Arkansas Water Resources Center

WATERSHED PRIORITIZATION

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EXECUTIVE SUMMARY

The overall objective of this two-year study was to evaluate the water quality in the thirty-seven sub-basin watersheds in the Illinois River in Arkansas and to arrive at a watershed prioritization list to use in targeting non-point source activities. A water quality monitoring program was conducted with sampling in all thirty-seven sub-basins during both storm and base flow events and more intensive sampling in eight representative sub-basins during storm events. Each sub-basin was sampled seasonally during low flow (base-flow) conditions and during high flow storm (storm flow) conditions. In addition to the regular sampling, the intensive sub-basins were sampled approximately 20 additional times during high flow.

The base flow and storm flow in each sub-basin was determined by a combination of measurements, modeling and estimation. Yearly average parameter concentrations and unit area loads (kg/ha-yr) were calculated for each sub-basin for total phosphorus, total nitrogen, and total suspended solids. The yearly parameter concentrations and unit area loads for headwater sub-basins were calculated directly from the measured median concentrations. The sub-basin yearly average concentration was equal to the product of the measured base flow median concentration times the fraction of base flow to total flow plus the product of the measured storm flow medium concentration times the fraction of storm flow to total flow. This yearly average sub-basin concentration represents the annual flow weighted average concentration for the sub-basin. However, yearly average concentrations and unit area loads for non headwater sub-basins and sub-basins receiving point source loads were not calculated directly because of the uncertainty of upstream load contributions from upstream basins or point sources.

In order to determine concentrations and loads for non-headwater sub-basins, modeling was used. Yearly average concentrations were modeled using the data from 16 headwaters sub-basins sampled, land use information, the median storm and base flow concentrations, and the storm and base flow rates. A model was developed based on total phosphorus, total nitrogen, and total suspended solids. A multiple linear regression analysis was performed between the headwater sub-basin yearly average concentration and the land use percentages in each sub-basin. This model was then used to calculate a yearly average concentration in each of the non-headwater sub-basins.

The calculated and modeled yearly average concentrations for each sub-basin was multiplied by the total flow to determine the total load and the total load was divided by the area to determine the load per unit area. The sub-basins were prioritized on the basis of annual unit area loads in kg/ha-yr. Three different prioritization rankings were developed based on three different parameters. The parameters that were emphasized were total phosphorus, total nitrogen, and total suspended solids. Each parameter prioritization was divided into three approximately equal priority ranking groups. The following sub-basin priority ranking groups were used.

	Priority Ranking Group		
Parameter	Low	Medium	High
Total Phosphorus, kg/ha-yr	0.05-0.065	0.065-0.95	0.95-1.85
Total Nitrogen, kg/ha-yr	0-5	5-15	15-52
Total Suspended Solids, kg/ha-yr	5-75	75-170	170-324

The following table list all of the sub-basins and the priority ranking for total phosphorus, total nitrogen and total suspended solids.

SUB-BASIN PRIORITY RANKING

Basin #	Basin Name	Total Phosphorus Priority	Total Nitrogen Priority	Total Suspended Solids Priority
110	Lake Wedington	Low	Low	Low
120	Ruby	Low	Medium	Medium
130	Goose Creek	Medium	Medium	High
140	Upper Illinois	High	Low	High
220	Hamstring	Low	Medium	Medium
221	Clear Creek	Medium	Medium	Medium
310	Fish	Low	Low	High
320	Robinson	Medium	Medium	Medium
330	Wildcat	Low	High	Low
340	Brush	Medium	High	Medium
351	Lower Osage	Medium	Medium	High
352	Upper Osage	High	High	High
360	Galey	Low	High	Low
371	Lick Branch	Low	Medium	Low
372	Little Osage	High	High	High
380	Spring	High	High	High
391	Cross	Medium	High	Low
392	Puppy	High	High	Medium
410	Muddy Fork	High	High	Medium
420	Blair Creek	Low	Low	Medium
430	Lower Moores	Medium	Medium	Medium
440	Upper Moores	Low	Low	Low
450	Kinion	High	Medium	Medium
510	Francis	Low	Medium	High
520	Gum Springs	Medium	Medium	Medium
530	Chambers	Low	Medium	Low
540	Pedro	Low	Medium	Low
550	Gallatin	Low	Medium	Low
610	Flint	Low	Medium	High
620	Little Flint	Medium	Medium	High
630	Sager	High	Medium	Medium
710	Cincinnati	High	High	Medium
720	Wedington	Medium	Medium	Medium
810	Upper Ballard	High	Low	High
820	Baron Fork	Low	Medium	Medium
830	Evansville	Low	Low	Medium
840	Fly Creek	High	Low	High

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The Illinois River Basin has experienced water quality impairment from nonpoint source pollution for many years. This fact was well documented in the State of Arkansas' Water Quality Assessment report, the Soil Conservation Service River Basin Study, and several University of Arkansas studies. In the Arkansas portion of the Basin, the Illinois River, Evansville Creek, Baron Fork, Cincinnati Creek, Muddy Fork, Moores Creek, Clear Creek, Osage Creek and Flint Creek were all classified as not supporting their designated use as primary contact recreation streams. The identified causes of the impairment were: sediment, bacteria and nutrients. The probable subcategory for the impairment was considered to be confined animal management/holding areas in all cases. Since much of the area is rapidly developing as an urban/suburban area, it is reasonable to believe that there are other unidentified causes of water quality impairment as well.

A considerable amount of money is being spent on Best Management Practice implementation in the Basin. The projects have been in many ways selected by a shotgun approach. Only in the Muddy Fork Hydrologic Unit Project are funds concentrated toward a specific area. Assistance in other areas is mainly on a first come, first serve basis. Prioritization of watersheds within the Basin will allow all agencies to target their efforts toward the most critical areas first.

The Oklahoma Conservation Commission has already prioritized watersheds in the Oklahoma portion of the Illinois River basin. The prioritization of watersheds proposed in this project is designed to use watersheds of similar size as those identified in Oklahoma. The parameters used in Arkansas' prioritization are also compatible with those of the Oklahoma Conservation Commission. A meeting was held on May 6, 1992 between the Oklahoma Conservation

Commission, the AWRC and the ASWCC to discuss the relative merits of the prioritization. It was agreed at that meeting that the two states were using compatible systems.

Thirty-seven sub-watersheds have been identified by the SCS in the Arkansas portion of the Illinois River basin. These watersheds are similar in area to those identified in the Oklahoma watershed prioritization project. To maintain continuity, the sub watersheds defined by NRCS were used in this project.

PROJECT OBJECTIVES AND SCOPE

The overall objective of this two-year study was to evaluate the water quality in the thirty-seven sub-basin watersheds in the Illinois River in Arkansas and to arrive at a watershed prioritization list to use in targeting nonpoint source activities.

On the basis of an addendum (dated December 18, 1992) to a previously executed cooperative agreement between ASWCC and the Arkansas Water Resources Center (AWRC) work on this project was conducted by AWRC. This project plan fell under the Approved Quality Assurance Program Plan for Arkansas Soil and Water Conservation Commission dated September 28, 1992 and approved by USEPA on November 19, 1992.

The ideal way to prioritize the basins would be to conduct a thorough analysis of the water quality in each of the thirty-seven basins under consideration. However, a thorough analysis of all thirty-seven basins was considered too expensive and a less-than-thorough analysis could have led to faulty conclusions about the water quality in the basins. Therefore, a combination of limited sampling and modeling techniques were used to prioritize the basins.

Both base flow and storm events were analyzed since activities in a sub-basin affect stream water quality in two ways. First, pollutants entering the stream can have a direct effect on water quality in the stream and thus the ecology of the streams within the sub-basin. The sub-basin effects can be determined by measuring the water quality and conducting a rapid bioassessment on the stream in the sub-basin. Second, pollutants can be transported out of the sub-basin and affect the water quality in basins and reservoirs downstream from the sub-basin. The transport of pollutants (pollutant flux) out of the basin can be determined by measuring both the water quality and the flow rate out of the basin. In this watershed, most of the pollutants that are transported downstream are carried during the relatively short duration, high flows caused by storm events. Estimations of flux based on monthly grab samples can and usually do under predict the actual flux from a basin.

Study Approach:

A water quality monitoring program was conducted with some sampling in all thirty-seven sub-basins during both storm and base flow events and more intensive sampling in eight representative sub-basins during storm events. The representative sub-basins were selected so that four predominant land use patterns were represented in both the Springfield Plateau and Boston Mountains physiographic regions. Land use patterns considered included forest, pasture, urban and concentrated confined animal feeding/rearing operations.

Sampling in all sub-basins was used to acquire water quality data needed to establish relationships between land use and water quality in the Illinois River Basin. At the same time, a geographical information system (GIS) developed for the Muddy Fork of the Illinois River Basin in Arkansas was expanded to include the entire Basin. This GIS database contains information about land use and other features that might influence water quality in the basins. It was determined from the combination of GIS work and the water quality work that functional relationships existed between land use and total phosphorus, nitrate nitrogen, TKN nitrogen and total suspended solids concentrations in the sub-basins. The models developed were ultimately only used to predict nonpoint source contributions from sub-basins that were either under the influence of an upstream basin or had a point source contribution from a wastewater treatment facility.

ASWCC conducted rapid bioassessments in the Illinois River basin under a separately funded project. AWRC will not utilize the results from this sampling as an input to the prioritization process.

The GIS that was used for the Illinois River Basin is similar to the work of Scott (1991) who reported on the GIS developed for the Muddy Fork watershed. The GIS software used was the Geographical Resources Analysis Support System which is known by the acronym GRASS. This software is public domain and will run on a Sun SPARC station in UNIX.

The primary databases utilized included: elevation, transportation, hydrography, soils, geology and land use.

Description of sub-basins and sample locations

The Illinois River Basin in Arkansas was subdivided into thirty-seven sub-basins. Figure 1 shows a general map of the Illinois River drainage basin in Arkansas and approximate sample locations. Figure 2 shows the outlines of all thirty-seven sub-basins. Table 1 lists each sub-basin and gives the total area and percent area in each of six land use categories. The land use and land area data comes from GIS databases provided by H. Don Scott. The GIS procedures and data bases are presented in Appendix A. Figure 3 shown a schematic of the sub-basins and the major point source locations.

Table 2 shows the category of each sub-basin and whether the sub-basin flow contributes to the flow in the main stem of the Illinois River in Arkansas. Each sub-basins is categorized in one of the following ways.

Headwaters - A sub-basin that receives no other sub-basin flow or point source discharge. (The category headwaters sub-basin will include intensive sub-basins.)

Intensive - A headwater sub-basin that was sampled more intensively than a typical headwater sub-basin

Other - A sub-basin that receives the flow from another sub-basin.

STP - A sub-basin that receives the flow from a point source discharge from a city wastewater treatment plant.

