State Water Survey Division
WATER QUALITY SECTION
AT
PEORIA, ILLINOIS

Illinois Department of
Energy and Natural Resources

SWS Contract Report 322

AN INVENTORY OF COURT CREEK WATERSHED CHARACTERISTICS THAT MAY RELATE TO WATER QUALITY IN THE WATERSHED

by
Donald Roseboom, Ralph L. Evans,
John Erickson, and Lyle G. Brooks

Prepared for the
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Project No. 83/2004

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CONTENTS

FIGURES

FIGURES *(Concluded)*

TABLES

TABLES *(Concluded)*

AN INVENTORY OF COURT CREEK WATERSHED CHARACTERISTICS THAT MAY RELATE TO WATER QUALITY IN THE WATERSHED

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INTRODUCTION

In recent years the time-honored policies and activities for the enhancement of water quality in the surface waters of Illinois have been complicated by a growing concern for non-point sources of pollution. Historically, stream and lake pollution abatement programs have concentrated efforts toward minimizing the adverse influences of waste discharges from municipalities and industries, i.e., point sources. As these efforts intensified and more and more waste treatment facilities became operative it was expected that established water quality standards would be achieved. However, statewide monitoring of Illinois streams indicated that this was not the case. In many instances the concentrations of bacteria of fecal origin, the nutrients nitrogen and phosphorus, and certain heavy metals persisted in streams in excess of water quality standards. Additionally, expressions of concern began to develop regarding the insidious effects of excessive suspended solids in stream waters. It is now apparent that concentrations of bacteria, nutrients, and heavy metals are not independent of suspended solids concentrations.

Quantifying non-point sources of pollution is an elusive business. Effective methodologies for developing an understanding of the linkage between land and stream quality lag behind the expertise for managing point sources of pollution. This progress report summarizes the first year of a 3-year study designed, in part, to examine several techniques that may be applicable to performing a detailed assessment of a watershed and its relationship to the quality of the surface waters within it.

The Court Creek watershed, located in the geographical center of Knox County, Illinois, is the study site. The principal objectives of the overall study are:

(1) To identify those sectors in the watershed which significantly influence the water quality of surface waters.

(2) To prepare a water quality management plan, in cooperation with local residents and land owners, designed to minimize the adverse influence, if any, of non-point sources of pollution.

The activities during the first year (beginning in August 1980) dealt mainly with performing an inventory of the watershed, selecting stream sampling stations, installing measuring devices, and reconnoitering streams and terrain. This report summarizes the information and the results obtained during the first year of the study. The information and results will form the basis for determining any relationships that may exist between the factors identified during the first year and the characteristics of stream-water quality defined during the second year of the study. A separate report will detail land use – water quality relationships.

Report Plan

This is a report of baseline information. It is data-oriented without significant conclusions. The report has five sections that deal with the following topics:

1) Description of the study area
2) Land use
3) Stream-related data
4) Fish populations
5) Wildlife resources

Each section can stand independent of the other sections. Included in each section except the first one is a description of the procedures used, a statement about the results, a discussion, and a summary. Considerable reliance has been placed on tables and figures. A set of appendices is also available under separate cover.

Acknowledgments

This report was prepared under the general administration of Stanley A. Changnon, Jr., Chief of the Illinois State Water Survey. The following individuals were extremely helpful and were important to the success of the Court Creek Study.

Jane Johnson, President of the Spoon River Watershed Tributary Project, labored diligently for a study of land management on the Spoon River and its tributaries. It was through her interest that the project was conceived and mainly through her untiring efforts that the project was funded.

Kenneth Russell, fishery biologist of the Illinois Department of Conservation, performed and evaluated a fish survey of Court Creek. His 18-year residence in the Court Creek watershed and his occupational experience throughout the state have made his contribution particularly valuable. Daniel Sallee, Robert Williamson, and Larry Smith performed the fish sampling and identification under adverse conditions.

Norman Emmerick, an upland game biologist of the Illinois Department of Conservation, evaluated the hunting and fur-bearing animal populations of Court Creek.

Robert Johnson of the United States Geological Survey determined the topography of the Court Creek watershed during 1978, so that the watersheds of Court Creek and its tributaries could be accurately measured. The Centerville (Missouri) Office was particularly helpful in obtaining advance copies of the topographic maps.

Several individuals of the Agricultural Stabilization and Conservation Service (ASCS) have aided the study. Melvin Neuman, director of the Knox County ASCS Office, has been especially helpful in providing direction on obtaining ASCS aerial photographs and their evaluations, as well as in offering meeting room facilities in his office. Mary McDonald of the Las Vegas Aerial Photography Field Office was especially helpful in obtaining earlier photographs of Court Creek.

Aerial Data Systems of Monmouth, IL, particularly Larry Daugherty, Steve Carrier, Jim Wells, and Jim Goldrick, were very patient in the original aerial analysis and subsequent data evaluations of that analysis.

Several Soil Conservation Service people from USDA were very important to the study. William Hartman, area conservationist of Region 3, and Roger Windhorn, Knox County Soil Survey leader, advanced the scheduling of soil surveys in Persifer and Knox Townships. Through their expert advice and data, the land management soils section has been completed. Bruce Houghtby of the Knox County Soil Survey was expecially helpful in establishment of a soil moisture probe and provision of soil maps. Rick Gledhill, director of the Knox County SCS office, has reviewed much of the land management and soil material included.

Illinois State Water Survey personnel who aided the project represented a broad spectrum of environmental sciences. Douglas Jones of the Climatology Section developed a network of 13 rain gages in the watershed. He and Keith Hendrie established a soil moisture installation in the watershed. Ming T. Lee of the Surface Water Section was extremely helpful in planning the experimental design for the land management and soil runoff sections. Also, Michael Terstriep and David Kisser designed a program of streambank erosion monitoring and bank monuments.

David Hullinger, head of the Water Quality Section chemistry laboratory, Dana Shackleford, Brent Gregory, and James Shields constantly received samples at unscheduled dates on the occurrences of heavy rainfall. Donald Schnepper and one of the authors of this report, Lyle G. Brooks, undertook the establishment of streamflow gages and the monitoring of instantaneous streamflow velocities at different stream stage heights. Thomas Butts, Richard Twait, Thomas Hill, and another of the authors, John Erickson, walked the entire length of Court Creek and North Creek while examining streambank erosion sites. In addition, Thomas Butts performed a meticulous determination of streambed length and rate of fall from the USGS topographic maps.

Jim Williams performed a detailed ground truth survey of the 1979 land management data, especially feedlot confinements. Phil Wang and Jud Williams prepared extensive summary tables of computer-compiled data and re-entered data into the Cyber computer system. Robert Sinclair, Carl

Lonnquist, Marvin Clevenger, and Ileah Trover established computer programs to evaluate land management data, enumerate raingage records, and establish rainfall-streamflow correlations.

John Erickson, Jim Williams, Jud Williams, and Richard Twait were especially considerate ±n stream sampling, as storm-caused flows often occurred after normal work hours or on the weekend. John Erickson, as a resident of Galesburg, maintained rain gages, monitored rainfall and stream flows, and summoned the water sampling personnel as conditions warranted. In addition John performed a survey of all literature in Galesburg City and Knox College libraries relevant to the Court Creek area.

Linda Johnson typed the original manuscript and the camera copy, and Gail Taylor edited the final report. John W. Brother, Jr., Linda Riggin, William Motherway, Jr., and Vicki Stewart expended great effort in producing the large number of maps and figures required for this type of project.

Most importantly, all the landowners of the Court Creek watershed were vital to the study's success as they related personal information about their land and streams, gave permission to sample soils and streambanks, and extended help and hospitality to Water Survey personnel throughout our first year of effort.

Knox County Road Supervisor Jack Witt was expecially helpful in the manufacturing and placement of the continuous stage recorder at Dahinda. William Folger, former road supervisor of Persifer township, was especially considerate about the placement of wire-weight and staff gages on township bridges.

DESCRIPTION OF STUDY AREA

As mentioned earlier, the Court Creek watershed is located in Knox County. Its 251-square-kilometer area (97 square miles) lies almost entirely within the four townships of Sparta, Copley, Knox, and Persifer (see figure 1). Its selection for study was not based on occurrences of water quality problems but rather on the assured cooperation of its residents and its on-site governmental agency personnel coupled with a diversity of land use within the watershed.

Agriculture has been and continues to be the stable economic force in the watershed. In addition to row crops, livestock, management is a significant activity. In 1938 strip mine operations for coal recovery commenced. Operations terminated in 1969, by which time about 9.3 sq km (3300 acres) had been mined. Most of the strip mining activities were located in Copley Township.

As shown in figure 1, there are four incorporated communities, all or in part, in the watershed. These include East Galesburg, Wataga, the northern portion of Knoxville, and a portion of Galesburg (not shown). Two

Figure 1. The watershed of Court Creek

unincorporated communities, Appleton and Dahinda, lie along Court Creek. In 1971 construction of the Oak Run housing development was begun in Persifer Township south of the major area of strip mining. About 8.6 sq km (2133 acres) of land were developed. In 1981 about 120 permanent dwellings existed at the Oak Run development, with about 60 summer homes.

Recreation areas in the watershed support camping, hiking, fishing, sightseeing, picnicking, and boating. There are numerous sportmen's clubs in the mine spoils area where impounded waters provide fisheries.

The rural and incorporated urban population within the watershed has not been static nor has growth been phenomenal. Included in table 1 are the recorded populations for the rural and urban areas.

Surface Waters

Court Creek originates in the vicinity of Rice Lake northwest of East Galesburg. As shown in figure 1, it flows eastward for about 23.3 km (14.5 miles) to its confluence with Spoon River near the community of Dahinda. There are three main tributaries to Court Creek, all originating northward of it. They are Middle, North, and Sugar Creeks. Middle Creek is about 16.0 km (10 miles) long, North Creek is about 19.1 km (12 miles) long, and Sugar Creek is about 16 km (10 miles) long. The drainage area for each stream and the percent of the watershed each represents are given in table 2.

With, the exception of Rice Lake, a man-made impoundment located in Knox Township near East Galesburg, all the impoundments in the watershed are located in the watershed of Sugar Creek. The longest of these is

Table 1. Population of the Court Creek Watershed

Townships	1940	1950	1960	1970	1980
Sparta	575	528	472	477	445
Copley	538	415	351	327	298
Knox	675	566	733	1046	1582
Persifer	716	724	654	600	822
Urban					
East Galesburg	605	651	660	706	928
Wataga	540	550	570	570	996
Knoxville*	747	736	853	977	1143
Galesburg**	5776	6288	7448	7260	7060

*Estimate based on 33% of total population
**Estimate based on 20% of total population

Table 2. Watershed Areas of Streams in the Court Creek Watershed

	Middle Cr.	North Cr.	Sugar Cr.	Court Cr.*	Total
Sq km	27.2	75.9	59.1	88.8	251.0
Square miles	10.5	29.3	22.8	34.4	97.0
Acres	6,720	18,720	14,560	22,080	62,080
% of watershed	10.8	30.2	23.5	35.5	100.0

* Excluding subwatersheds

Spoon Valley Lake, located in Persifer Township. This man-made impoundment, constructed as part of the Oak Run development, is about 6.4 km (4 miles) long with a water surface area of about 2.1 sq km (512 acres) . Its normal water surface is at an elevation of 199 meters (652 feet) above mean sea level. Other impoundments in the Sugar Creek watershed originate from strip mine activities in Copley Township. They are small without governed releases.

More pertinent information regarding the physical characteristics of the streams, flow patterns, slopes, stream bottoms, etc., will be discussed in a later section of this report. It is the water quality of Court Creek and its three main tributaries that is the focus of the study.

Climate

Most of the discussion here regarding the climate of Knox County is based on a narrative prepared by William Denmark, former Illinois State Climatologist of the U.S. Weather Bureau. The county has a continental climate typical of northern Illinois. The annual range of temperatures often varies from 15 to 20° below zero in the winter to 100° or higher in the summer. Low pressure areas, or storm centers ard/or associated weather fronts, bring frequent short-period changes in temperature, humidity, cloudiness, and wind direction.

January is normally the coldest month of the year, with December and February temperatures averaging about 4 or 5 warmer. Eighty-five to ninety percent of the days from December to March are likely to have minimum temperatures below freezing, with an average of eleven of these days having below zero temperatures. The daily mean temperature averages freezing or below from about the first of December until the last of February.

Summers are warm, but prolonged hot spells are infrequent. July is the warmest month on the average, although the temperature is likely to reach 90° or above on about half the days in both July and August.

Light snows are frequent, but on the average there are only 8 to 10 snowfalls a year of 1 inch or more. The total annual snowfall averages about 25 inches, but more than 20 inches has fallen in a single month.

Thunderstorms average about 50 each year, with 65 percent of these occurring during the period May through August. A single thunderstorm can produce in excess of an inch of rain along with hail and damaging winds. Nearly 5 inches of rain has been measured in a 24-hour period.

Yearly precipitation averages slightly more than 35 inches, and only once has it been less than 27 inches. Monthly precipitation during the past 15 years has varied from less than 1/2 inch to nearly 12 inches. Nearly 60 percent of the total yearly precipitation can normally be expected during the crop growing season between mid-April and mid-September.

There is an average "growing season" of 170 to 175 days between the average dates of the last freezing temperature or below in the spring and the first freezing temperature in autumn.

An examination of daily precipitation records for the last 15 years indicates that rainfall equal to or greater than 0.25 inches will occur about 45 days each year on the average. This is consistent with the long-term record of about 50 thunderstorms per year. It is during these events that surface runoff will occur if it does at all. And it is during these events that the streamwaters must be sampled if the linkage between land and water quality is to be properly assessed.

Total monthly precipitation for the Court Creek watershed for the period 1968 to 1979, as recorded at Galesburg, is shown in figure 2.

Topography and Soils

The basic landform of the Court Creek watershed was sculptured by glacial ice, flowing water, and windblown deposits. It has been modified by erosion and more recently by strip mining activities. The highest point in the watershed, located southwest of Wataga in the northwest portion of the watershed, is 256 meters (840 feet) above mean sea level (msl). The lowest point is in the southeast portion of the watershed near Dahinda at about 177 meters (580 feet) msl. Within this drop in elevation of 79 meters (260 feet), the landscape is variable and consists of many soil series and phases.

The side slopes are severe and the floodplain is limited for Middle Creek and that portion of Court Creek upstream of its confluence with North Creek. The main stem of North Creek and that portion of Court Creek below its confluence with North Creek are also bordered by severe side slopes. However, the floodplain is more expansive in these stream sectors. This is illustrated in figure 3.

The majority of the parent material in the Court Creek watershed is the result of glaciers and glacio-fluvial deposits of the Wisconsinan and Illinoian stages. Although these resulting soils are associated with glaciers or glacial deposits, their characteristics vary widely within short distances. Dominant parent materials were deposited as glacial till, gla-

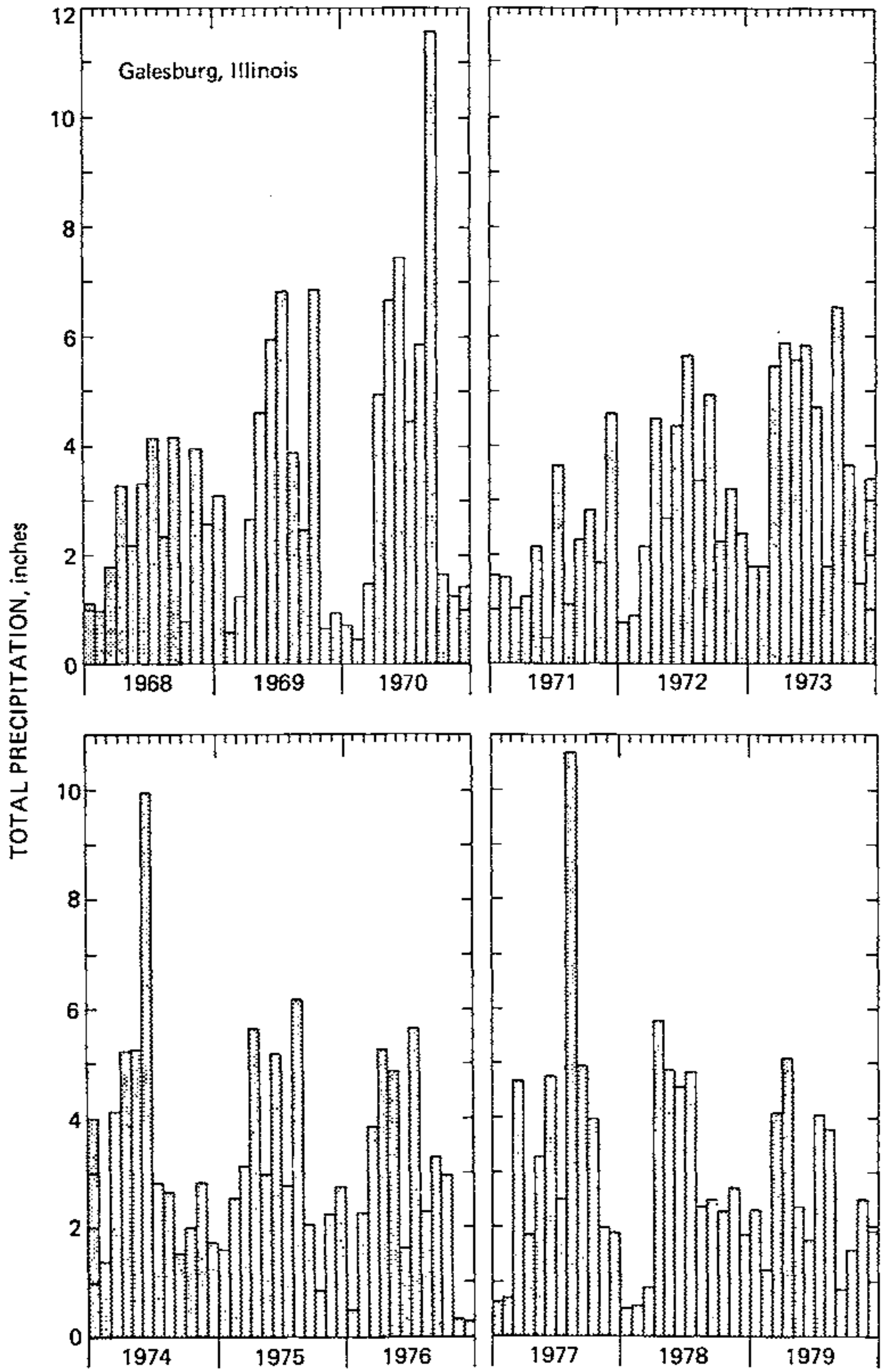


Figure 2. Total monthly precipitation at Galesburg, Illinois

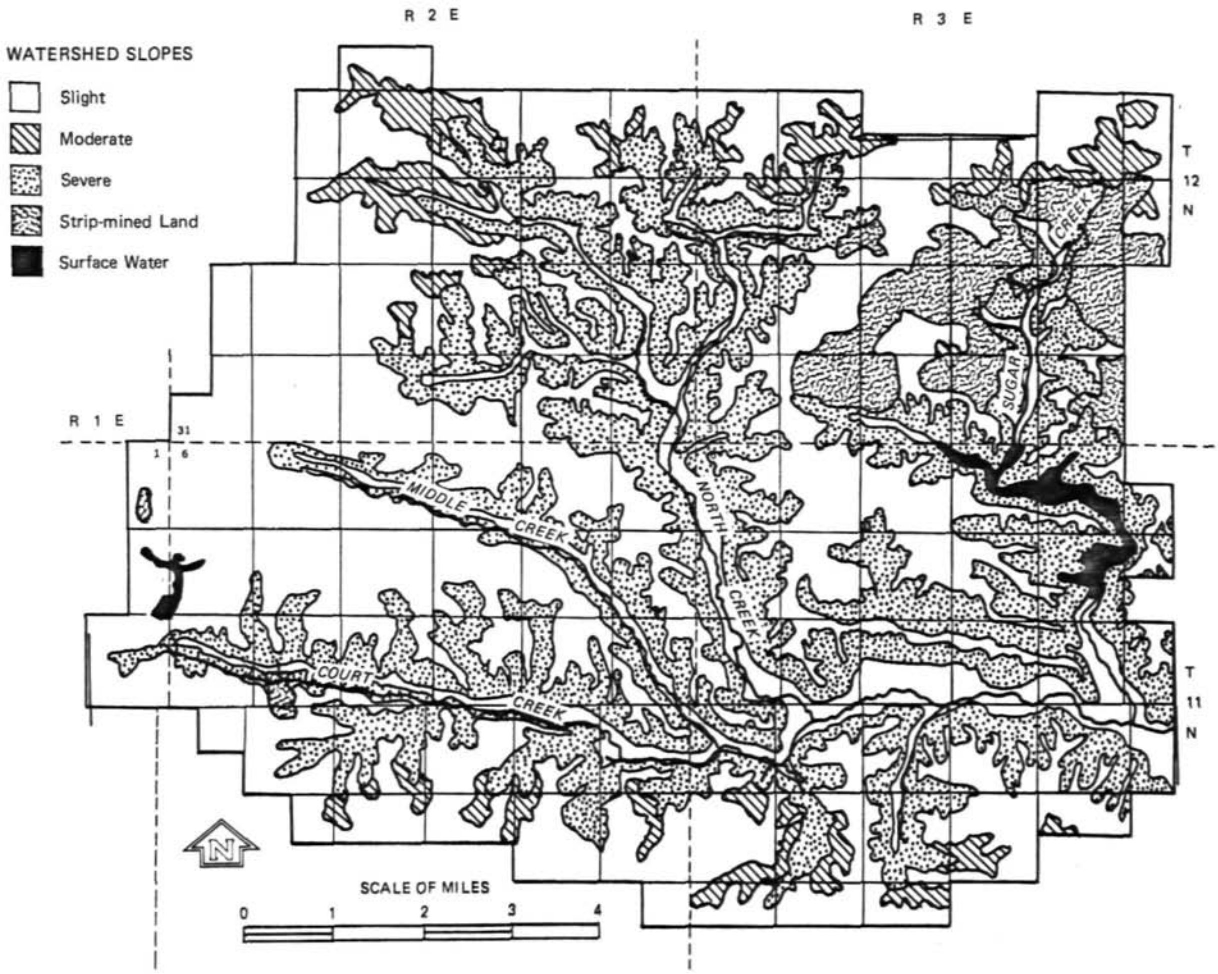


Figure 3. Landform slopes in the Court Creek watershed

cial outwash, loess, and alluvium. Erosion of the landscape has removed overlying deposits so that shale and siltstone are parent material in portions of the watershed. Strip mining activity has also created a new parent material within the last 45 years.

Glacial till is material deposited directly by glaciers with a minimum of water action, so that small pebbles have distinct edges and corners. It consists of particles of different sizes mixed together when deposited during the Illinoian stage. Glacial till soils are located on side slopes where erosion has removed overlaid material, as in the Hickory soil type. In some areas a soil developed in the upper part of the Illinoian glacial till during the time between the Illinoian and Wisconsinan glaciers (the Sangamonian Stage). These soils are called paleosol or "old soil." Therefore some present day soils (for example, the Atlas and Assumption soil series) are a composite of glacial till and paleosol.

Glacial outwash was deposited by flowing water from melting glaciers. Outwash deposits consist of layers of similar-sized particles, such as loamy sand, sandy loam, and loam. As water velocity decreased, large heavy particles were deposited first, and then progressively smaller particles were deposited. Camden and Dickinson are examples of these soil series.

After initial deposition, some alluvium in the glacial outwash was carried by the prevailing wind to distant locations. This material, loess, consists of very uniform, calcareous, silt-sized particles. The major source of Court Creek loess was the Mississippi River Valley. Loess covered the Illinoian glacial till for depths of 2.1 to 4.9 m (7 to 16 ft). The majority of "upland soils was formed in this manner. Examples of these soil series are the Ipava, the Tama, and the Sable soil series.

Alluvium in Knox County is sediment deposited from floods in geologically recent events. The relatively narrow floodplains of Court Creek are representative of these soils, which consist mainly of Lawson, Huntsville, and Sawmill soils. The floodplains generally have a silty texture, which reflects the loess nature of their source.

Pennsylvanian age shale, siltstone, and coal underlie the other parent materials. Where erosion has been intensive, these materials themselves become parent material. In a few places sandstone occurs at the top of the bedrock sequence instead of shale. A relatively soft shale was formed from silt loam or silty clay loam. Marseilles is a common example of a soil formed in soft shale and siltstone. A recent parent material formed during strip mining for Pennsylvanian No. 6 coal in the tributary watershed of Sugar Creek. The resultant mine spoil soils, consisting of a heterogeneous mixture of glacial till, loess, shale, and siltstone, are Lensburg and Rapatee.

Native vegetation has greatly affected these parent materials. Those soils designated as Tama, Ipava, and Sable were formed under tall grass prairies. These grasses had many fine fibrous roots, which added large amounts of organic matter near the soil surface. Such soils have thick, black or dark brown surface layers and are located on broad upland divides between streams.

Other soils formed under deciduous hardwood forests. Organic contributions of forest soils were from leaf litter as the root systems were less fibrous near the surface. This process resulted in a thinner, lighter colored surface and subsurface layer. These soils are located on side slopes of streams or the narrow upland divides between streams. The floodplain region contained a mixture of trees and prairie grasses, as did border regions between stream side slopes and the level prairies. The floodplain soils are much darker because of organic matter deposited during floods.

These soils, consisting of 39 series and 62 phases, along with the areal extent of each and some of their characteristics, are listed in table 3.

Table 3. Acreage and Percent of Watershed for Court Creek Soil Types

Soil phase	Series	Acreage	Percent	Slope percentage	Surface texture
7D3	Atlas	108	0.14	10-18	Silty clay loam
8D2	Hickory	918	1.16	10-15	Silt loam
8E2	Hickory	4510	5.70	15-30	Silt loam
8G	Hickory	3343	4.23	30-50	Loam
16	Rushville	5	0.01		Silt loam
17A	Keomah	1899	2.40	1-3	Silt loam
19C3	Sylvan	379	0.48	5-10	Silty clay loam
19D3	Sylvan	131	0.17	10-15	Silty clay loam
36B	Tama	6489	8.20	1-4	Silt loam
36B2	Tama	675	0.85	2-5	Silt clay loam
36C2	Tama	2448	3.09	5-10	Silty clay loam
36D2	Tama	94	0.12	10-15	Silty clay loam
43A	Ipava	12222	15.45	1-3	Silt loam
45	Denny	167	0.21		Silt loam
68	Sable	3314	4.19		Silty clay loam
74A	Radford	139	0.18	1-3	Silt loam
77A	Huntsville	605	0.76	1-3	Silt loam
81A	Littleton	235	0.30	1-3	Silt loam
87B	Dickinson	32	0.04	1-5	Loam
104	Virgil	10	0.01		Silt loam
107	Sawmill	598	0.76		Silty clay loam
119D2	Elco	1167	1.48	8-15	Silt loam
119E2	Elco	1612	2.04	15-20	Silt loam
131D2	Alvin	2	0.003	8-15	Silt loam
134B	Camden	17	0.02		
134C2	Camden	5	0.01	5-10	Silt loam
134D2	Camden	8	0.01	10-18	Silt loam
239	Dorchester	727	0.92		Silt loam
249	Edinburg	26	0.03		Silty clay loam
257	Clarksdale	167	0.21		
257A	Clarksdale	3415	4.32	1-3	Silt loam
259C2	Assumption	210	0.27	5-10	Silt loam
259D2	Assumption	295	0.63	10-15	Silt loam
259D3	Assumption	103	0.13	8-15	Silty clay loam
279B	Rozetta	6810	8.61	1-5	Silt loam
279C2	Rozetta	8333	10.53	5-12	Silt loam
280B	Fayette	82	0.10	2-5	Silt loam
280C2	Fayette	75	0.09	5-10	Silt loam
280D2	Fayette	251	0.32	10-15	Silt loam
280E	Fayette	9	0.01	15-25	Silt loam
344B	Harvard	33	0.04	1-5	Silt loam
386B	Downs	1246	1.58	2-6	Silt loam
415	Orion	360	0.46		Silt loam
451A	Lawson	2085	2.63	0-3	Silt loam
533	Urban, Land	516	0.65		
536	Dumps, Mine	157	0.20		Mine
549D2	Marseilles	163	0.21	10-15	Silt loam
549E2	Marseilles	2015	2.55	15-30	Silt loam
549G	Marseilles	2999	3.79	30-60	Silt loam
567B2	Elkhart	64	0.08		
567C2	Elkhart	407	0.51	5-10	Silty clay loam
567D3	Elkhart	20	0.03	8-15	Silty clay loam
660C2	Coatsburg	81	0.10	5-12	Silty clay loam
801B	Orthents	330	0.42	1-5	Silty
802B	Orthents	135	0.17	1-5	Loamy
863	Pits, Clay	93	0.12		Clay
871B	Lensburg	27	0.03	1-7	Silty clay loam
871G	Lensburg	2913	3.68	20-70	Silty clay loam
2036B	Tama-Urban	386	0.49	3-10	
2901B	Ipava-Urban-Tama	986	1.25	1-5	
2902A	Ipava-Urban-Sable	1526	1.93	0-3	
	Water	989	1.25		

The Soil Conservation Service, as part of their Knox County Soil Survey, has designated six major soils associations applicable to the Court Creek watershed. The number designation and principal soils of each association are as follows:

Soil association	*Principal soils*
1	Ipava-Sable
2	Ipava-Tama-Assumption
3	Rozetta-Elco-Keomah
4	Hickory-Elco-Marseilles
5	Lawson-Huntsville-Downs
6	Lensburg-Rapatee

The distributions of the six soil associations are shown in figure 4, Associations 1, 2, and 3 generally support row crops, while' hay and pasture are secondary uses. Association 4, Hickory-Elco-Marseilles, is a soil found on steep to very steep, moderately well and well-drained slopes composed of glacial till, loess, paleosols, and shale. Slopes range from 15 to 60 percent and are generally short and smooth. This association primarily supports woodlands, although the more gradual slopes are used for pasture.

Soil Association 5, Lawson-Huntsville-Downs, consists of nearly level bottomlands and gently sloping terraces. Slopes range from 0 to 6%. These soils are formed in alluvium and in loess. They are well-suited as primary row crop areas and secondary pasture. There is an abundance of open-land wildlife and also some wetland game in limited areas.

Soil Association 6, Lensburg-Rapatee, is formed from loamy strip mine material. In the tributary watershed of Sugar Creek this association is made of the Lensburg soil in high parallel ridges and swales, where little reclamation has taken place. Slopes range up to 70%. The soils are well drained and have numerous small lakes. The land either is idle with some scrub timber or is pasture.

Of the 39 soil series located in the watershed, 9 of them account for about 80 percent of the land within the watershed. These most common soils and some of their characteristics are set forth in table 4. Soil textures in the entire watershed range from sandy loam to silty clay.

Figure 5 indicates the suitability of land sections in the Court Creek watershed for grain and forage, principally on the basis of soil type and slope. The areas termed "good" represent Soil Associations 1, 2, and 5. Areas marked "fair" represent Soil Association 3. "Poor" areas are in Soil Association 4. Strip-mined land is represented by Soil Association 6, the Lensburg soil series.

