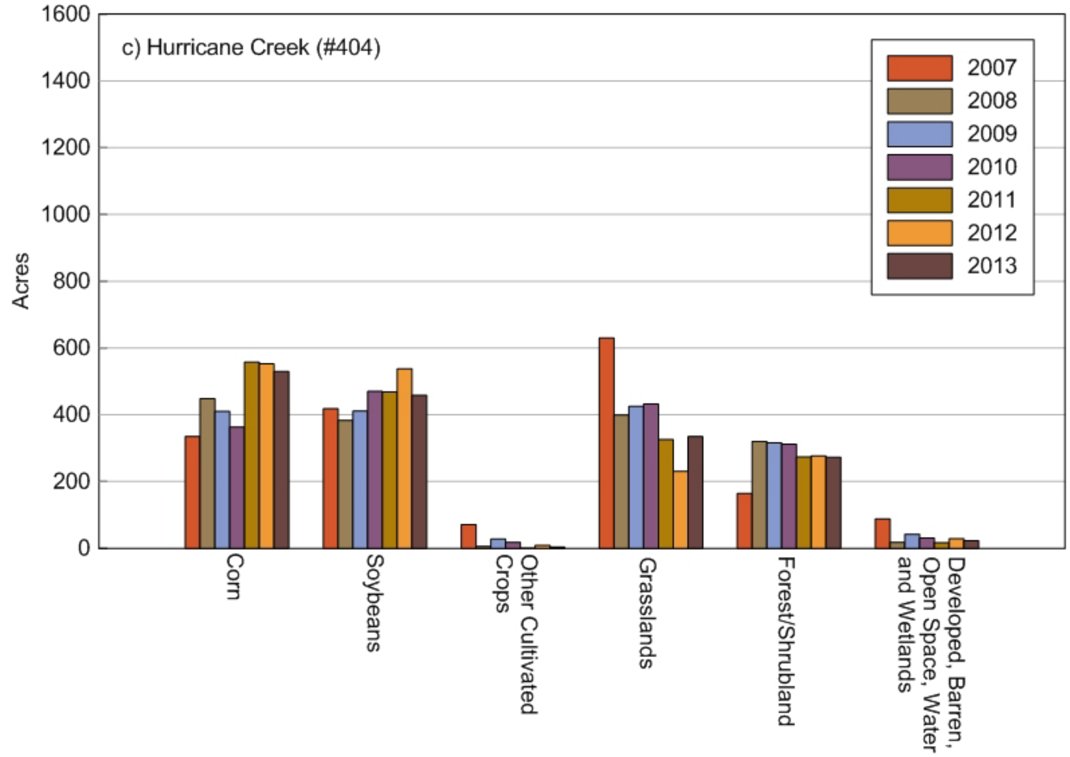


Figure 4-9. Hurricane Creek watershed from ISWS Station 404: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