Figure 1. Generalized Location Map

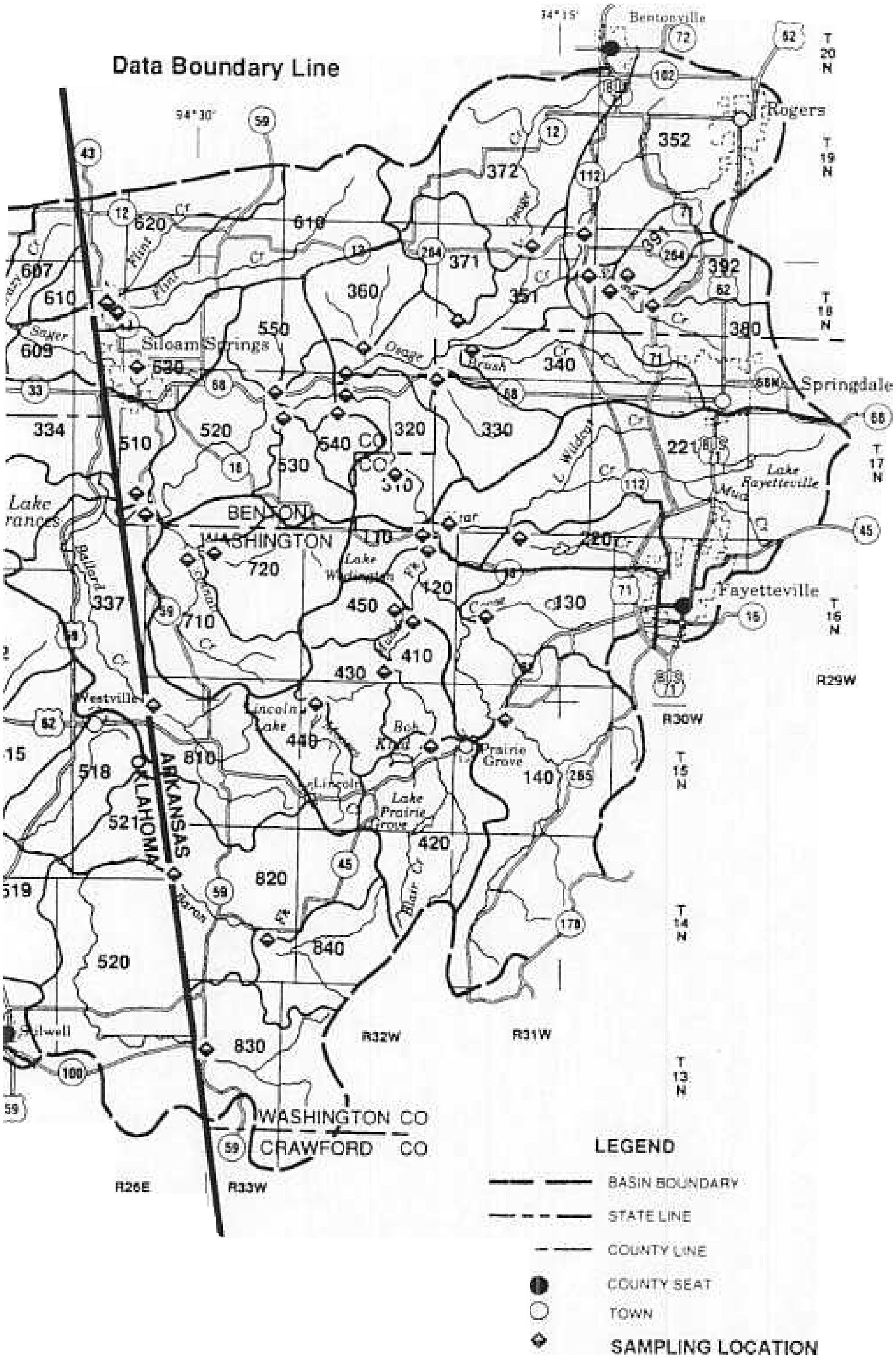


Figure 2. Sub-basins in the Illinois River in Arkansas

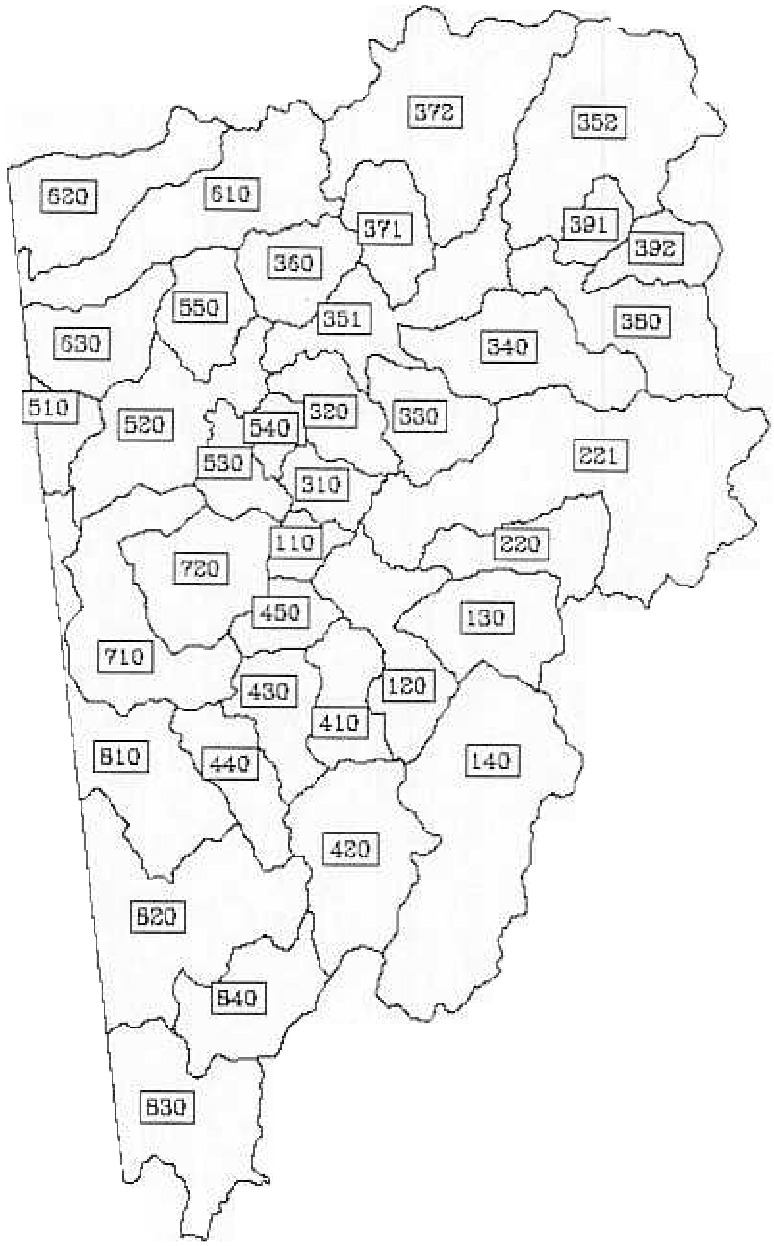


Table 1
Sub-basin Land Use Patterns

Illinois River Basin In Arkansas

Basin #	Basin Name	Total Area Hectares	Percent Urban	Percent Pasture	Percent Forest	Percent Confined	Percent Roads	Percent Water
110	Lake Wedington	1325.52	3.78	24.74	63.04	0.00	3.68	4.76
120	Ruby	5160.10	0.74	62.41	29.64	0.37	3.97	2.87
130	Goose Creek	4617.96	8.03	62.80	22.14	0.45	4.42	2.16
140	Upper Illinois	13743.35	0.58	48.91	44.66	0.37	2.83	2.64
220	Hamstring	3773.50	14.39	50.78	27.91	0.58	4.41	1.92
221	Clear Creek	16058.73	23.23	47.83	21.80	0.67	3.99	2.48
310	Fish	1908.79	0.56	30.37	61.62	0.22	3.28	3.95
320	Robinson	3032.78	0.48	50.12	43.53	0.48	2.40	2.99
330	Wildcat	3509.14	0.64	69.29	21.38	1.69	4.24	2.75
340	Brush	5973.06	13.58	65.21	11.78	1.48	4.48	3.46
351	Lower Osage	5878.67	0.24	61.22	30.33	0.72	3.60	3.89
352	Upper Osage	10071.15	28.16	52.96	12.16	0.75	3.32	2.65
360	Galey	3269.69	0.53	56.55	36.80	0.70	2.57	2.85
371	Lick Branch	3150.61	0.87	73.50	16.96	0.90	5.11	2.66
372	Little Osage	10976.59	2.96	75.10	13.03	1.11	4.61	3.20
380	Spring	5591.00	29.54	49.33	14.77	0.73	3.89	1.74
391	Cross	1490.20	1.18	78.56	11.65	1.55	4.68	2.38
392	Puppy	2320.88	11.96	70.23	10.82	0.45	4.27	2.26
410	Muddy Fork	3063.34	1.23	75.50	16.50	0.67	3.47	2.63
420	Blair Creek	6974.54	2.66	51.10	38.25	0.49	3.48	4.02
430	Lower Moores	3195.59	0.40	66.99	26.41	0.42	3.27	2.51
440	Upper Moores	3339.27	2.60	53.46	34.87	1.10	4.06	3.91
450	Kinion	1938.01	0.24	61.99	31.70	0.53	3.47	2.07
510	Francis	1669.29	8.29	36.29	47.91	0.23	3.44	3.83
520	Gum Springs	6429.71	0.61	55.45	37.73	0.41	3.12	2.68
530	Chambers	2150.33	0.42	43.76	49.99	0.32	2.47	3.05
540	Pedro	1193.15	0.06	18.25	76.83	0.02	2.34	2.50
550	Gallatin	3096.10	0.68	63.21	29.91	0.33	3.59	2.28
610	Flint	8370.85	5.28	62.76	24.24	0.98	4.10	2.63
620	Little Flint	5590.97	4.72	67.17	18.14	0.73	4.19	5.05
630	Sager	4036.47	25.11	57.21	11.05	1.01	4.13	1.50
710	Cincinnati	7263.69	0.58	66.16	27.11	0.66	3.30	2.18
720	Wedington	5303.54	0.28	66.42	27.34	0.25	3.00	2.70
810	Upper Ballard	7106.24	1.44	62.57	28.83	0.85	3.72	2.58
820	Baron Fork	10087.30	1.11	52.18	40.52	0.47	2.66	3.06
830	Evansville	7170.43	0.21	40.73	53.64	0.25	2.90	2.27
840	Fly Creek	4692.01	0.39	54.98	37.85	0.63	3.12	3.03
	Total Area	194522.56						

Figure 3

Schematic of Study Area

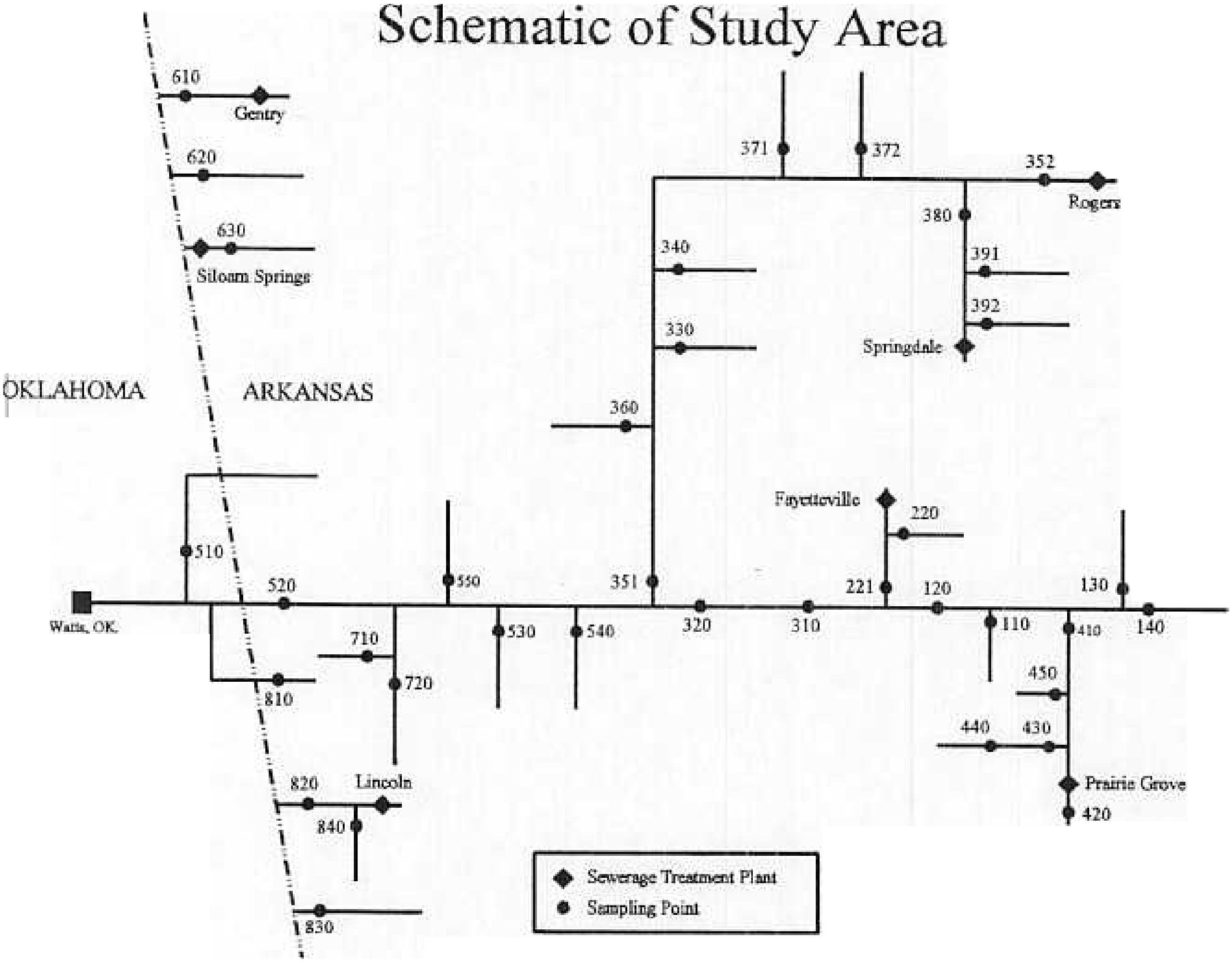


Table 2
Categories of Sub-Basins

Illinois River Basin In Arkansas

Basin #	Basin Name	Total Area Hectares	Category	Contribute to Main Stem
110	Lake Wedington	1325.52	Headwaters	yes
120	Ruby	5160.10	Other	yes
130	Goose Creek	4617.96	Intensive	yes
140	Upper Illinois	13743.35	Intensive	yes
220	Hamstring	3773.50	Headwaters	yes
221	Clear Creek	16058.73	STP	yes
310	Fish	1908.79	Other	yes
320	Robinson	3032.78	Other	yes
330	Wildcat	3509.14	Intensive	yes
340	Brush	5973.06	Intensive	yes
351	Lower Osage	5878.67	Other	yes
352	Upper Osage	10071.15	STP	yes
360	Galey	3269.69	Intensive	yes
371	Lick Branch	3150.61	Headwaters	yes
372	Little Osage	10976.59	Headwaters	yes
380	Spring	5591.00	STP	yes
391	Cross	1490.20	Intensive	yes
392	Puppy	2320.88	Headwaters	yes
410	Muddy Fork	3063.34	STP	yes
420	Blair Creek	6974.54	Headwaters	yes
430	Lower Moores	3195.59	Other	yes
440	Upper Moores	3339.27	Headwaters	yes
450	Kinion	1938.01	Headwaters	yes
510	Francis	1669.29	Headwaters	no
520	Gum Springs	6429.71	Other	yes
530	Chambers	2150.33	Headwaters	yes
540	Pedro	1193.15	Intensive	yes
550	Gallatin	3096.10	Headwaters	yes
610	Flint	8370.85	Headwaters	no
620	Little Flint	5590.97	Headwaters	no
630	Sager	4036.47	Intensive	no
710	Cincinnati	7263.69	Headwaters	yes
720	Wedington	5303.54	Headwaters	yes
810	Upper Ballard	7106.24	Headwaters	no
820	Baron Fork	10087.30	STP	no
830	Evansville	7170.43	Headwaters	no
840	Fly Creek	4692.01	Headwaters	no
	Total Area	194522.56		

Sampling locations were picked as near to the downstream drainage location in each sub-basin as possible. The actual sample locations were located at convenient access points from which representative samples could be collected. The approximate locations of the sampling sites are listed in Table 3.