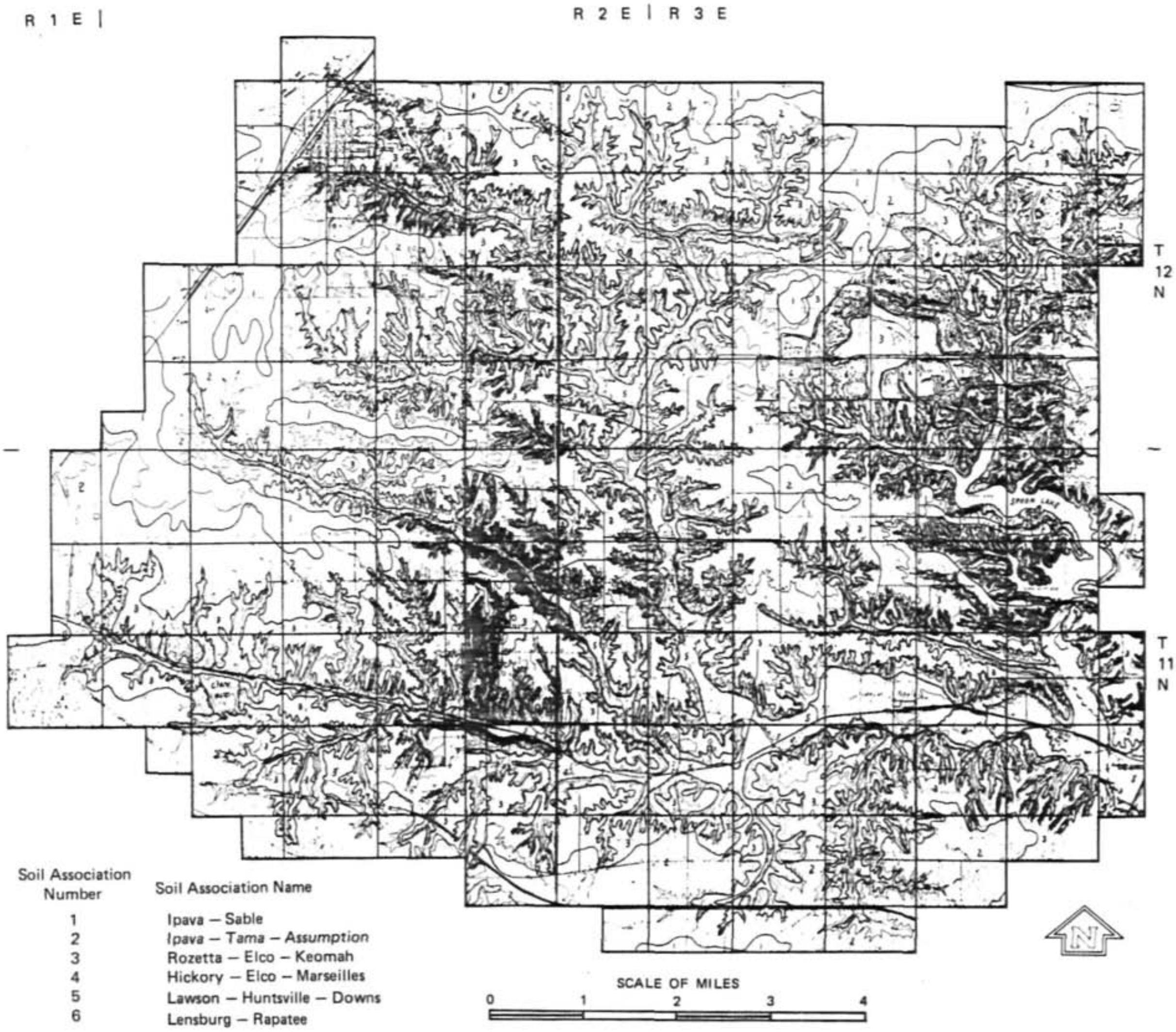


Figure 4. Distribution of six soil associations in the Court Creek watershed

The soils of Court Creek are the broadly generalized A and N soil series, which represent about 21% of Illinois soils (figure 6). These soils are located in the Galesburg Plain and northern portions of the Springfield Plain.

Point Sources of Pollution

Point sources of pollution in the watershed are limited. Currently there are four small domestic waste treatment facilities. Two of them serve the Village of Wataga. Another treatment facility serves the Oak

Table 4. Principal Soils in the Court Creek Watershed

Soil	Texture	Prevalent slope (%)	Percent of Watershed
Rozetta	Silt	1-1	19.1
Ipava	Silt	1-3	15.5
Tama	Silty clay	5-10	12.3
Hickory	Silt	15-50	11.3
Marseilles	Silt	15-60	6.6
Sable	Silty clay	0	4.2
Clarksdale	Silt	1-3	4.2
Lensburg	Silty clay	20-70	3.7
Elco	Silt	8-20	3.5
		Total	80.4

Run development in Persifer Township; and a campground located on the upper end of Sugar Creek is served by a small wastewater treatment facility. Domestic wastes originating in East Galesburg, Galesburg, and Knoxville are treated by facilities with discharge to another watershed.

The treatment units at Wataga, known as the North and South treatment facilities, consist of two-cell aerated lagoons and submerged sand filters. The effluents are chlorinated. Estimated flows range from 20,000 to 70,000 gallons per day. Effluents discharge into the northernmost branches of North Creek.

The treatment plant serving the Oak Run development consists of an aerated lagoon and a clarifier. The effluent is chlorinated and discharges into Sugar Creek downstream of the Spoon Valley Lake dam. Estimated flows range from 5000 to 10,000 gallons per day.

The campground, located upstream of the lake, is served by a septic-tank – sand filter arrangement with provision for chlorination. Discharge is to Sugar Creek.

The treatment plants are designed to produce effluents equal to or less than 10 mg/1 BOD_5 and 12 mg/1 suspended solids. As would be expected for small treatment plants, the sampling of effluents and subsequent quality analyses are infrequent. Thus existing records are of very little value for assessing the degree of treatment being provided. Nevertheless the type of treatment -units being employed (waste lagoons with supplemental solids removal units) suggest that effluents are not likely to exceed 30 mg/1 BOD_5 and suspended solids most of the time. And ammonia concentrations, except during cold weather months, are probably consistent with stream quality standards.

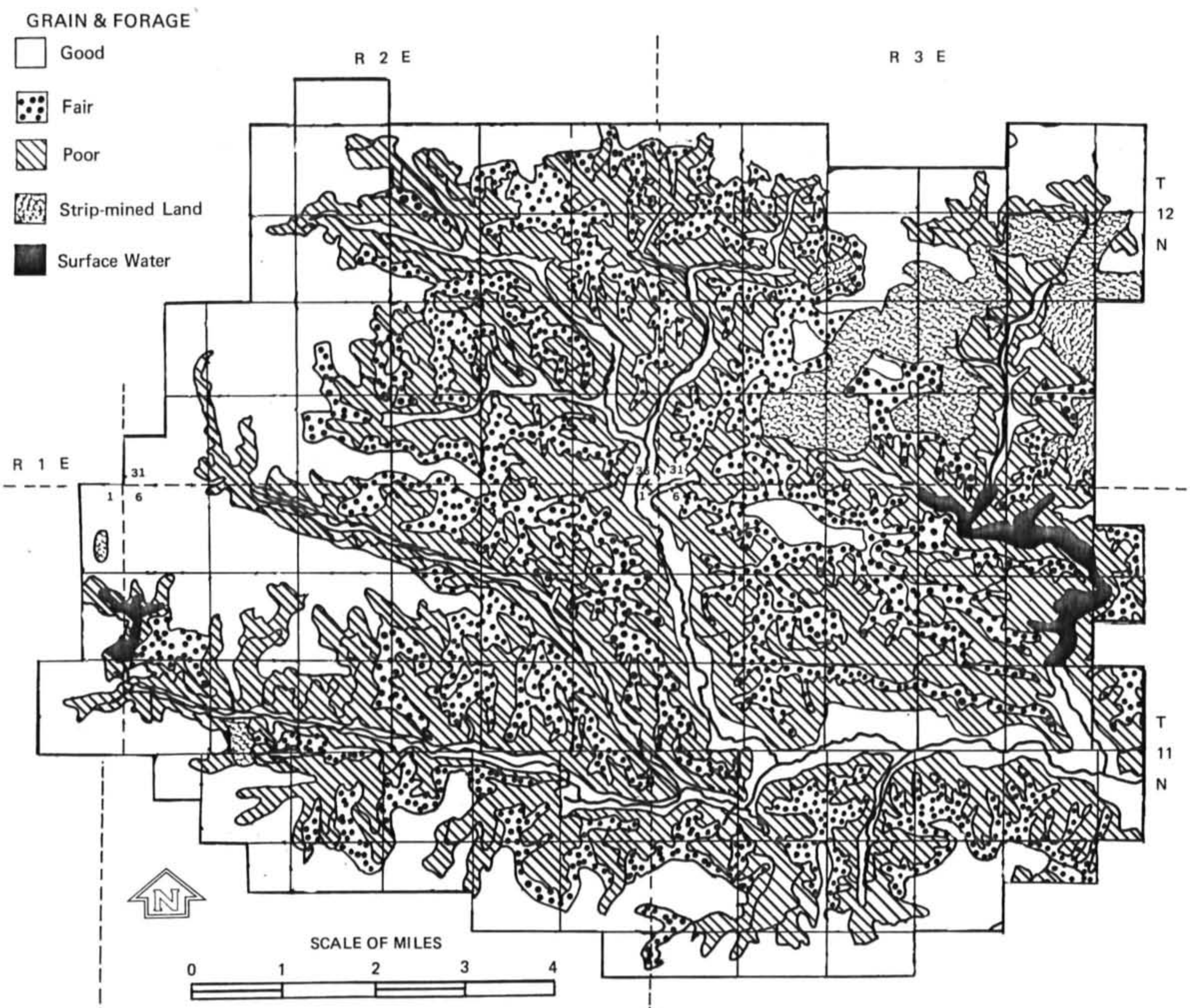


Figure 5. Suitability of land in the Court Creek watershed for grain and forage

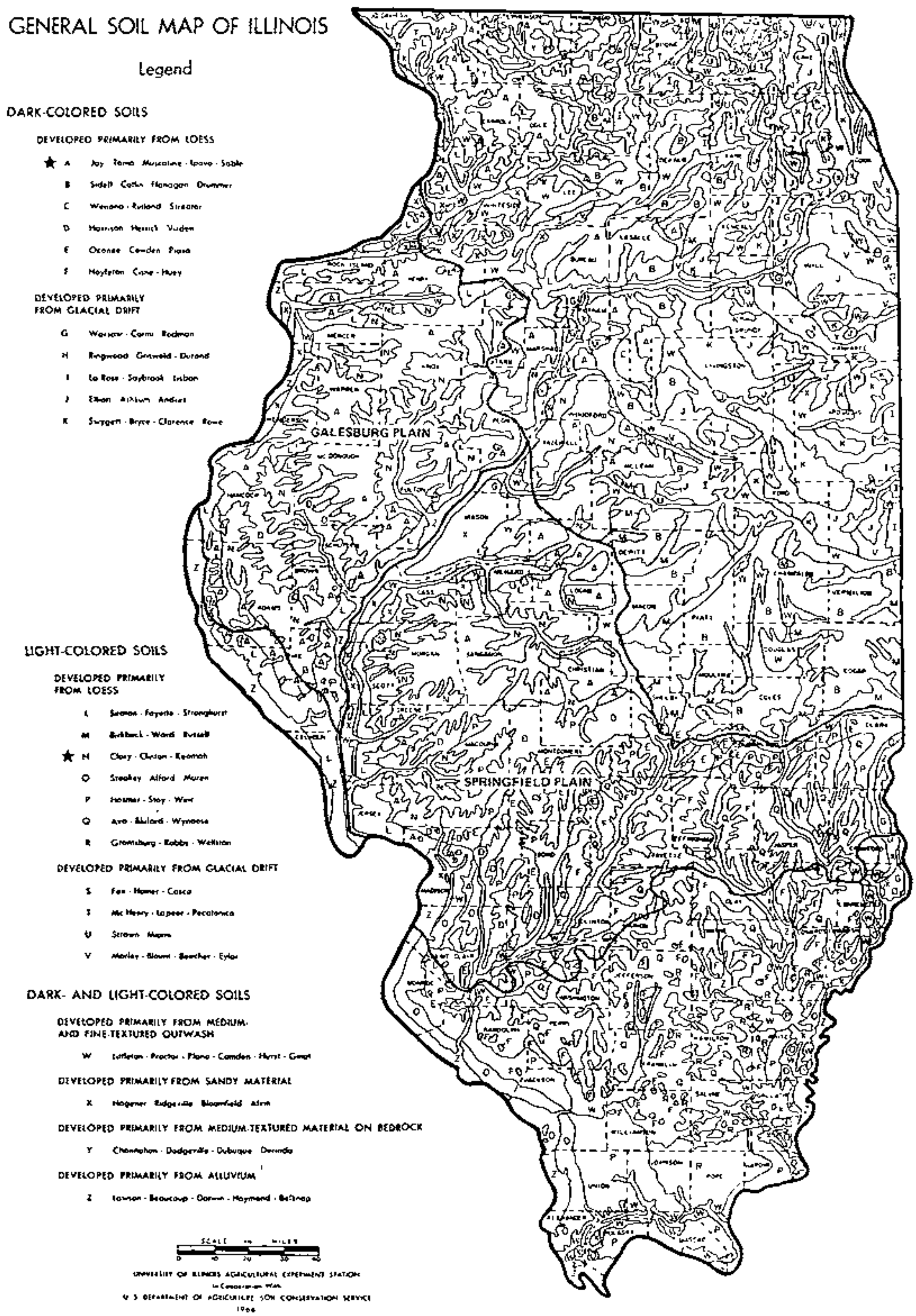


Figure 6. General soil map of Illinois

As will be discussed later, there are stormwater drainage systems serving the urban areas at the headwaters of Court Creek. For the purposes of this study these systems are considered non-point sources.

LAND USE

Is there a definite relationship between land use in a watershed and the water quality of streams in the watershed? Many water resource management policies and abatement schemes are predicated on the premise that definite relationships do indeed exist. Among the predominant land uses usually associated with non-point pollution are agriculture, forestry, surface mining, and urban living. Agricultural practices with attendant soil erosion, fertilizers, pesticides, and animal wastes are viewed as playing a prime role. This is the prevailing view in Illinois.

Is the water quality of streams in the Court Creek watershed governed by land use in the watershed? Deriving an answer to this question is one of the principal objectives of this study. To properly assess the relationship, if any, requires an inventory of land use in the watershed. Also pertinent to the assessment is a sense of historical perspective regarding the use of land in past years as well as during the present, with a broader data base the likelihood of accurate predictions for the future is enhanced.

The methods employed to accomplish the tasks are described in this part of the report. Findings are supported by tabular information and figures, and a discussion and summary are included.

Methods

Ten land use classifications were established for the Court Creek watershed. One classification has a sub-class of two activities. All are included in table 5. These classifications were initially derived from conversations with residents in the watershed and local representatives of the U.S. Agricultural Stabilization Conservation Service (ASCS), U.S. Soil Conservation Service (SCS), Illinois Department of Conservation (IDOC), and the Extension Service of the University of Illinois.

Reliance was placed on the examination of aerial photographs (1" = 660') to define the distribution of the land use classifications in the watershed. Aerial photos for the years 1940, 1950, 1963, 1969, and 1979 were obtained from the ASCS's depository in Las Vegas, Nevada. Contractual arrangements were made with an aerial data system analyst to examine the photographs and designate land uses for each quarter section or fraction thereof (135 to 160 acres) of land in the watershed. This required land use designations for 388 quarter sections for each of the five separate years, extending over a 40-year period.

Table 5. Ten Land Use Classifications and Their Abbreviations

1.	Row crops	RC
2.	Wooded pasture	WPAS
3.	Pasture	PAS
4.	Woods	WDS
5.	Water	WTR
6.	Confined animal feedlots	CFL
7.	Urban	URB
8.	Non-productive land (farmhouses, sheds)	NP
9.	Active mineral land	AM
10.	Inactive mineral land	IM
	(a) Recreation	IMR
	(b) Pasture	IMP

The areal extent of row crops, consisting mainly of corn and soybeans, was defined with very little difficulty. Pastures included those lands with less than 20 percent tree cover, exclusive of strip-mining activities. Lands with tree cover in excess of 20 percent were classified as woods. Wooded pasture was separated from woods on the basis of existing livestock paths.

Although some difficulty was experienced in defining the smaller confined feedlot operations, the large ones were quite easily identified. All confined feedlot designations for the 1979 period are current and confirmed by field reconnaissance.

Urban land consisted of well-defined corporation limits and the close grouping of houses in unincorporated areas. Farmhouses, barns, and attendant structures were classified for the purposes of the study as nonproductive. Also included in this classification were the clay pit area of the former Puritan Brick Company and the county landfill operations near Wataga.

The mineral land use, solely related to the strip mining of coal, was considered <u>active</u> on the basis of the presence of machinery and the lack of vegetation on obviously disturbed overburden; and <u>inactive</u> if the opposite was observed. The designation of recreation for inactive mineral land was predicated on the presence of cottages, trailers, boat houses, or boats. Similarly the designation of pasture for inactive mineral land was supported by the presence of abundant vegetation or livestock.

The land use data for each quarter section in the watershed, covering a 40-year period, including legal descriptions and watershed locations, were sorted and stored in the Cyber computer system at the University of Illinois. These were the data used to prepare the land use map of the watershed depicted in figure 7.

In addition to the examination of aerial photographs coupled with field reconnaissance, a search for available records regarding livestock management and row crop production was performed. The most useful sources were

COURT CREEK WATERSHED 1979 LAND USE MAP

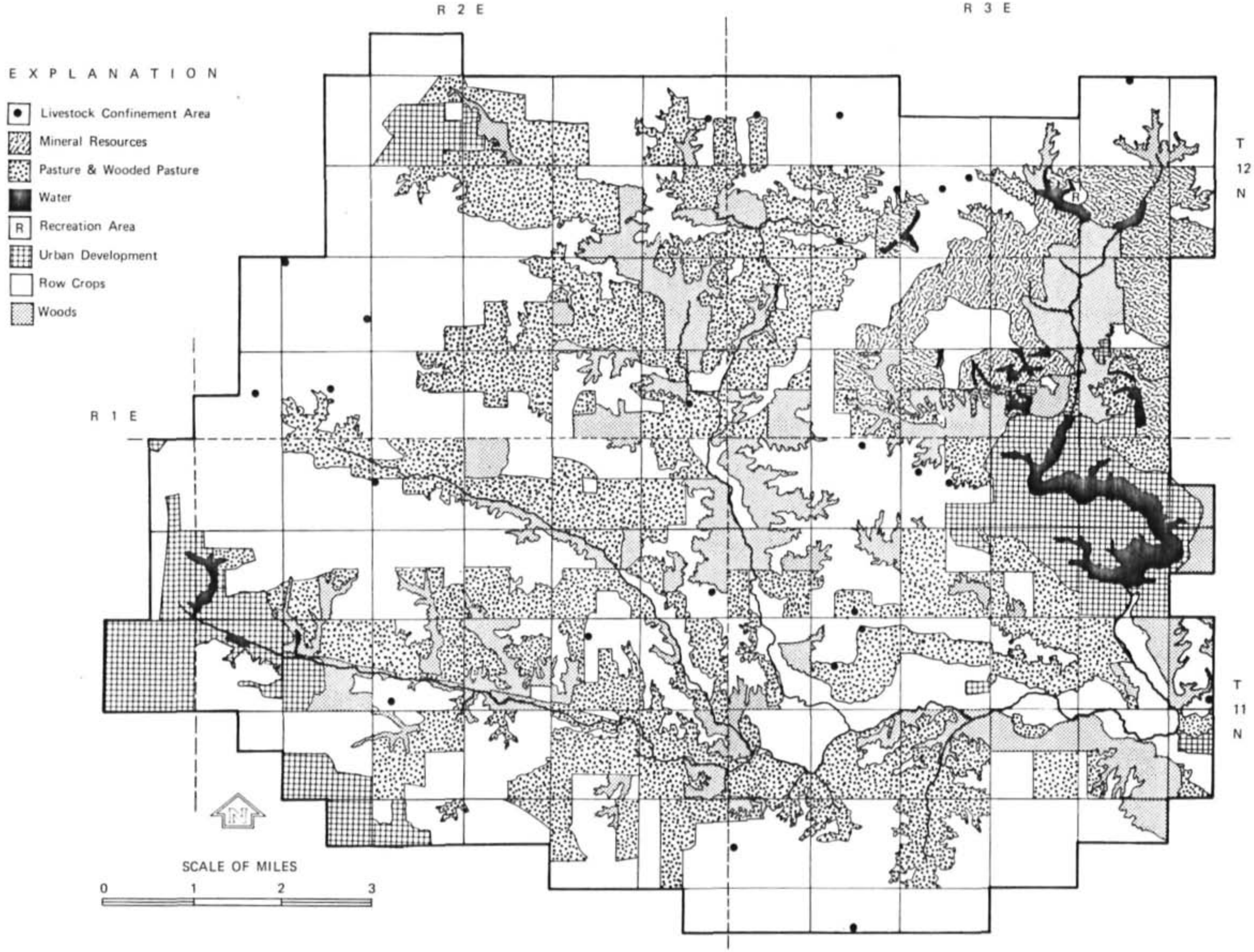


Figure 7. Land use in the Court Creek watershed during 1979

publications issued by the Illinois Department of Agriculture based on the assessor's annual farm census as part of the Illinois Cooperative Reporting Service. Although the records were not of long duration and were sometimes fragmentary, they served a useful purpose.

Results

The application of the land use data was viewed from two perspectives. For general information and to gain an insight into the patterns of land use, the data were compiled on the basis of townships. To facilitate an assessment of relationships between land use and water quality, data were compiled on the basis of discrete sub-watersheds.

A cursory examination of figure 7 shows that most of the land use in the watershed is agriculturally oriented, with row crops and pasture predominating. (See additional information in Appendix A regarding the crops harvested.) Row crop acreage within the watershed has remained relatively stable in the townships during the past 40 years. The number of farms, however, has declined. As shown in figure 8, during the past 21 years there has been an overall decrease of about 46 percent in the number of farms. The decreases for the townships of Copley, Knox, Persifer, and Sparta are, respectively, 50, 43, 51, and 48 percent.

The land use acreage for each of the four townships is shown in table 6. The stability of row crop acreage is quite apparent. On the average, about 50 percent of the land in all the townships is in cultivation. Generally such land use averages from a low of 40 percent of the area in Copley Township to a high of 57 percent of the area in Sparta Township.

As shown in table 6 there have been significant changes in land use in the townships of Copley and Persifer during the past 40 years. In Copley Township, active coal mine operations reduced the acreage in row crops and pasture during 1950 and early in the 1960s.

In fact, with the exception of some minor activity in Knox Township, all the strip-mining operations in the watershed occurred in Copley Township. However, as active mining diminished in Copley Township, the disturbed areas reverted to pasture. This cycle of mining operations decreased available pasture use to about 23 percent of the total land in the watershed in Copley Township during 1963 but provided a pasture use of about 46 percent of the total land in 1969. Row crop land use in Copley Township never regained its high of about 48 percent in the 1940s and 1950s.

In Persifer Township the reduction in pasture land was brought about by the Oak Run housing development and the creation of Spoon Valley Lake on Sugar Creek. Wooded pasture and pastureland were reduced from about 40 percent of the total land to about 22 percent as the result of these developments. Row crop acreage was not affected.

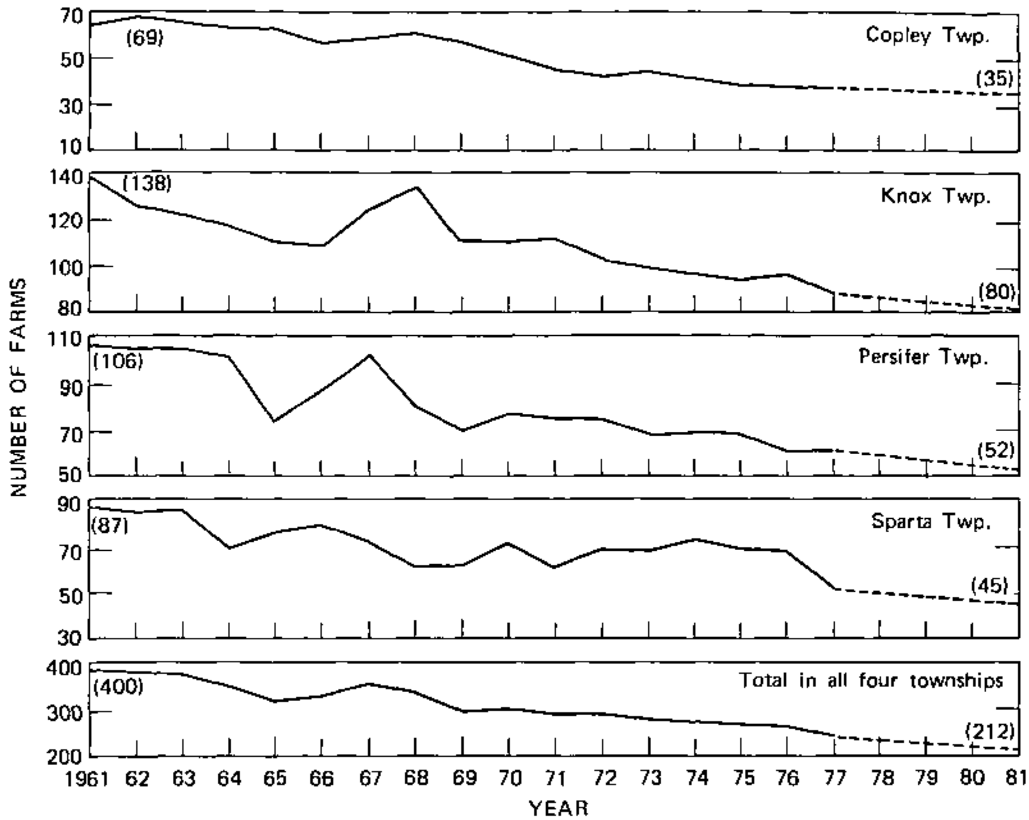


Figure 8. Number of farms in townships in the Court Creek watershed (1961-1981)

In the other two townships, Knox and Sparta, pastureland remained reasonably stable during the 40-year period. The overall variation was from 30 to 40 percent of the total land use during the period.

The differences in woods acreage with time generally are a function of whether or not they were being pastured. Some modification of woods acreage occurred in Copley Township due to strip mining activities.

As shown in table 6 the discontinuance of mining activities increased the acreage of impounded water in Copley and Knox Townships. The development of Spoon Valley Lake in Persifer Township measurably increased water acreage there. The increase of urban land in Copley and Persifer Townships was produced by the housing development previously mentioned.

The changing patterns of land use, particularly those changes related to pasture, most likely have had some influence on livestock production in the watershed. The number of cattle marketed in the townships during the period 1961 to 1977 is shown in table 7. Table 8 shows the number of hogs and pigs marketed during the period 1970 to 1977.

Table 6. Land Use Acreage for Townships in the Court Creek Watershed

Copley Twp

Year	RC	WPAS	PAS	WDS	WTR	CFL	URB	NP	AM	IMR	IMP	Watershed area
1940	6145	2139	2443	1457	5	0	0	192	249	0	0	12630
1950	5990	2978	1232	840	46	0	0	150	1424	0	0	12660
1963	4927	1028	1794	1498	219	0	0	132	2861	16	23	12498
1969	5061	860	2229	870	340	24	0	291	243	32	2681	12631
1979	5327	1553	289	1296	226	23	397	165	0	21	3343	12640

Knox Twp

Year	RC	WPAS	PAS	WDS	WTR	CFL	URB	NP	AM	IMR	IMP	Watershed area
1940	7909	1379	5241	943	64	0	758	330	141	0	0	16765
1950	8221	2707	4320	337	65	0	632	434	102	0	0	16818
1963	8618	1710	3970	1349	77	41	618	333	104	0	0	16820
1969	8683	2655	3513	679	134	57	620	479	0	0	0	16820
1979	8604	3800	1578	1348	158	100	726	565	0	0	84	16863

Persifer Twp

Year	RC	WPAS	PAS	WDS	WTR	CFL	URB	NP	AM	IMR	IMP	Watershed area
1940	7949	2519	4693	1697	5	5	68	309	15	0	0	17260
1950	8325	5273	2094	1207	6	0	102	265	0	0	0	17272
1963	8674	2351	3363	2470	37	4	40	321	0	0	0	17260
1969	7978	2958	4091	1452	2	27	87	670	0	0	0	17265
1979	8061	2448	1272	2756	520	71	1821	279	0	0	10	17238

Sparta Twp

Year	RC	WPAS	PAS	WDS	WTR	CFL	URB	NP	AM	IMR	IMP	Watershed area
1940	7305	734	3641	1034	1	0	334	211	0	0.	0	13280
1950	7572	2270	2458	366	3	0	358	225	0	0	0	13252
1963	7577	1678	2500	974	12	12	242	265	0	0	0	13260
1969	7578	1497	2729	767	22	22	278	363	0	0	0	13256
1979	7759	2458	905	1300	3	25	407	333	0	0	78	13268

Note: RC = row crons; WPAS = wooded pasture; PAS = pasture; WDS == woods; WTR = water; CFL = confined animal feedlots; URB = urban; NP = non-productive land; AM = active mineral land; IMR = inactive mineral land (recreation); IMP = inactive mineral land (pasture)

Although there have been fluctuations in the number of cattle marketed during the period of record, no trend (either upward or downward) is suggested in table 7. The average annual number marketed during the 17-year period is about 6500. On the other hand there was a substantial increase in the number of hogs and pigs marketed during the 8 years of record, as shown in table 8. The total number increased from about 37,000 in 1970 to a peak of about 61,000 in 1976. Most of the increase occurred in Copley Township where about 11,500 were marketed in 1970 compared to about 21,500 in 1977, and in Sparta Township where similar increases from about 6,300 to 10,700 occurred. Production in Knox and Persifer Townships was reasonably stable. Most of the hog and pig production, though not all, employs confined feedlots. Some cattle are also maintained in similar facilities. The total number and their locations in the watershed are depicted in figure 7 for the year 1979.

As part of the water quality assessment of the streams in the watershed, 16 water sampling stations were established. A more detailed discussion of their use will be presented later in this report. To examine the relationships,

Table 7. Number of All Cattle Marketed in Townships in 1the Court Creek Watershed

Year	Copley	Knox	Persifer	Sparta	Total
1977	1467	961	2031	2050	6509
76	1405	1199	1970	2509	7083
75	1397	981	2945	2234	7557
74	1127	1097	1961	1782	5967
73	1179	1008	2216	1601	6004
72	1593	914	2124	1397	6028
71	1576	833	2106	1125	5640
70	1857	848	2366	1806	6874
69	1890	1041	2482	2131	7544
68	2103	899	1628	1654	6284
67	1777	1457	1403	1585	6222
66	1784	1414	1757	1972	6927
65	1845	1298	1811	1944	6898
64	1830	1137	1524	1632	6123
63	1556	1396	524	1877	5353
62	1356	908	921	2336	5521
61	1829	1991	1647	2203	7670
Max	2103	1991	2945	2509	7670
Avg	1622	1140	1848	1873	6483
Min	1127	833	524	1125	5353

From: Illinois Agricultural Statistics: Assessor's Annual Farm Census (1962-1978), Illinois Cooperative Reporting Service.