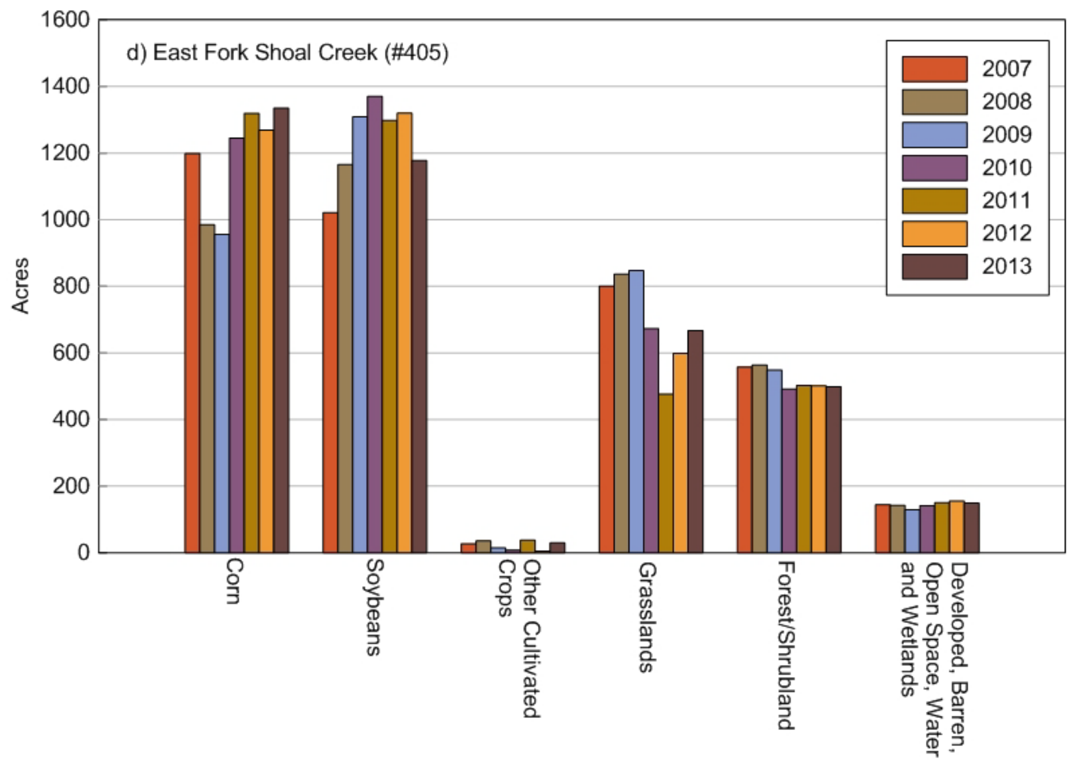


Figure 4-10. East Fork Shoal Creek watershed from ISWS Station 405: Generalized NASS Cropland Data Layer Acreage Totals: 2007-2013.

and wetlands. Land cover area changes between years is represented in acres. Therefore, some watersheds may appear to have greater changes in acreage from year to year but may only represent a small percentage of the watershed depending on the total watershed acres. Lost Creek watershed (figure 4-7) acres varied for corn, soybeans, and grasslands with corn and soybeans increasing in acres when comparing 2007 and 2013. All other land covers remained constant over the 7-year period. North Fork Kaskaskia watershed (figure 4-8) saw similar variability as Lost Creek watershed in most corn, soybeans, and grasslands acreage. Only minor increases in acres for forest/shrubland. North Fork Kaskaskia has equal acres in Grasslands and forest/shrubland, as well as slightly more Soybean acres than Corn. Lost Creek has the lowest acres of forest/shrubland of the four watersheds. Hurricane Creek (figure 4-9) appeared to have a significant decrease in Grasslands and Developed land covers and increase in Forest/shrubland from 2007 to 2008. . Finally, East Fork Shoal Creek (figure 4-10) exhibits the same annual variability in land cover acres between 2007 and 2013 as the other three monitored watersheds. Lost Creek and East Fork Shoal Creek watersheds have the most agriculture land covers of the four monitored watersheds, whereas North Fork Kaskaskia and Hurricane Creek watersheds are more evenly distributed of Corn, Soybean, Grassland, and forest/shrubland land covers. All four watersheds have extremely low acres devoted to other cultivated crops.

Conservation Practices

There has been a significant increase in the implementation of conservation practices in Illinois in recent years with CREP making a major contribution. Figure 4-11 shows the location of approved Illinois CREP contracts from the state of Illinois as of 2014. With this type of information it will be possible to identify areas where there has been significant participation in the CREP program and where changes in sediment and nutrient delivery should be expected. The information will provide important input data to the watershed models that are being developed to evaluate the impact of CREP practices.