Table 3

Sampling Locations

	Description	Location
	Lake Wedington	T16N-R32W, Section 2, Wheeler Quad, C37 off SH16
	Ruby	T17N-R32W, Section 36, Wheeler Quad, SH16 (bridge)
	Goose Creek	T16N-R31W, Section 20, Wheeler Quad, C646
	Upper Illinois	T15N-R31W, Section 8, Prairie Grove Quad, USH62 (bridge)
	Hamstring	T17N-R31W, Section 33, Wheeler Quad, C842
221	Clear Creek	T17N-R32W, Section 31, Wheeler Quad, C845
310	Fish	T17N-R32W, Section 23, Robinson Quad, C848
320	Robinson	T17N-R32W, Section 4, Gallatin Quad, C196
330	Wildcat	T18N-R32W, Section 36, Robinson Quad, USH412
	Brush	T18N-R31W, Section 33, Robinson Quad, C60
351	Lower Osage	T18N-R32W, Section 34, Gallatin Quad, C9 near Logan
352	Upper Osage	T18N-R31W, Section 1 Bentonville South Quad, SH264
360	Galey	T17N-R32W, Section 27, Gallatin Quad, C12
371	Lick Branch	T18N-R32W, Section 20, Robinson Quad, C218
372	Little Osage	T18N-R31W, Section 10, Centerton Quad, SH264
380	Spring	T18N-R31W, Section 12, Springdale Quad, SH112
391	Cross	T18N-R30W, Section 18, Springdale Quad, C60
392	Puppy	T18N-R30W, Section 21, Springdale Quad, C60
	Muddy Fork	T16N-R32W, Section 23, Wheeler Quad, C612
420	Blair Creek	T15N-R32W, Section 13, Prairie Grove Quad, C64
	Lower Moores	T16N-R32W, Section 34, Wheeler Quad, C62
	Upper Moores	T15N-R32W, Section 6, Rhea Quad, Lincoln Lake dam

Table 3. Continued

	Kinion (Kinyon)	T16N-R32W, Section 22, Wheeler Quad, C612
	Francis	T19N-R26E, Section 7, Siloam Springs Quad, FAS 2486 (OK)
	Gum Springs	T17N-R33W, Section 31, Watts Quad, SH59
	Chambers	T17N-R32W, Section 18, Gallatin Quad, NFM, C3
	Pedro	T17N-R32W, Section 9, Gallatin Quad, C196
	Gallatin	T17N-R33W, Section 1, Gallatin Quad, USH412
	Flint	T18N-R34W, Section 24, Siloam Springs Quad, SH43
	Little Flint	T18N-R34W, See 610, Northern fork
	Sager	T18N-R34W, Section 31, Siloam Springs Quad, John Brown Univ.
	Cincinnati	T16N-R33W, Section 8, Watts Quad, C25
720	Wedington	T16N-R33W, Section 8, Watts Quad, C25
810	Ballard Creek	T15N-R33W, Section 7, Westville Quad, C76 (Ballard Crk Rd)
820	Baron Fork	T14N-R33W, Section 21, Lincoln Quad, SH59 & SH45
	Evansville	T13N-R33W, Section 16, Evansville Quad, SH59
	Fly Creek	T14N-R33W, Section 23, Evansville Quad, SH45

(*=Reservoir Outlet, C=COUNTY, SH=STATE HIGHWAY, USH=U.S. HIGHWAY)

RESULTS AND ANALYSIS OF RESULTS

Sampling Results

Each sub-basin was sampled seasonally during low flow (base-flow) conditions and during high flow storm (storm flow) conditions. In addition to the regular sampling, the intensive sub-basins were sampled approximately 20 additional times during high flow. All of the water quality lab results are shown in data tables in Appendix B. The data tables in Appendix B show the following information for each sample collected:

1 The sub-basin number
2. The date the sample was collected
3. whether the sample was collected during storm or base flow condition
4. The value of the measured parameter
5. The minimum, maximum, mean, and median values for both storm and base flow samples for each sub-basin

Data tables for the non-headwater (other) and STP sub-basins reflect the contributions of the given parameters from the upstream sub-basins and point sources.

Sub-Basin Flow Determination

The base flow and storm flow in each sub-basin was determined by a combination of measurements, modeling and estimation. First, the total flow in the Illinois River in Arkansas was established from USGS gauging station records. Second, the base and storm flow portion of the total flow was established. Third, the measured base flows in all the sub-basins were proportioned to equal the total base flow. Fourth, the sub-basin storm flows were estimated and proportioned to equal the total storm flow.

Estimate of the Total Flow in the Main Stem of the Illinois River in Arkansas

The flow at the USGS gauging station on the Illinois River at Oklahoma Highway 59 at Watts, OK was used for determination of flow estimation for modeling. The annual average flows at Watts for the calendar years 1992 through 1995 are listed.

Year	Average Annual Average Flow Rate
	760 cfs
	163 cfs
	679 cfs
	807 cfs

Flows in the Arkansas portion of the main stem of the Illinois River were based on an annual average flow of 760 cfs.

Estimate of the Total Storm and Base Flow in the Main Stem of the Illinois River in Arkansas

Storm flow rates were based on an observation of the flow patterns of USGS daily flow records at Watts for 1993-94. The base flow portion of each years total flow was determined by assuming that the base flow was the lowest daily flow for that month. The storm flow was than calculated by subtracting the lowest daily flow in each month from the total flow for that month and then summing the twelve months flows. The resulting storm flow percentage fore each year is shown.

Year	Storm Flow as % of Total Flow
	65%
	58%
	55%

The estimated storm flow in the Arkansas portion of the main stem of the Illinois River was estimated as 60% of 760 cfs. The resulting estimated flows were used in this evaluation.

Estimated Total, Storm, and Base Annual Average Flows

in Main Stem of Illinois River in Arkansas

Total Flow	= 760 cfs
Storm Flow	= 456 cfs
Base Flow	= 304 cfs

Base Flow in the Sub-basins

The base flow in all basins was measured during June-August, 1995 during low flow conditions at least seven days after any rainfall event. Because the flows were measured during dry Summer conditions the sum of the measured base flows was lower than estimated annual average base flows. The measured base flows were scaled up by a multiplication factor so that the sum of the base flows in the main stem was equal to the 304 cfs annual average base flow estimate and the remainder of the base flows were scaled up in the same proportion..

Estimates of the Storm Flows in Sub-basins

The storm flows in each sub-basin were estimated by the following process. First, a two-year twenty-four hour storm runoff simulation was performed using HEC-1 computer simulation software. The ratio of simulated runoff from each sub-basin to the sum of all the basins was calculated. Next, the ratio of simulated runoff for each sub-basin was multiplied by the total assumed storm flow (456 cfs) for all of the main stem basins. Those Sub-basins not contributing to the main stem in Arkansas were calculated by scaling up each sub-basin flow by the ratio of the main stem total flow to the main stem total simulated flow. Table 4 shows the annual average base and storm flows for each sub-basin

Table 4
Annual Average Flows

Illinois River Basin In Arkansas

Basin #	Basin Name	Category	Storm Average cfs	Base Average cfs	Total average
110	Lake Wedington	Headwaters	2.15	0.00	2.15
120	Ruby	Other	13.24	0.84	14.08
130	Goose Creek	Intensive	15.37	1.11	16.48
140	Upper Illinois	Intensive	43.74	3.34	47.08
220	Hamstring	Headwaters	9.16	4.45	13.61
221	Clear Creek	STP	46.34	32.08	78.42
310	Fish	Other	3.63	3.30	6.93
320	Robinson	Other	7.80	5.20	13.00
330	Wildcat	Intensive	10.05	13.72	23.77
340	Brush	Intensive	17.14	44.50	61.64
351	Lower Osage	Other	16.86	14.45	31.31
352	Upper Osage	STP	33.73	30.81	64.54
360	Galey	Intensive	9.81	1.11	10.92
371	Lick Branch	Headwaters	7.58	1.48	9.06
372	Little Osage	Headwaters	40.63	84.54	125.17
380	Spring	STP	18.28	31.19	49.47
391	Cross	Intensive	5.24	1.11	6.35
392	Puppy	Headwaters	8.20	4.45	12.65
410	Muddy Fork	STP	8.28	5.07	13.35
420	Blair Creek	Headwaters	20.00	0.37	20.37
430	Lower Moores	Other	8.67	0.36	9.03
440	Upper Moores	Headwaters	9.58	3.34	12.91
450	Kinion	Headwaters	5.81	2.08	7.89
510	Francis	Headwaters	2.25	5.19	7.44
520	Gum Springs	Other	16.55	9.13	25.68
530	Chambers	Headwaters	5.84	6.30	12.14
540	Pedro	Intensive	2.43	4.08	6.51
550	Gallatin	Headwaters	7.97	0.00	7.97
610	Flint	Headwaters	14.84	17.80	32.63
620	Little Flint	Headwaters	16.22	16.69	32.91
630	Sager	Intensive	15.61	7.42	23.02
710	Cincinnati	Headwaters	22.97	13.35	36.31
720	Wedington	Headwaters	16.76	2.22	18.98
810	Upper Ballard	Headwaters	20.42	1.11	21.54
820	Baron Fork	STP	25.99	0.51	26.50
830	Evansville	Headwaters	17.43	0.37	17.80
840	Fly Creek	Headwaters	14.12	0.74	14.86

Sub-Basin Unit Area Load Modeling

Yearly average parameter concentrations and unit area loads (kg/ha-yr) were calculated for each sub-basin for total phosphorus, total nitrogen, and total suspended solids. The yearly parameter concentrations and unit area loads for headwater sub-basins were calculated directly from the measured median concentrations as shown in Appendix B and the sub-basin flow data as shown in Table 4. The sub-basin yearly average concentration was equal to the product of the measured base flow median concentration times the fraction of base flow to total flow plus the product of the measured storm flow medium concentration times the fraction of storm flow to total flow. This yearly average sub-basin concentration represents the annual flow weighted average concentration for the sub-basin. However, yearly average concentrations and unit area loads for non headwater sub-basins and sub-basins receiving point source loads were not calculated directly because of the uncertainty of upstream load contributions from upstream basins or point sources. In order to determine concentrations and loads for non headwater sub-basins, modeling was used.

Parameter yearly average concentrations were modeled using the data from 16 headwaters sub-basins sampled (Table 2), the land use information (Table 1), the median storm and base flow concentrations (Table 3), and the storm and base flow rates (Table 4). Two of the headwater sub-basins (110 Lake Wedington and 440 Upper Moores) were not used in the model because both of these sub-basins contain lakes that could effect parameter concentration and load discharges. A model was developed based on total phosphorus, total nitrogen, and total suspended solids.

A multiple linear regression analysis was performed between the headwater sub-basin yearly average concentration and the land use percentages in each sub-basin (Appendix C). This model was then used to calculate a yearly average concentration in each of the non-headwater sub-basins.

The calculated and modeled yearly average concentrations for each sub-basin was multiplied by the total flow to determine the total load and the total load was divided by the area to determine the load per unit area. The results of the concentration modeling are shown in the following

Table 5. Non-Point Source Total Phosphorus

Table 6. Non-Point Source Total Nitrogen

Table 7. Non-Point Source Tot

Tables 5, 6, and 7 have been ranked by both concentration and unit area loading from low to

Figures 4, 5 and 6 show the ranked unit area loading graphically.

Table 5. Non-Point Source Total Phosphorus

Basin #	Category	Annual Average Concentration mg/L
440	Headwaters	0.02
110	Headwaters	0.04
310	Other	0.05
360	Intensive	0.06
510	Headwaters	0.06
371	Headwaters	0.06
340	Intensive	0.08
330	Intensive	0.08
540	Intensive	0.09
530	Headwaters	0.11
620	Headwaters	0.14
550	Headwaters	0.14
610	Headwaters	0.16
221	STP	0.16
220	Headwaters	0.16
420	Headwaters	0.16
351	Other	0.17
372	Headwaters	0.18
830	Headwaters	0.18
380	STP	0.21
352	STP	0.21
710	Headwaters	0.22
820	STP	0.24
391	Intensive	0.24
320	Other	0.24
120	Other	0.25
520	Other	0.26
630	Intensive	0.26
720	Headwaters	0.27
130	Intensive	0.28
392	Headwaters	0.29
430	Other	0.33
410	STP	0.34
450	Headwaters	0.34
140	Intensive	0.39
840	Headwaters	0.44
810	Headwaters	0.65

Basin #	Category	Unit Area Annual Load kg/ha-yr	Total Annual Load kg/yr
110	Headwaters	0.05	67
440	Headwaters	0.08	268
371	Headwaters	0.16	500
360	Intensive	0.17	555
310	Other	0.17	331
510	Headwaters	0.23	388
550	Headwaters	0.32	996
830	Headwaters	0.40	2888
420	Headwaters	0.42	2962
540	Intensive	0.44	523
330	Intensive	0.49	1705
220	Headwaters	0.52	1977
530	Headwaters	0.54	1170
610	Headwaters	0.56	4690
820	STP	0.56	5667
120	Other	0.60	3111
221	STP	0.71	11323
340	Intensive	0.71	4269
620	Headwaters	0.73	4064
351	Other	0.82	4848
430	Other	0.83	2637
720	Headwaters	0.86	4569
130	Intensive	0.90	4162
520	Other	0.93	5954
391	Intensive	0.93	1380
320	Other	0.93	2833
710	Headwaters	0.98	7142
140	Intensive	1.20	16502
352	STP	1.22	12289
840	Headwaters	1.24	5833
450	Headwaters	1.25	2414
410	STP	1.31	4014
630	Intensive	1.33	5355
392	Headwaters	1.42	3306
380	STP	1.68	9413
810	Headwaters	1.75	12462
372	Headwaters	1.85	20255

Table 6. Non-Point Source Total Nitrogen ($TKN + NO_3$)

Basin #	Category	Average Annual Concentration mg/L
310	Other	0.25
440	Headwaters	0.44
830	Headwaters	0.45
110	Headwaters	0.82
810	Headwaters	1.02
420	Headwaters	1.02
840	Headwaters	1.14
540	Intensive	1.29
620	Headwaters	1.49
140	Intensive	1.49
510	Headwaters	1.87
450	Headwaters	2.10
530	Headwaters	2.48
220	Headwaters	2.66
320	Other	2.71
820	STP	2.73
520	Other	2.78
120	Other	2.79
630	Intensive	2.79
550	Headwaters	2.86
221	STP	2.88
351	Other	2.91
130	Intensive	3.17
380	STP	3.53
430	Other	3.64
352	STP	3.82
610	Headwaters	3.92
391	Intensive	4.38
710	Headwaters	4.40
410	STP	4.41
720	Headwaters	4.53
371	Headwaters	4.60
330	Intensive	4.98
372	Headwaters	5.02
392	Headwaters	5.31
340	Intensive	5.34
360	Intensive	5.55