Table 8. Number of Hogs and Pigs Marketed in Townships in the Court Creek Watershed

Year	Copley	Knox	Persifer	Soarta	Total
1977	21,565	7610	15,516	10,741	55,432
76	21,387	7705	14,324	17,308	60,724
75	16,321	7331	12,782	14,732	51,161
74	14,527	7070	13,145	13,896	48,638
73	13,980	6302	14,963	13,779	49,044
72	14,788	6828	13,381	11,098	46,095
71	15,485	6424	9,055	7,262	38,226
70	11,471	6400*	13,125	6,349	37,345*

* Estimated

Prom: Illinois Agricultural Statistics: Assessor's; Annual Farm Census (1971-1978), Illinois Cooperative Reporting Service.

if any, between land use and the water quality of surface waters, reliance was placed on land use data compiled for the year 1979.

The initial step in the effort to examine the relationship of land use to water quality involved the development of figure 9. This figure shows in a simplified fashion the portion of the total watershed providing drainage to the 16 sampling stations. Those stations with the prefix "C" are located on Court Creek proper, while those with the prefixes "M," "N," and "S" are

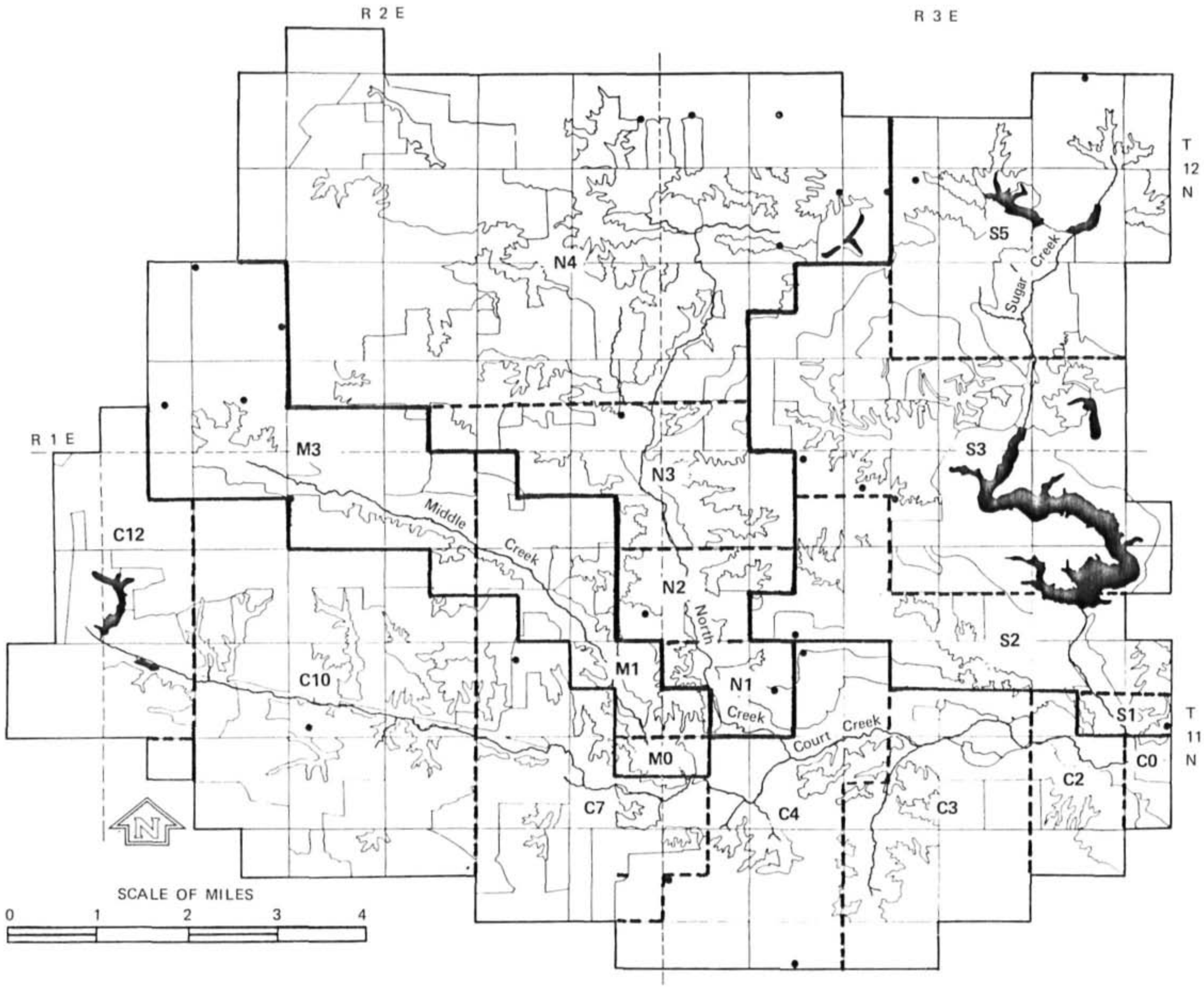


Figure 9. Drainage basins upstream of designated stream sampling stations in the Court Creek watershed

located on Middle, North, and Sugar Creeks, respectively. The designation CO signifies the confluence of Court Creek with the Spoon River rather than a sampling site, and the designation MO represents the confluence of Middle and Court Creeks. It is important to realize that although a station such as N4 has a single discrete boundary depicted in figure 9, the drainage basin delineated as N4 plus that of N3 are tributary to the next downstream station, N3. Similarly, for example, all "M" drainage basins plus all upstream "C" drainage basins are tributary to station C7.

The upstream area and the percentage of the total area that each upstream land drainage system represents- above the sampling stations are compiled in table 9. The tabulation demonstrates the integration of drainage areas with downstream movement. It also is useful for the exercise of integrating downstream water flow, based on drainage area, with actual streamflow measurements at selected sites.

Table 10 shows the land uses and their respective areas in the drainage basins above each sampling station, based on 1979 land use data. Similar information for other years is in Appendix B.

A review of table 10 shows either the increasing acreage of a specific land use classification with downstream movement, or else the stability of a specific land use.

Table 9. Drainage Areas of Stream Sampling Stations in the Court Creek Watershed

Site	Area (acres)	Area (sauare miles)	Percent of watershe
Court Creek			
C0 (Confluence with Spoon River)	62,080	97.0	100
C2	61,760	96.5	99.5
C3	46,080	72.0	74.2
C4	42,880	67.0	69.1
C7	20,960	32.8	33.8
C10	10,080	15.8	16.2
C12	3,200	5.0	5.1
North Creek			
Confluence with Court Creek	19,040	29.8	100
N1	18,720	29.3	98.3
N2	17,920	28.0	94.1
N3	16,800	26.3	88.2
N4	14,080	22.0	73.9
Sugar Creek			
S1	14,560	22.8	100
S2	14,240	22.3	97.8
S3	11,360	17.8	78.0
S5	4,960	7.8	34.1
Middlee Creek			
MO (Confluence with Court Creek)	6,720	10.5	100
M1	6,400	10.0	95.2
M3	4,320	6.8	64.3

Table 10. Land Use Areas in the Court Creek Watershed above Stream Sampling Stations, 1979

(Acres)

	RC	WPAS	PAS	WDS	WTR	CFL	URB	NP	AM	IMR	IMP	Total
Sugar Cr. watershed												
S5	2115	246	30	312	82	11	0	55	0	21	2098	4960
S3	3380	1040	224	568	654	17	2078	149	0	21	3238	11360
S2	4488	1901	572	954	709	27	2136	192	0	21	3247	14240
S1	4627	1909	572	1121	709	32	2140	195	0	21	3247	14560
North Cr. watershed												
N4	7588	2951	761	1774	41	21	408	332	0	0	197	14080
N3	8756	3325	1008	2638	42	24	408	395	0	0	197	16800
N2	9234	3491	1063	3011	43	43	408	418	0	0	197	17920
Nl	9678	3600	1148	3164	43	58	408	423	0	0	197	18720
Middle Cr. watershed												
M3	3093	493	385	255	0	4	0	70	0	0	0	4320
Ml	3927	1317	515	480	2	35	0	113	0	0	0	6400
Confluence with Court Creek	4023	1393	564	571	2	35	0	121	0	0	0	6720
Court Cr. watershed												
C12	1358	264	102	0	64	9	1299	103	0	0	0	3200
C10	5011	1706	656	474	151	43	1603	349	0	0	84	10080
C7	11161	4083	1754	1258	172	117	105	461	0	0	84	20960
C4	23159	8203	3010	4670	210	147	2041	1188	0	0	300	42880
C3	25095	8446	3479	5143	210	147	2037	1276	0	0	300	46080
C2	30194	10388	4107	6732	926	185	4200	1439	0	21	3582	61760
Confluence with Spoon River	30369	10388	4110	6768	926	185	4284	1446	0	21	3582	62080

Note: RC = row crops;; WPAS = wooded pasture; PAS = pasture; WDS = woods; WTR = water; CFL = confined animal. feedlots; URB = urban; NP = non-productive land; AM = active mineral land; :IMR = inactive mineral land (recreation); IMP = inactive minera1 land (pasture)

Table 11 has been prepared from the information contained in table 10. In table 11 the land use classifications for each drainage basin upstream from the sampling stations are presented as a percentage of the area of the drainage basin. Here the increasing or decreasing importance of a specific land use classification as influenced by downstream movement is shown. For example the contribution of the drainage basin of North Creek, in terms of a percentage of the land use for each classification, remains fairly constant with downstream movement, i.e., N4 to Nl. However for the Middle Creek basins there is considerable variation for the row crop category from M3 to Ml. Row crop usage makes up about 72 percent of the land area in the M3 basin but only about 61 percent in the Ml basin. Similar data for years other than 1979 are included in Appendix C.

Discussion

Some land use changes have occurred in all of the major drainage basins of the Court Creek watershed during the past 40 years. The major changes

Table 11. Percentage of Total Land Use in the Court Creek Watershed above Stream Sampling Stations;, 1979

	RC	WPAS	PAS	WPS	WTR	CFL	URB	NP	AM	IMR	IMP	Total area (acres)
Sugar Cr. watershed												
S5	42.64	4.96	0.61	6.3	1.65	0.22	0.0	1.11	0	0.42	42.3	4,960
S3	29.76	9.16	1.97	5.0	5.76	0.15	18.3	1.31	0	0.17	28.5	11,360
S2	31.52	13.35	4.02	6.7	4.98	0.24	15.0	1.35	0	0.15	22.8	14,240
S1	31.78	13.11	3.93	7.7	4.87	0.23	14.7	1.34	0	0.14	22.3	14,560
North Cr. watershed												
N4	53.89	20.96	5.41	12.6	0.29	0.15	2.9	2.36	0	0.00	1.4	14,080
N3	52.12	19.79	6.00	15.7	0.25	0.14	2.5	2.35	0	0.00	1.2	16,800
N2	51.53	19.48	5.93	16.8	0.24	0.24	2.3	2.33	0	0.00	1.1	17,920
N1	51.70	19.23	6.11	16.9	0.23	0.23	2.2	2.26	0	0.00	1.1	18,720
Middle Cr. watershed												
M3	71.66	11.41	8.92	5.9	0.00	0.09	0.0	1.62	0	0.00	0.0	4,320
M1	61.36	20.58	8.04	7.5	0.03	0.54	0.0	1.77	0	0.00	0.0	6,400
Confluence with Court Creek	59.87	20.73	8.39	8.5	0.03	0.51	0.0	1.80	0	0.00	0.0	6,720
Court Cr. watershed												
C12	42.45	8.26	3.18	0.0	2.00	0.29	40.6	3.21	0	0.00	0.0	3,200
C10	49.71	16.92	6.51	4.7	1.50	0.43	15.9	3.46	0	0.00	0.8	10,080
C7	53.25	19.48	8.37	6.0	0.82	0.43	7.9	3.30	0	0.00	0.4	20,960
C4	54.01	19.14	7.02	10.89	0.49	0.43	4.76	2.77	0	0.00	0.67	42,880
C3	54.46	18.33	7.55	11.16	0.46	0.34	4.42	2.66	0	0.00	0.62	46,080
C2	48.89	16.82	6.65	10.9	1.50	0.30	6.8	2.33	0	0.03	5.8	61,760
C0 (Confluence with Spoon River)	48.92	16.73	6.62	10.9	1.49	0.30	6.9	2.33	0	0.03	5.7	62,080

Note: RC = row crops; WPAS = wooded pasture; PAS = pasture; WDS = 'woods; WTR = water; CFL = confined animal feedlots; URB = urban; NP = non-productive land; AM = active mineral land; IMR = inactive mineral land (recreation);; IMP = inactive mineral land (pasture)

have occurred in the Sugar Creek basin. Here over 25 percent of the land area has been disturbed as a result of strip mining operations, and about 20 percent of the basin has been influenced by the creation of an urban housing development and impounded waters. The overall effect has been to lessen the acreage of land for row crops and woodland by about 11 and 9 percent, respectively. In addition significant hydrologic modifications have been imposed on the basin due to these developments. The ceasing of mine operations has freed more land for pasture use. Most of the disturbed land has reverted to pasture to the extent that the acreage for such use is currently about the same as that existing 40 years ago.

The drainage basins of North Creek and Middle Creek have both increased row crop acreage by about 4 to 5 percent during the past 40 years. Total acreage for woodland has also increased by about 11 to 13 percent. These increases (row crops and woodland) have been at the expense of pastureland. However the loss of pasture has been compensated for by increased usage of woodland for pasturing livestock.

Overall within the Court Creek Watershed, with a view from the creek's confluence with the Spoon River, there has not been a change in row crop acreage in 40 years. However the woodlands have increased by 9 percent, urbanization has increased by 4 percent, and there has been a 14 percent loss in pastureland. This loss has introduced more livestock to the woodland for pasturing purposes.

The current major land uses in the watershed of Court Creek are summarized in table 12. The wide differences in land use in the different basins show the prudence of examining drainage basins in a watershed rather than relying on an integrated approach as represented by the data summarized for the Court Creek watershed in table 12. The basins of Middle and North Creek are basically agriculturally-oriented without significant influences from mining, urbanization, or water impoundment. The Sugar Creek basin is influenced by those activities.

What are not shown in table 12, but are clearly demonstrated in figure 9, are the locations of urban influences, former mining operations, and confined feedlots in the watershed. The headwaters of Court Creek proper receive the runoff of urban drainage from the Galesburg area. And though much of the former mining area in the Sugar Creek basin is now in pasture, there remain exposed remnants of disturbed overburden from which surface drainage is tributary to Sugar Creek. The substantial number of hogs and pigs confined on the watershed (50,000-60,000) provides a potential for the introduction of animal waste to surface waters.

Also not shown in table 12 is the likely impact of hydrologic modifications that have been imposed on the various drainage basins because of strip mine operations, stream channelization, and the impoundment of water. These alterations are a major consideration in developing relationships between land use and water quality. Their implications will be discussed later.

The interpretation of aerial photographs has provided an historical perspective of land use in the watershed. Data gathered from the interpretation of 1979 photographs coupled with interrogation and reconnaissance have permitted the assignment of current land use practices to drainage basins in the

Table 12. Current Major Land Uses on the Stream Drainage Basins of the Court Creek Watershed

(Percent of total land)

Sugar Creek basin	
Row crops	32
Wooded pasture, pasture, inactive mineral land (pasture)	39
Woods	8
Urban	15
Water	5
	99%

Middle Creek basin	
Row crops	50
Wooded pasture, pasture	29
Woods	9
Urban	0
Water	0
	98%

North Creek basin	
Row crops	52
Wooded pasture, pasture, inactive mineral land (pasture)	26
Woods	17
Urban	2
Non-productive land	2
	99%

Court Creek watershed	
Row crops	49
Wooded pasture, pasture, inactive mineral land (pasture)	29
Woods	11
Urban	7
Non-productive land	2
	98%

Summary

- Ten land use classifications were established for the Court Creek watershed (see table 5).

- The interpretation of aerial photographs for the years 1940, 1950, 1963, 1969, and 1979 provided an historical perspective of land use in the watershed over a 40-year period (see table 6).

- A land use map of the watershed reflecting current usage was prepared (see figure 7).

- The number of cattle marketed in the watershed has remained stable over the years (average 6500); however, there has been a substantial increase (to 50,000-60,000) in the number of hogs and pigs marketed annually (see tables 7 and 8).

- For assessing the relationship between land use and water quality, the land use classifications were applied to discrete drainage basins in the watershed in terms of acreage and percent of the total area above selected stream sampling stations (see tables 10 and 11).

- The boundaries of the drainage basins upstream of the selected stream sampling stations were established and pictorially depicted.

- The current major land uses were identified and summarized for each stream basin (see table 12).

- The Sugar Creek drainage basin, in terms of land use, has been considerably modified during the past 40 years. The impact of coal mining, urbanization, and the creation of impoundments has lessened row crop acreage and woodlands.

- Row crop and woodland acreage in the drainage basins of Middle and North Creeks have increased with time at the expense of pastureland acreage. However, compensation for the loss has been achieved by introducing livestock to woodlands for pasturing purposes.

- Within the total watershed the acreage of row crops has not changed, remaining about 49 percent of the total land use. However urbanization has increased about 4 percent and the increase of woodland and decrease in pastureland, as described for the North and Middle Creek basins, prevails in the whole watershed.

• The differences in land use for each drainage basin make it prudent to examine these basins as parts of the whole if reliable relationships between land use and water quality are to be achieved.

STREAM-RELATED OBSERVATIONS

Quantitative data are a basic necessity for assessing the relationships between land use and the quality of stream water. Such data are also essential for adequately defining and weighing the major factors influencing the relationships. The first consideration is probably streamflow (runoff) information, and its corollary, precipitation data. Then, of course, there is the need for quantifying streamwater quality under varying runoff conditions. The evaluation of water quality data, and indeed the location of sampling stations, would be constrained without pertinent information concerning the physical characteristics (slope, cross sections, length, water depth, bottom and bank stability) of the streams. Such data, or instrumentation for providing them, did not exist on the Court Creek watershed.

The purpose here is to describe the types and scope of instrumentation that was placed on the watershed to assemble data on runoff, precipitation, and soil moisture. Information will be presented on the procedures and judgments used in establishing and using stream sampling stations, performing the analyses required for the samples collected, and defining the physical characteristics of the streams' geometry. Also included are the results of these endeavors coupled with some discussion and an overall summary.

Methods

The selections of sites for streamflow gaging, and the types of streamflow gaging devices used, were predicated on two basic considerations: upstream land use, and the physical suitability of the stream channel for flow measurements. Upstream land use was also a prime consideration in selecting primary stream sampling stations. Therefore it was desirable to have streamflow gaging stations at least at the sites of the primary stream sampling stations. Funding constraints were also a consideration in selecting the types of streamgaging stations to employ.

Nine locations for streamflow gaging were established. Their locations and designations are shown in figure 10. Three types of devices were used. These included continuous recorders, staff gages, and wire-weight gages. Their distribution was as follows (CR = continuous recorder; S = staff gage; W-W = wire-weight gage) :

C2 (CR)	M3 (S)	N1 (S)	S5 (S)
C10 (S)	M1 (W-W)		S3 (S and CR)
C12 (S)			S2 (W-W)

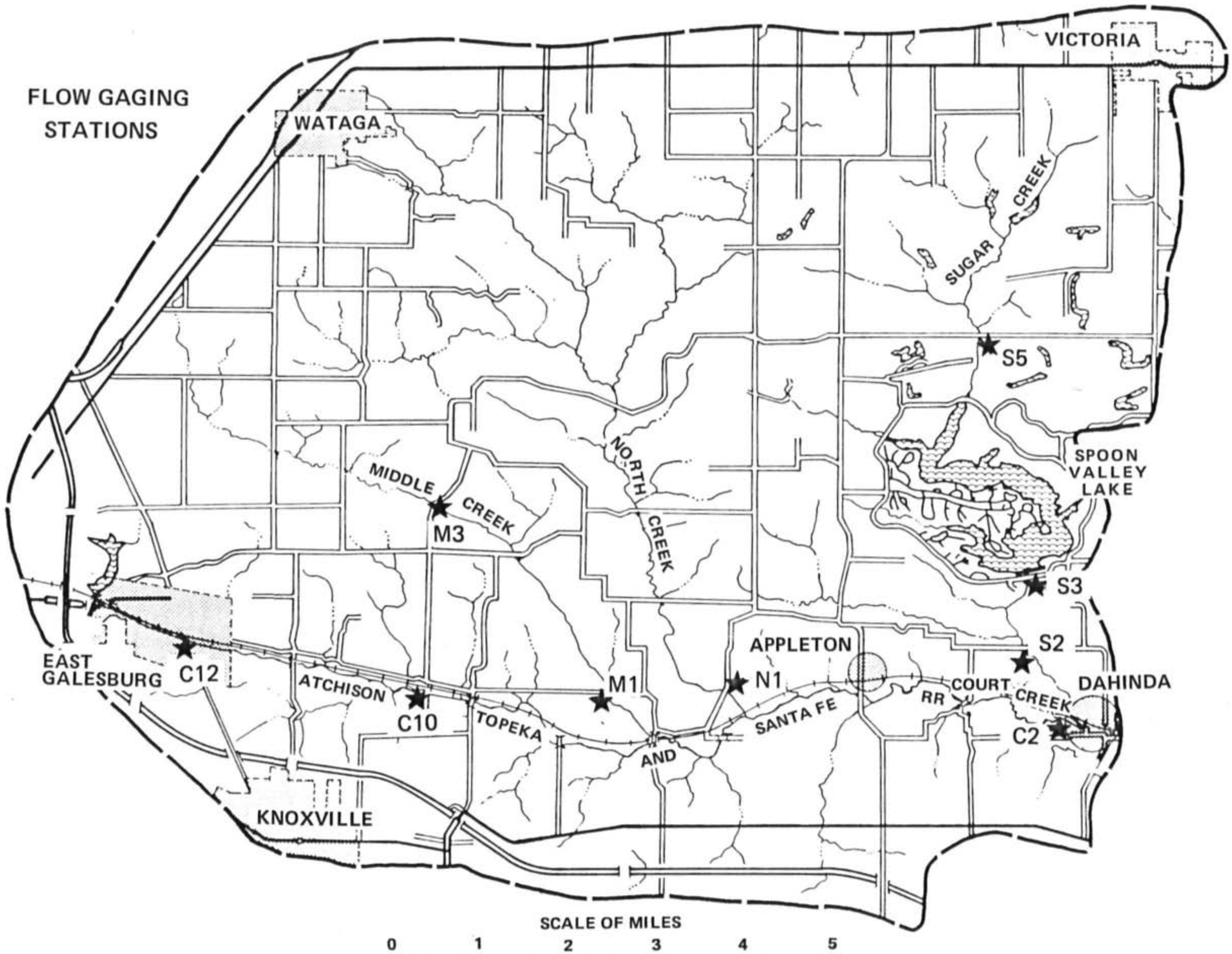


Figure 10. Locations of streamflow gaging stations in the Court Creek watershed

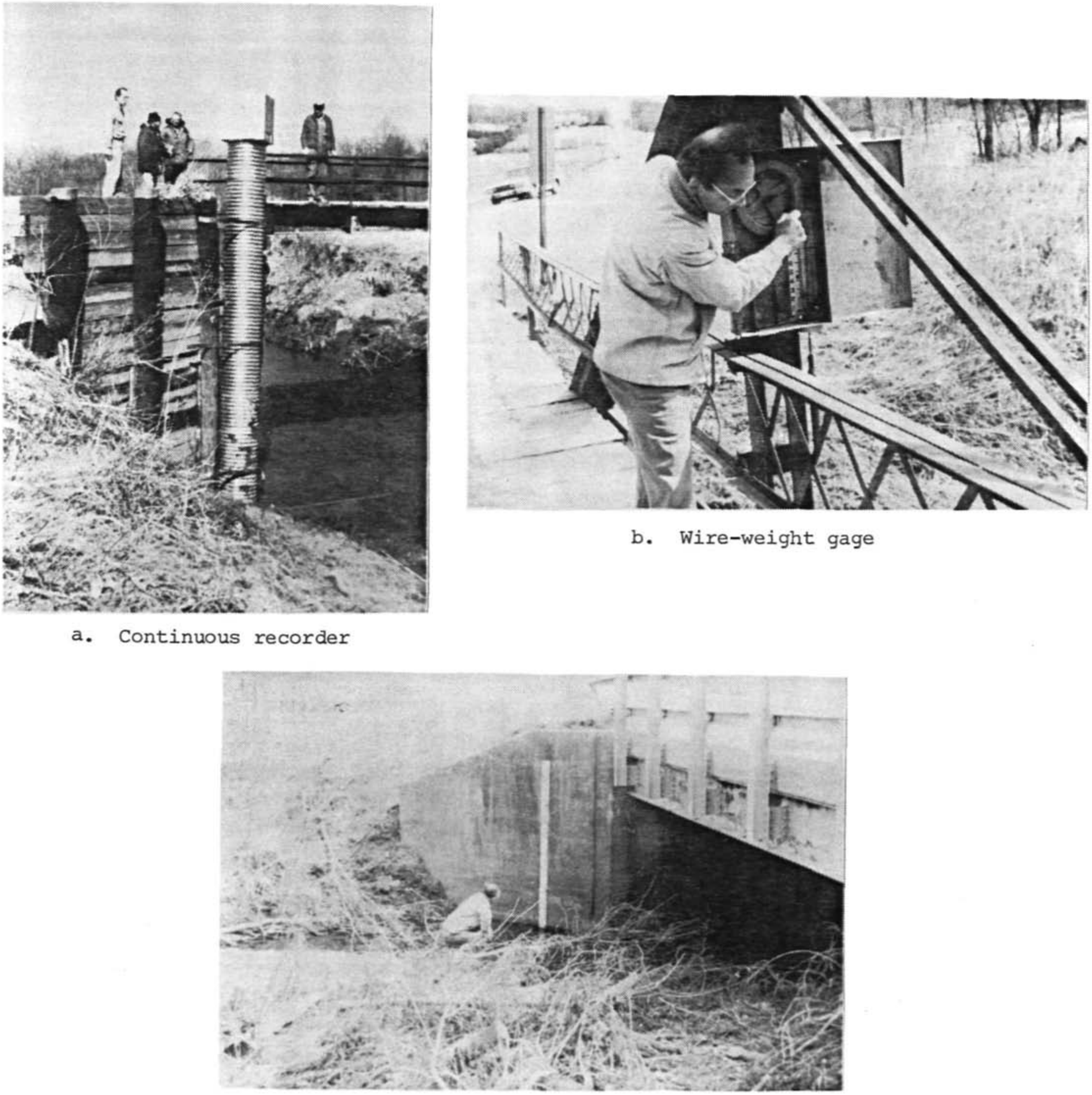
Initially a staff gage was used at station S3. It was later supplemented by a continuous recorder located at the dam site on Spoon Valley Lake. The continuous recorders consisted of weight-driven Stevens Model A-35B recorders actuated by 12-inch floats housed in 24-inch corrugated tubes. The staff and wire-weight gages were observed at least weekly, but more frequently during significant precipitation events. Photographs of each type of device are shown in figure 11. All stage data recorded thus far are included in Appendix D.

Rating curves for each streamgage location had to be developed. The results will be discussed later. The development of rating curves required instantaneous flow measurements in conjunction with observed stage readings. Flow measurements were performed in accordance with U.S. Geological Survey procedures. These procedures require, in addition to adequate stream velocity measurements, rather precise stream cross section information. The cross sections for each gaging station are shown in figures 12 through 15.

Streamflow data for the Court Creek watershed, based upon observations during the course of this study, will be limited from an historical perspective. This limitation will restrict the desirable capability of predicting the frequency of flow occurrences as well as the frequency of occurrence for certain water quality features in the streams of the watershed. In order to overcome this constraint, reliance will be placed on the historical flow records of Indian Creek. The Indian Creek watershed is located about 20 miles northeast of the Court Creek watershed. The U.S. Geological Survey has maintained a continuous flow recording device on the stream, in the vicinity of Wyoming, Illinois, since 1960. The watershed is located in the same physiographic division of the state (Galesburg Plain) as the Court Creek watershed. Its drainage area is about 163 km (63 sq mi) compared to the Court Creek watershed area of 251 km (97 sq mi). From the available 21 years of streamflow records at Indian Creek an effort will be made to develop certain hydrological data for the Court Creek streams where applicable and necessary.

Raingage stations were established at 13 sites on the watershed. Their locations and designated site numbers are shown in figure 16. Each raingage is the Belfort weighing-bucket type equipped with a chart drive for strip charts. A typical installation is shown in figure 17. The installations were serviced weekly with chart renewal at the time of service. Recorded precipitation data were quantified in terms of total quantity and duration. All precipitation data for the 13 locations on the watershed are included in Appendix E.