There are many conservation practices implemented through the watersheds as a result of federal and state conservation reserve programs. In order to evaluate watershed monitoring efforts, knowing the when and what conservation practices are implemented in the watershed is important. Figures 4-12 to 4-15 are show the cumulative acres of conservation practices installed in the four monitored watersheds from 1999 through 2015. The order by which the practices are listed in the legend represent, from the largest to smallest, the sum of the acres by practice from 1999-2015. The most popular conservation practice is filter strips in Lost Creek and East Fork Shoal Creek watersheds, which are the two watershed with more percent agriculture land cover. Hurricane Creek and East Fork Shoal Creek favored upland bird habitat buffers. The two watersheds identified with higher percent area of woodland and grass/pasture/open lands (North Fork Kaskaskia River and Hurricane Creek) favored permanent wildlife habitat, upland bird buffers, new and existing grasses/legumes, and SAFE-wildlife enhancement conservation practices. North Fork Kaskaskia and Hurricane Creek watersheds have the most variety of practices installed.

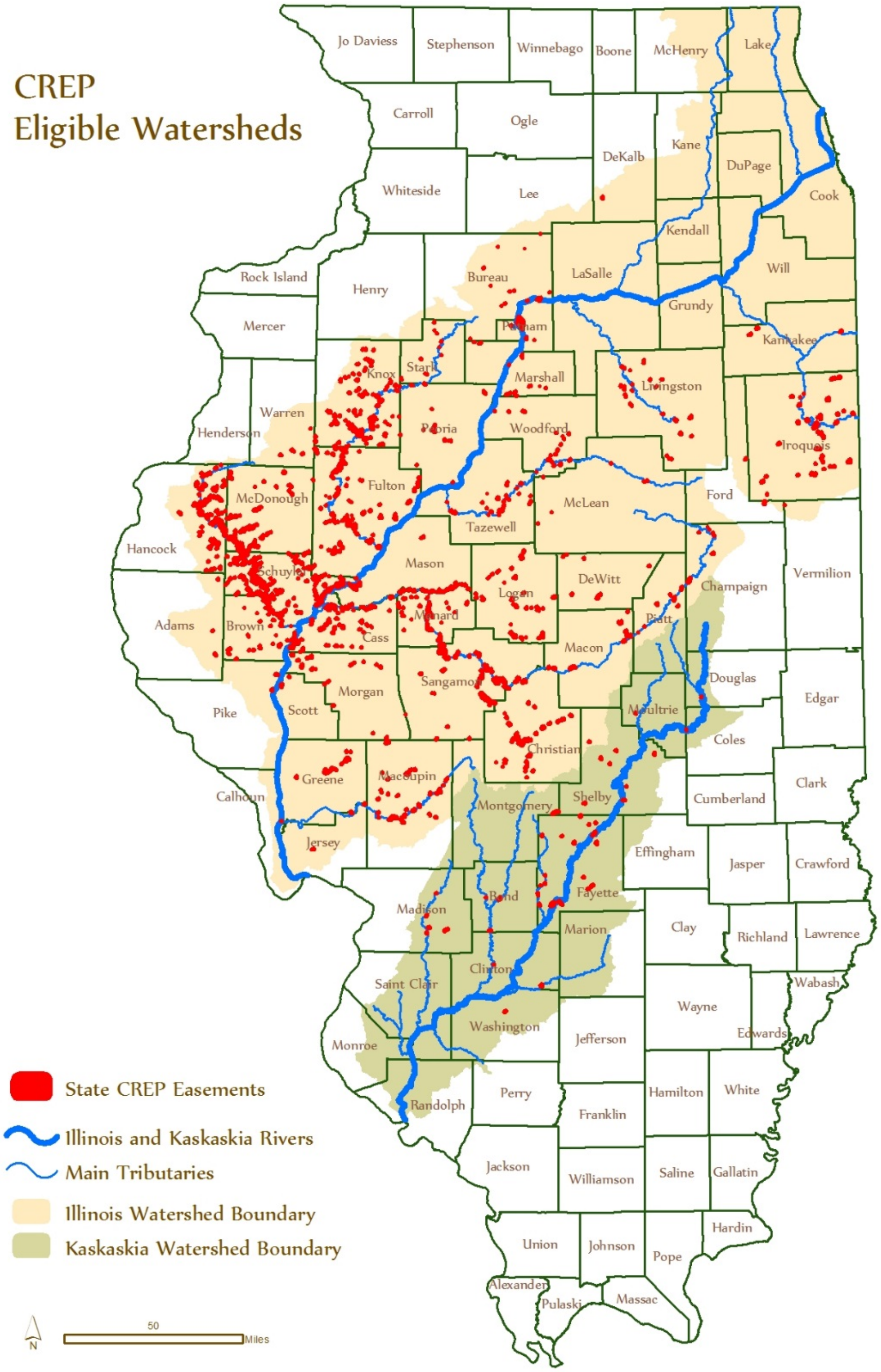


Figure 4-11. State CREP contract locations (IDNR, 2015).

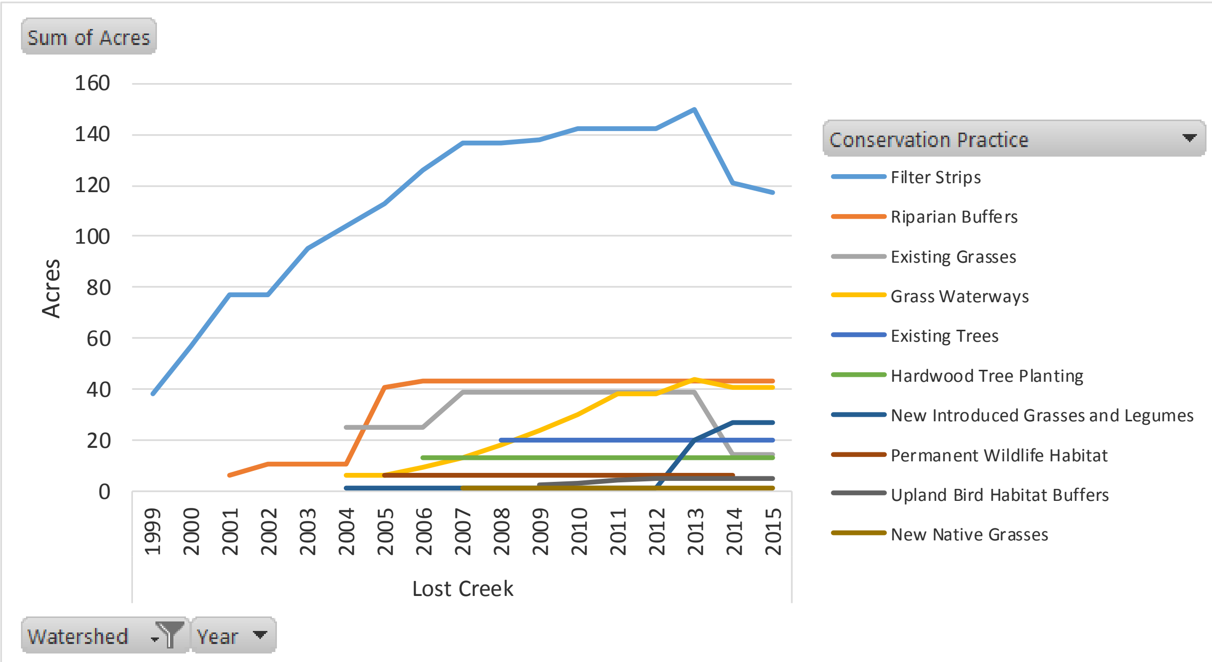


Figure 4-12. Cumulative acres of conservation practices installed in Lost Creek watershed at monitoring station ISWS #402 from 1999-2015.