Basin #	Category	Unit Area Annual Load kg/ha-yr	Total Annual Load kg/yr
310	Other	0.80	1528
830	Headwaters	1.00	7195
110	Headwaters	1.19	1572
440	Headwaters	1.51	5036
420	Headwaters	2.67	18632
810	Headwaters	2.76	19595
840	Headwaters	3.23	15145
140	Intensive	4.56	62710
540	Intensive	6.31	7526
820	STP	6.40	64601
550	Headwaters	6.57	20356
120	Other	6.80	35106
510	Headwaters	7.44	12425
450	Headwaters	7.63	14779
620	Headwaters	7.82	43740
220	Headwaters	8.58	32371
430	Other	9.18	29326
520	Other	9.91	63738
130	Intensive	10.11	46701
320	Other	10.37	31457
371	Headwaters	11.81	37196
530	Headwaters	12.53	26939
221	STP	12.56	201687
610	Headwaters	13.66	114370
351	Other	13.84	81369
630	Intensive	14.23	57421
720	Headwaters	14.49	76855
360	Intensive	16.56	54131
391	Intensive	16.67	24838
410	STP	17.17	52597
710	Headwaters	19.63	142562
352	STP	21.88	220367
392	Headwaters	25.83	59951
380	STP	27.91	156057
330	Intensive	30.14	105776
340	Intensive	49.19	293816
372	Headwaters	51.09	560823

Table 7. Non-Point Source Total Suspended Solids

Basin #	Category	Annual Average Concentration mg/L
440	Headwaters	2
530	Headwaters	9
330	Intensive	10
360	Intensive	10
371	Headwaters	11
110	Headwaters	11
550	Headwaters	11
340	Intensive	13
540	Intensive	13
391	Intensive	19
630	Intensive	24
392	Headwaters	26
372	Headwaters	28
710	Headwaters	29
380	STP	30
450	Headwaters	31
352	STP	33
720	Headwaters	33
420	Headwaters	35
221	STP	37
410	STP	40
320	Other	42
820	STP	43
430	Other	44
520	Other	45
351	Other	45
220	Headwaters	45
120	Other	49
310	Other	55
610	Headwaters	55
130	Intensive	55
620	Headwaters	62
510	Headwaters	63
830	Headwaters	68
810	Headwaters	80
140	Intensive	84
840	Headwaters	103

Basin #	Category	Unit Area Annual Load kg/ha-yr	Total Annual Load kg/yr
440	Headwaters	6	19371
110	Headwaters	16	20555
550	Headwaters	26	79361
371	Headwaters	27	85570
360	Intensive	31	101150
530	Headwaters	48	102401
330	Intensive	58	201923
540	Intensive	65	77017
391	Intensive	74	110009
420	Headwaters	92	638820
820	STP	101	1023209
720	Headwaters	106	564025
430	Other	112	358464
450	Headwaters	113	219045
340	Intensive	120	717097
120	Other	120	621625
630	Intensive	124	499960
392	Headwaters	128	296808
710	Headwaters	131	954907
220	Headwaters	146	550537
830	Headwaters	150	1078535
410	STP	156	478510
520	Other	159	1020749
221	STP	159	2557611
320	Other	160	485539
310	Other	177	337583
130	Intensive	177	816800
352	STP	187	1887319
610	Headwaters	193	1614027
351	Other	214	1258152
810	Headwaters	215	1530566
380	STP	241	1346078
510	Headwaters	250	417086
140	Intensive	257	3535234
372	Headwaters	282	3095061
840	Headwaters	290	1360985
620	Headwaters	324	1808804

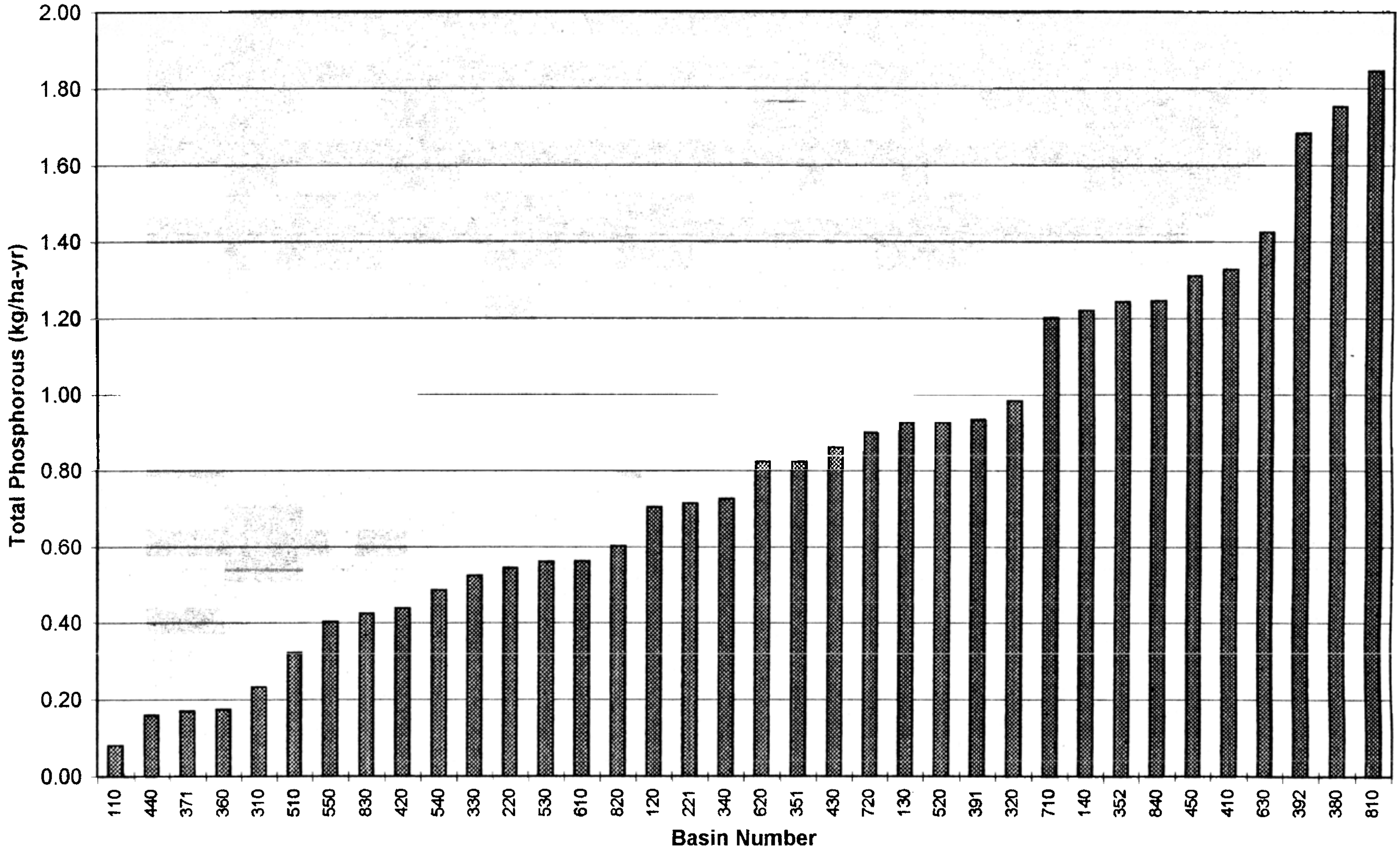
CONCLUSIONS (Sub-Basin Prioritization)

The sub-basins were prioritized on the basis of annual unit area loads in kg/ha-yr. Three different prioritization rankings were developed based on three different parameters. The parameters that were emphasized were total phosphorus, total nitrogen, and total suspended solids. Each parameter prioritization was divided into three approximately equal priority ranking groups. The following priority ranking groups were used.

	Priority Ranking Group		
Parameter	LOW (kg/ha-yr)	MEDIUM (kg/ha-yr)	HIGH (kg/ha-yr)
Total Phosphorus	0.05-0.065	0.065-0.95	0.95-1.85
Total Nitrogen	0-5	5-15	15-52
Total Suspended Solids	5-75	75-170	170-324

Figures 4, 5, and 6 show the magnitude of the unit area loading for all the sub-basins and, Figures 7, 8, and 9 show the locations of each sub-basin and its priority of either LOW, MEDIUM, or HIGH. Table 8 shows a list of all of the thirty-seven basins with their respective rankings.