For the purpose of establishing areas of influence for each of the rain gage sites reliance was placed on the Thiessen method. The method is a procedure for determining the mean depth of precipitation over a given area. The fundamental principle involved consists in "weighing" the value at each station by a suitable proportion of the land area for which a mean is desired.



a. Continuous recorder

b. Wire-weight gage

c. Staff gage

Figure 11. Types of streamflow gaging devices used in the Court Creek watershed

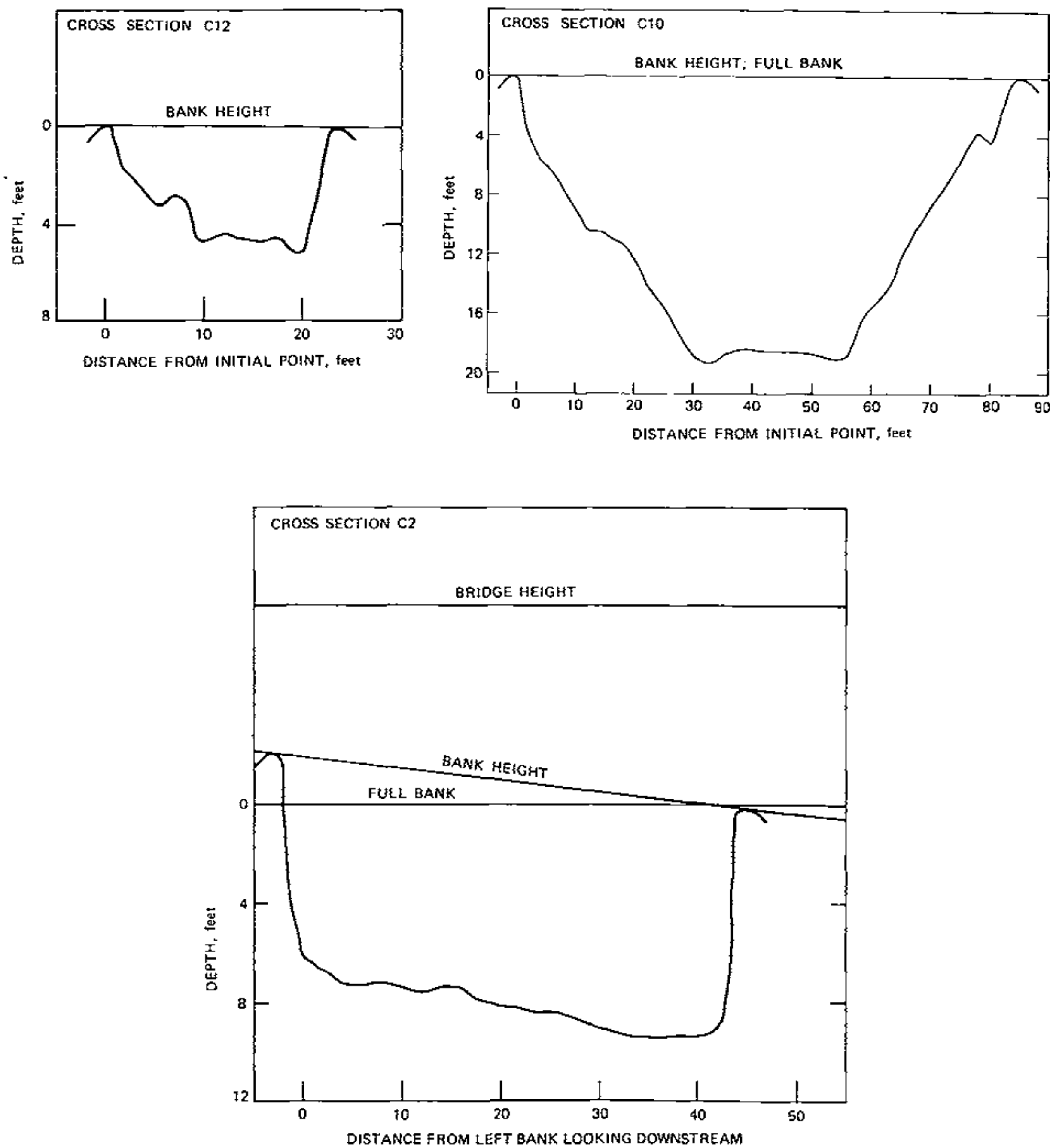


Figure 12. Cross sections of Court Creek at gaging stations C12, C10, and C2

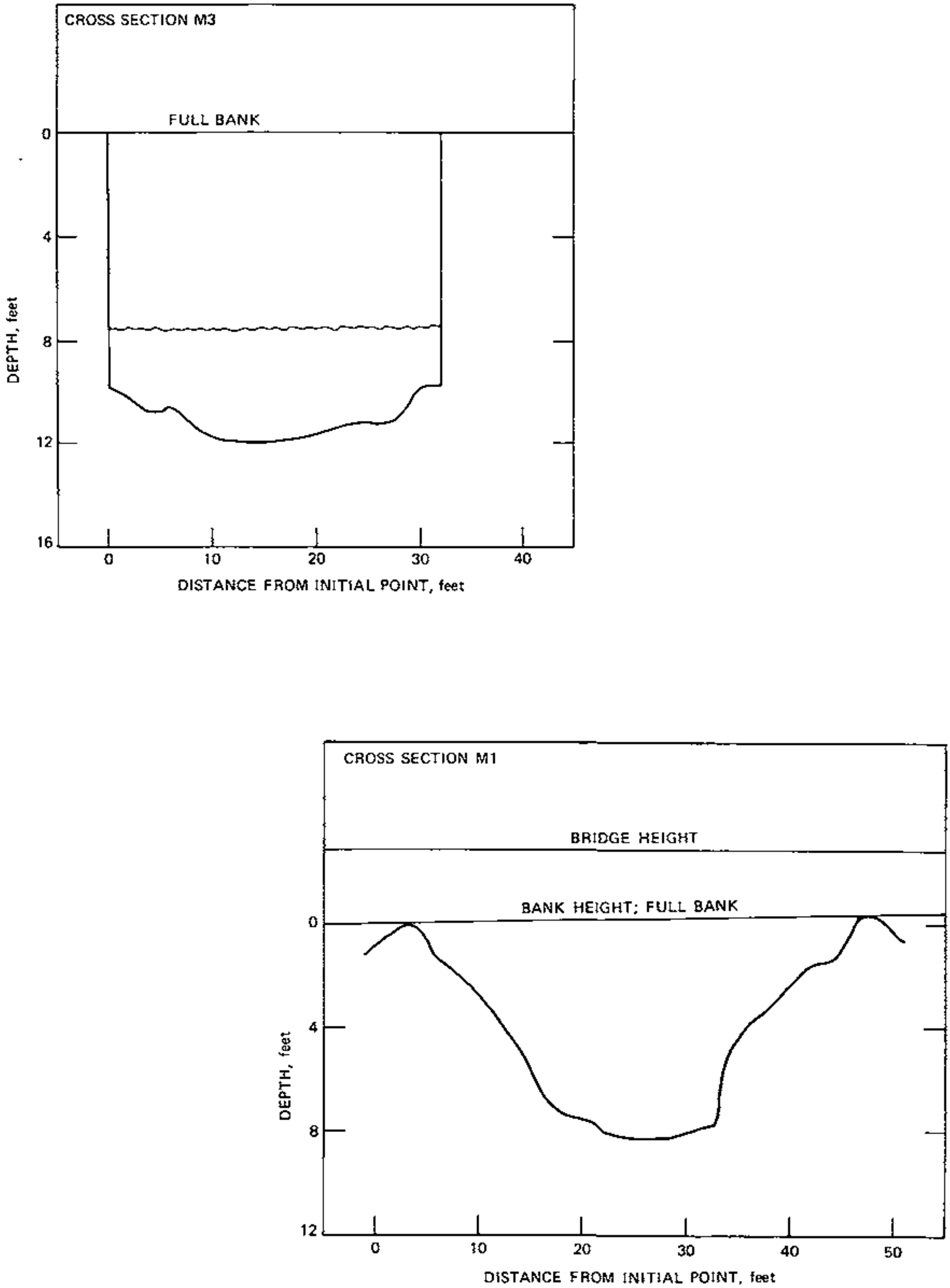


Figure 13. Cross sections of Middle Creek at gaging stations M3 and Ml

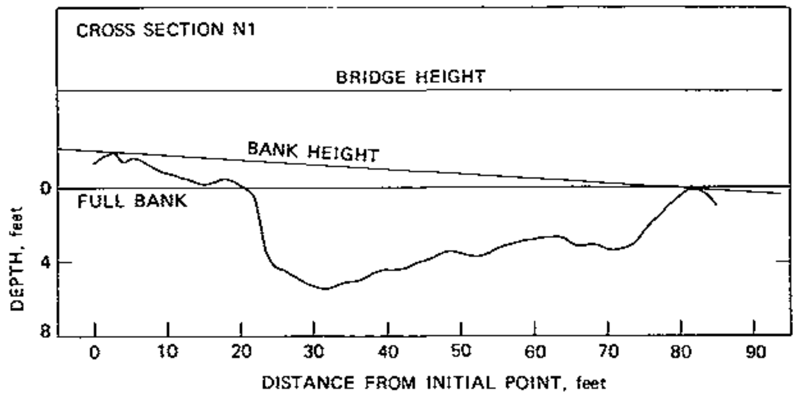
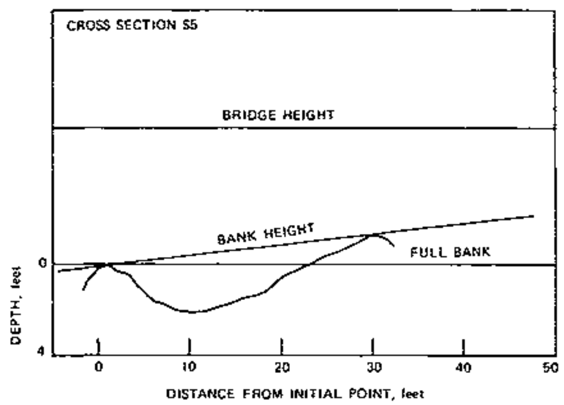


Figure 14. Cross section of North Creek at gaging station Nl



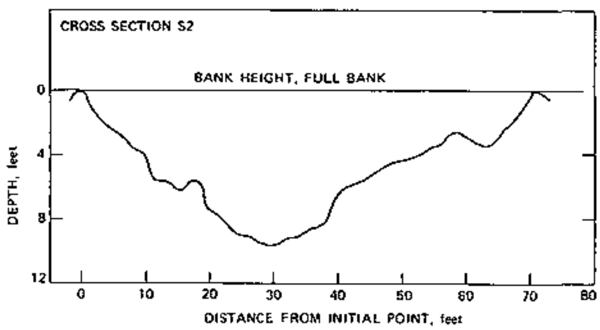


Figure 15. Cross sections of Sugar Creek at gaging stations S5 and S2

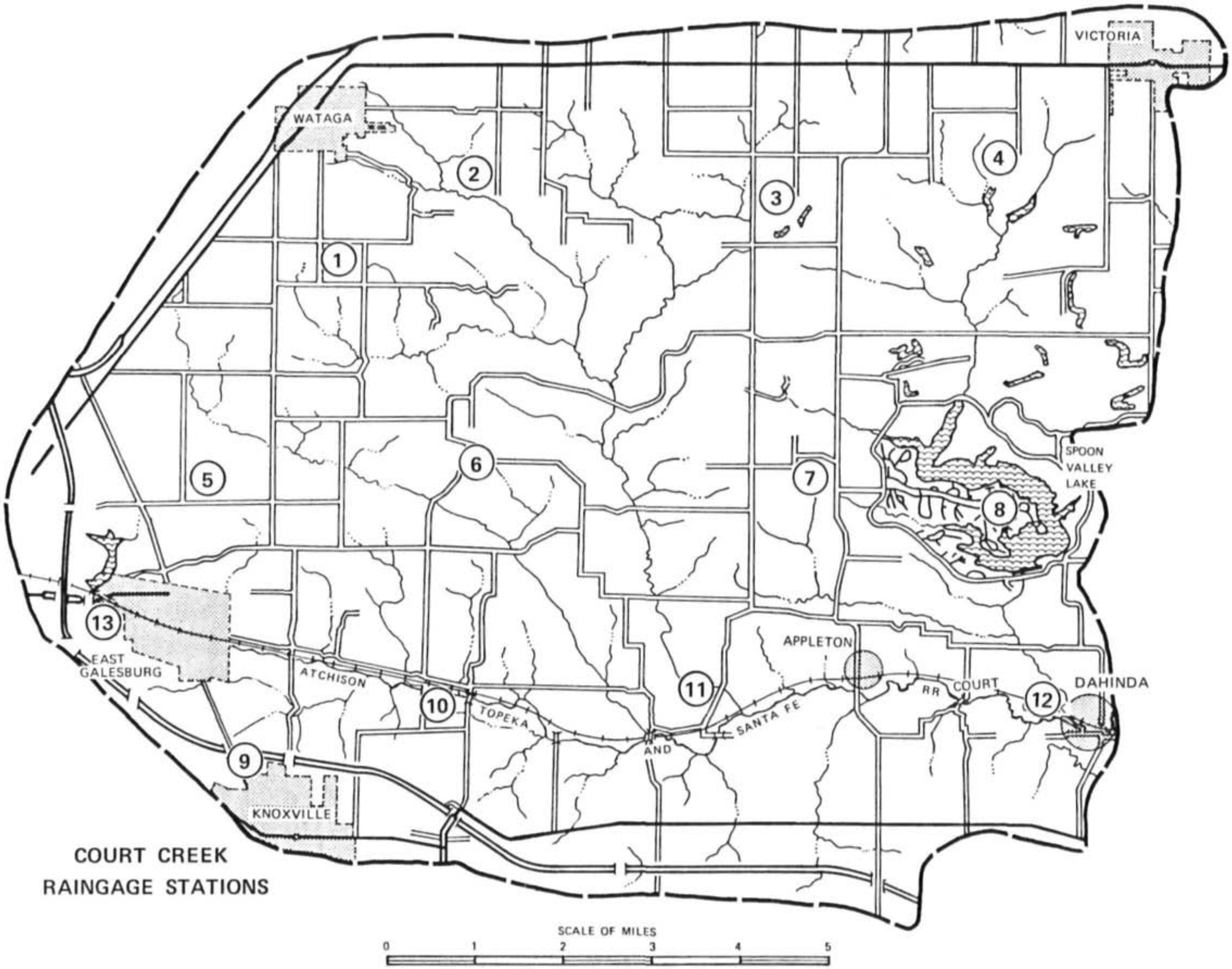


Figure 16. Locations of raingage stations in the Court Creek watershed

Figure 17. Typical raingage installation in the Court Creek watershed

The procedure is as follows. On a base map such as the one in figure 16, straight connecting lines are drawn from each station to the adjacent ones. From the mid-point of these lines a second set of lines, the perpendicular bisectors of the lines connecting the stations, is drawn. The lines of the second set form the interior boundaries of the area allocated to each station. In most cases the exterior boundaries are formed by the boundary lines of the watershed. The area apportioned to each raingage site, here denoted as the area of influence, is normally measured and expressed as a percentage or fraction of the total area within the watershed.

For the Court Creek watershed the areas of influence were determined and quarter sections of the watershed were assigned to each designated land area. The fraction of the watershed denoted by each area of influence was determined by dividing the number of quarter sections assigned to each area of influence by the total number of quarter sections in the watershed (388). Figure 18, which depicts the area allocated to each raingage site, was developed from the Thiessen method.

As mentioned earlier, the basic purpose of the procedure is to develop mean rainfall for the total watershed based upon data from 13 discrete sites. As shown in table 13 the recorded rainfall at each site is multiplied by the fraction of the watershed it represents. The totals of all products are summed to obtain the average rainfall in the watershed for a specific event. The designated areas of influence will also be useful for deriving estimates of runoff in the watershed streams during storm events. The assignment of quarter sections to each area, whereby the land use of each quarter section has been determined, will be helpful in an evaluation of effects on land use and water quality.

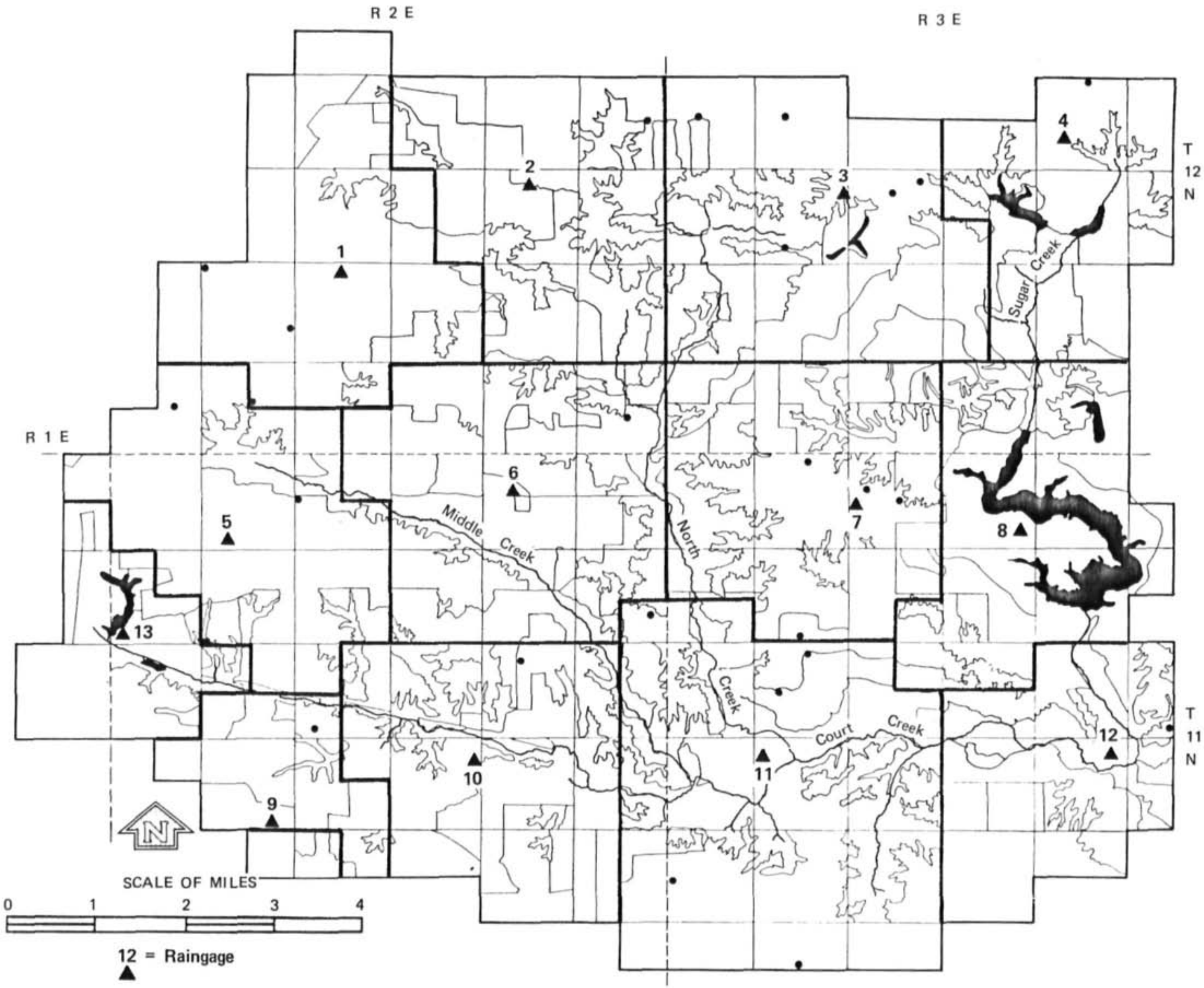


Figure 18. Areas of influence for raingages in the Court Creek watershed

Table 13. Typical Calculations for Determining Mean Rainfall on the Court Creek Watershed

Site	Number of quarter sections	Fraction of watershe	Inches of recorded rainfall	Inches of weighted rainfall
1	33	0.085	1.0	0.085
2	30	0.077	2.0	0.150
3	37	0.095	3.0	0.285
4	23	0.059	4.0	0.236
5	30	0.077	1.0	0.077
6	37	0.095	2.0	0.195
7	33	0.085	3.0	0.255
8	30	0.077	4.0	0.308
9	14	0.036	1.0	0.036
10	31	0.080	2.0	0.240
11	51	0.131	3.0	0.393
12	24	0.062	4.0	0.248
13	15	0.039	5.0	0.195
Total quarter sections	388	Total fraction 0.998	Average watershed amount	2.703

A thin-walled steel soil moisture access tube was installed at the site of raingage 8 (see figure 17) to permit measurement of the moisture content of soil. It was placed in the most common soil type in the watershed: Rozetta. The measurement devices were Chicago Nuclear Surface and Depth Neutron Probes. The neutron sources in both devices are beryllium-radium, equipped with lead and paraffin shielding.

The moisture content of the soil surface is obtained by placing the surface probe on the ground surface. When activated, neutrons are beamed downward. The depth of neutron penetration is mainly a function of soil moisture. This method is effective for the upper 5 to 20 centimeters (2-8 inches) of the soil layer.

The moisture content of the soils was also determined at 20, 40, 60, 100, 120, 140, 160, 180 and 200 centimeters (8, 16, 32, 40, 48, 56, 64, 72, and 80 inches) into the soil layer. In these cases neutrons are beamed outward into the soil through a thin-walled access tube of steel. The moisture content is determined as a function of the number of returning neutrons slowed by the hydrogen atoms in the soil pore water.

The soil moisture content and moisture deficit are expressed as water equivalents, that is, the equivalent depth of water expressed in millimeters (1 mm = .04 inches). The data for moisture content and moisture deficit are included in Appendix F.

The selection and location of stream sampling sites on the watershed was an evolutionary process. Coupled with the desire to locate stream sampling sites with streamflow gaging stations was also the need to establish them downstream of isolated identifiable land uses such as urban, mining, impounded waters, and agricultural practices. With these thoughts in mind 9 primary stream sampling locations were initially selected. After several sampling events, an additional 7 supplemental stream sampling sites were established. The locations and number designations of the 16 stations are shown in figure 19. The category of each station is as follows:

Primary	*Supplemental*
C12	C7
C10	C4
C2	C3
Nl	N4
M3	N3
Ml	N2
S5	S1
S3	
S2	

The principal differences in the two types of sampling stations relate to whether or not the streamflows at the stations were gaged and the types of analyses performed on the water samples that were collected. All 9 primary stations were located at streamflow gaging sites, and generally complete analyses were performed on all water samples collected at these stations. Analyses for the water samples collected at the 7 supplemental sites were generally limited to determinations for concentrations of suspended solids and ammonia-nitrogen.

The relationships of the 16 sampling stations to their upstream drainage areas have been identified previously (see table 9 and figure 9). These relationships, in combination with estimated runoff and land use for each upstream drainage area, will be compared to the water quality characteristics observed at the stream sampling stations.

The collection of streamwater samples was generally predicated on the occurrence of a major runoff event. This procedure is essential if indeed relationships between land use and water quality are to be detected. A major runoff event was usually defined as an occurrence when rainfall equalled or exceeded 1 inch during a 24-hour period. Some collections were performed during base streamflow for comparative purposes.

All water samples were collected with a 22-pound DH-59 sampler equipped with a glass pint container. The sampler was either hand-held or suspended

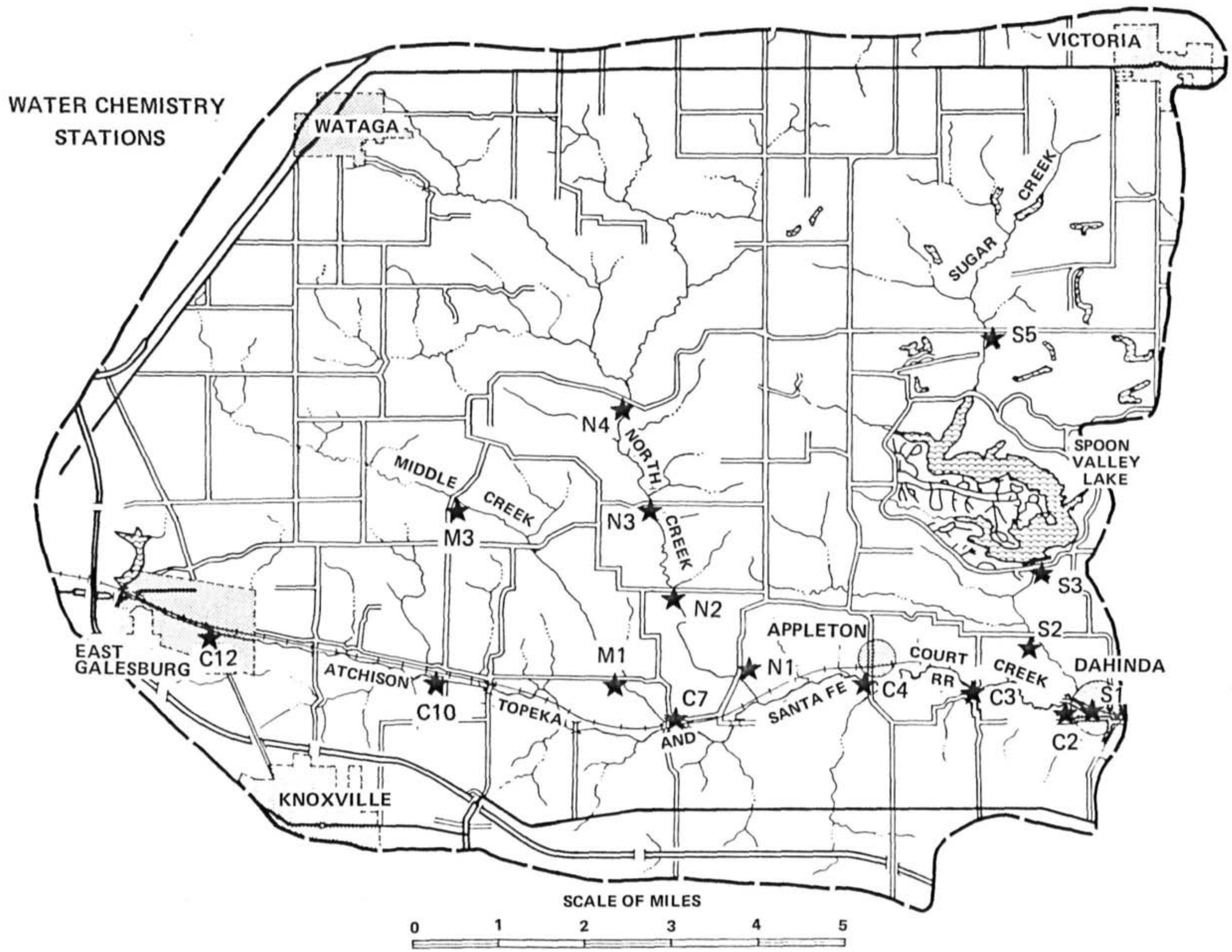


Figure 19. Locations of stream sampling stations in the Court Creek watershed

by cable from a crane-mounted winch on bridges. In either case depth integrated samples were collected by lowering the sampler at a uniform rate to the bottom of the stream, instantly reversing it upon contact with the bottom, and raising it to the surface again at a uniform rate. In this manner samples were collected at appropriate intervals across the width of the stream until a 2-liter composited sample was obtained. After samples were collected they were transported to laboratory facilities and immediately stored in refrigeration units.

Certain determinations were performed in the field. These included measurements for temperature and dissolved oxygen concentrations. For these a Yellow Spring Model 57 DO meter was usually used. Calibration of the dissolved oxygen probe was accomplished by using the modified Winkler Method for dissolved oxygen determinations. In some cases the Winkler method was used alone for dissolved oxygen determinations. All field observations were recorded in notebooks.

As implied earlier, the types of analyses performed at each sampling station were contingent on whether or not it was a primary or supplemental station. The types of analyses performed on streamwater samples and the methods of analysis are shown in table 14. As indicated in the table, some determinations were made for the dissolved as well as the total concentration of a constituent. This was the case for ammonia, phosphorus, and the heavy metals lead, copper, zinc, and iron. Samples from only two stations were routinely examined for heavy metals. One station, S5, is representative of a drainage area dominated by a formerly active strip mining activity.

Table 14. Analyses Performed on Stream Samples

	Sampling stations	Method of analysis
Temperature (field)	Primary	Thermister
Dissolved oxygen (field)	Primary	Oxygen meter
pH	Primary	Glass electrode
Alkalinity	Primary	Potentiometric method
Turbidity	Primary	Nephelometric method
Suspended solids	Primary and supplemental	Gooch filtration
Nitrates	Primary	Chromotrophic method
Sulfates	Primary	Turbidimetric method
Chlorides	Primary	Argentometric method
Ammonia*	Primary and supplemental	Buchi distillation, Indophenol colorimetric
Phosphorus*	Primary	Ascorbic acid
Lead*	Only S5 and C12	Atomic absorption
Copper*	Only S5 and C12	Atomic absorption
Zinc*	Only S5 and C12	Atomic absorption
Iron*	Only S5 and C12	Atomic absorption

*Total and dissolved

Note: The primary stations are stations C12, C10, C2, Nl, M3, Ml, S5, S3, and S2.
The supplemental stations are stations C7, (C4, C3, N4, N3, N2, and S1.

The other station, C12, principally represents the influence of urban activity. The determinations for the dissolved component of a constituent were performed on a filtrate after passage through an 0.45 μm millipore filter. All water quality data thus far obtained are included in Appendix G.

The slopes of the streambeds of Court Creek and its three major tributary streams were estimated on the basis of topographic maps provided by the U.S. Geological Survey, which were developed from surveys performed in 1978-1979. Profiles of the streambeds are depicted in figure 20.

Use can be made of the slope data for estimating streamwater velocities during in-bank streamflows. Such information will not only provide insights regarding bottom scour and bank erosion but will also be valuable for ascertaining the type of aquatic organisms that may be supported by those instream flow conditions governed by the slopes of the streambeds.

A major effort for gaining pertinent information on the physical characteristics of the streams in the watershed involved a detailed field reconnaissance of Court and North Creeks. The streambeds of the two streams were "walked" throughout most of their entire length, and observations were recorded at various sites relative to land use, vegetation, stream widths, bank heights, stream bottoms, bank erosion, and hydrographic modifications.

During the field reconnaissance of Court Creek, notes were recorded for 51 sites. These sites are designated in figure 21. In addition to observations and measurements, samples of soil were collected from the mid-height of streambanks at 25 locations. On several occasions soil samples were collected from both sides of the stream. A total of 39 samples were processed for particle size analyses. All samples were collected with, a soil sampler consisting mainly of a stainless steel split sleeve coring body 3/4 inch in diameter and 12 inches long.

With reference to figure 21, proceeding upstream from site 1 the stream meanders through a broad alluvial floodplain up to site 26. Thereafter the stream valley narrows. Much of the stream, commencing at site 13 to site 32, is bordered on the south by steep bluffs. Streambank heights and widths are recorded in table 15 for all sites. Also included is the extent of sand and gravel widths in the streambed.

Within the alluvial plain row crops generally exist to the streambank's edge. It is within these areas that major streambank erosion occurs. As noted in table 15 the bank heights vary from 12 to 19 feet within the alluvial plain segment of the stream, with an average height of about 13 feet.

There was considerable evidence of major hydrographic modifications along the course of the stream. These modifications, which will be documented later in this report, appeared to have been undertaken to gain more row crop acreage in the floodplain. The modifications consisted mainly of re-directing the channel of the stream to eliminate meanders or to ensure that a bluff served as one of the channel banks.