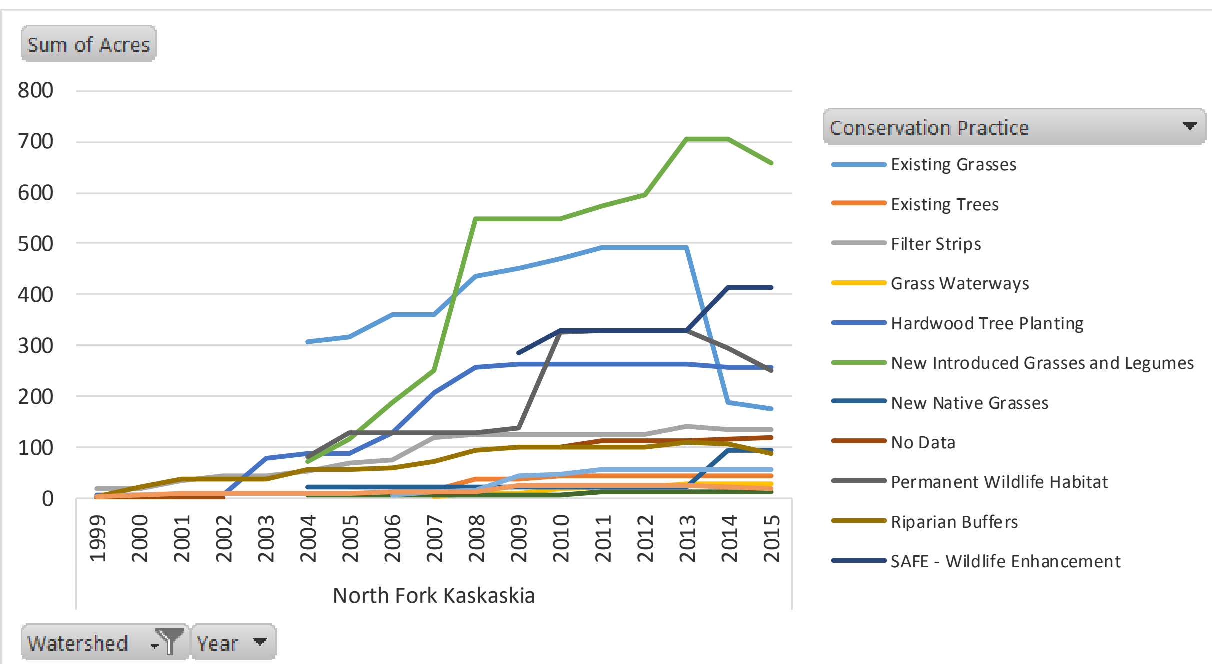


Figure 4-13. Cumulative acres of conservation practices installed in North Fork Kaskaskia River watershed at monitoring station ISWS #403 from 1999-2015.