Figure 4. Total Phosphorus Unit Area Load



Figi re 5. Total Nitrogen Unit Area Load

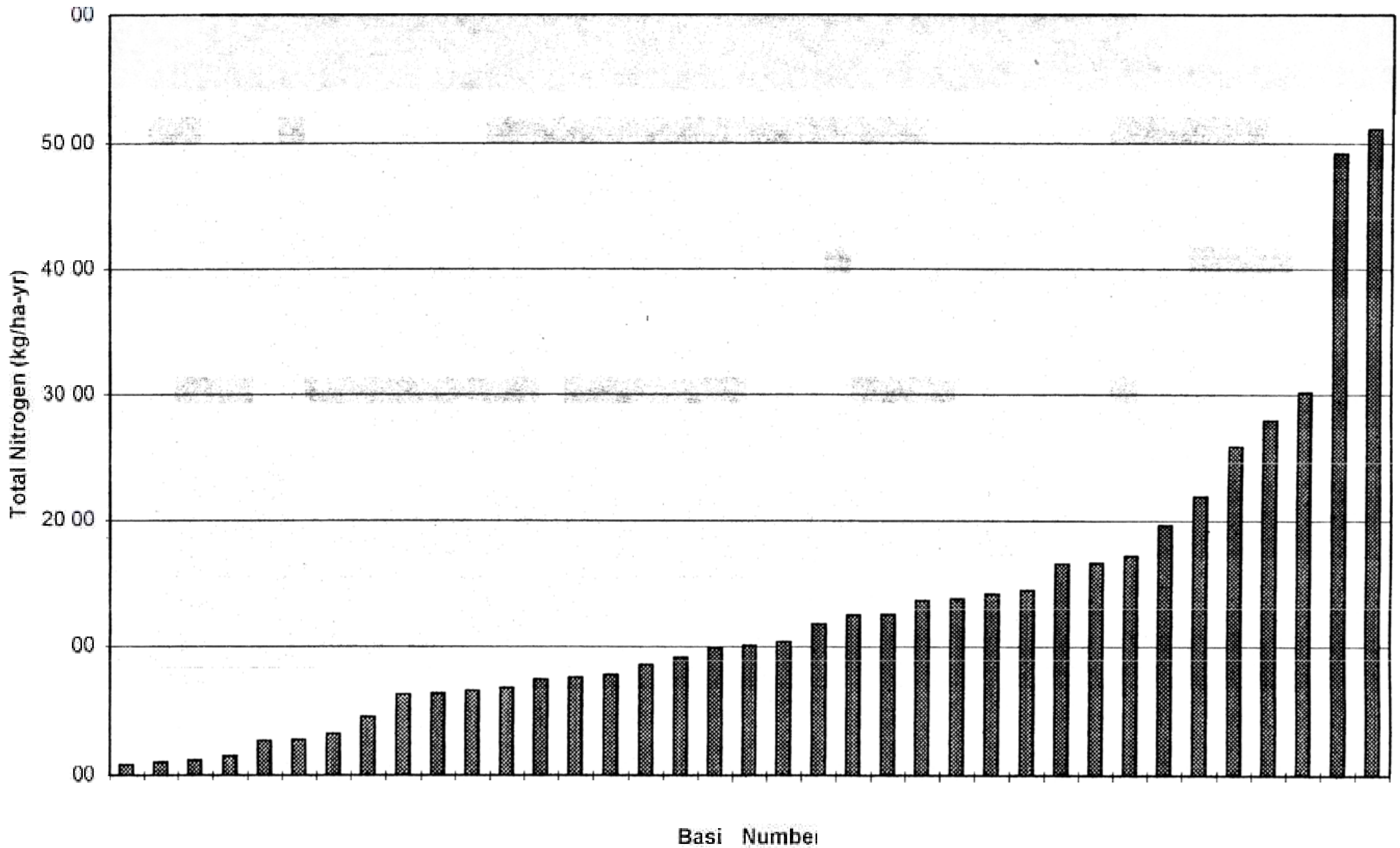


Figure 6. Total Suspended Solids Unit Area Load

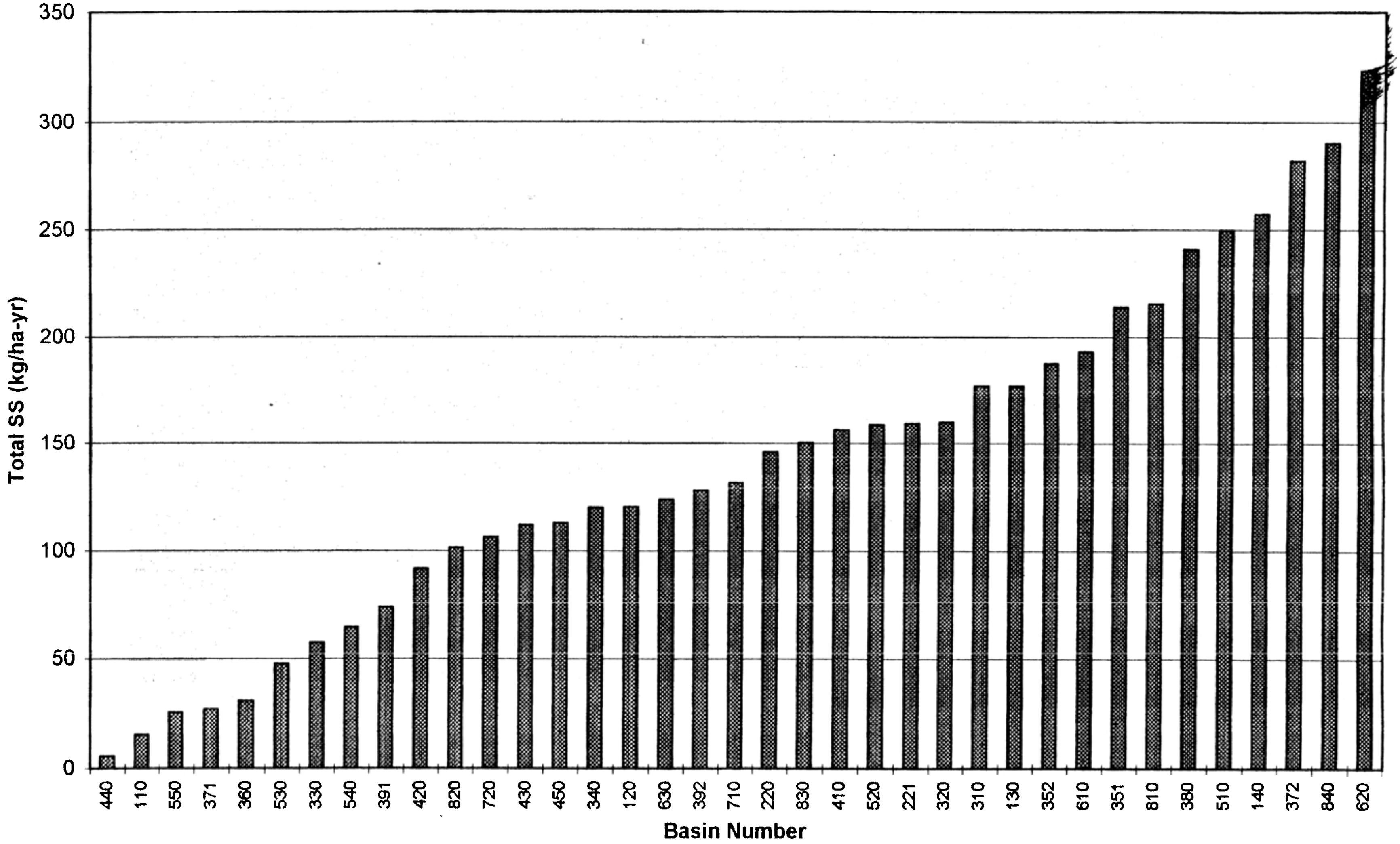


Figure 7. Total Phosphorus Priorities

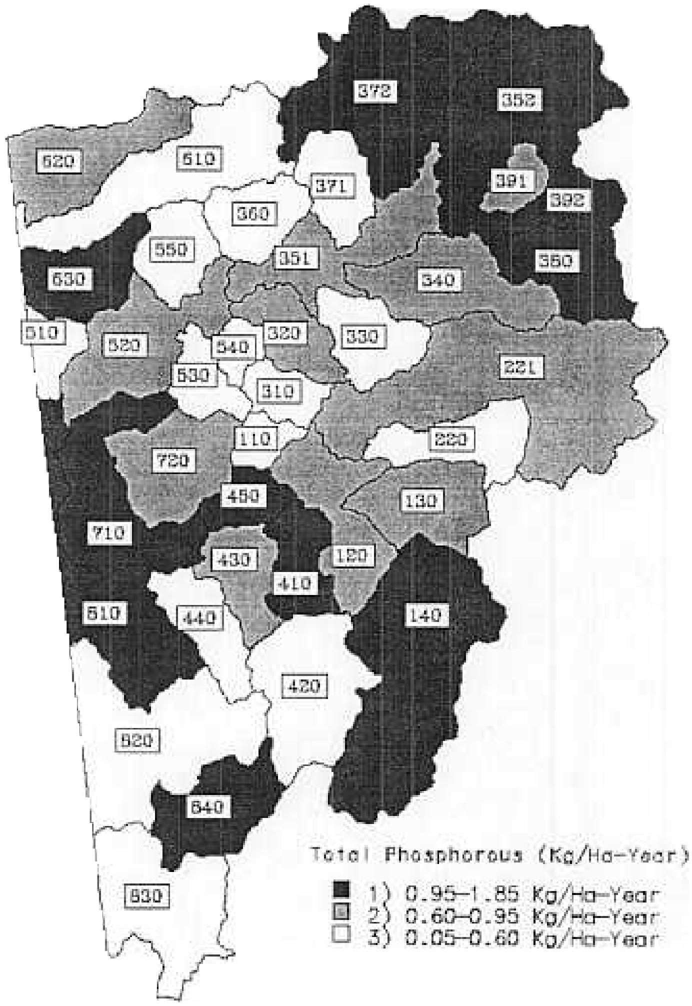


Figure 8. Total Nitrogen Priorities

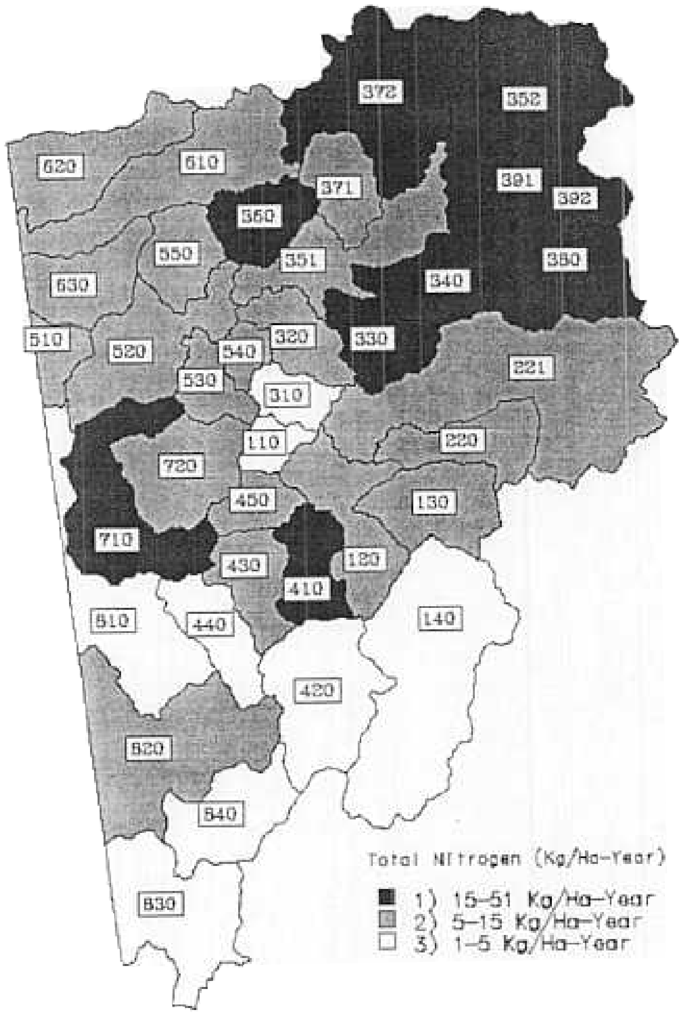


Figure 9. Total Suspended Solids Priorities

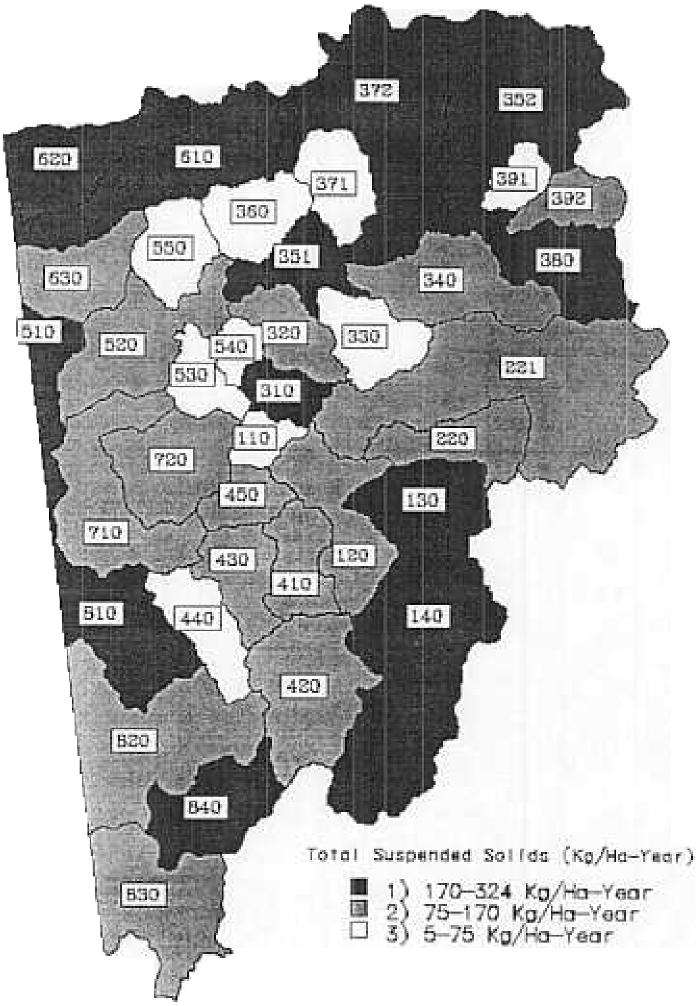


Table 8. Sub-Basin Priority

Basin #	Basin Name	Total Phosphorous Priority	Total Nitrogen Priority	Total Suspended Solids Priority
110	Lake Wedington	Low	Low	Low
120	Ruby	Low	Medium	Medium
130	Goose Creek	Medium	Medium	High
140	Upper Illinois	High	Low	High
220	Hamstring	Low	Medium	Medium
221	Clear Creek	Medium	Medium	Medium
310	Fish	Low	Low	High
320	Robinson	Medium	Medium	Medium
330	Wildcat	Low	High	Low
340	Brush	Medium	High	Medium
351	Lower Osage	Medium	Medium	High
352	Upper Osage	High	High	High
360	Galey	Low	High	Low
371	Lick Branch	Low	Medium	Low
372	Little Osage	High	High	High
380	Spring	High	High	High
391	Cross	Medium	High	Low
392	Puppy	High	High	Medium
410	Muddy Fork	High	High	Medium
420	Blair Creek	Low	Low	Medium
430	Lower Moores	Medium	Medium	Medium
440	Upper Moores	Low	Low	Low
450	Kinion	High	Medium	Medium
510	Francis	Low	Medium	High
520	Gum Springs	Medium	Medium	Medium
530	Chambers	Low	Medium	Low
540	Pedro	Low	Medium	Low
550	Gallatin	Low	Medium	Low
610	Flint	Low	Medium	High
620	Little Flint	Medium	Medium	High
630	Sager	High	Medium	Medium
710	Cincinnati	High	High	Medium
720	Wedington	Medium	Medium	Medium
810	Upper Ballard	High	Low	High
820	Baron Fork	Low	Medium	Medium
830	Evansville	Low	Low	Medium
840	Fly Creek	High	Low	High

APPENDIX A

GIS CHARACTERIZATION OF THE ILLINOIS RIVER WATERSHED

GIS CHARACTERIZATION OF THE ILLINOIS RIVER WATERSHED

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MATERIALS AND METHODS

Digital characterization of the Illinois River Watershed involved the creation of several primary data layers consisting of natural resource information. Natural resources of the watershed such as soils and geology were not originally available in digital format. These data layers were converted to a digital format by means of scanning or digitizing.

Software

The GIS software Geographical Resources Analysis Support System known as GRASS was utilized in this research. GRASS is a public-domain image-processing GIS, written in the C programming language and runs under the UNIX operating system. GRASS was originally designed and developed by researchers at CERL's Environmental Division to assist land managers at military installations. GRASS is ideal for environmental modeling because it provides means for calculating area statistics for each map category on a thematic map layer, combination of categories selected from several maps to make a new map, and tabulation of coincident occurrences of all categories from another map layer (Burrough, 1986).

Other computer software used in this study included

CADImage/Scan (CIS), Line Trace Plus (LTPlus) Pathfinder, and Touchdown. CIS and LTPlus were used for scanning and editing base maps for GIS input. PCI, an image processing package, was used to classify satellite imagery for updating landuse and landcover information in the watershed Pathfinder and Touchdown are software distributed by TRIMBLE for downloading and correcting data collected with global positioning units (GPS)

Hardware

The hardware utilized in this study consisted of SUN SPARCstations (models 1, 5, and 10) which operated on a UNIX platform, an Altek AC-30 digitizer, Tangent 486 PC, Context FSS8000 size E scanner, and a Trimble GPS Basic Receiver.

Digital Database Development

Data required for watershed studies are typically obtained through field work, from maps, and from various technical publications. Compilation of the various types of data and determining the necessary input parameters to run a model is usually time-consuming and expensive. Therefore, a large percentage of this research was dedicated to creating a digital geographic database for the Illinois River Watershed

The Illinois River Watershed boundary and associated sub-basins were manually interpreted from 1:24,000 Geological Survey (USGS) 7.5 minute quadrangles by personnel in the Civil Engineering Department at the University of

Arkansas. The watershed and sub-basin boundaries were then manually digitized into the database. The delineation boundary and location of the 7.5 minute quads in the watershed are shown in Figure 1. Coverage of the study area encompassed all or portions of 23, 1:24,000 scale, 7.5 minute USGS quadrangles (Table 1).

Table 1. USGS 7.5' quadrangles and year of original compilation in the Illinois River Basin.

Quadrangle Name	Year	Quadrangle Name	Year
Bentonville South	1970	Robinson	1970
Centerton	1971	Rogers	1958
Cherokee City	1971	Siloam Springs	1972
Elkins	1958	Sonora	1958
Evansville	1970	Springdale	1970
Fayetteville	1958	Stilwell East	1972
Gallatin	1970	Strickler	1970
Gentry	1971	Watts	1972
Lincoln	1970	Westville	1972
Natural Dam	1970	Wheeler	1970
Prairie Grove	1970	Winslow	1973
Rhea	1970		

A map or data layer is a set of data describing the spatial variation of one characteristic in a geographic area or region (Tomlin, 1990). The primary data layers or attributes for this study were obtained from various sources in digital or map format and at varying scales and resolutions (Table 2). Figure 1 shows the Illinois River Watershed boundary and locations of pertinent 7.5 min quadrangles.

Table 2. Primary attributes, scale or resolution, and sources.