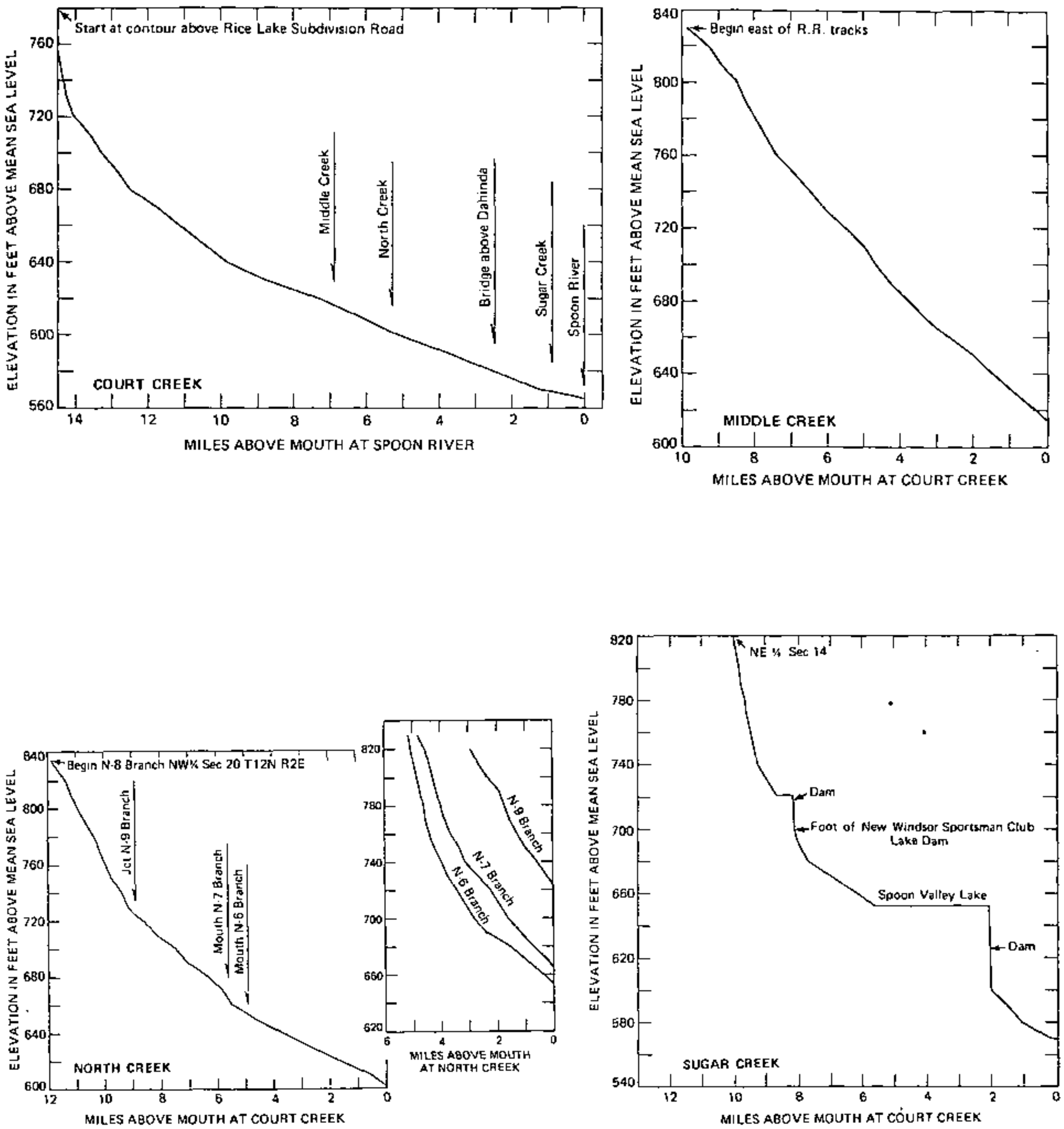


Figure 20. Streambed slopes of Court, Middle, North, and Sugar Creeks

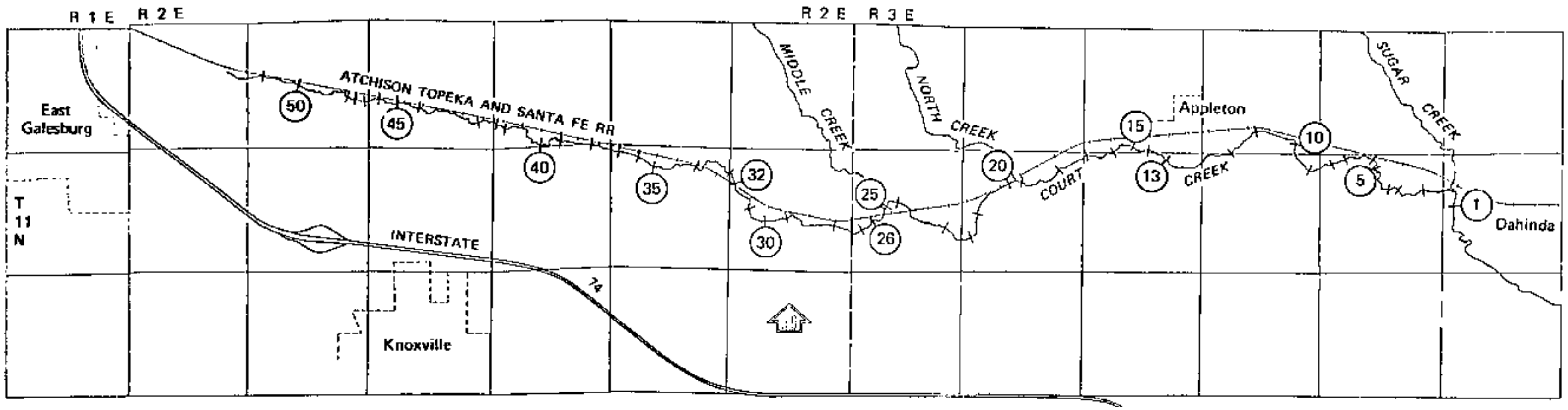


Figure 21. Field reconnaissance sites along Court Creek

Table 15. Some Observations of Stream Widths, Bank Heights, and Stream Bottoms along Court Creek

Site	Sand gravel width (ft)	Bank to bank width (ft)	Bank height (ft)	Remarks
1	43	43	10	Upstream of station C2
2	34	61	12	Upstream of Sugar Cr. confluence
3	38	58	11	
4	24	61	9	
5	25	101	11	
6	42	69	15	
7	46	54	11	
8	50	62	18	
9	33	70	10	Upstream of station C3
10	100	100	11	Soil sample from bank
11	47	71	15	Soil sample from bank
12	38	78	14	Soil sample from ban):
13	38	78	15	Upstream of station C4 Soil sample from bank
14	40	60	10	
15	70	80	12	Soil sample from bank
16	50	80	19	
17	45	65	12	Soil sample from bank
18	65	80	15	Soil sample from bank
19	75	75	13	Soil sample from bank
20	32	52	13	Upstream of North Cr. confluence Soil sample from bank
21	30	47	13	Upstream of station C6
22	45	72	13	Soil sample from bank
23	45	80	15	Soil sample from bank
24	30	45	15	Soil sample from bank
25	77	84	12	Upstream of station C7 Soil sample from bank
26	25	40	12	Upstream of Middle Cr. confluence Soil sample from bank
27	34	42	12	Soil sample from bank
28	23	52	12	
29	18	42	14	
30	25	40	10	Soil sample from bank
31	20	45	15	Upstream of station C8
32	20	40	16	Soil sample from bank
33	25	50	18	Soil sample from bank
34	15	45	16	Soil sample from bank
35	20	40	15	
36	18	40	17	Upstream of station C9
37	15	30	9	Soil sample from bank
38	20	30	15	
39	30	45		Upstream of station C10 Soil sample from bank
40	18	30	13	
41	20	36	17	
42	14	25	9	Soil sample from bank
43	10	30	15	Soil sample from bank
44	10	30	6	Upstream of station Cll Soil sample from bank
45	20	25	6	
46	12	25	3	
47	20	25		Soil sample from bank
48	20	20		
49	32	32		
50	19	19		
51	11	30		Upstream of station C12

In the upland valley of Court Creek, extending from sites 26 to 51, the land use along the banks is characterized by pasture and woodland. Bank erosion is not severe or extensive. It is usually limited to areas where fallen trees obstruct flow. There is no evidence of significant hydrographic modifications.

During the field reconnaissance of North Creek, notes were recorded for 30 sites. The locations of these sites are shown on the map in figure 22. With reference to this figure, the configuration of the alluvial floodplain and upland valley segment is not unlike that of Court Creek. Proceeding upstream from site 1 the stream meanders through an alluvial plain up to site 21. Thereafter the stream valley narrows. Unlike Court Creek, however, only a small segment of stream (between sites 3 and 4 and sites 11 and 13) is constrained by a bluff. Observations concerning bank heights and widths as well as the extent of sand and gravel in the streambed are included in table 16.

As noted for Court Creek there was evidence of significant hydrographic modifications along the course of North Creek within the alluvial plain segment, and major bank erosion sites also were limited to this segment of the stream.

In the upland valley portion of the stream, above site 21, the banks are well covered with uncultivated vegetation and timber.

Results

In the previous section an outline was presented of the methodologies and judgments used in selecting streamflow and raingaging stations and stream sampling stations. Methodologies also were described for collecting stream samples, performing analyses for water quality characteristics, and developing streambed slope data. In addition the field reconnaissance procedures undertaken for Court and North Creeks were described. In most cases the methodologies and outlines were supported by figures and tabular data. It is the purpose here to present some of the data generated from these activities.

All water level stages recorded at the streamgaging stations during the period November 19, 1980, to October 26, 1981, are included in Appendix D. Data are missing for station M3 because it was not installed until April 1982. Stage-flow relationships were developed by in-stream discharge measurements. From the relationships, rating curves for the streamgaging stations were prepared. The rating curves for each station except C2 are included in figures 23-26. Backwater influences at C2 due to the influence of the Spoon River have delayed the preparation of a rating curve for C2. On the basis of the rating curves in conjunction with periodic stage observations, instantaneous streamflows at each station were estimated. The streamflows developed thus far are included in table 17.

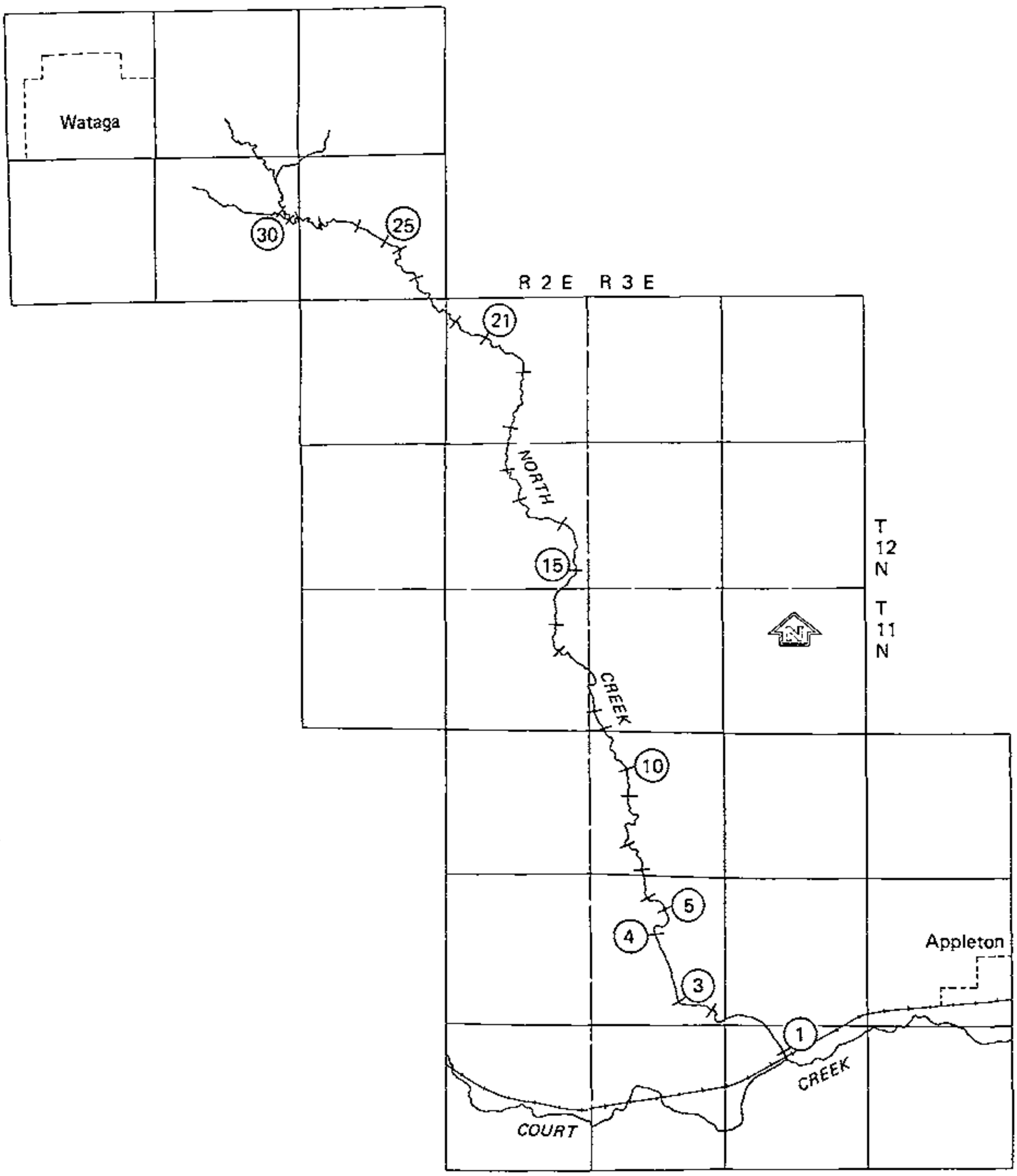


Figure 22. Field reconnaissance sites along North Creek

Table 16. Some Observations of Stream Widths, Bank Heights, and Stream Bottoms along North Creek

Site	Sand gravel width (ft)	Bank to bank width (ft)	Bank height (ft)	Remarks
1	30	50	14	
2	38	53	7	Upstream of station Nl
3	31	48	9	
4	28	40	10	
5	34	47	10	
6	34	48	9	
7	26	48	10	Upstream of station N2
8	30	72	8	
9	34	51	13	
10	32	50	12	
11	25	40	11	
12	30	50	12	Upstream of station N3
13	25	42	8	
14	35	45	6	
15	22	50	12	
16	31	64	14	Upstream of station N3
17	16	41	8	
18	18	40	9	
19	25	30	9	
20	12	21	3	
21	20	40	5	Upland valley commences
22	20	29	6	
23	15	18	5	
24	18	25	5	
25	11	18	3	
26	15	18	8	
27	12	20	9	
28	10	15	6	
29	6	12	6	
30	4	11	6	

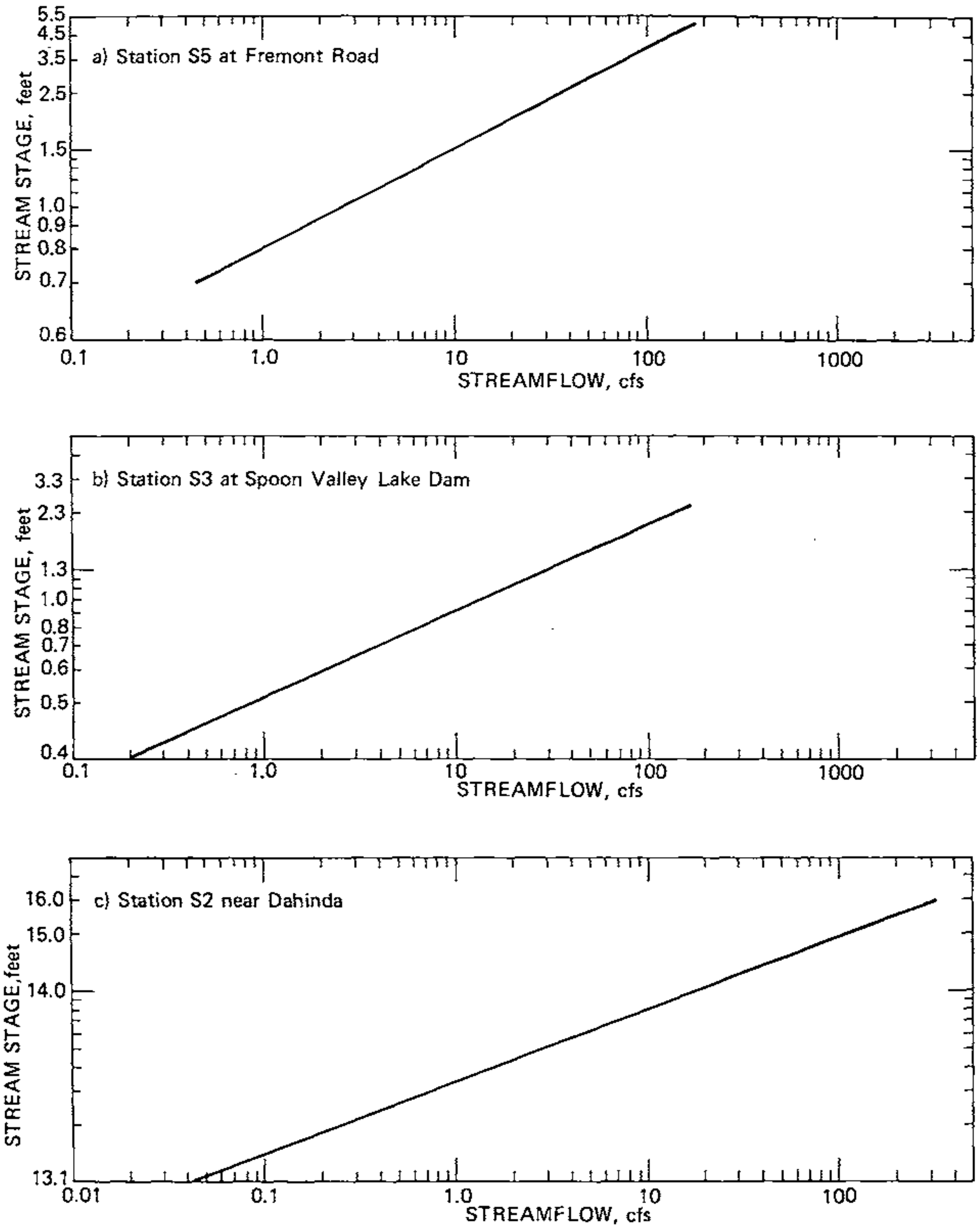


Figure 23. Rating curves for three gaging stations on Sugar Creek

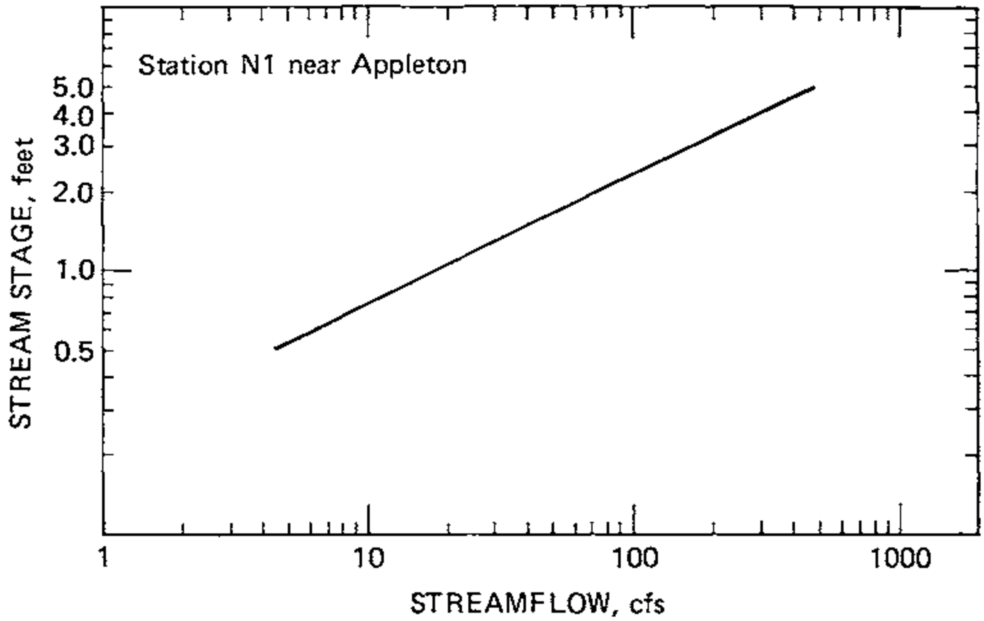


Figure 24. Rating curve for station Nl on North Creek

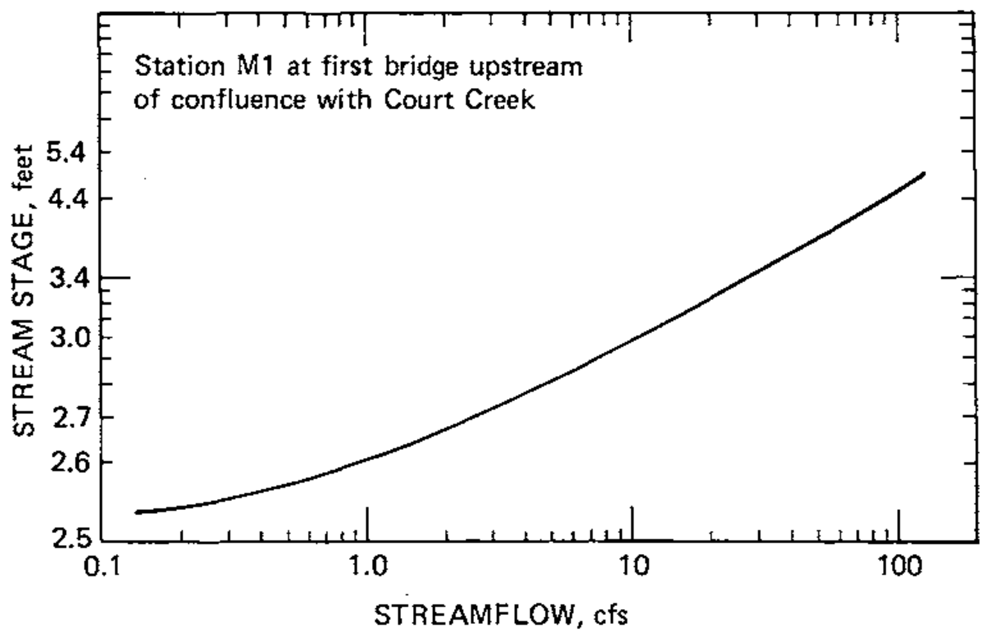


Figure 25. Rating curve for station Ml on Middle Creek

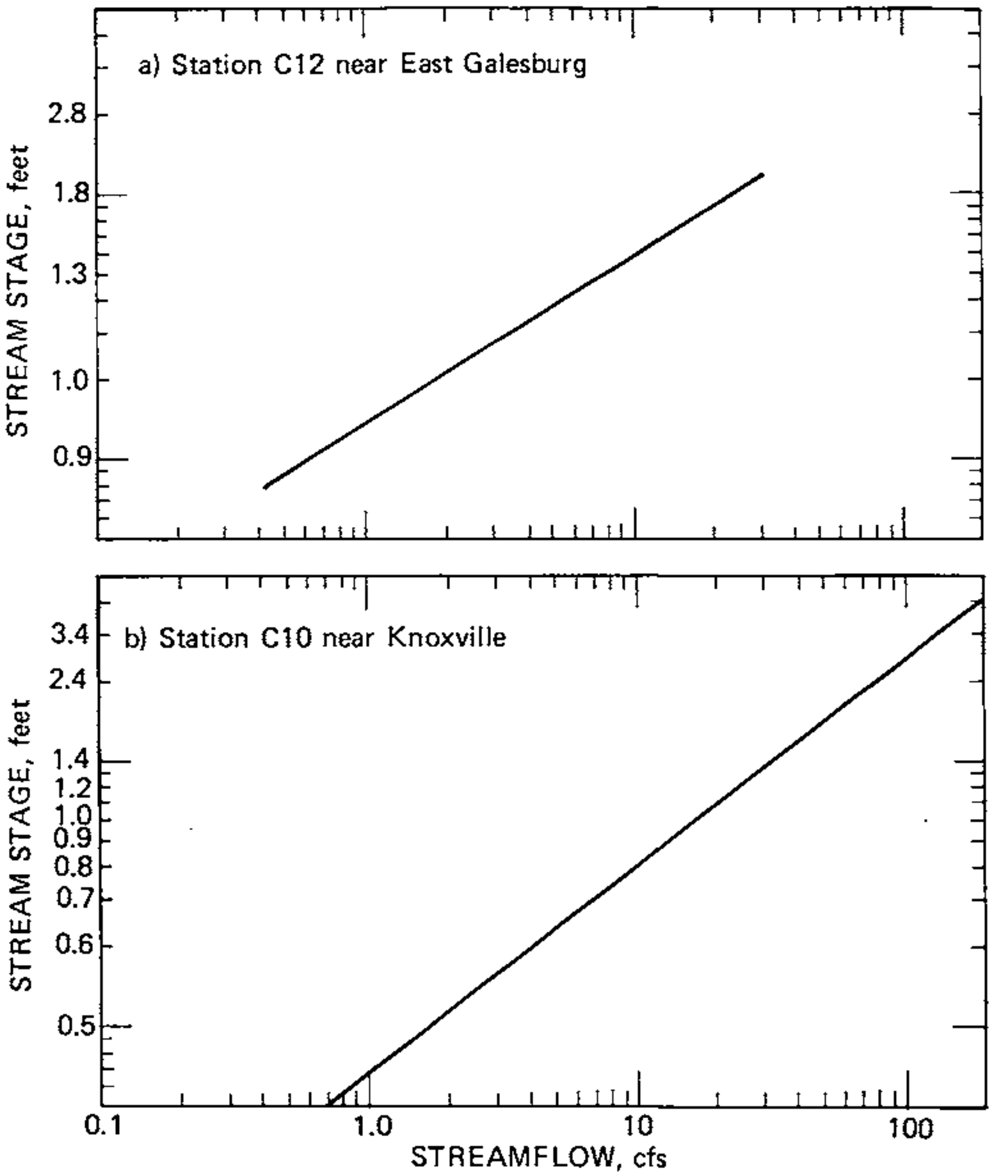


Figure 26. Rating curves for two gaging stations on Court Creek

Table 17. Instantaneous Streamflows in the Court Creek Watershed

(Flows in cubic feet per second)

	S5	S3	S2	N1	M1	C12	C10
11-19-80	10.0	26.0	31.0	18.0	11.0	8.1	12.0
11-21-80			30.0	17.0	0.6	8.1	11.0
11-26-80			34.0	18.0	1.2	9.0	12.0
12-1-80			32.0	16.0	0.9	1.5	12.0
12-5-80	20.0		48.0	18.0	1.3	7.6	15.0
12-8-80	45.0		137.0	188.0	50.0	16.0	71.0
12-9-80	21.0		38.0	80.0	13.0	14.0	32.0
12-15-80	6.2	28.0	40.0	32.0	8.8	7.6	15.0
12-17-80	3.8	35.0	35.0	28.0	1.4	7.1	16.0
12-18-80	3.6	28.0	38.0	28.0	3.3	7.1	13.0
2-22-81	29.0	74.0	122.0	150.0	59.0	4.9	69.0
3-3-81	3.8			25.0	1.6	3.0	10.0
4-12-81	34.0	43.0	70.0	148.0	48.0	27.0	59.0
4-13-81	30.0	46.0	58.0	144.0	40.0	27.0	63.0
4-14-81	40.0	159.0	60.0	116.0	38.0	27.0	63.0
4-15-81	18.0	62.0	72.0	76.0	18.0	18.0	38.0
4-16-81	14.0	52.0	37.0	62.0	20.0	14.0	31.0
4-20-81	6.6	20.0	20.0	40.0	8.8	9.5	21.0
4-28-81	77.0	71.0	113.0	>1400	84.0	15.0	82.0
4-29-81	37.0	43.0	41.0	128.0	17.0	12.0	35.0
5-4-81	4.3	22.0	12.0	40.0	10.0	8.6	19.0
5-11-81	9.1	24.0	15.0	43.0	10.0	3.7	20.0
5-12-81	6.6	26.0	17.0	34.0	6.9	3.0	14.0
5-14-81	81.0	88.0	220.0	342.0	69.0	23.0	158.0
5-21-81	3.6	26.0	13.0	40.0	6.6	7.1	19.0
5-26-81	3.6	13.0	11.0	26.0	5.5	4.9	9.8
6-2-81	2.7	7.3	4.8	21.0	1.2	3.7	8.6
6-8-81		2.9		18.0	0.6	2.7	6.2
6-9-81	4.6	12.0	6.0	31.0	9.7	7.6	15.0
6-13-81	75.0	66.0	222.0	413.0	107.0	27.0	184.0
6-15-81	11.0	66.0	63.0	34.0	12.0	10.0	20.0
6-22-81	4.1	20.0	13.0	25.0	0.4	8.1	16.0
6-24-81	38.0	34.0	50.0	198.0	41.0	13.0	54.0
6-29-81	2.6	19.0	9.6	21.0	4.4	2.1	8.0
7-6-81	2.9	20.0	9.6	23.0	6.1	8.1	17.0
7-13-81	1.1	4.0	3.4	12.0	1.0	2.7	6.2
7-20-81	1.4	4.0	1.8	12.0	.2	2.1	6.8
7-27-81	2.5	20.0	15.0	24.0	9.1	6.2	8.0
7-28-81	27.0	52.0	40.0	142.0	23.0	5.1	58.0
8-2-81	165.0	66.0	84.0	429.0	144.0	29.0	29.0
8-3-81	34.0	78.0	60.0	38.0	8.8	3.7	13.0
8-10-81	3.6	37.0	30.0	18.0	2.8	2.8	6.2
8-17-81	5.2	51.0	33.0	20.0	2.2	2.5	5.7
8-24-81	1.5	9.3	8.4	9.0	1.8	1.0	2.1
8-41-81	1.2	5.6	5.8	9.8	3.1	1.6	3.5
9-7-81	.8	2.7	3.2	16.0	.7	.7	1.2
9-14-81	.8	1.1	2.4	32.0	4.0	.5	.8
9-21-81	.5	.6	1.7	53.0	6.6	.4	.7
9-28-81	1.0	.7	1.3	4.9	4.4	.8	1.2
10-5-81	.9	.5	1.7	6.2	9.7	8.6	1.4
10-12-81	.8	1.2	2.2	16.0	7.8	.4	1.6
10-13-81	.8	1.5	1.5	5.1	1.0	.4	1.6
10-19-81	2.0	.9	.8	3.0	1.2	6.0	3.3
10-26-81	1.2	.2	.4	33.0	1.8	1.2	2.8

Note: No data are available for stations M3 (not installed until April 1982) or C2 (rating curve pending)

Since a historical record of streamflow is not available for the streams in the Court Creek watershed, and particularly for Court Creek, reliance will be placed on the 21-year record available for nearby Indian Creek. A summary of mean and maximum mean daily flows for Indian Creek during the period 1960-1980 is included in tables 18 and 19.

All precipitation data for the 13 raingage sites are included in Appendix E. Daily mean rainfall for the period December 1980 to September 1982 is shown in figure 27. Similarly the monthly mean rainfall is shown in figure 28.

During the period November 19, 1980 to October 13, 1981, at least 12 water samples from the 9 primary stations were collected and analyzed. The results are included in Appendix G. Additional samples (totaling 16) were collected and analyzed for suspended sediment concentrations. During the period of sample collection, nine storm events occurred with total daily precipitation exceeding 1 inch. Streamwater collections were made during seven of the storm events. In several instances samples were collected on several days following a storm event. Of the 16 sampling days for suspended solids only three occurred in the absence of the influence of a storm event; i.e., base streamflow. An example of differences observed for concentrations of total suspended solids and some heavy metals for base flow versus storm flow is shown in table 20.

Table 18. Monthly Mean and Annual Mean Streamflows in Indian Creek
(Flows in cubic feet per second)

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Annual
1960	16	19	36	91	40	136	199	90	100	28	14	5	65
1961	7	7	4	4	7	21	15	12	26	33	16	79	19
1962	29	78	31	24	47	201	77	76	27	15	5	2	51
1963	7	4	2	1	5	110	22	31	7	7	2	1	17
1964	1	2	1	12	3	26	37	16	52	11	2	2	14
1965	1	1	3	133	74	82	133	46	13	7	13	33	45
1966	14	9	27	66	57	26	52	153	45	20	8	3	40
1967	2	4	10	4	26	44	84	62	35	31	22	6	27
1968	10	51	39	39	42	31	36	21	26	12	4	6	26
1969	3	6	59	222	40	19	32	26	49	117	27	8	51
1970	48	26	15	17	51	30	135	225	156	32	37	184	79
1971	95	69	46	16	52	58	23	15	10	12	4	2	33
1972	3	2	21	12	22	41	57	52	122	51	66	30	40
1973	21	66	77	84	62	144	193	224	118	41	17	12	88
1974	36	26	56	223	91	142	90	189	338	30	10	8	103
1975	6	6	8	14	39	61	83	69	69	30	20	10	34
1976	8	9	34	17	57	121	172	129	39	17	6	2	51
1977	3	2	2	2	5	18	11	48	6	6	17	74	16
1978	87	129	56	23	12	41	69	168	39	21	8	5	55
1979	4	7	9	5	6	272	189	101	35	23	9	2	56
1980	3	4	7	3	4	34	45	28	126	22	26	100	33
Mean	19	25	26	48	35	79	84	82	68	27	16	27	45

Table 19. Maximum Mean Daily Streamflows in Indian Creek

(Flows in cubic feet per second)

Water year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.
1960	100	32	190	466	61	1010*	822	183	394	58	56	12
1961	73	24	8	8	35	61	31	46	639	273	121	476
1962	150	184	54	35	90	675	146	288	43	36	10	4
1963	86	10	4	3	40	850	279	119	19	86	5	3
1964	3	6	2	100	20	84	92	32	885	25	3	10
1965	2	4	5	1090	78-	1010	705	92	30	40	146	102
1966	24	16	166	524	728	43	136	772	76	46	20	7
1967	6	15	31	15	200	120	295	151	108	150	100	13
1968	46	104	89	150	168	70	55	27	263	28	10	79
1969	4	53	821	1180	200	46	44	74	258	355	51	19
1970	215	34	20	80	200	67	320	1680	776	54	215	848
1971	384	120	90	35	350	200	35	40	27	69	13	6
1972	15	4	140	26	190	110	188	99	1370	405	562	75
1973	95	143	840	350	200	544	1090	939	342	64	35	30
1974	101	38	176	1400	183	398	225	790	2880	80	14	21
1975	12	14	14	47	279	300	410	222	428	70	200	30
1976	11	33	154	25	230	828	1420	380	70	23	12	9
1977	14	4	4	2	30	61	23	221	20	29	82	334
1978	257	839	165	32	13	130	202	1250	56	34	23	22
1979	8	17	18	10	19	1680	800	557	66	76	32	5
1980	9	12	33	9	13	127	100	225	1070	90	337	1340
	**	0	0	2	0	4	3	3	7	0	0	1

* The underlined values indicate the maximum mean daily flows in each calendar year.