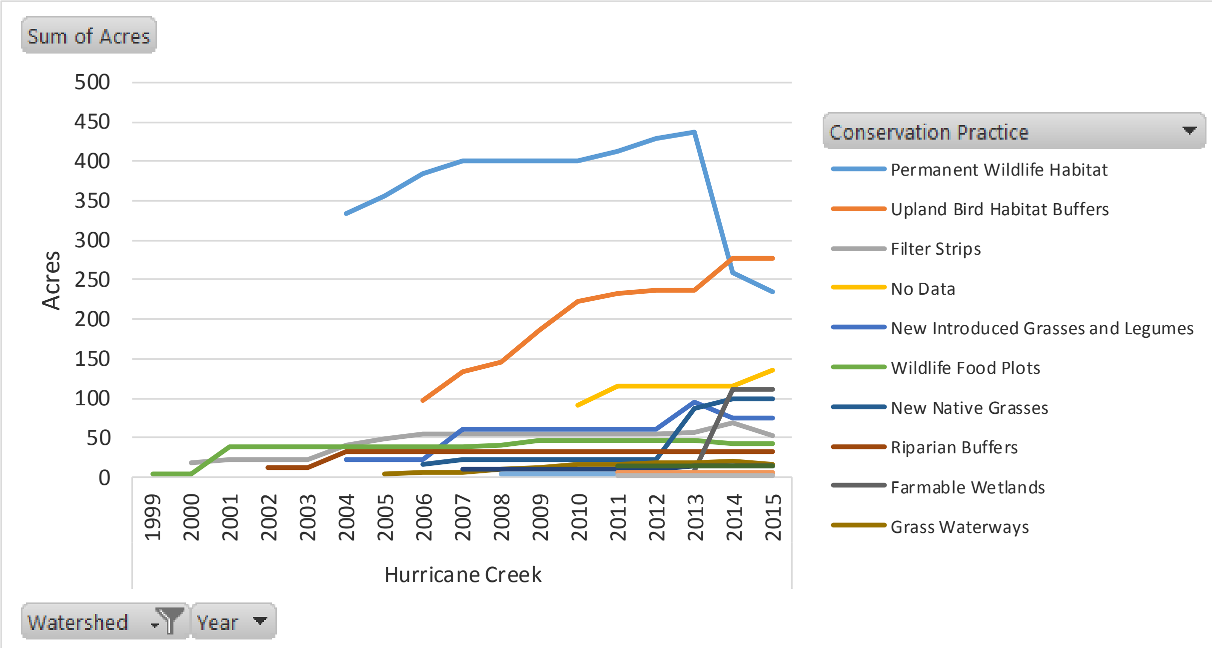


Figure 4-14. Cumulative acres of conservation practices installed in Hurricane Creek watershed at monitoring station ISWS #404 from 1999-2015.

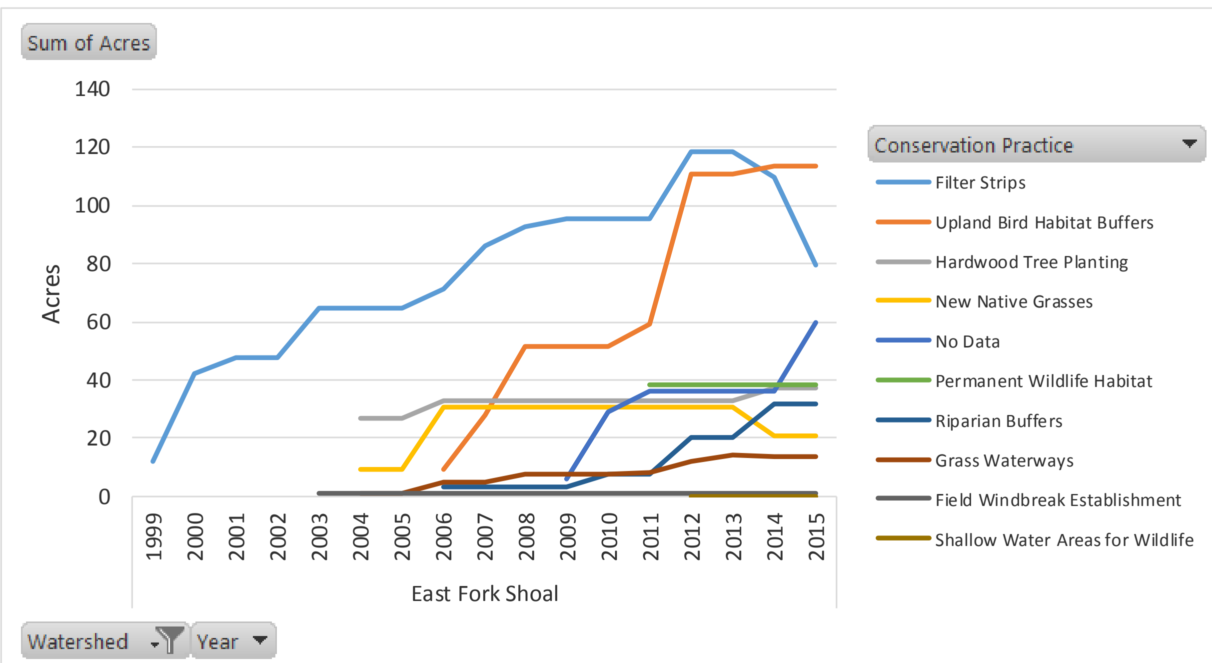


Figure 4-15. Cumulative acres of conservation practices installed in East Fork Shoal Creek watershed at monitoring station ISWS #405 from 1999-2015.