Attribute	Scale/Resolution	Format	Source
Elevation	30m and 80m	digital	USGS[a]
Roads	1:100,000	digital	USGS
Hydrography	1:100,000	digital	USGS
1972 LULC	1:250,000	digital	USGS
1985 LULC	1:24,000	mylar	OSU[b]
1992 LULC	30m	digital	CAST[c]
Soils	1:24,000	mylar	NRCS[d]
Geology	1:24,000	paper	AGC[e]

[a] United States Geological Survey
[b] Oklahoma State University
[c] Center for Advanced Spatial Technology
[d] Natural Resources Conservation Service
[e] Arkansas Geological Commission

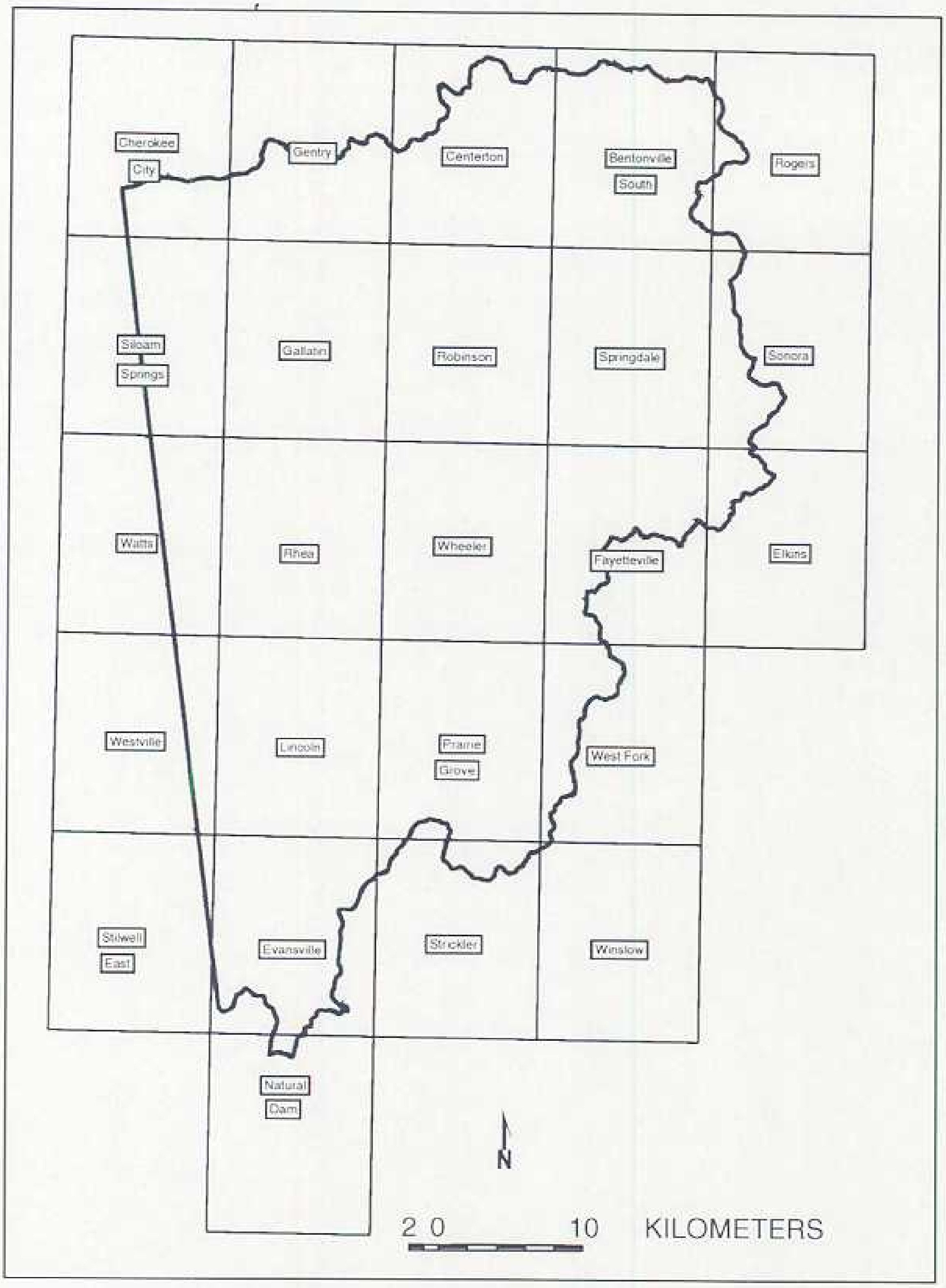


Figure 1. Illinois River Watershed Boundary Location of 7.5 Minute Quadrangles.

Reclassification or mathematical manipulation of the primary attributes leads to the generation of secondary attributes. Secondary attributes are frequently more important because they redefine the primary attribute into more useful forms (McKimmey, 1994).

Data stored on conventional media such as a map have to be transformed to a digital form by either digitizing or by scanning. The following sections describe how each primary data layer was developed for the digital database of the Illinois River Watershed.

Hydrography and Transportation

Stream and road networks of the watershed were obtained in digital format by the Center for Advanced Spatial Technologies (CAST) at the University of Arkansas. CAST maintains a digital archive of data distributed by the USGS and the Census Bureau in the form of DLGs and TIGER files for Arkansas. The USGS provides DLGs for hydrography and transportation for the continental United States at varying scales. The files used for this study incorporated the DLG-3 format for each data layer at a scale of 1:100,000. The DLG-3 data have a full range of attribute codes and are fully topologically structured.

The hydrography data described all flowing water, standing water, and wetlands. The transportation files contained information based on three major categories: 1) roads and trails, 2) railroads, and 3) pipelines, transmission lines, and miscellaneous transportation (USGS, 1989)

Geology

The surface geology of the Illinois River Watershed was first thematic data layer to be completed. The source maps were provided by the Arkansas Geological Commission (AGC at a scale of 1:24,000. Source maps were interpreted from aerial photographs or field surveys and drawn on 7.5 minute topographic quadrangles. After this stage was complete, the geology maps were transferred to a more stable medium of vellum. These maps were manually digitized to record the surface geology and major faults of the watershed. Digitizing the geology maps was selected over scanning, to reduce editing time. If the maps were scanned, the removal of contour data from the topographic quadrangles would have been extremely time-consuming.

The first step in the digitizing procedure of geology was the creation of a registration file (GRASS command v.reg) for each quadrangle found in the watershed. These files contained information on the datum, projection, and associated coordinates of quadrangle corners. The coordinates quadrangle corners are referred to as control points Once a map was secured to the digitizing table, it was registered to the control points contained in its corresponding registration file. Residual mean averages below

2.0 were required in the registration process to meet national cartographic standards. Once properly registered, the maps were digitized by tracing the formation contacts and fault lines with the Altek-AC30 digitizing puck.

After all geology maps had been digitized and labeled, it was necessary to build topology of the newly created files. This was accomplished by running the GRASS command v.support.

In order to produce a seamless coverage of the study area, each 7.5 minute quadrangle was edge-matched to adjoining quadrangles. Edge-matching involved the alignment of formation contacts, faults, and attribute codes across adjoining maps. At this stage, anomalies of surface geology were found between certain quads. Mismatches were usually found between adjacent quadrangles that were mapped by different geologists at different times. The most common problem encountered during edge-matching was a result of different classification schemes. Classification differences between maps were usually a result of geologic units having been combined on one map but not on an adjacent map. An example of this is the Mpfb geological formation. The Mpfb formation is Mississippian in age and consists of a combination of Pitkin limestone, Fayetteville Shale and Batesville sandstone. In some areas of the watershed, this formation was broken down and mapped as the separate units. Where this occurred, the units were simply combined to construct the Mpfb formation. To avoid further interpretation or field work, the lower level of detail concerning the Mpfb formation was kept consistent in the development of the geologic primary data layer of the Illinois River Watershed. In some cases, it was not evident how to correct mismatches across quadrangle boundaries. Corrections of this nature were made possible after personal consultation with Dr. Boyd Haley of the AGC in Little Rock

Once edge matching of formation contacts was completed, a copy of each digital geology map was made and edited to produce a new map consisting of fault information only. The editing process of the second geology map included the removal of formation contacts, leaving fault information only. The original digital geology maps were then edited to remove fault information, except in places where a fault or a portion of a fault formed a contact between geologic units. After all fault files were created and labeled, procedures similar to the edge-matching discussed previously were completed to generate a continuous surface of mapped faults in the watershed.

Land Use and Land Cover

Landuse encompasses several different aspects of people's relationship to the environment (e.g., activity, ownership, land quality). Land cover is represented by the natural and artificial compositions covering the earth's surface at a certain location. For example, the land cover for a given area might be classified as deciduous forest while land use of that same area is classified as a wildlife refuge (Avery and Berlin, 1992).

1985 LULC

A cooperative agreement with Oklahoma State University provided the land use data for 1985. The land use maps were originally developed by the Lockheed Corporation from 1:24,000 scale aerial photographs. Interpretation of landuse/landcover data were copied from the aerial photographs to an acetate medium. Scanning the source materials was chosen over manual digitizing to save time. However, these thin acetate maps proved difficult to scan unless they were attached to stronger material (e.g. paper). Most maps were scanned at 400 dpi (dots per inch) in a rlc format. This format was chosen due to the ease of importing rlc files to LTPlus, the editing software. Source maps of LULC had numbers identifying different categories that had to be removed in the editing process. Each quadrangle was checked in LTPlus in a cross-track motion from top to bottom to check for unwanted tags, spurs, holes, gaps in the scanned linework. Editing was complete when every quadrangle of the watershed had been assembled and ready for import to GRASS for edge-matching and labeling.

Edge-matching adjoining quadrangles was accomplished in the v.digit module of GRASS. A quadrangle was displayed in the active window of v.digit and the adjoining quads were then overlaid to evaluate line matching across quadrangle borders. If two lines did not match across the quad boundaries, then each line was moved half the distance of separation to meet in the middle. There were some instances where a polygon had no lines to join with across adjoining maps. In this case, unclosed polygon, according to its size, had to be removed or closed at the quad boundary. Smaller polygons were simply removed and larger polygons were closed with the quad boundary interpreted as their area edge.

The labeling process was also completed in the v.digit module. The classification scheme for categorizing the 1985 LULC was similar to the level II categories of the 1972 data. The main difference occurred in the categories of animal confinements. Personnel at OSU expanded this category quantifying how many chicken houses or swine operations located at a particular site. For example, the USGS category of 23 indicates confined animal operations. Personnel at OSU expanded this category by specifying the type of confined animal operation and the number of confined animal houses present at a particular site (see Table 3). For example, the OSU category of 254 describes an area of broiler production with 4 houses, and category 278 indicates a hog breeding farm with 8 houses.

The 1985 landuse/landcover greatly enhanced the digital.

Table 3. 1985 Landuse and Landcover categories developed by personnel at Oklahoma State University.

Category #	Description
10	Residential - Single family
11	Residential - Multi family
12	Residential - Mobile Home Parks
13	Commercial and Services
14	Industrial
15	Transportation, Communication, Utilities
16	Commercial and Industrial Complexes
17	Mixed Urban
18	Other Urban
19	Land Construction Activities
20	Field Crops
21	Row Crops
22	Pasture
23	Orchards, Groves, and Vineyards
24	Nurseries
25	Poultry Operation
29	Dairy
30	Other Agricultural Land
31	Herbaceous
32	Shrub and Brush
33	Mixed Herbaceous, Shrub, and Brush
40	Evergreen
41	Deciduous
42	Mixed Evergreen/Deciduous
50	Streams and Canals
51	Impoundment
52	Lakes
53	Reservoirs
100	Waste Treatment Plant
251	Poultry (Broilers) - 1 house
252	Poultry (Broilers) - 2 houses
253	Poultry (Broilers) - 3 houses
254	Poultry (Broilers) - 4 houses
255	Poultry (Broilers) - 5 houses
256	Poultry (Broilers) - 6 houses
257	Poultry (Broilers) - 7 houses
258	Poultry (Broilers) - 8 houses
259	Poultry (Broilers) - 9 houses
261	Poultry (Egg layers) - 1 houses
262	Poultry (Egg layers) - 2 houses
263	Poultry (Egg layers) - 3 houses
264	Poultry (Egg layers) - 4 houses

265	Poultry (Egg layers) - 5 houses
271	Hog Breeding - 1 house
272	Hog Breeding - 2 house
278	Hog Breeding - 8 houses
283	Hog Rearing - 3 houses
284	Hog Rearing - 4 houses
285	Hog Rearing - 5 houses
286	Hog Rearing - 6 houses
287	Hog Rearing - 7 houses
2510	Poultry (Broilers) - 10 houses
2511	Poultry (Broilers) - 11 houses
2716	Hog Breeding - 16 houses
2810	Hog Rearing - 10 houses
2811	Hog Rearing - 11 houses
2812	Hog Rearing - 12 houses
2816	Hog Rearing - 16 houses
2828	Hog Rearing - 28 houses

database for the Illinois River watershed. Quantification of the confined animal operations located in the watershed and the higher resolution was a great improvement over the 1972 USGS landuse/lancover data

1992 LULC

Satellite imagery for the watershed was provided through a cooperative agreement with the University of Arkansas Center for Advanced Spatial Technology (CAST). The satellite imagery was obtained on October 10, in the fall of 1992 from the Landsat 5 Thematic Mapper (TM) sensor. The TM sensor simultaneously collects radiance data in seven narrow spectral bands ranging between 0.45 and 12.5 Fm. Band designations and spectral ranges are presented in Table 4. Bands may be viewed one at a time to determine land characteristics, or a combination or ratio of bands to enhance resource mapping.

Table 4. Characteristics of the Landsat 5 Thematic Mapper. (Source: Fundamentals of Remote Sensing and Airphoto Interpretation, 1992)

Band Number	Wavelength Range (Fm)	Spectral Location	Resolution (m)
1	0.45-0.52	Blue-green	30
2	0.52-0.60	Green	30
3	0.63-0.69	Red	30
4	0.76-0.90	Near IR	30
5	1.55-1.75	Mid IR	30
6	10.40-12.50	Thermal IR	120
7	2.08-2.35	Mid IR	30

The PCI imagery processing software was used to classify the satellite imagery. Image classification is an information extraction process that involves the application of pattern recognition theory to multispectral images. Image classification involved the analyses of the spectral properties of various surface features of the image sorting the spectral data into similar categories. Categories of LULC were grouped using an unsupervised classification scheme based on spectral reflectance. Unsupervised classification refers to the extraction of dominant spectral response patterns that occur within an image and their subsequent identification with ground truthing or ancillary data.