** The numbers in the bottom row indicate the number of maximum mean daily flows in each calendar month.

Table 20 Concentrations of Total Suspended Solids; and 5ome Heavy Metals during Base Flow and Storm Flow

(Concentrations in milligrams per liter)

Date	Station	Total susp. S0l.	Total iron	Total zinc	Total copoer
November 19, 1980 (Base flow)	Ml	5	0.4	Trace	Trace
	Nl	1	0.3	Trace	Trace
	S5	26	0.2	Trace	Trace
	S2	7	0.2	Trace	Trace
	C12	4	0.3	Trace	Trace
	C10	5	0.4	Trace	Trace
	C2	5	0.4	Trace	Trace
December 8 , 1980 (Storm flow)	Ml	616	21.5	0..09	0.05
	Nl	860	24.7	0,.09	0.04
	S5	142	4.4	0,.03	0.02
	S2	132	5.6	0..03	0.02
	C12	50	2.7	0 .04	0.02
	C10	260	10.9	0..06	0.03
	C2	1320	33.2	0 .11	0.04

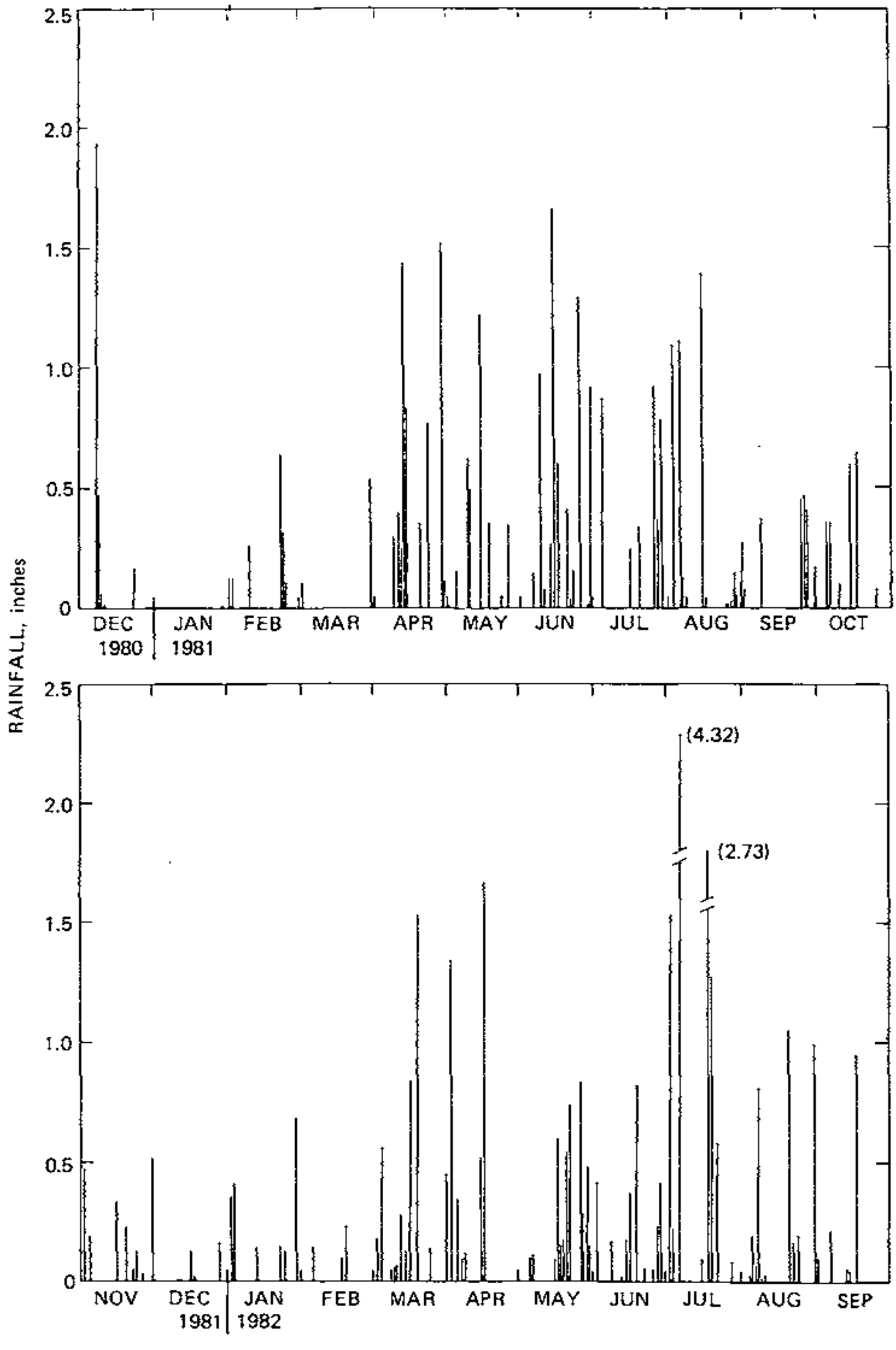


Figure 27. Daily mean rainfall in the Court Creek watershed (December 1980 – September 1982)

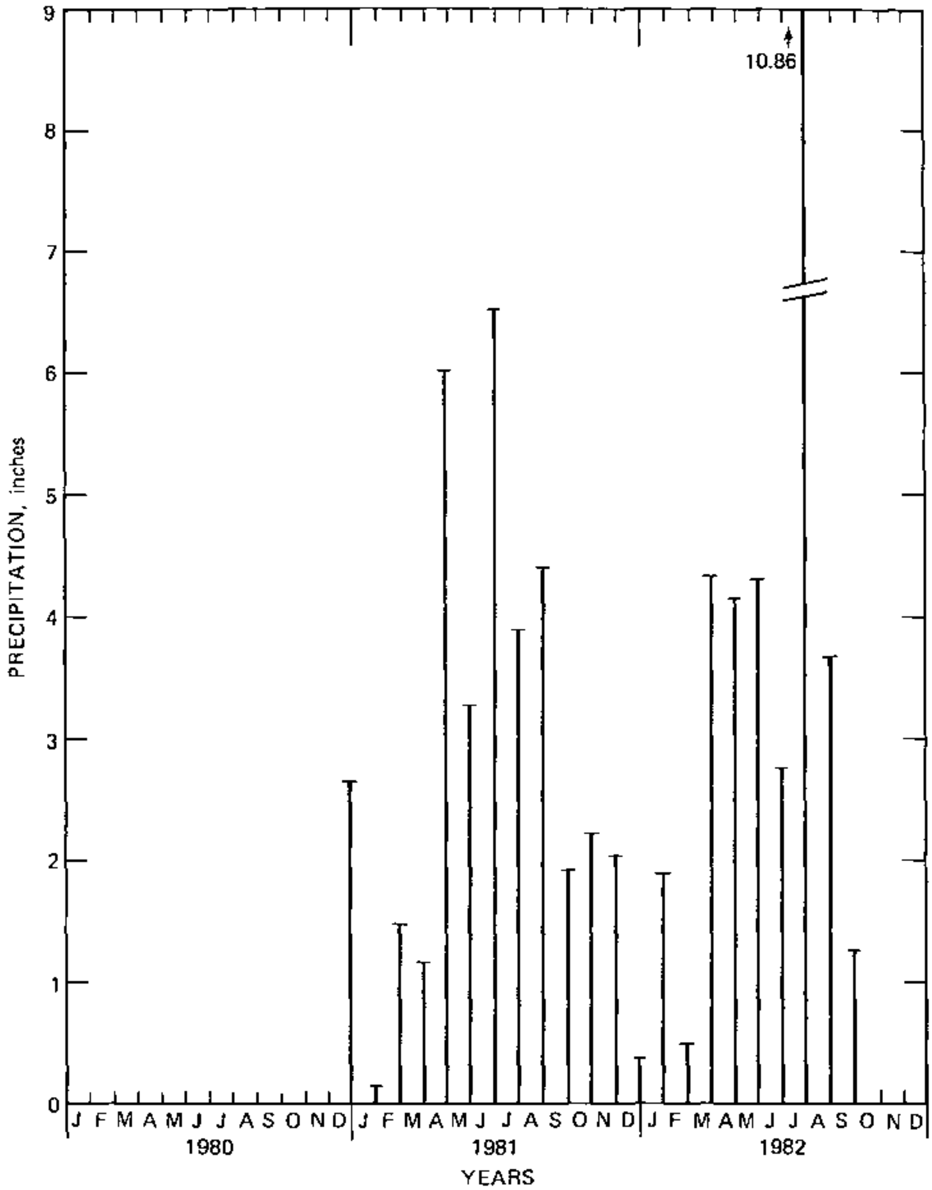


Figure 28. Monthly mean rainfall in the Court Creek watershed (December 1980 – September 1982)

It is important to realize that the major stream sampling effort, as part of this project, was not proposed for the period which this report is intended to cover. Rather the sampling effort is part of the second phase of this project to be reported on at a later date. Nevertheless there was a need to establish sampling stations, test the procedures for collection purposes, and work out a system of logistics that would permit a rapid response to storm events. Much of the sampling and analyses reported here are the results of exercises to improve on the methodologies required. The fact that these were exercises performed in anticipation of the major effort to be performed during the second year of the study does not diminish the importance or the validity of the streamwater quality results thus far obtained. The fact that seven collections were made during the nine storm events occurring during this investigative phase is testimony to the reasonableness of the response procedures developed.

The profiles of the streambeds of the streams in the Court Creek watershed have been shown in figure 20. The values of the slopes of the streambed sectors upstream of stream sampling stations are included in table 21.

The field reconnaissance of Court Creek and North Creek revealed that extensive bank erosion occurs in those sectors of the stream coursing through the alluvial plain of each valley. Extensive hydrographic modifications were also noted. At sites of major bank erosion the adjacent vegetation was limited to cultivated row crops.

Following the initial reconnaissance effort more detailed examinations in the field, supplemented by aerial photographs, led to the identification of nine major erosion sites on Court Creek. In addition, the locations of significant hydrographic modifications along Court Creek and North Creek that have occurred since 19.40 were identified. Figure 29 depicts the nine major erosion sites and channel modifications along Court Creek from its confluence to station C6. Included in figure 30 are the channel modifications for North Creek from its confluence to station N4.

Table 21. Slopes of Streambed Sectors Upstream of Sampling Stations

	Feet per foot	Feet per mile
Court Creek		
Upstream C12	0.00906	47.84
C12 to C10	0.00336	17.74
C10 to C2	0.00150	7.94
C2 to confluence	0.00085	4.50
Middle Creek		
Upstream M3	0.00472	24.92
M3 to confluence	0.00331	17.48
North Creek		
Upstream N4	0.00482	25.45
N4 to N2	0.00197	10.40
N2 to N1	0.00164	8.65
N1 to confluence	0.00263	13.88
Sugar Creek		
Upstream S5	0.00928	49.00
Spoon Valley Lake		
S3 to S2	0.00397	20.96
S2 to confluence	0.00199	10.50

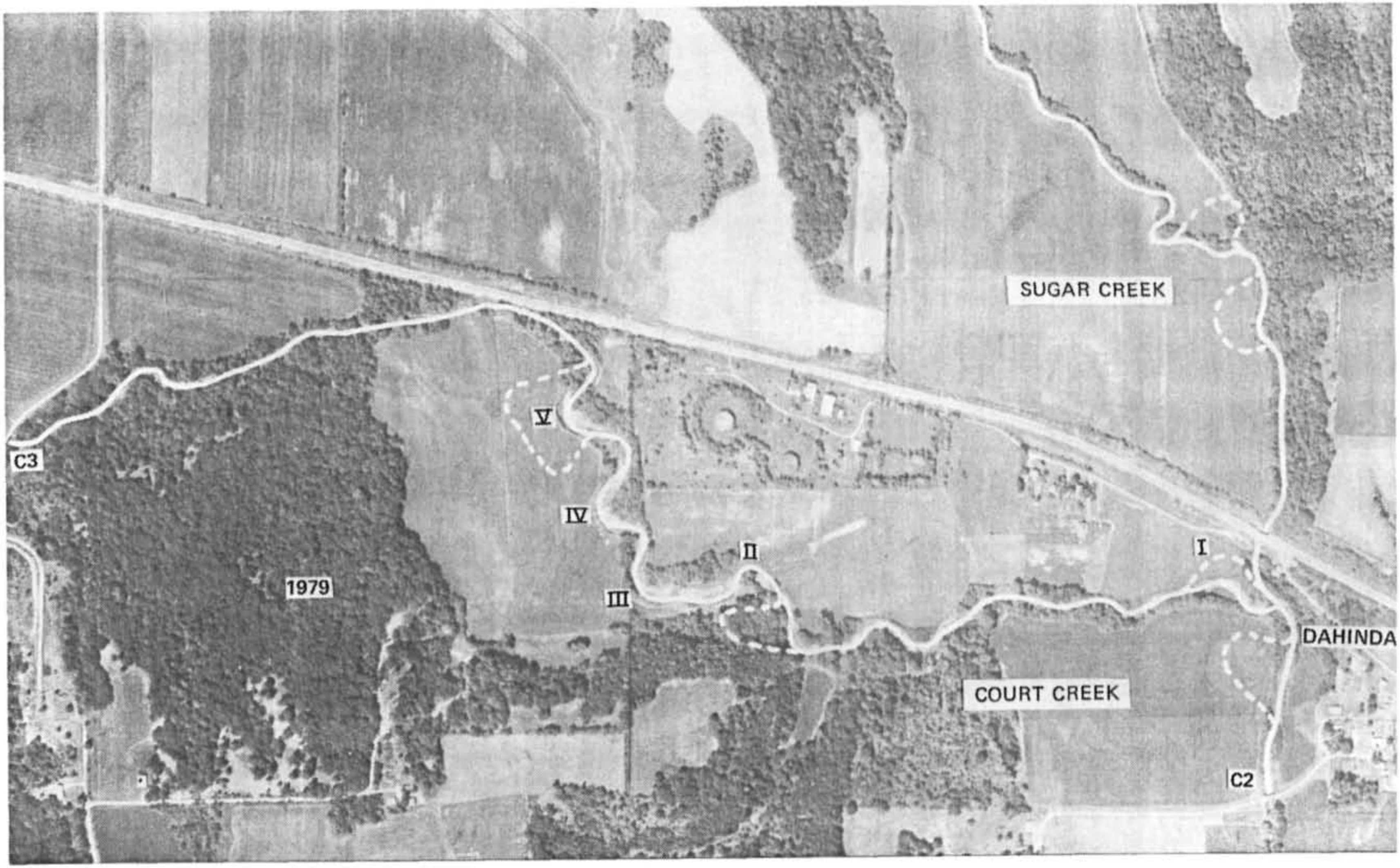


Figure 29a. Locations of five major bank erosion sites on Court Creek between stations C2 and C3 (Dashed line represents the channel of the stream in 1940 that has subsequently been modified)

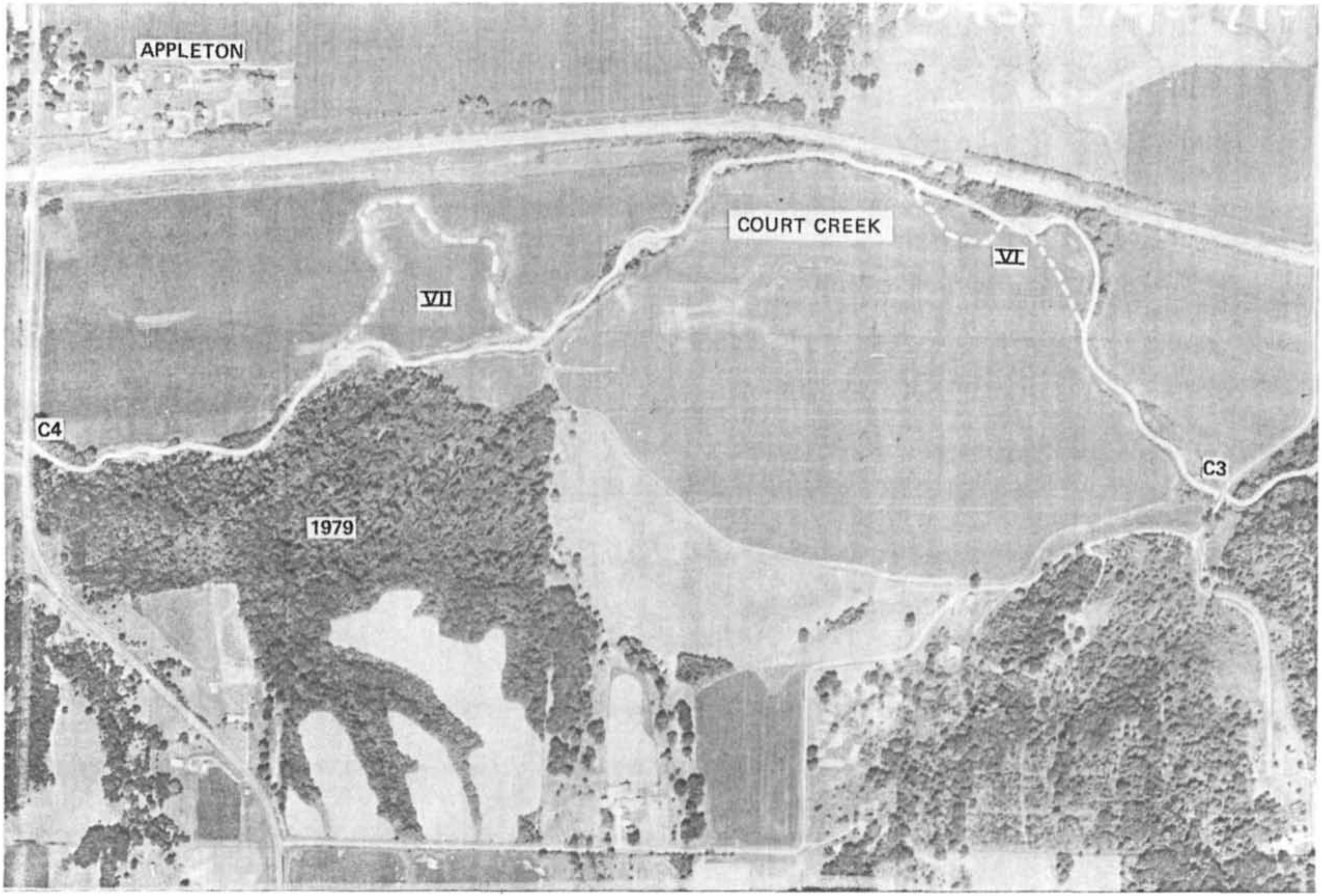


Figure 29b. Locations of two major bank erosion sites on Court Creek between stations C3 and C4 (Dashed line represents the channel of the stream in 1940 that has subsequently been modified)

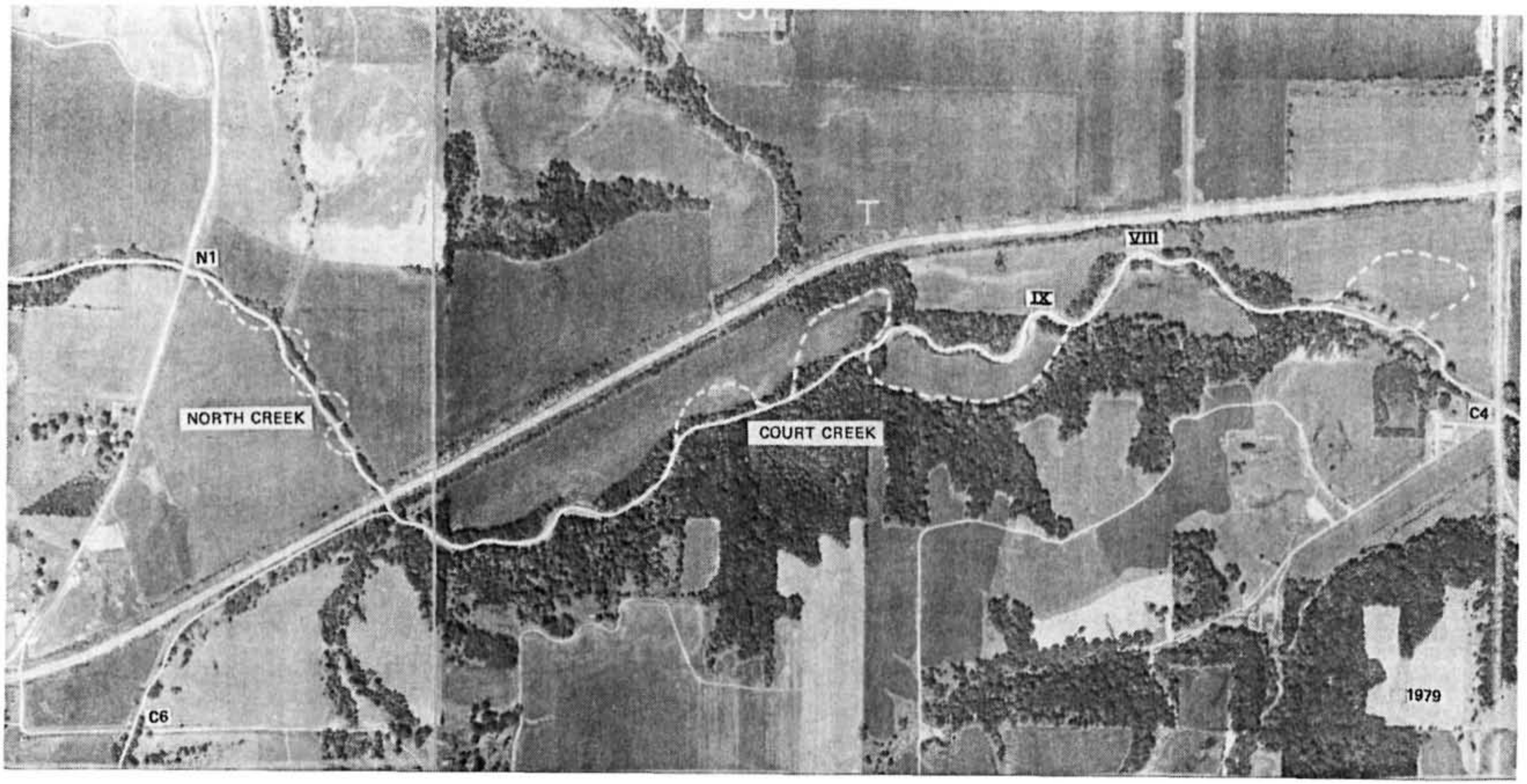


Figure 29c. Locations of two major bank erosion sites on Court Creek between stations C4 and C6 (Dashed line represents the channel of the stream in 1940 that has subsequently been modified)

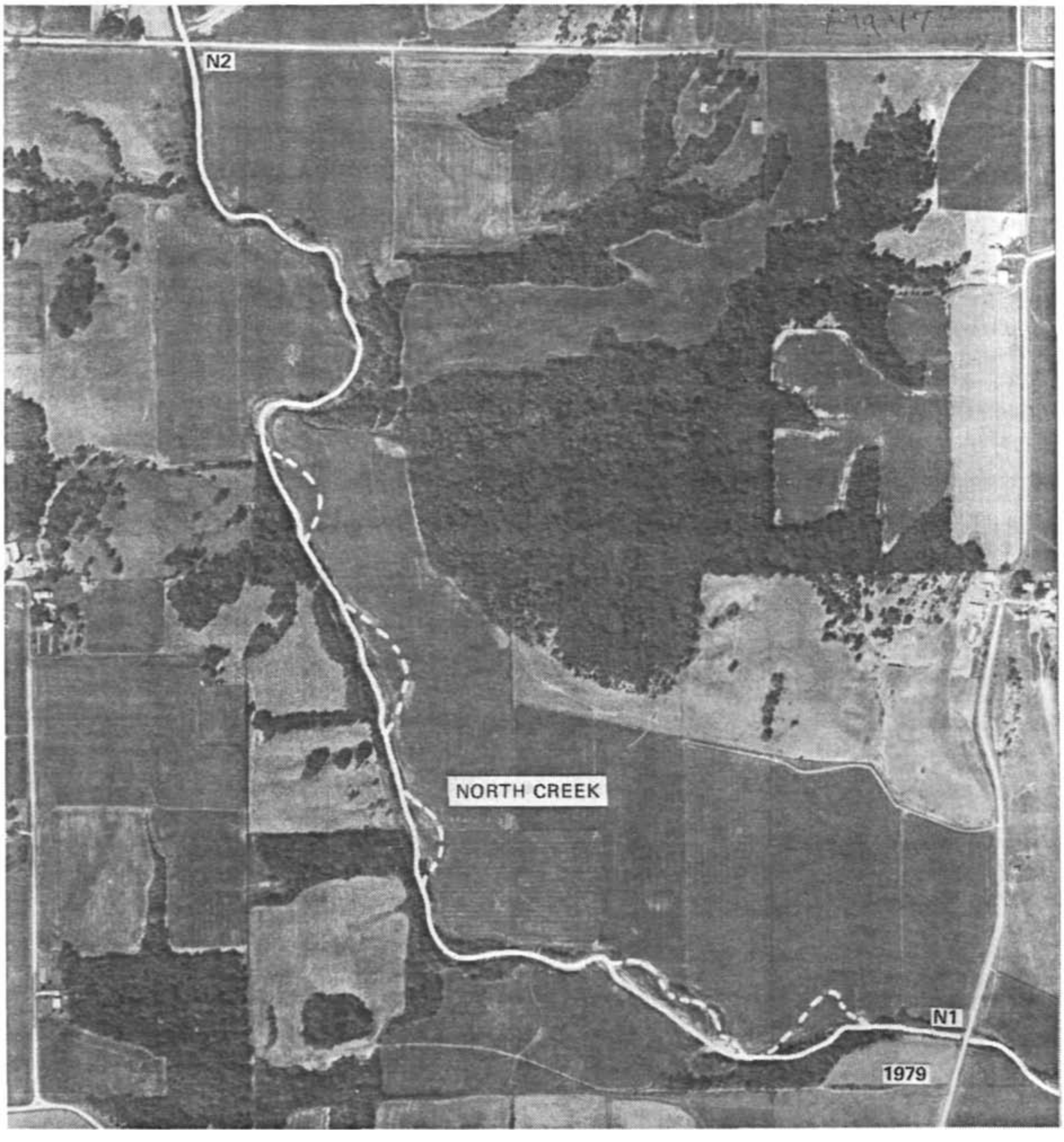


Figure 30a. Channel modifications along North Creek between stations N1 and N2 (Dashed line represents the channel of the stream in 1940 that has subsequently been modified)

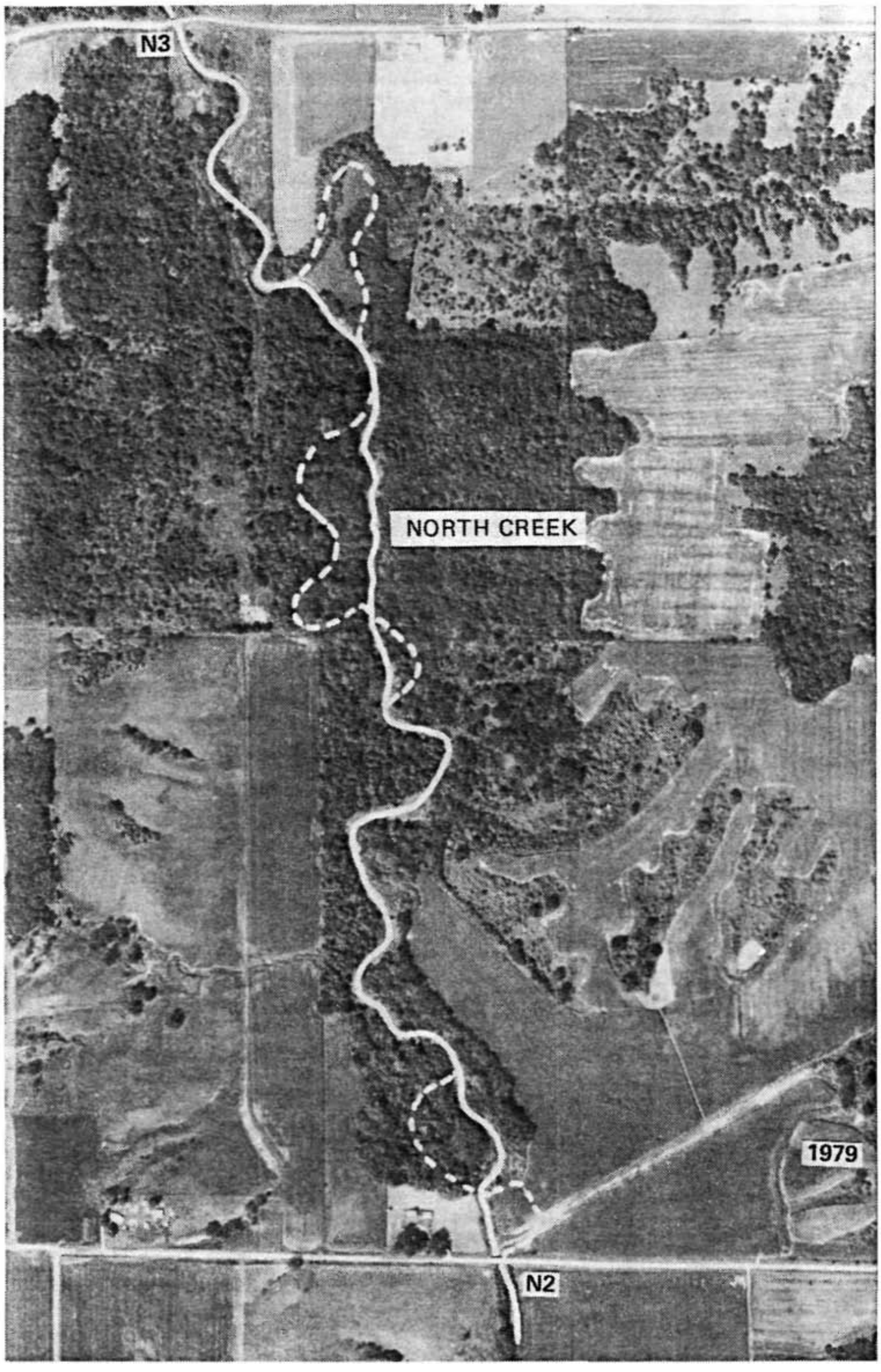


Figure 30b. Channel modifications along North Creek between stations N2 and N3 (Dashed line represents the channel of the stream in 1940 that has subsequently been modified)

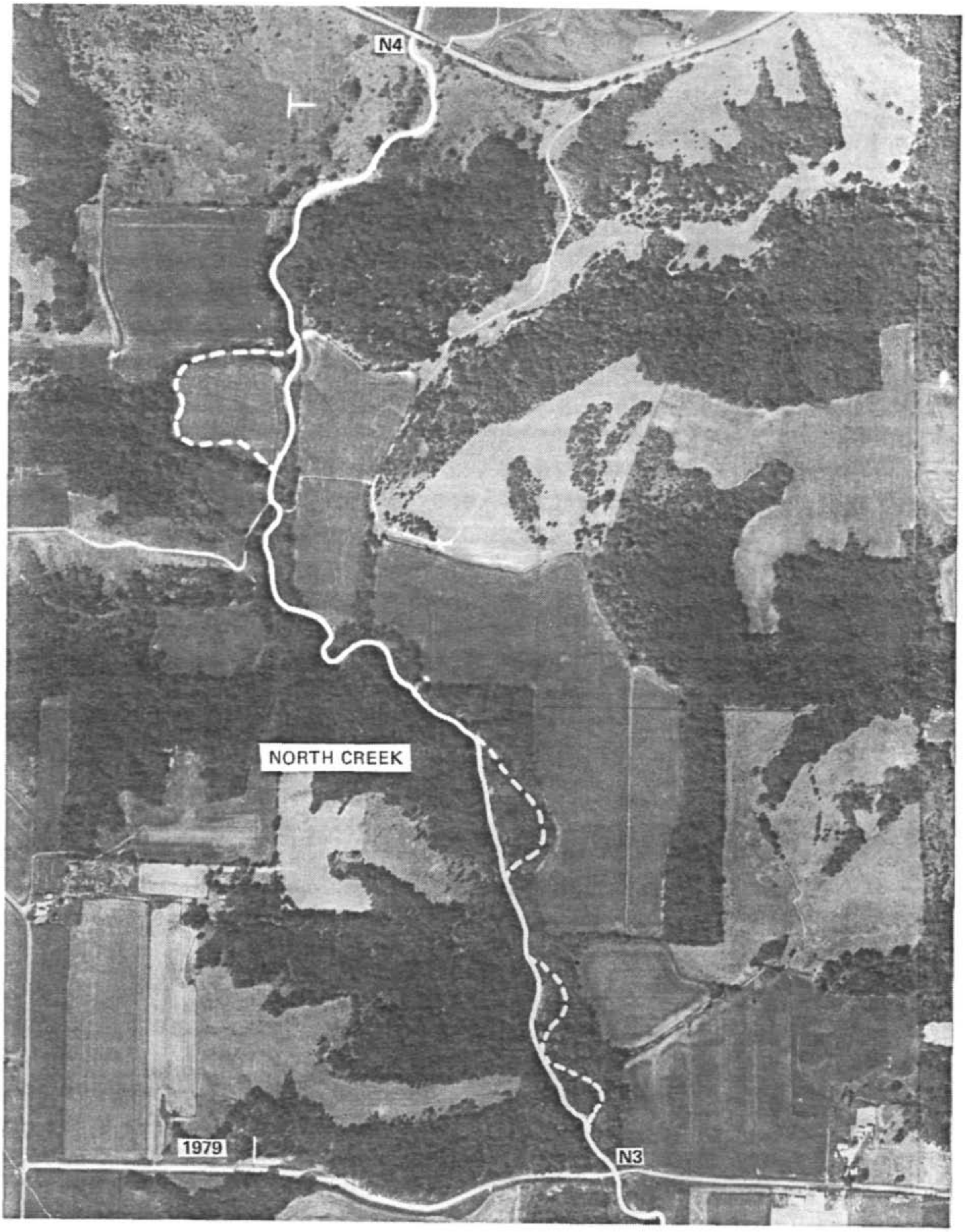


Figure 30c. Channel modifications along North Creek between stations N3 and N4 (Dashed line represents the channel of the stream in 1940 that has subsequently been modified)

In cooperation with Bruce Houghtby, a soil scientist with the U.S. Soil Conservation Service, the nine major bank erosion sites along Court Creek were examined in terms of the soil composition of the banks and some chemical characteristics. Arrangements were later made to survey seven of the sites by establishing monuments and developing cross-sectional data. In addition, bank pins were installed to monitor soil loss on the banks at six sites during individual storm events. The observations dealing with soil types, material-depth relationships, and other factors are set forth in table 22. The results of particle size analyses and ammonia content for six of the bank erosion sites are included in table 23.