5. Summary and Conclusions

The Conservation Reserve Enhancement Program (CREP) was initiated as a joint federal/state program with the goal of improving water quality and wildlife habitat in the Illinois and Kaskaskia River basins. Based on numerous research and long-term data in the Illinois River basin, the two main causes of water quality and habitat degradations in major river corridors were known to be related to sedimentation and nutrient loads. Based on this understanding, the two main objectives of the CREP were to reduce the amount of silt and sediment entering the main stem of the Illinois and Kaskaskia Rivers by 20 percent; and to reduce the amount of phosphorous and nitrogen loadings to by 10 percent. To assess the progress of the program towards meeting the two goals, the Illinois Department of Natural Resources (IDNR) and the Illinois State Water Survey (ISWS) are developing a scientific process for evaluating the effectiveness of the program.

The monitoring and data collection component consists of a sediment and nutrient watershed monitoring program for selected sub-watersheds within the Kaskaskia River basin and also to collect and analyze land use data throughout the basin. Currently available data is insufficient to monitor long-term trends especially in small watersheds where changes can be observed and quantified more easily than in larger watersheds. To fill the data gap and to generate reliable data for small watersheds, the Illinois Department of Natural Resources funded the Illinois State Water Survey to establish a monitoring program to collect precipitation, hydrologic, sediment, nutrient and land cover data for selected small watersheds in the Kaskaskia River basin that will assist in making a more accurate assessment of sediment and nutrient delivery.

The four small watersheds selected for intensively monitoring sediment and nutrient in the Kaskaskia River basin are located within the Crooked Creek, North Fork Kaskaskia River, Hurricane Creek and Shoal Creek watersheds. In addition, two continuous recording raingages were established near the monitored watersheds. Lost Creek (402) is a tributary of Crooked Creek which, in turn is a direct tributary of the Kaskaskia River with its confluence downstream of Carlyle Reservoir. The Carlyle Reservoir is a U.S. Army Corps of Engineers impoundment on the Kaskaskia River. The North Fork Kaskaskia River (403) and Hurricane Creek (404) are direct tributaries of the Kaskaskia River and discharge directly into the upstream end of Carlyle Reservoir. East Fork Shoal Creek (405) is a tributary of Shoal Creek, the largest direct tributary of the Kaskaskia River, with its confluence downstream of Carlyle Reservoir.

After assessing and evaluating many physical, geological, biological, land cover and CRP program data and information, as well as impacts of the 2012 drought, four intensive monitoring stations were selected and the sediment and nutrient monitoring network was established for the 2014 water year (October 2013-September 2014). The WY2014 started in one of the coldest winters recorded in the region for some time. This was followed by a particularly wet spring and summer. Water Year 2015 (October 2014-September 2015) also had a particularly cold winter followed by a wet spring but did not continue very far into the summer months as happened the previous year. During WY2014-15 nitrogen and phosphorus species concentrations more associated with particulate forms (TKN, t-P) were higher than concentrations of the dissolved forms (NO_3-N and TDP). Suspended sediment concentrations were higher in watersheds with higher percent area devoted to agriculture production or higher upland slopes. However, suspended sediment yield results indicate that the highest yield of the 4 monitoring stations is from Hurricane Creek (404) which has the highest slope of the four watersheds. Nitrate-N and total phosphorus yields were highest in East Fork Shoal Creek (405) and TKN yield was highest in Lost Creek (402) and Hurricane Creek (404). Some of the highest concentrations for sediment, nitrogen, and phosphorus occurred in June of 2015 which had the highest recorded monthly discharges.

6. References

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