Cluster analyses are the most widely used procedures unsupervised classification. Clustering is a statistical technique to automatically group unknown pixels into spectral classes. The ISODATA procedure of the PCI software was used in the unsupervised classification of the Illinois River Watershed imagery. This procedure entailed specifying the spectral bands to be classified and the maximum and minimum number of clusters to be generated from the ISOCLUS clustering algorithm. Landsat Thematic Mapper bands 1, 2, 3, 4, 5, and 7 were specified along with bands depicting wetness, brightness, and greenness which were generated from a tassel-cap algorithm. The maximum number of clusters specified was 60 with a minimum of 20. The result of the ISOCLUS clustering algorithm was a theme map with 59 clusters encoded with a unique grey level. Each cluster was then grouped into the following landuse categories: water, urban, agricultural, forests, and barren. The landuse categories were then given a unique color with a pseudo-color table.

One area of improvement in previous landuse/landcover classification methods of the watershed was established with the distinction between fescue and bermuda pasture lands. This was accomplished by utilizing supervised classification techniques. In the supervised approach, example fields of each cover type are located from which the computer software computes spectral signatures. First, it was necessary to obtain training areas of the two forage types on the ground. Training areas were used to "train" the computer to recognize each pasture type by using the spectral response of the example pixels within designated field boundaries to compute spectral signatures (PCI Users Manual).

Training areas of fescue and bermuda grass were collected with a Trimble GPS Basic Plus receiver using static and kinematic positioning. Static positioning was accomplished by collecting data in a single position for a significant period of time to accurately determine the location of that point. Kinematic positioning is the process of collecting data while in motion (Hurn, 1989). Static positioning methods were used when conditions were not suitable to drive the perimeters of fields. This procedure was used with an external antenna on top of the vehicle. The coordinates for different fields were downloaded to a PC (model type) using the Trimble software Pathfinder. This software was also used to run differential corrections on the data collected to defeat selective availability errors introduced into GPS by the US Department of Defense. Differential corrections works by using base station files collecting GPS signals from a known NGS (National Geodetic Survey) control point to calculate error in GPS signals to the receiver.

Soils

The source maps of the soil data layer were provided by the Natural Resources Conservation Service (NRCS) in Little

Rock in two formats based on Order II soil surveys of Washington and Benton counties. The first format was a 1:24,000 scale hand-drafted Mylar. The second format was compiled from orthophotographic bases at a scale of 1:20,000.

Order II surveys incorporate field procedures which include plotting of soil boundaries by observation and by interpretation of remotely sensed data (U.S.D.A., 1993). Components of the delineated map units are phases of soil series or phases of miscellaneous areas. Delineations are variable in size depending on landscape complexity and survey objectives. The minimum size delineation for a soil map scale of 1:24,000 is 5.7 acres while a soil map with a scale of 1:20,000 is 4.0 acres.

Several computer software programs were utilized to complete the soil primary data layer for the Illinois River Watershed. First, the scanning software CAD Image/Scan was used to bring the soil map into a digital raster format. Scanning was chosen for the soil maps due to the complexity of the soil line work. Also, scanning is quicker and considered to be more accurate than hand digitizing soil lines.

Editing the raster soil map was completed using software developed by the National Forest Service and NRCS, LTPlus (Line Trace Plus). Editing was necessary on the hand-drawn soil maps to close gaps, remove any tags of overlapping soil lines, and to reduce the soil lines to a one pixel width.

The resulting image was then converted into a suitable format to be imported into GRASS for labeling. After the labeling process was completed, the soil quads were patched together for a seamless coverage of the Illinois River Watershed.

GRASS has a MAPGEN interface which produces vector-plotted maps. The MAPGEN interface module was used to generate check plots of every soil map produced for the watershed. Check plots served as a quality control mechanism to ensure accuracy of line work and labeling. If errors were found, the maps were corrected and updated. Secondary soil data layers such as hydrologic group, pH, erodability factors, percent organic carbon, or percent clay were generated for modeling P and sediment transport in the watershed.

Elevation

Digital Elevation Models (DEMs) are used to derive a wealth of information about the morphology of a land surface (USGS, 1990). A DEM consists of a sampled array of elevations for ground positions that are usually at regularly spaced intervals. The Soil Physics Lab obtained elevation data at a resolution of 80m for all the quadrangles located in the Illinois River Watershed. Secondary attributes of slope and aspect were produced from this 80m data layer using the GRASS command r.slope.aspect. The algorithm used to determine slope and aspect used a 3x3 neighborhood around each cell in the elevation file. The resulting slope map layer contained slope values stated in degrees of inclination from the horizontal The raster aspect map indicated which directions the slopes of the watershed were facing. The aspect categories represented the number of degrees from east (CERL, 1993). Generated slopes and aspect are averages of each cell thus, the larger areal coverage of each cell, the more inaccurate the generated data. As the resolution of the DEM is increased, the quantitative description of the topography is increased.

There was only partial coverage of the watershed at 30m resolution. The 7.5 minute quadrangles that are lacking 30m elevation data include: Springdale, Sonora, Fayetteville, Elkins, Lincoln, Prairie Grove, and West Fork. The lack of 30m elevation data prevented modeling P transport in the entire watershed.

RESULTS AND DISCUSSION

Digital Characterization of the Watershed

Characterization of the Illinois River Watershed was accomplished by generating areal statistics on the various primary data layers using the r.report module of GRASS. This module allows the user to establish a series of report parameters to be applied to a raster map layer, and creates a statistical report. Possible units of measurement are square miles, square meters, square kilometers, acres, hectares, cells, or percent cover.

The Illinois River Watershed is subdivided into nine major basins including the: Upper Illinois, Clear Creek, Osage Creek, Muddy Fork, Middle Illinois, Flint Creek, Cincinnati Creek, Ballard Creek, and Baron Fork (Figure 2). The areal extent of the basins in the Illinois River Watershed is given in Table 5. Osage Creek is the largest basin which encompasses nearly 30% of the total watershed. Ballard Creek is the smallest basin and comprises only 3.65% of the watershed. The Muddy Fork basin, which has been the focus of several water quality research projects, is located in the south-central portion of the watershed.

The major basins of the Illinois River Watershed can be further divided into 37 sub-basins

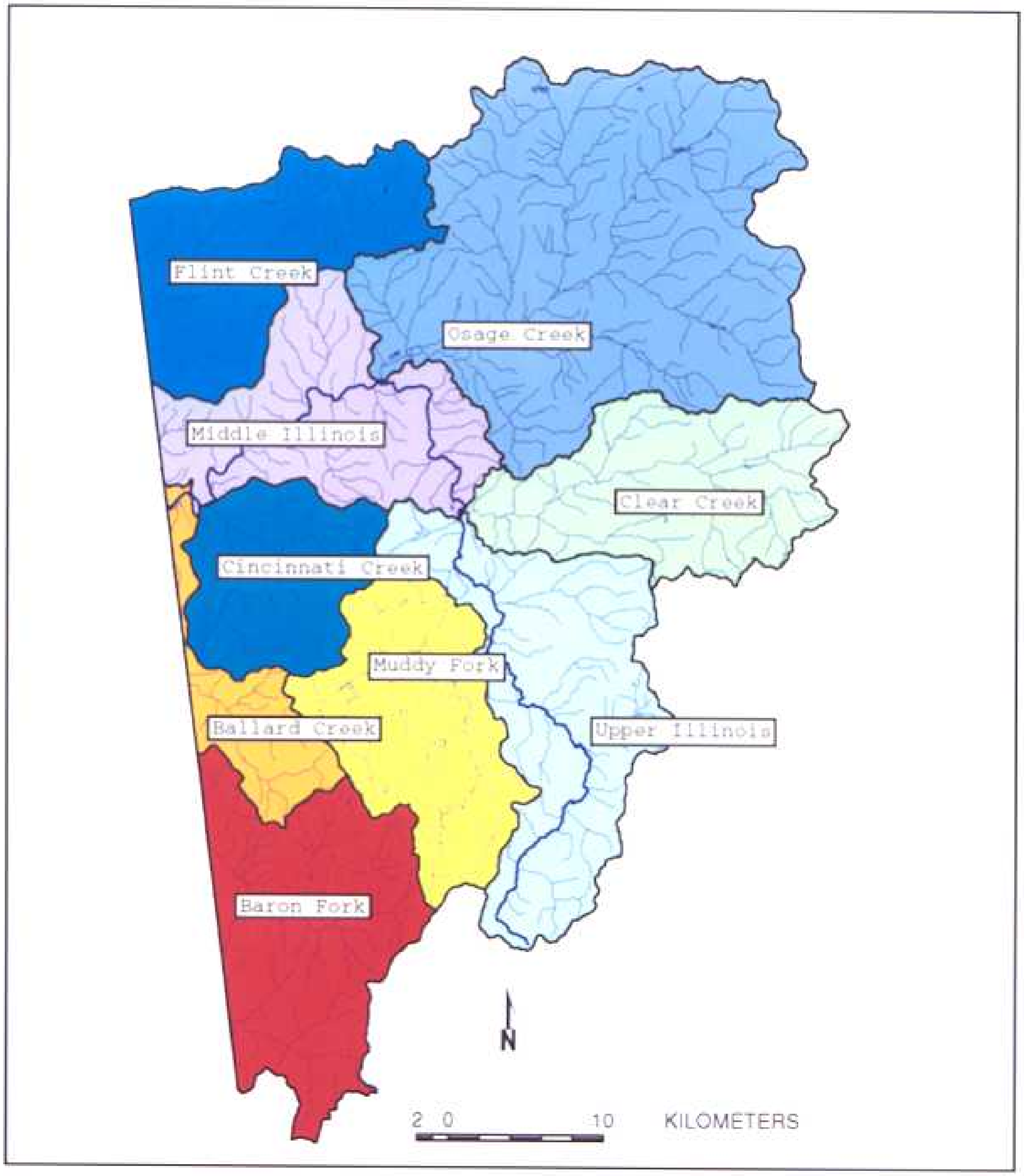


Figure 2. Major Basins of the Illinois River Watershed. Data Were Interpreted by Personell in the Civil Engineering Department at the University of Arkansas.

Table 5. Areal extent of the Illinois River Watershed in Arkansas by basin.

Basin	Acres	% Cover
Upper Illinois Basin	61,536	12.75
Clear Creek	49,341	10.22
Osage Creek	141,897	29.40
Muddy Fork	45,762	9.48
Middle Illinois River	35,986	7.46
Flint Creek	44,710	9.26
Cincinnati Creek	31,029	6.43
Baron Fork	54,435	11.28
Ballard Creek	17,621	3.65

The areal extent and proportion of the Illinois River Watershed in Arkansas for each county is given in Table 6. Washington county comprises the majority of the watershed, whereas Crawford county encompasses less than 1% of the surface area. The spatial distribution of the watershed within these counties is delineated in Figure 3.

Table 6. Areal coverage of the Illinois River Watershed by county in Arkansas.

County	Acres	Percent Coverage
Benton	187,452	39.0%
Crawford	998	0.5%
Washington	292,071	60.5%

The statistics on county area were generated in GRASS with the r.report module. By masking all the counties in Arkansas except those in the Illinois River Watershed, a new

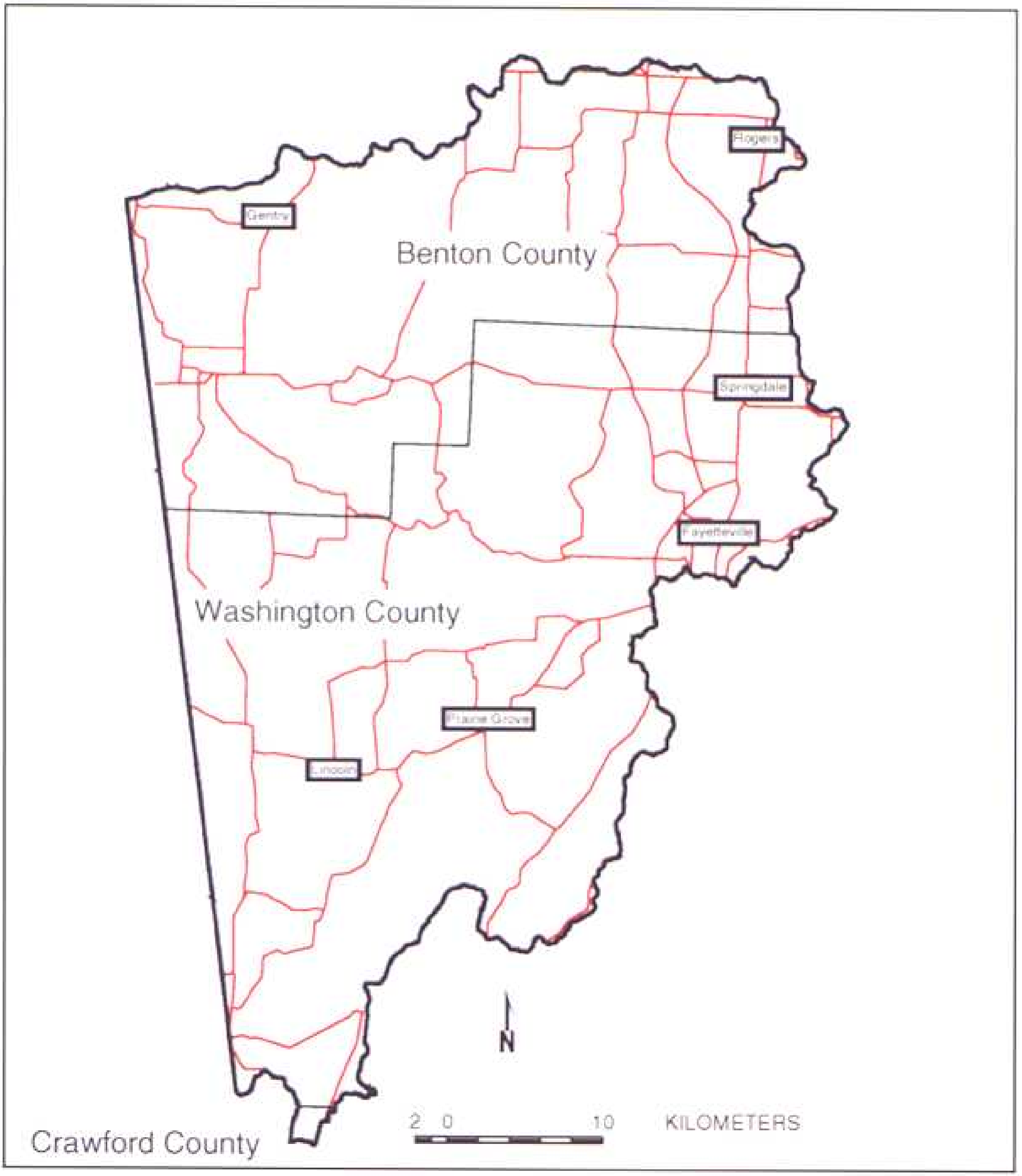


Figure 3. Spatial Distribution of Counties and Major Roads in the Illinois River Watershed.

file was created to add to the database.