Discussion

At this time the types and quality of the data being gathered from stream-related observations appear satisfactory for use in achieving the principal objectives of the study. Although there is a temptation based on the information gathered so far to speculate about the relationships of

Table 22. Some Characteristics of Major Bank Erosion Sites on Court Creek, and Scope of Data Collection

Site	Soil series	Depth and type of material			Monuments	Samples
I	Huntsville (77A)	0-36" Sandy, outwash	36"-96" Stratified, loamy & sandy		Yes	No
II	Dickinson (87B)	0-36" Sandy, outwash	36"-96" Stratified, loamy & sandy		Yes	Yes
III	Huntsville (77A)				Yes	No
IV	Huntsville (77A)	0-12" Sandy	12"-60" Silty	60"-96" Sandy	Yes	No
V	Huntsville (77A)	0-36" Sandy, overwash	36"-84" Silty	84"-96" Sandy	Yes	Yes
VI	Orion (415)	0-24" Loamy, overwash	24"-96" Silty		Yes	Yes
VII	Huntsville (77A)	0-8" Loamy, overwash	8"-72" Silty	72"-96" Loamy	Yes	Yes
VIII	Huntsville (77A)	0-24" Sandy, overwash	24"-98" Silty	48"-96" Stratified, sandy & silty	No	Yes
IX	Huntsville (77A)	0-24" Sandy, overwash	24"-60" Silty	60"-96" Loamy	No	Yes

Table 23. Particle Size and Nitrogen Content of Soils at Some Major Bank Erosion Sites

Site	Sand (percent)	silt (percent)	Clay (percent)	Ammonia-nitrogen (ppm)	Kjeldahl-nitrogen (ppm)
II	21.5	58.8	19.7	74	766
V	38.6	42.4	19.0	54	585
VI	31.4	52.0	16.6		
VII	32.9	49.0	18.1	51	608
VIII	41.8	43.3	14.9	70	732
IX	48.3	37.3	14.4	63	795

stream flow to precipitation, land use to water quality, and bank erosion to hydrographic modifications, this will not be done here. Rather certain aspects of the data will be emphasized with particular regard to their future use in the evaluation process.

A close review of the estimated streamflows included in table 17 suggests some abnormalities. This is frequently the case when instantaneous flows are recorded on "flashy" streams. The streamflows in the Court Creek watershed respond rapidly to significant precipitation events. The rises in stream stage are rapid and the peaks are of short duration. This poses problems where reliance is placed on devices other than those of the continuous recording type.

For example, there are occasions when flows at a downstream station are recorded as less than those at the corresponding upstream station. This happened at C10 and C12 on October 5 and 19, 1981 (see table 17). Similar occurrences are recorded for S3 and S2 during April, May, and June 1981. These apparent discrepancies are usually a function of time intervals between recorded observations. Therefore proper judgment is essential when applying the data in the evaluative process.

During the period December 1980 to October 1981 daily mean rainfall exceeded 1 inch on 9 separate occasions. This is shown in figure 27. On a monthly mean basis the distribution for the 1981 calendar year (in inches) was as follows:

January	0.14	July	3.90
February	1.48	August	4.42
March	0.67	September	1.91
April	6.03	October	2.21
May	3.29	November	2.03
June	6.63	December	0.37

The yearly average precipitation of about 33 inches was slightly less than the long-term yearly average of 35 inches. However almost 80 percent of the rainfall occurred during the period April – September, as compared to the long-term record of 60 percent. The conclusion is that though the total precipitation during 1982 was slightly less than average the degree of wetness during the growing season was greater than average. Also there were not any extended periods of dryness. In essence it was a good year for observing the interrelationship of land drainage and stream quality. Nevertheless, the collection of stream samples and the results of analyses performed during the year are considered preliminary data at this time.

With that in mind some selective observations of the water quality data are offered here. The source of the data is Appendix G. As mentioned earlier certain stream sampling stations were selected with knowledge of the principal land use upstream of them. Station C12 was an "urban" station; station S5 was a "mining" station; station Ml principally represented agricultural practices; and station C2, the most downstream station, represented the integration of all stations. Other stations served other purposes; i.e., impounded water, bank erosion effects, etc. But this discussion will be limited to some preliminary observations at stations C12, S5, Ml, and C2 without regard to flow regimes.

The results of analyses for sulfate concentrations at the four stations during 12 sampling events are included in table 24. It is obvious that Sugar Creek is the principal source of sulfates. This is not surprising since exposures of disturbed geological formations at strip mining sites are often the sources of higher sulfate concentrations in Illinois streams. However, the effect on Court Creek at C2 is minimal. Whether this is a function of dilution or the modifying influence of Spoon Valley Lake downstream of S5 remains to be determined.

Table 24. Concentrations of Sulfate at Selected Stream Stations on the Court Creek Watershed

(Concentrations in milligrams per liter)

Sampling event	Stations			
	C12	Ml	S5	C2
1	22	21	128	49
2	66	42	201	40
3	53	54	267	48
4	55	50	258	62
5	78	56	272	88
6	62	31	238	32
7	59	30	194	50
8	38	55	228	53
9	43	28	196	24
10	51	30	188	27
11	50	20	164	27
12	51	59	302	66

The results for chloride concentrations for the four stations are included in table 25. Though concentrations are not excessive by any means (the stream standard is 500 mg/1), it is quite apparent that the "urban" station C12 has the highest chloride concentrations.

The results for total phosphorus concentrations for the four stations are included in table 26. Here station Ml has higher concentrations than either station C12 or S5. Similar analyses for dissolved phosphorus suggest that most of the phosphorus content of the streamwater is in particulate form. Thus the concentrations of phosphorus at these stations are also reflective of suspended solids concentrations. Whether or not the principal source of phosphorus is the land surface or the streambanks remains to be evaluated. Nevertheless it is apparent that urban drainage, represented by station C12, and mine drainage, represented by S5, are not significant sources of phosphorus or indeed suspended solids in the Court Creek watershed.

Table 25. Concentrations of Chloride at Selected Stream Stations on the Court Creek Watershed

(Concentrations in milligrams per liter)

Sampling event	Stations C12	M1	S5	C2
1	31	21	13	16
2	26	15	9	18
3	32	19	11	30
4	33	19	11	21
5	38	21	12	23
6	29	4	10	6
7	26	8	3	12
8	44	23	15	17
9	22	5	4	10
10	28	9	11	9
11	21	4	7	9
12	47	23	10	24

Table 26. Concentrations of Total Phosphorus at Selected Stream Stations on the Court Creek Watershed

(Concentrations in milligrams per liter)

Sampling event	Stations C12	M1	S5	C2
1	0.04	0.13	0.05	0.04
2	0.27	1.35	0.31	1.34
3	0.24	2.39	0.25	1.93
4	0.16	1.94	0.09	1.58
5	0.33	0.43	0.06	0.25
6	0.20	0.29	0.06	2.15
7	0.38	4.01	0.67	4.33
8	0.03	0.37	0.10	5.79
9	3.94	9.47	0.16	9.35
10	0.32	7.22	0.38	10.80
11	0.35	5.07	1.07	7.76
12	0.14	0.44	0.11	0.07

A more rigorous analysis of the water quality data collected as part of this study will be performed when all sampling is completed. The purpose here is solely to present some preliminary findings.

As mentioned earlier, most sampling events occurred when streamflow was influenced by a significant storm event; i.e., precipitation equal to or greater than 1 inch. Table 27 shows the estimated instantaneous streamflows during the period of stream sampling, except those for station C2. In the table all the sampling dates are noted. On 3 of the 16 dates there was no storm influence. This does not mean that on the remaining 13 dates precipitation equalled or exceeded 1 inch. The following shows the relationship of these sampling dates to precipitation:

	Date	*Pvecipitaftion (-inches)*
(1)	12-8-80	1.94 on 12-7-80
(2)	4-12-81	1.44
(.3)	4-13-81	0.83
(4)	4-14-81	None
(5)	4-28-81	1.52
(6)	5-14-81	1.23
(7)	5-15-81	None
(8)	6-9-81	0.98 on 6-8-81
(9)	6-13-81	1.67
(10)	6-15-81	0.61
(11)	6-24-81	1.34
(12)	7-28-81	0.80
(13)	8-2-81	1.11

Table 27. Streamflows during Sampling Events

(Flows in cubic feet per second)

	Stations						
	S5	S3	S2	Nl	Ml	C12	C10
11-19-80*	10	26	31	18	11	8.1	12
12-8-80	45		137	188	50	16	71
4-12-81	34	43	70	148	47	27	59
4-13-81	30	46	58	144	40	27	63
4-14-81	40	159	60	116	38	27	63
4-20-81*	6.6	20	20	40	8.8	9.5	21
4-28-81	77	71	113	>1400	84	15	82
5-14-81	81	88	220	342	69	23	158
5-15-81							
6-9-81	4.6	12	6	31	9.7	7.6	15
6-13-81	75	66	222	413	107	27	184
6-15-81	11	66	63	34	12	10	20
6-24-81	38	34	50	198	41	13	54
7-28-81	27	52	40	142	23	5.1	58
8-2-81	165	66	84	429	144	29	29
10-13-81*	0.8	1.5	1.5	5.1	1.0	0.4	1.6

* Without storm influence

Note: No data are available for stations M3 (not installsd until April 1982) or C2 (rating curve pending)

As expected the upland stream slopes are generally more steep than those nearer the mouth of the streams (see table 21). This is the case for all streams except North Creek. Extensive channelization exists in the lower portion of the stream between Nl and its mouth. Presumably such conditions are responsible for the steeper slope in this reach than would be expected in the absence of channelization.

The lack of available data regarding slopes for other streams in Illinois, other than major ones, does not permit a comparison.

The field reconnaissance of Court and North Creeks was a valuable exercise. In addition to providing a view of natural happenings within the stream systems it also provided the impetus for more detailed scrutiny of bank erosion and stream modification sites.

At the time of the field reconnaissance, Court Creek harbored several beaver dams at sites 18, 31, and 45 (see figure 21), and there were log jams at sites 4 and 40. Bank erosion is intensified at log jams. Where natural vegetation occurred at erosive sites on the banks (such as at sites 11 and 12), willows were dominant. The streambed consisted mainly of sand and gravel. When this was not the case the bottom was usually sandy silt. Sand and gravel always existed in the streambed on the inside of curves. There was outcropping of shale in some areas in the upland valley.

The stream bottom in North Creek was like that observed in Court Creek. Log jams were observed at sites 7 and 9 (see figure 22). In contrast to Court Creek only portions of the stream were bordered by steep bluffs, as at the sectors between sites 3 and 4 and from sites 11 to 13. Beaver dams occurred at sites 20 and 21. Sites 12 and 16 were bordered by pasture and timber, while those sites from 1 to 12 were edged by cultivated fields. The channel of North Creek has been extensively modified.

Nine major bank erosion sites have been identified along Court Creek (see table 22). Seven of them, located between the communities of Dahinda and Appleton, have been monumented and cross sections have been established by transit and stadia. The other two are located west of Appleton.

During the collection of soils from the banks at the erosion sites the soil scientist, Bruce Houghtby, made the following observations:

> "At all locations a recent overwash layer was present. This layer varied from 8 to 36 inches in depth and was either sandy or loamy in general texture. The next layer was a developed soil in most cases. It was usually a silt loam or silty clay loam in texture and ranged from 24 to 72 inches thick. A third layer was usually observed. It was usually sandy but ranged from sand to silt loam in texture. This layer was observed at a depth of 48 to .84 inches below the surface. These soils were observed in the streambank cuts which varied from 6 to 10 feet in vertical height.

> The top layer must be recent overwash. When I looked at the soil away from the stream bank (30+ feet) this sandy layer was not evident and the silty material was on the surface. This is an example of a natural levee forming close to the stream where floods are more frequent and material is deposited at a faster rate. This top layer was also stratified with thin individual layers and shows no evidence of development.
>
> The middle layer was a well developed soil. It had moderate structure and therefore must be thousands of years old in order to be this well developed. The layer usually has a silt loam texture.
>
> The bottom layer, when present, was stratified sandy material. But the individual strata were sand, sandy loam, loam, clay loam, and silt loam in texture. This layer must be very, very old since it is below a developed layer. This layer is possibly Wisconsinan in age. Even though the Court Creek watershed was never covered by the Wisconsinan glacier, the nearby Spoon River must have carried meltwaters from the Wisconsinan glacier and could have deposited this material along the Court Creek floodplain.
>
> The soils at these sites would not be typical of the soil series in whch they were included. Because of their close proximity to Court Creek each soil had a varying amount of overwash on the surface and therefore [they] are not typical of the named soil series."

A review of figure 29 for Court Creek and figure 30 for North Creek shows quite conclusively that streambank erosion sites and sites of hydrographic modification are not exclusive of each other. And the effects these man-made alterations of the stream channel have on the water quality of the streams compared to other modifications of the landform by other uses remain to be ascertained.

Summary

- Streamflow gaging stations have been established at 9 locations.
- Instantaneous stream stages have been recorded at all stations for the period November 19, 1980 to October 26, 1981.
- Cross-sectional data have been developed for each flow gaging station.
- Except for station C2, rating curves have been prepared for each station.

- Flow records for Indian Creek have been gathered for use in developing long-term flow patterns for the Court Creek watershed.
- Raingage stations have been established at 13 locations.
- Areas of influence have been identified for each raingage site on the basis of the Thiessen method.
- Rainfall data have been recorded for the period December 7, 1980 to September 17, 1982.
- Streamwater sampling stations have been established at 16 sites.
- Procedures have been developed for stream sampling, and the types of analyses required for the samples have been defined.
- Twelve stream samples have been collected at each of the nine primary sampling stations and analyses have been performed.
- The slopes of the streambeds above each primary sampling station have been determined.
- A detailed field reconnaissance of Court Creek and North Creek has been completed.
- Major bank erosion sites have been identified on Court Creek, and surveys using stadia and transit have been used to develop cross-sectional information at seven of the sites. These sites have also been monumented for future reference.
- Major hydrographic modifications have been identified on Court Creek and North Creek.

FISHERY RESOURCES OF STREAMS

It is not sufficient to rely solely on the physical and chemical characteristics of a stream's water for assessing its water quality. Just as important if not more so is the quality of aquatic organisms the stream is capable of propagating as well as sustaining. For this reason arrangements were made with the Illinois Department of Conservation to perform a comprehensive fish population survey on the Court Creek watershed. The principal objectives were to determine the existing carrying capacity (standing crop) of the streamwaters, examine the density of fish and species diversity along the streams, and evaluate the fish habitats. Excluded from the study were the impounded waters on the watershed.

The work was performed under the direction of Mr. Kenneth Russell, District Fishery Biologist of the Illinois Department of Conservation. Mr.

Russell provided the descriptions in the "Methods" and "Results" sections that follow. He also furnished the descriptions of stations and listings of fish collected at each station which are included in Appendix H.

Methods

Fish survey sites were established at 13 locations in the watershed. The sites were representative of the lower, middle, and upper sectors of the four principal streams in the watershed. The locations of each site are shown in figure 31. Although 13 locations were established, fish collections were not made at site S5 on Sugar Creek because of drought conditions. However, the potentiality of S5 as a fish habitat was evaluated.

At each of the 12 remaining sites fish were collected from stream segments varying in length from 46 meters (150 feet) to 91 meters (300 feet). Within each stream segment there was an integrated habitat. The rotenone-potassium technique was used for the fish survey. This involved introducing a fish toxicant (rotenone) at the upper end of the stream segment, providing a 1/4-inch mesh blocking net at the lower end, and introducing a detoxifying agent (potassium permanganate) at the lower end. Water Survey and Department of Conservation personnel collected the distressed and dead fish within the stream segment. All specimens- collected were sorted into species groups. Specimens within each group were counted, weighed, and measured for length at the site.

Subjective habitat evaluations were performed for each stream segment surveyed. These involved on-site observations of streambed materials and stability, bank stability and vegetative cover, degree of channel sinuosity, instream cover, pool depth and riffle characteristics, and other pertinent features of the aquatic environment. Within each segment a sample of the streambed was obtained by an Ekman dredge. The samples were subsequently analyzed for particle size_ distribution.

From the fish collections made and the observations recorded, estimates were made of abundance, standing crop, density, and diversity of fish, and each fishery habitat was rated.

Results

During the course of the fish survey 13,472 specimens were recovered. As shown in table 28 the collection included 33 fish species. The bluntnose minnow was found at all locations. It was the most abundant species and represented nearly 40 percent of the number of fish recovered. Of the total collection, forage species represented 87.6 percent, sport species represented 8.3 percent, and commercial species represented 4.1 percent. The number of species recovered per sampling site ranged from 11 to 24.

For evaluating standing crop, density, and diversity the sites were grouped into two classes based on watershed area. One group was character-

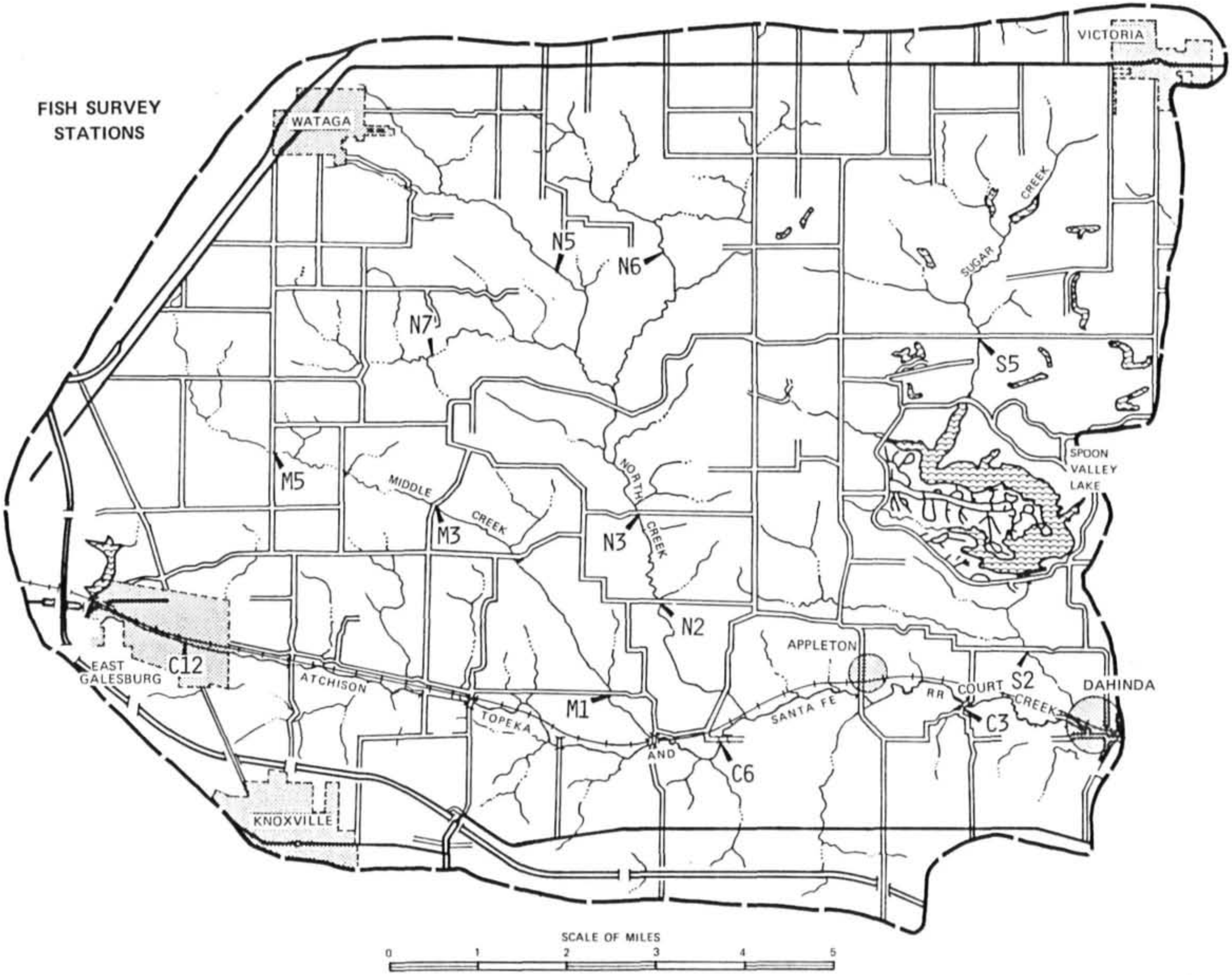


Figure 31. Locations of fish survey stations in the Court Creek watershed

Table 28. Number and Percent of Fish Occurring at 1980 Sampling Stations

Species	C3	C6	C12	N2	N3	N5	N6	N7	Ml	M3	M5	S2	No.	% of total no. of fish	% of sites where found
	Stations														
1. Largemouth bass	22	10	4	8	8	8	1			1		10	72	.54	75
2. Smallmouth bass	8	87							6				101	.75	25
3. Bluegill	29	15		26	21	14	7		5	4		113	234	1.73	75
4. Green sunfish	19	11	107	9	25	2	7	3		26		4	213	1.58	83
5. Blue-green hybrid	2												2	.02	8
6. Orangesootted sunfish					1								1	.01	8
7. Channel catfish	11	9											20	.15	17
8. Black bullhead				2	34		40	66	7	34		38	221	1.64	58
9. Yellow bullhead	12	38	19	23	71	2	13		51	13		18	260	1.93	83
10. Stonecat	7	26		2	8								43	.32	33
11. Freckled madtom					1								1	.01	8
12. River carpsucker		14											14	.10	8
13. Quillback	33	40		13	13		18		2			7	126	.93	58
14. White sucker		2	19	15	28	84	63		14	19		5	249	1.85	75
15. Golden redhorse	9	76	1	20	19	1	6			10		1	143	1.06	75
16. Shorthead redhorse				5	1							1	7	.05	25
17. Carp		3		1	1							6	11	.08	33
18. Stoneroller	107	37	186	21	73	3	447	291	334	64	162	1	1726	12.81	100
19. Hornyhead club	35	24	52	19	16	12	7	2	12	18	18		215	1.60	92
20. Golden shiner			1					2		2			5	.04	25
21. Emerald shiner	116												116	.86	8
22. Striped shiner	9	56	5	15	27	21	55		3	9		1	201	1.49	83
23. Bigmouth shiner	134	3		44	51	38	250	119	219	151	26	3	1038	7.70	92
24. Red shiner	360	93		93	30		134		13	6	5	2	736	5.46	75
25. Sand shiner	769	59		60	76	8	94	4	40				1110	8.24	67
26. Suckermouth minnow	3						35		4	5	2		49	.36	42
27. Southern redbelly dace								19	1	3	39		62	.46	33
28. Bluntnose minnow	928	1963	46	213	87	73	1032	18	356	258	248	18	5240	38.89	100
29. Fathead minnow	3		2		3		64	49	7		10		138	1.03	58
30. Creek chub	23	31	74	32	60	46	142	138	156	99	114	1	916	6.80	100
31. Johnny darter	7	6	11	3	8	22	52	14	10	8	13		154	1.14	92
32. Orangethroated darter		3		4	5	2	3	2	10	10	7		46	.34	75
33. Logperch		1			1								2	.02	17
No. of fish	2646	2607	527	628	668	336	2470	727	1250	740	644	229	13,472		
No. of species	22	23	13	21	24	15	20	13	19	19	11	16			

Note: There were no fish at station S5 at the time of the survey

ized by large watershed areas varying from 57 to 186 sq km (22 to 72 sq mi) and the other group by small watershed areas varying from 5 to 23 sq km (2 – 9 sq mi). The groupings are shown in table 29. As shown in the table the number of species increased with an increase in watershed area. This is consistent with the findings of others(Larimore, R. Weldon, and Phillip W. Smith, 1963, The Fishes of Champaign County: As Affected by 60 Years of Stream Changes, Illinois Natural History Survey Bulletin, vol. 28, art. 2, pp. 299-382).

The fish standing crop poundage (pounds of fish per acre)., which is a measure of stream carry capacity, is shown in table 29. The standing crop poundage generally decreased with an increase in watershed area. This is somewhat inconsistent with the findings of Larimore and Smith, who concluded that the total amount of fish flesh per unit of area is probably constant when other factors are equal. The point to be made for the data developed from the Court Creek watershed survey is that these other factors were not equal. Factors such as environmental stability were not the same when comparing the small watershed areas (upstream) to the large watershed areas (downstream). The downstream sites were more biologically and physically degraded.

Table 29. Fish Standing Crop, Fish Density, Fish Species Diversity, and Habitat Ratings at Fish Survey Sites

Station	Watershed area (sq mi)	Standing crop (lbs/ac)	Fish density (no./sta.)	Species diversity (no. species/sta.)	Habitat rating
		Large watershed sampling stations			
C3	72	100	2646	22	Semi-degraded (fair)
C6	35	303	2607	23	Balanced (good)
N2	28	147	628	21	Semi-balanced (good-minus)
N3	24	149	667	24	Balanced (good-minus)
S2	22	341 (193)*	229	16	Semi-degraded (fair-minus)
Average	36.2	208 (178)*	1355	21.2	
		Small watershed sampling stations			
M1	9	241	1250	19	Semi-degraded (fair-plus)
N6	7	239	2470	20	Balanced (good-minus)
N5	6	222	336	15	Semi-degraded (fair)
M3	6	185	740	19	Semi-degraded (fair)
C12	4	214	527	13	Semi-degraded (fair-minus)
N7	3	334	727	13	Semi-degraded (fair-minus)
M5	2	260	644	11	Semi-degraded (fair-minus)
Average	5.3	242	956	15.7	

* The standing crop of 341 pounds per acre at station S2 does not represent the true carrying capacity of the stream at that location, since three large carp in the collection were not produced at that site (spillway loss from 552-acre Spoon Lake located just above the station). An adjusted 193 pounds per acre standing crop figure was used to better represent the actual or true carrying capacity.

The fish density in the Court Creek watershed (see table 29) generally increased as the watershed increased. This relationship too is contradictory to the findings of Larimore and Smith and again illustrates environmental instability in the downstream sites.

Following are summations of the characteristics of each fish survey site. In addition to those factors previously mentioned that were used for habitat evaluation the following were also considerations:

- Water level stability
- Sediment loading
- Turbidity
- Water chemistry
- Depth and width
- Channel alignment
- Instream structures (snags, brush, etc.)
- Degree of shading
- Livestock access

A rating has been assigned to each survey site in terms of their suitability for sustaining an adequate fish population; i.e., well-balanced, balanced, semi-balanced, semi-degraded, degraded, or severely degraded.

Station C3

Court Creek station C3, located 2.5 miles upstream from the stream's confluence with the Spoon River, has a drainage area of approximately 72 square miles. The aquatic habitat at this site is characterized by a streambed of 75 percent shifting sand; stable banks covered by a mixture of grasses, annual weeds, shrubs, and small trees (unstable banks west of the bridge); a low degree of channel sinuosity; long, low-gradient fine gravel riffles; and medium-depth pools having minimal instream cover. Within recent years, no fish kills have been reported on Court Creek; however, many potential sources of pollution are located in the drainage basin. Flooding and highly fluctuating water levels are common at this site due to the rapidly drained land area of intensely cultivated cropland in the watershed.

Fishery inventories, using the rotenone-potassium permanganate method of collection, were completed at this site in 1964 and again in 1980. A 1975 distributional study of "The Fishes of the Spoon River Basin" included this site, but fish were collected only by seine. The 1980 fish collection revealed 22 species having a standing crop of 100.24 pounds per acre. Forage species represented 95 percent of the collection by number and 55 percent by weight. Bluntnose minnow, considered to be a pollution-tolerant species, was the most abundant fish followed by the sand shiner which is normally associated with degraded habitat in the form of an unstable sand substrate. Game fish species comprised only 4 percent of the collection by weight.

The quality of the aquatic habitat at station C3 of Court Creek, as assessed by the observation of streambed materials, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), and species diversity, composition and density, was rated slightly better than fair or semi-degraded.

Station C6

Court Creek station C6, located 6.1 miles upstream from the stream's confluence with the Spoon River, has a drainage area of approximately 35 square miles. The aquatic habitat is characterized by a streambed consisting of bedrock, gravel, and rubble with low amounts of silt and sand; stable banks covered by a mixture of grasses, shrubs, and mature trees; a low degree of channel sinuosity; long, low-gradient pools of sufficient depth with good instream cover of snags and undercut tree roots; and high-gradient riffles composed of coarse gravel and large rubble. No known fish kills have been reported at this site; however, many potential sources of pollution exist in the drainage area. Highly fluctuating water levels occur at this site, but not with the frequency found at other sites further downstream having more watershed drainage.

The 1980 fish collection revealed 23 species having a standing crop of 302.73 pounds per acre. Forage fish species represented 88 percent of the collection by number, but only 10 percent by weight. Game or sport fish species, mainly consisting of smallmouth bass, comprised 22 percent of the collection by weight. Bluntnose minnow, considered to be a pollution-tolerant species, was the most abundant fish; however, a highly diverse population of smallmouth bass (pollution-intolerant species) in the collection illustrated a balanced aquatic habitat.

The quality of the aquatic habitat at station C6 of Court Creek, as assessed by the observation of streambed materials, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated as excellent; in fact, the best on the entire Court Creek drainage basin.

Station C12

Court Creek station C12, located 14.0 miles upstream from Court Creek's confluence with the Spoon River, has a drainage area of approximately 4.6 square miles. Urban areas of Galesburg and East Galesburg contribute more than half the rainfall runoff to this site and pose a serious threat to the water quality; however, no known fish kills have been reported. The aquatic habitat is characterized by a streambed consisting of high percentages of sand, gravel and rubble; stable banks covered by a mixture of grasses, shrubs and small trees; no channel sinuosity; a long low-gradient pool of shallow depth; and a short riffle area littered with discarded bricks and broken concrete. Highly fluctuating water levels occur at this site due to street storm water drainage in the immediate watershed.

The 1980 fish collection revealed 13 species having a standing crop of 213.64 pounds per acre. Forage fish species represented 72 percent of the collection by number and 64 percent by weight. Green sunfish dominated the sport fish list and are thought to be escapement from two small, shallow ponds in the immediate drainage area. The overall fish collection was characterized by pollution-tolerant species and low species diversity.

The quality of the aquatic habitat at station C12 of Court Creek, as-assessed by the observation of streambed materials, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated slightly below fair or semi-degraded.

Station N2

North Creek station N2, located 1.7 miles upstream from the stream's confluence with Court Creek, has a drainage area of approximately 28 square miles. The aquatic habitat is characterized by a streambed consisting primarily of shifting sand with lesser amounts of gravel; very unstable, raw banks on the outside bends of the channel; a low degree of channel sinuosity; long, low-gradient pools of sufficient depth having good instream cover of snags and drift; and low-gradient riffles consisting of fine gravel. The fishery habitat of lower North Creek is generally degraded due to an unstable streambed, lack of instream cover, channel sinuosity, and pool depth; however, the site described above for station N2 is a favorable habitat. Fish kills, resulting from discharges of livestock wastes, have been known to occur at this section of North Creek. Highly fluctuating water levels occur at this site with annual frequency.

The 1980 fish collection revealed 21 species having a standing crop of 147.40 pounds per acre. Forage fish represented 81 percent of the collection by number; however, the total weight was nearly equal among the sport, commercial, and forage species. The quality of the sport fishery was poor and relates directly to the fact that the sampling area was an "island" of good habitat within a larger area of inferior habitat. No strong correlation seemed to exist between pollution tolerant and intolerant species.

The quality of the aquatic habitat at station N2 of North Creek, as assessed by the observation of streambed materials, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated slightly below good or semi-balanced.

Station N3

North Creek station N3, located 4.4 miles upstream from the stream's confluence with Court Creek, has a drainage area of approximately 24 square miles. The aquatic habitat is characterized by a streambed consisting of high amounts of sand (60 percent) and gravel (30 percent) with low amounts of silt or clay; unstable banks covered by a mixture of grasses, willows, shrubs, and mature trees; a moderate degree of channel sinuosity; long, medium-gradient pools of sufficient depth having good instream cover of snags and drift piles; and long riffles composed of varying amounts of fine to coarse gravel. Fish kills, resulting from discharge of livestock confinement wastes, have been known to occur in this section of North Creek. Highly fluctuating water levels occur at this site with annual frequency.

The 1980 fish collection revealed 24 species having a standing crop of 148.50 pounds per acre. Forage fish represented 67 percent of the collection by number; however, the total weight was nearly equal among the sport, commercial, and forage species. The sampling site contained the greatest fish species diversity (24 species per sampling station) of any site within the 1980 Court Creek watershed investigations. Sport fish and pollution-intolerant species comprised a high percentage of the overall fish collection, illustrating a balanced aquatic habitat.

The quality of the aquatic habitat at station N3 of North Creek, as assessed by the observation of streambed materials, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated as good-minus.

Station N5

North Creek station N5, located 7.8 miles upstream from the stream's confluence with Court Creek, has a drainage area of approximately 6 square miles. The aquatic habitat is characterized by a streambed consisting primarily of sand and gravel with a small amount of silt and clay; unstable banks covered by a mixture of grasses, shrubs, and trees; a high degree of channel sinuosity; short, high-gradient pools of sufficient depth with a fair amount of instream cover of snags, brush, and undercut tree roots;

and high gradient riffles composed of fine gravel with little rubble. No known fish kills have been reported at this site; however, several potential point and non-point sources of pollution exist in the drainage area. The village of Wataga is situated within the direct drainage. Highly fluctuating water levels are common, but are not as frequent as at other sites further downstream having a greater drainage basin.

The 1980 fish collection revealed 15 species having a standing crop of 222.36 pounds per acre. Forage fish represented 67 percent of the collection by number but only 18 percent by weight. White sucker, considered to be a pollution-tolerant species, was the most abundant fish and represented 70 percent of the total standing crop weight. Game or sport fish species, consisting of largemouth bass, bluegill, green sunfish, and yellow bullhead, comprised only 9 percent of the collection by weight.

The quality of the aquatic habitat at station N5 of North Creek, as assessed by the observation of streambed materials, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), and fish species diversity, composition, and densities, was rated as fair or semi-degraded.

Station N6

Fish sampling station N6 of the east tributary of North Creek, located 1.9 miles upstream from the stream's confluence with North Creek, has a drainage area of approximately 6.9 square miles. The aquatic habitat is characterized by a streambed consisting of gravel (50 percent), sand (30 percent), silt (18 percent) , and rubble (2 percent); a channel having a moderate degree of sinuosity and instability; short, high-gradient pools of sufficient depth; good instream cover consisting of pools, riffles, snags, undercut banks, rubble, and aquatic vegetation (rooted and immersed plants); raw, unstable and unvegetated banks on the outside bends of the channel; and high-gradient riffles consisting of coarse gravel and limited rubble. Fish kills, resulting from discharges of livestock wastes, have been recorded within this section of stream. Highly fluctuating water levels occur at this site.

The 1980 fish collection revealed 20 species having a standing crop of 238.54 pounds per acre. Forage fish represented 94 percent of the collection by number and 57 percent by weight. Black and yellow bullhead comprised 78 percent of the sport fishery by number and 91 percent by weight. Several black bullhead were of catchable sizes. Pollution-susceptible species such as the suckermouth minnow and orange-throated darter were collected, but in very low numbers. Bluntnose minnow, a pollution-tolerant species, was the most abundant fish collected.

The quality of the aquatic habitat at station N6 of the east tributary of North Creek, as assessed by the observation of streambed materials and stability, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated as balanced or good-minus.

Station N7

Fish sampling station N7 of the west tributary of North Creek, located 2.1 miles upstream from the stream's confluence with North Creek, has a drainage area of approximately 3.4 square miles. The aquatic habitat is characterized by a streambed consisting of sand (50 percent), silt (30 percent), and gravel (20 percent); a channel having a moderate degree of sinuosity and instability; short, high-gradient pools of shallow depth; a lack of instream cover; unstable and eroding banks on the outside bends of the channel; and high-gradient riffles consisting of a mixture of gravel sizes. An improved habitat can be described at various sites downstream from the fish sampling site summarized above. Due to the high percentage of cropland within the drainage area, this site has a rapid rise in water level following extensive rainfall. Fish kills, resulting from discharges of livestock wastes (confinement operations) have been known to occur at this site; in fact, during the survey a fish kill was in progress immediately downstream from the sampling area.

The 1980 fish collection revealed 13 species having a standing crop of 333.81 pounds per acre. Forage fish represented 90 percent of the collection. Commercial species were not collected; however, white sucker, quillback and golden redhorse had been collected prior to this survey at a downstream location. Black bullhead comprised 97 percent of the sport fishery by weight, illustrating an aquatic habitat degraded by low dissolved oxygen levels. The southern redbelly dace (a pollution susceptible species) was collected, but in very low numbers. Stoneroller, a herbivorous feeder, was the most abundant fish collected. Species diversity was low (13) compared to other similar sized sampling sites in the Court Creek drainage basin.

The quality of the aquatic habitat at station N7 of the west tributary of North Creek, as assessed by the observation of streambed materials and stability, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated as semi-degraded or fair-minus.

Station M1

Middle Creek station Ml, located 1.1 miles upstream from the stream's confluence with Court Creek, has a drainage area of approximately 9 square miles. The aquatic habitat is characterized by a streambed consisting of sand (50 percent), gravel (40 percent), and silt (10 percent); a narrow channel (4 to 10 feet) having a high degree of sinuosity; short, high-gradient pools of sufficient depth; fair amounts of instream cover consisting of snags, brush, undercut tree roots and riffles; unstable banks vegetated by annual weeds and willows; and high-gradient riffles composed of fine gravel. No fish kills have been reported for this site; however, several agriculture-related pollution hazards exist in the watershed. Moderate to severe water level fluctuations occur at this site.

The 1980 fish collection revealed 19 species having a standing crop of 241 pounds per acre. Forage fish represented 93 percent of the collection by number and 82 percent by weight. Sport fish accounted for only 10 percent of the collection by weight. Harvestable sized sport fish were not collected. Pollution intolerant species such as the smallmouth bass and southern redbelly dace were collected, but in very low numbers. Bluntnose minnow, a pollution tolerant species, was the most abundant fish collected.

The quality of the aquatic habitat at station Ml of Middle Creek, as assessed by the observation of streambed materials and stability, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated as fair-plus, or semi-degraded.

Station M3

Middle Creek station M3, located 4.0 miles upstream from the stream's confluence with Court Creek, has a drainage area of approximately 6 square miles. The aquatic habitat is characterized by a streambed consisting of gravel (60 percent), sand (20 percent), silt (5 percent), and rubble (5 percent) ; a narrow channel (5 to 12 feet) having a low degree of sinuosity; short, high-gradient pools of sufficient depth; good instream cover of snags, brush, undercut tree roots, and large rubble; stable banks having many unvegetated areas due to excessive cattle grazing; and high-gradient riffles composed of coarse gravel and rubble. No fish kills have been reported at this site; however, hog confinement operations within the immediate watershed may be impacting the fishery. The dissolved oxygen level was a low 4.2 ppm on the survey date. Moderate water level fluctuations occur at this site.

The 1980 fish collection revealed 19 species having a standing crop of 184.57 pounds per acre. Forage fish represented 86 percent of the collection by number and 52 percent by weight. Sport fish accounted for 31 percent of the collected weight, but only one 7.2-inch black bullhead was of a harvestable size. Pollution intolerant species such as the southern redbelly dace and, to a lesser degree, the suckermouth minnow and orangethroated darter (susceptible species) were collected in very low numbers, indicating environmental instability.

The quality of the aquatic habitat at station M3 of Middle Creek, as assessed by the observation of streambed materials and stability, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated as fair or semi-degraded. Without the organic pollution, the site would have been rated as balanced.

Station M5

Middle Creek station M5, located 8.6 miles upstream from the stream's confluence with Court Creek, has a drainage area of approximately 2 square miles. The aquatic habitat is characterized by a streambed consisting of silt (70 percent), sand (20 percent), and gravel (10 percent); a narrow channel (2 to 6 feet) having a high degree of sinuosity; short, high-gradient pools of very shallow depth; good instream cover of snags, brush, and undercut tree roots; low, stable banks having many unvegetated areas due to excessive cattle grazing; and high-gradient riffles composed of fine gravel. No fish kills have been reported at this site; however, the downstream area is polluted from a nearby hog lot and does not support fish life. Moderate water level fluctuations occur at this site.

The 1980 fish collection revealed 11 species having a standing crop of 260.0 pounds per acre. Sport or commercial fish were not collected. Bluntnose minnow, a pollution tolerant fish, was the most abundant species (39 percent of the collection); however, the southern redbelly dace (a pollution intolerant species) was also collected in good numbers. Pollution susceptible species such as the orangethroated darter and suckermouth minnow were collected but in very low densities.

The quality of the aquatic habitat at station M5 of Middle Creek, as assessed by the observation of streambed materials and stability, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop), species diversity, and fish composition and density, was rated slightly below fair or semi-degraded.

Station S2

Sugar Creek station S2, located an equal distance (1.05 miles each direction) between the stream's confluence with Court Creek and the spillway of Spoon Lake, has a drainage area of approximately 22 square miles. The drainage is highly diversified and contains nearly 4000 acres of rugged pre-law (prior to 1962) strip mine lands, intensive agricultural development in grain and livestock production, and Spoon Lake and its surrounding residential development. The aquatic habitat is characterized by a streambed consisting of high percentages of sand (60 percent) and silt (25 percent); unstable, raw banks on the outside bends of the channel; a low degree of channel sinuosity; long, low-gradient pools of shallow depth having sparce instream cover; and low-gradient riffles consisting of fine gravel. Fish kills, resulting from discharges of confinement livestock wastes, have been known to occur within this section of Sugar Creek. Water levels fluctuate widely with annual frequency.

The 1980 fish collection revealed 16 species having a standing crop of 340.55 pounds per acre. The standing crop calculated for this station is misleading since the three large carp (spillway loss from Spoon Lake just above the station) included in the collection were not the product of the sampling area and therefore the figures misrepresent the stream's productivity.

Without the three large carp included in the collection, the standing crop would have been 193.27 pounds per acre. Forage fish density was very low (11 percent of the collection) due to predation from an extremely high (80 percent of the collection) population of sport fish. Bluegill and black bullhead dominated the sport fishery with 83 percent of the collection; however, none were of catchable or usable sizes. Species diversity and density were low at this sampling site.

The quality of the aquatic habitat at station S2 of Sugar Creek, as assessed by the observation of streambed materials and stability, bank stability, degree of channel sinuosity, instream cover, pool depth, riffle characteristics, fish biomass (standing crop) , species diversity, and fish composition and density, was rated slightly below fair or semi-degraded.

Station S5

Sugar Creek station S5, located one mile upstream from the stream's confluence with Spoon Lake, has a drainage area of approximately 6.7 square miles containing strip mines, timber, pasture, and rowcrop lands. Roundhouse and Windsor Lakes are situated within the immediate drainage area. Due to a midsummer drought, the stream was not flowing on the present survey date. Four small pools contained within the 150-foot station limits were sampled with rotenone (a fish toxicant) and found to be void of fish life. Dissolved oxygen levels in these pools were 0.1 ppm, too low for sustaining fish life. During normal flow conditions, the stream is speculated to contain a high density of small minnow species. The natural character of the stream has been greatly degraded within the sampling station area due to excessive cattle grazing. During normal water flow conditions, the aquatic habitat is characterized by an irregular streambed consisting of equal amounts of silt, sand, and gravel with some visible rubble; denuded banks having a high degree of young tree growth; shallow pools containing some instream cover of snags, brush, and undercut tree roots; and high-gradient riffles composed of fine gravel. Highly fluctuating water levels are rare at this site due to the numerous impoundments and high percentage of uncultivated lands in the drainage area.

The quality of the aquatic habitat was rated as poor or degraded at this site due to intensive cattle grazing.

Overview of Results

With one exception (the middle section of Court Creek at site C6), the fish survey sites in the Court Creek watershed did not support fishable populations of sport fish. The major factors contributing to these inadequate habitats were: lack of water depth, unstable water levels, lack of gravel and rubble in the streambed, high turbidity, and streambeds characterized by shifting sand. With regard to the latter, the particle size distributions of the streambed material at the fish survey sites are shown in table 30. From a review of the table for comparison with the assigned

Table 30. Particle Size Distributions of the Stream Bottom at Fish Survey Sites

(Percent)

Station	Gravel	Sand	Silt and clay
C3	7.7	91.2	1.1
C6	76.8	21.7	1.5
C12	59.1	38.6	2.3
N2	46.1	52.2	1.7
N3	32.7	66.0	1.3
N5	9.5	86.8	3.7
N6	53.3	44.4	2.3
N7	15.6	75.2	9.2
M1	46.4	52.4	1.2
M3	59.5	39.7	0.8
M5	12.8	75.9	11.3
S2	10.2	61.7	28.1
S5	10.7	74.3	15.0

ratings of the habitat it appears that the makeup of the streambed material has considerable influence on the suitability of the habitat.

Generally, where gravel exists in quantity or is dominant in the streambed the habitat is rated good; and where sand predominates in the streambed it is rated degraded. As found in the field reconnaissance previously described, most of the sand-dominated streambeds are located in the lower ends of the streams. It is reasonable to conclude that most of the lower ends of the streams are unsuitable fish habitats because of "shifting sand bottoms."

Discussion

During the summer of 1964 Mr. Kenneth Russell and his colleagues at the Illinois Department of Conservation performed a fish survey on Court Creek at a location near station C3. Rotenone was used as the toxicant. About 500 fish were recovered. The pertinent comments prepared as the result of the work done on July 8, 1964 are as follows:

> "The stream contains good populations of yearling channel catfish (av. 5.0 inches) and some specimens up to 13.0 inches in length. Subadult smallmouth bass (5.5 to 7.5 inches) are present in good numbers. Court Creek represents an excellent Spoon River nursery stream for channel catfish and smallmouth bass. The green sunfish are abundant but few are of catchable size; some 6.0-inch fish are present. The yellow bullhead is also quite abundant with some individuals attaining 8.0 inches in length. Carpsuckers are numerous as are redhorses and white sucker. The carp was not collected but is undoubtedly present. The fish collection contained, by number, 72% forage fish, 23%

game fish and 5% commercial species; by weight the percentages were 51% game fish, 31% forage fish and 18% commercial species. The stream is lightly fished."

On July 15, 1975, another survey was performed on Court Creek near station C3. The fish were collected with a 15-foot bag seine (three hauls). Because the collection procedure differed from that used in 1964 it is not fair to compare the fish collections. However the observations recorded in 1975 pertaining to habitats, compared to those in 1964, are interesting. The comment recorded in 1975 is short:

> "Stream habitat at this location is very unstable due to a shifting sand bottom."

In July 1975 fish surveys were also performed on Sugar Creek near S2, on North Creek near N3, and on Middle Creek near M3. The following observations were noted during that work:

Station S2: "Stream has a high population of largemouth bass and bluegill due to overflow from Spoon Lake which is 3/4 mile upstream."

Station N3: "Stream at this location has excellent habitat containing high population of forage minnows. Smallmouth bass present but stream has very little sport fishing potential."

Station M3: "An excellent forage minnow stream with no sport fishery potential except as a nursery area."

The results of the fish surveys performed in 1964, 1975, and 1980 provide an excellent baseline from which improvements or degradation can be measured in the future. They also suggest that Middle and North Creeks are principally "minnow streams" with adequate forage to function as nursery areas for smallmouth bass. This is also the case for the uppermost segment of Court Creek. Sugar Creek's game fish population is probably influenced by the nearby upstream impoundment, Spoon Valley Lake. From the mid-length of Court Creek downstream to its confluence with the Spoon River, sports fishing appears limited because of poor habitat characterized by an unstable sandy bottom and fluctuating water levels.

Summary

- Thirteen stations were established on the watershed and a fish survey was performed at 12 of them.
- The rotenone-potassium permanganate technique was used to recover fish in various lengths of stream segments.
- About 13,470 specimens were recovered, representative of 33 species.

- Forage species by number represented 87.6 percent, sport species represented 8.3 percent, and commercial species represented 4.1 percent.

- The standing crop (pounds of fish per acre) varied from 100 to 335 and generally decreased with increasing watershed area.

- The density (number of fish per station) varied from 229 to 2646 and generally increased with increasing watershed area.

- The species diversity (number of species per station) varied from 11 to 23 and generally increased with increasing watershed area.

- The bluntnose minnow was the most abundant species, representing nearly 40 percent of the total number of fish recovered.

- Only one site, station C6 in the middle section of Court Creek, supported fishable populations of sport fish.

- The number of stations for each habitat rating are as follows:

Well-balanced	0
Balanced	3
Semi-balanced	1
Semi-degraded	8
Degraded	0
Severely degraded	0

- The principal factors contributing to the degradation of habitat are unstable water levels, high turbidity, and unstable streambeds characterized by shifting sand.

- Most of the fish habitats in the lower ends of the streams, especially Court Creek, are unsuitable because of unstable sandy bottoms and fluctuating water levels.

WILDLIFE RESOURCES

Any inventory regarding land use in the Court Creek watershed would not be complete without an assessment of its wildlife resources. For this purpose reliance was placed on Mr. Norman Emmerick, District wildlife Manager of the Illinois Department of Conservation. Mr. Emmerick developed a report entitled Terrestrial Habitat and Wildlife Populations, which is the basis for the following discussion. The only modifications of his report as presented here involve ordering it in a format consistent with the other sections of this report. The assessment is principally an evaluation of the terrestrial habitat and associated wildlife populations in the watershed in terms of deer, upland game, waterfowl, and non-game bird populations.

Methods

The forest game section of the Illinois Department of Conservation has developed a population simulation model which has been useful for inventorying the forest areas of the state on a county basis. It has- been estimated that whitetail deer number 44 per sq km (17.1 per sq mi) in wooded habitats. However for the total land area they number 5.9 per sq km (2.3 per sq mi).

There is no upland game census route in Knox County. However, there is one in the adjoining county of Fulton with habitats similar to those existing in the Court Creek watershed. Like the watershed, the route in Fulton County has forested stream corridors, open fields, and strip-mined land. The 52 km (20 mile) route is surveyed three times per year to monitor population changes, and the results are considered applicable to the watershed.

The Department of Conservation maintains a record of raccoons harvested on the basis of geographic sections (Hubert, G.F., Jr., 1980, Trapper Harvest Survey, Illinois Department of Conservation P-R Project, Rep. @-49-R-27, 35 p). The Court Creek watershed lies within the western prairie forest geographic section and the results observed for that section are applicable to the watershed.

A spring count of non-game bird populations is performed annually in Knox County. The eight years of record during 1973-1980 were used to estimate the bird population in the watershed.

Results

From the application to the watershed of the population simulation model for deer, it is estimated that the 89 sq km (32 sq mi) of wooded area will support 222 deer. The remaining portion of the watershed will support only an additional 59 deer. Records of deer harvests on the watershed confirm the reasonableness of the model. Deer check stations are maintained during the hunting season, where hunters are required to indicate the deer kill sites on a map. The map of the deer kill sites for 1978 is depicted in figure 32. About 89 percent of the kill sites were within forested areas made up of woods, wooded pasture, and the strip-mined land.

The largest number of rabbits observed along the upland game census route during July 1981 was 21-22 per km (13-14 per mile). This was along 3.2 km (2 miles) of strip-mined ground reclaimed with an unmowed mixture of grass and legume cover. The highest quail counts (44, 34, and 32) were at three sites on a woody stream corridor that had a diversity of timber and pasture.

In the western prairie forest section of Illinois, during the 1978-1980 season, an estimated 14 trappers harvested 141 raccoons per 100 sq km (3.7/sq mi) and about 76 hunters harvested 672 raccoons per 100 sq km (17.4/sq mi). On this basis the 251 sq km (97 sq mi) watershed of Court Creek will produce an annual harvest of 2042 raccoons. The average price per pelt during

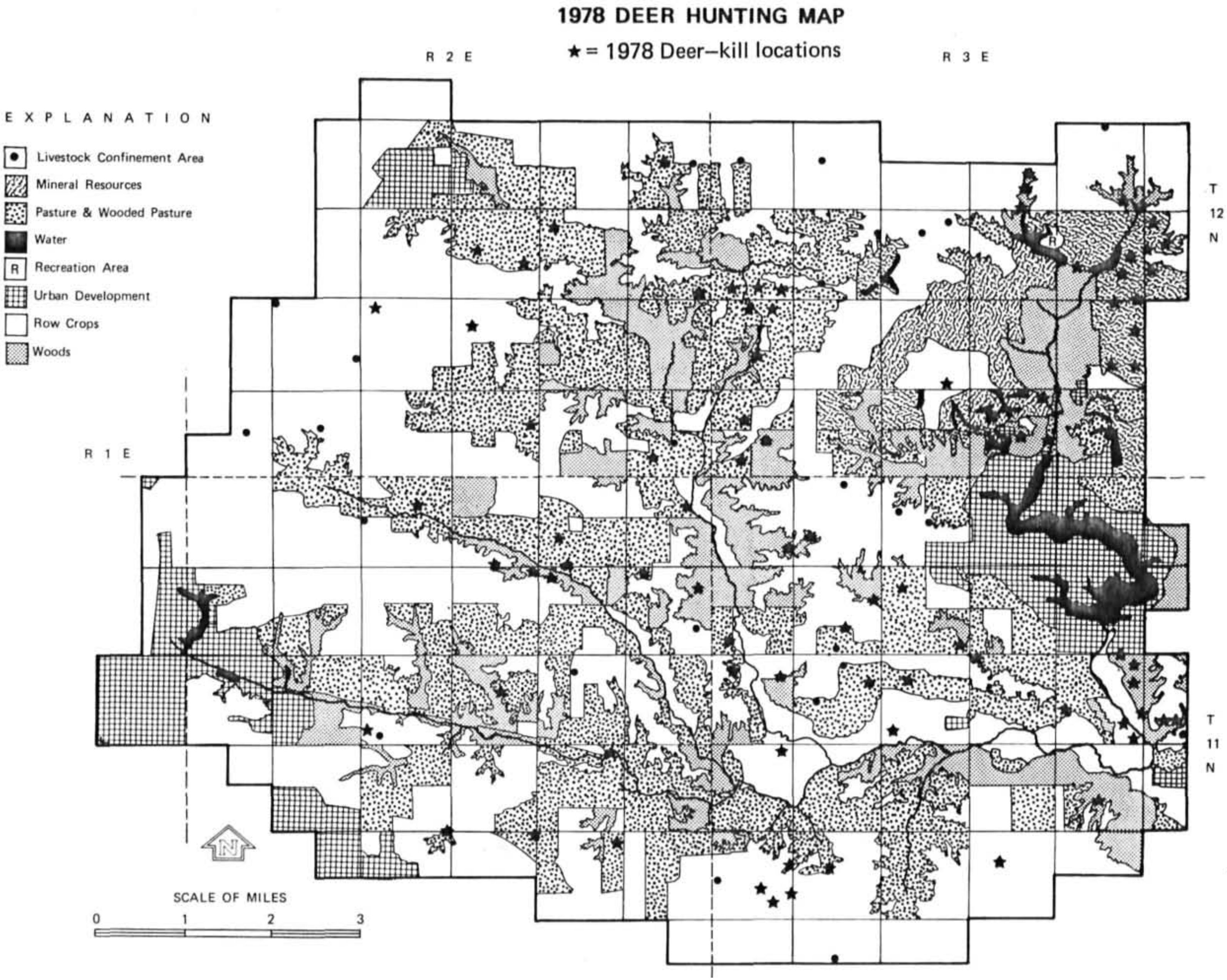


Figure 32. Locations of deer kills during 1978 in the Court Creek watershed

the 1979-1980 hunting seasons was $25.50. This suggests that the raccoon harvest in the watershed has a potential value of $52,070 per annum.

Several species of birds use the area during the spring and fall migrations. Based on the 8-year record of spring counts (1973-1980), about 75 species were recorded in an observed bird population of 2233.

Discussion

Although whitetail deer require other types of habitat during different times of the year, a good dispersion of forest habitat within the watershed will guarantee their survival. Any clearing of the wooded area will decrease their population. Conversely, any increase in forest habitat will increase their population.

The perpetuation of upland game is dependent on a diversity of habitat. The more diversity in habitat types that can be established within a given area, the greater the density of species and numbers of individuals within a species that will be present.

In addition to raccoon the muskrat is a primary furbearer in the watershed. The coyote, mink, weasel, opossum, striped skunk, beaver, red fox, and grey fox are also present. Muskrat and beaver are more abundant in strip mine ponds and along the creeks. Raccoons occur in all parts of the watershed but prefer a hardwood timbered habitat. Such timber may be either dense forest or only a narrow stand of trees bordering a stream, pond, lake, or marsh. Their home is usually a den in a hollow tree, but many other sites suffice, such as woodchuck burrows, bulldozed timer piles, and old buildings.

In 1975, by a cooperative effort of the Illinois Department of Conservation and members of a local sportsman's club, a population of giant Canadian geese were established in the strip mining area of the watershed. These geese are unique in that they nest this far south and stay in the area until freeze-up. Their primary resting sites are on islands located within the strip mine ponds; however, they have started to move out into surrounding impoundments. Any increase in the number of ponds constructed within the watershed, especially those with islands built in them, will provide additional nesting habitats which will increase the population of Canadian geese.

There are no known rare or endangered species using the watershed on a permanent basis. The key to the proper maintenance and improvement of wildlife in the watershed is habitat. And good management of wildlife populations strives for a diversity of habitat. The greater the variety of crops grown on agricultural land bounded by wooded streambanks and timbered tracts, the greater is this diversity. As is the case in most of Illinois, land use in the Court Creek watershed has changed from more diversified farming to row-crop farming (corn and beans). The wildlife population has decreased. Any conservation practices which will reverse this trend will provide a richer natural resource to be enjoyed by Court Creek residents.

Summary

- An inventory was made of wildlife populations in terms of deer, upland game, waterfowl, and non-game bird populations.
- The watershed will support about 280 whitetail deer. About 80 percent will be supported in the wooded areas.
- The largest number of rabbits will be found along strip-mined land reclaimed with an unmowed mixture of grass and legume cover.
- Quail populations are likely to reach their highest counts per site (30-40) on woody stream corridors with a diversity of timber and pasture.
- The watershed will produce an annual harvest of about 2040 raccoons at an estimated value of $52,070.
- During the spring about 75 species of non-game birds are likely to be sighted.
- In addition to the raccoon, the muskrat is a primary furbearer in the watershed.
- Other furbearers co-existing on the watershed are coyote, mink, weasel, opossum, skunk, beaver, red fox, and grey fox.
- A Canadian goose population has been established in the strip mining area of the watershed. They are starting to move into surrounding impoundments.
- Any conservation practices that will lead to more diversity of habitat will improve the quantity and quality of wildlife in the watershed.

A NOTE CONCERNING THE APPENDICES TO THIS REPORT

The appendices referred to in this report are not included in this volume. They have been printed separately, and a limited number of copies are available upon request from the Illinois State Water Survey, Water Quality Section, Box 697, Peoria, Illinois 61652, (309) 671-3196.