Land use/land cover

Landuse data, compiled from the 1985 high altitude photographs, suggest that most of the Illinois River Watershed is dominated by pasture and agricultural lands. The agricultural lands consisted of field or row crops, orchards or vineyards, nurseries, and confined animal operations. The majority of the forested lands in the watershed consisted of deciduous trees. Urban areas included residential, transportation, and commercial activities. The spatial distribution of the 1985 landuse landcover data is given in Figure 4.

Surficial Geology

Although the geology primary data layer was not incorporated in any modeling procedures, it is important to recognize the role of geology in affecting water quality. Future hydrogeological studies in the area which focus on the ground water of the region will benefit from this digital database. The areal distribution of surface geology in the Illinois River Watershed is given in Table 7. The spatial distribution of surface geology is delineated in Figure 5.

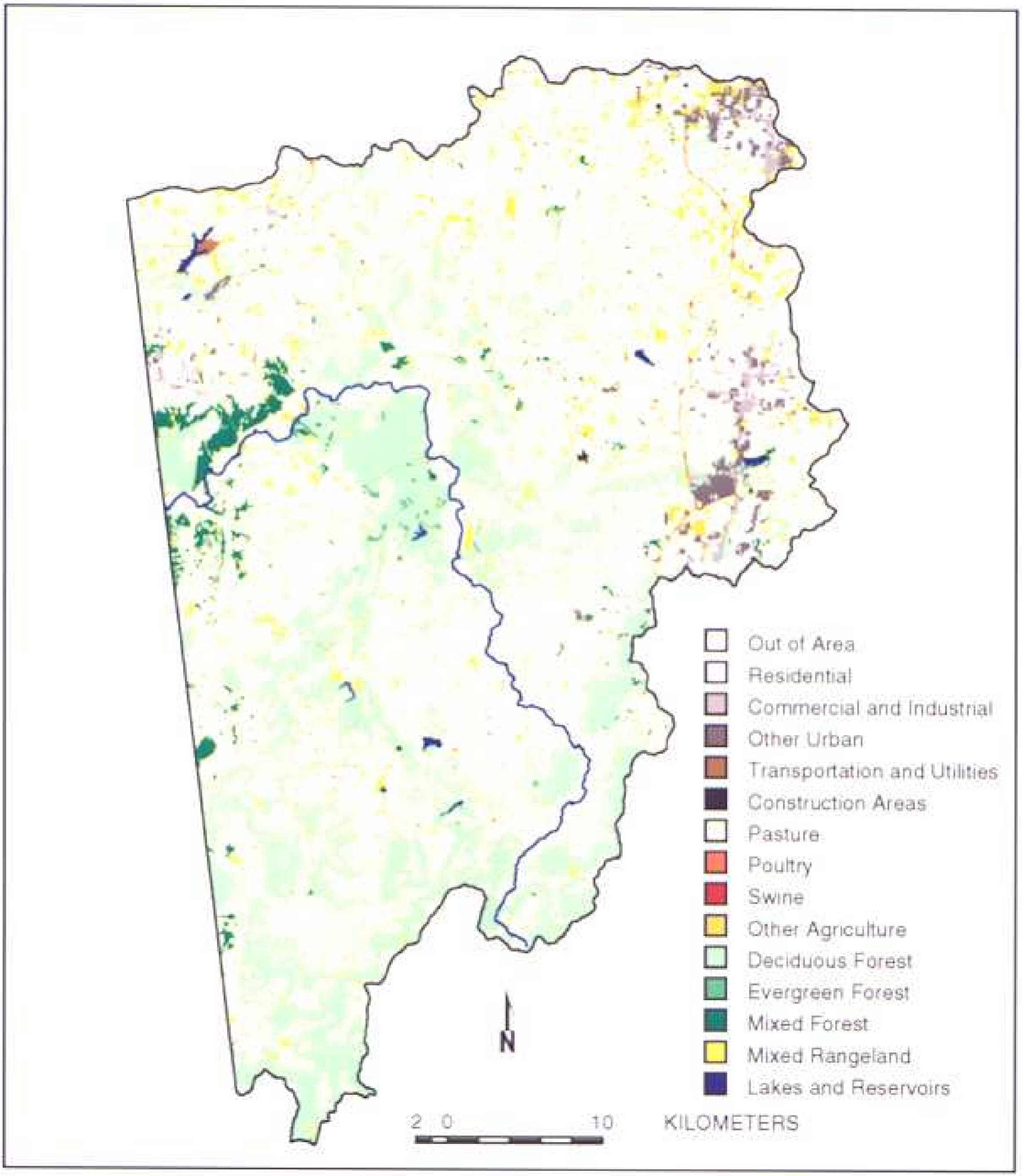


Figure 4. LULC Data of the Illinois River Watershed. Source Material Were Compiled From 1985 High Altitude Aerial Photographs.

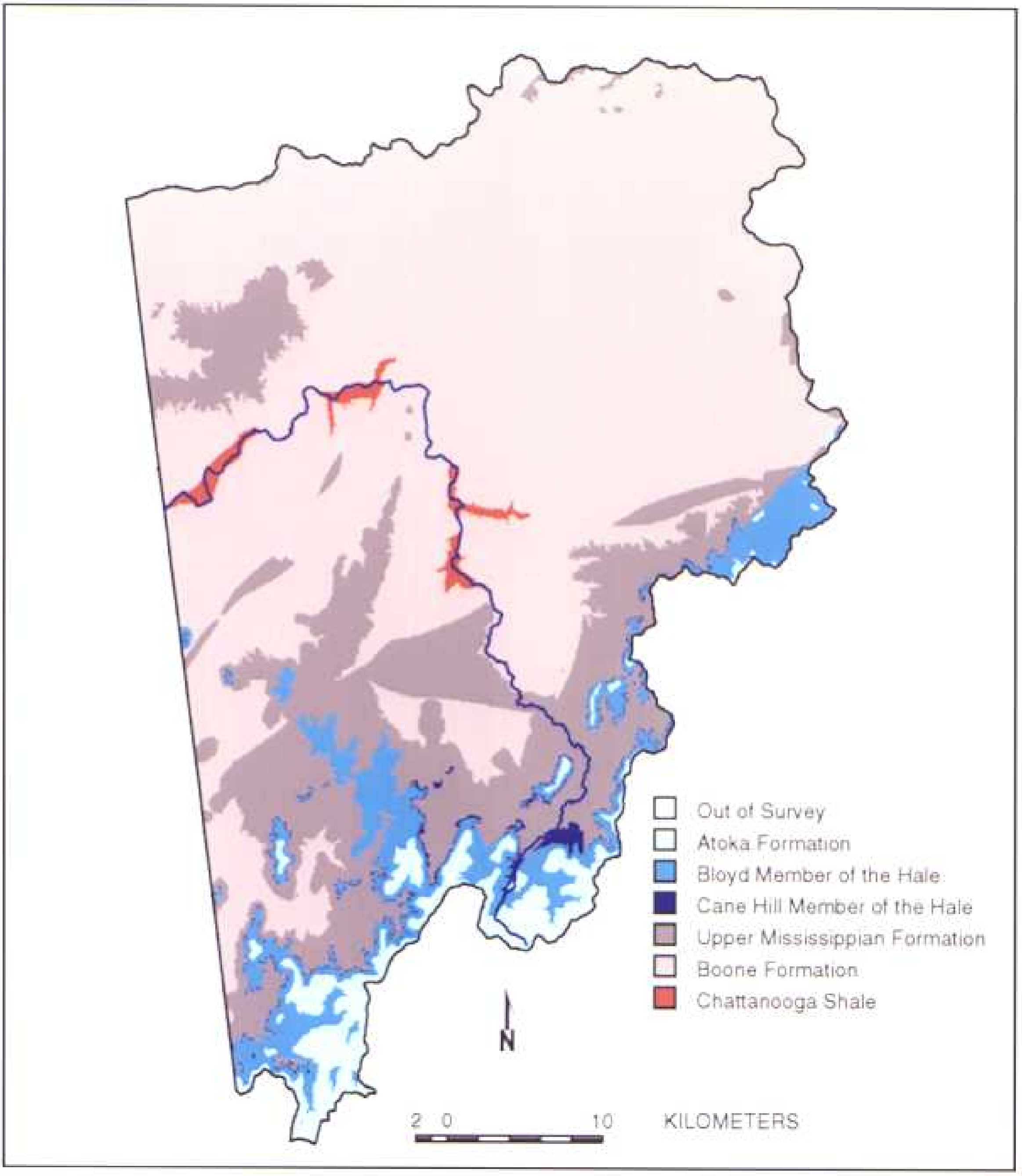


Figure 5. Spatial Distribution of the Surficial Geology Found in the Watershed. Source Material Were Provided by the AGC at a Scale of 1:24,000.

Table 7. Areal distribution of surface geology within the Illinois River Watershed.

Surface Geology	Acres	% Cover
Atoka Formation	19,810	4
Bloyd Formation	33,894	7
Cane Hill Member	3,652	1
Pitkin limestone, Fayetteville shale, Batesville sandstone	106,779	23
Boone Formation	312,741	64
Chattanooga Shale	5,049	1

The following descriptions of stratigraphy were excerpted from the guidebook of a University of Arkansas Geology field trip. A large portion of the watershed is composed of the Boone formation which is composed of limestone and chert with occasional shale beds. The total thickness of the formation ranges from 300 to 450 feet. The Boone Formation rests with probable disconformity on the Chattanooga shale and is overlain disconformally by the Batesville or Fayetteville Figure 8. Spatial distribution of the surficial geology found in the watershed. In Northwest Arkansas, the Batesville formation is divided into two members, the Hindsville limestone member at the base, and the upper Batesville. The Hindsville limestone consists of beds of fossiliferous limestone, oolitic limestone and occasional beds of sandstone and conglomerate. The upper part of the Batesville formation is composed of fine grained, calcareous, sandstones, calcareous and fine-grained dense limestones.

The Fayetteville formation, where found in its entirety, consists of three members, (1) the Lower Fayetteville shale, (2) the Wedington sandstone, and (3) the Upper Fayetteville shale. The lower Fayetteville shale is a black, carbonaceous, platy shale. Limestone and clay ironstone concretions are common. The Wedington sandstone is a fine-grained, partly calcareous sandstone. The Upper Fayetteville shale is similar to the lower shale and where the Wedington sandstone is absent is becomes impossible to separate the two. In general, however, the upper shale is somewhat lighter in color than the lower shale.

The Pitkin limestone is the youngest Mississippian formation exposed in northern Arkansas. The formation in northwestern Arkansas consists predominantly of gray to bluish-gray, compact to dense, fossiliferous limestone.

The Hale formation is composed of two members: 1. The Prairie Grove member, a fine to medium-grained , calcareous sandstone, and 2. The Cane Hill member, varying from a basal, clay-pebble conglomerate to a siltstone, silty sandstone and fine-grained sandstone (Muse, 1982). Only the Cane Hill member of the Hale formation was mapped in the Illinois River Watershed.

The Bloyd formation consists of shale and siltstone with two fairly persistent limestone members, the lower member is the Brentwood limestone, and the upper member is the Kessler limestone. The majority of the Brentwood limestone is composed of beds of limestone that are usually gray to dark gray, fine to coarsely crystalline, and fossiliferous. The shale which makes up the greatest part of the Bloyd formation is bluish-gray to black with some interbedded silty shale and siltstone. The Kessler limestone member consists of beds of gray to dark gray, crystalline, cross-bedded limestones, interbedded with varying thicknesses of shale.

The Atoka formation was named for the town of Atoka, Oklahoma, near which it is well exposed. The Atoka consists predominantly of shale with lesser amounts of inter-bedded sandstone. The Atoka Formation rests unconformably on the Bloyd Formation, and is the youngest formation that outcrops in the Boston Mountains.

Soils

The following definitions of soil hierarchial classification used in this thesis were taken from the Soil Survey Manual to provide insight of soil taxonomy to the layman of Soil Science. A soil series is a group of soils or polypedons that have horizons similar in arrangement and in differentiating sets of properties. Some characteristics used to differentiate soil series include the thickness and arrangement of horizons and their structure, color and texture. A map unit is a collection of areas defined and named the same in terms of their soil components or miscellaneous areas or both. Each map unit differs in some respect from all others in a survey area and is uniquely identified on a soil map. Each individual area on the map is a delineation. Complexes and associations consist of two or more dissimilar components occurring in a regularly repeating pattern.

The major soil associations for the Illinois River Watershed (Figure 6) referencing the 1:250,00 scale state map include the Clarksville-Nixa-Noark, Linker-Mountainburg-Sidon, Enders-Nella-Mountainburg-Steprock and Captina-Nixa-Tonti. The soils of the Clarksville-Nixa-Noark Association are located on ridgetops and sideslopes of the Springfield Plateau. The soils of the Captina-Nixa-Tonti Association are located on broad uplands of the Springfield Plateau. Soils of the two previous associations formed in residuum from cherty limestone.
The Linker-Mountainburg-Sidon soils are on benches, sides, and tops of hills in the Boston Mountains. These soils formed in loamy residuum weathered from sandstone or interbedded sandstone, siltstone and shale. The soils of the Enders-Nella-Mountainburg-Steprock Association occur on benches, sides, tops, and footslopes of hills and mountains. Enders soils formed in a thin layer of loamy colluvial material and clayey residuum weathered from shale or interbedded shale, siltstone, and sandstone. Mountainburg and Steprock soils formed in loamy residuum weathered from sandstone or

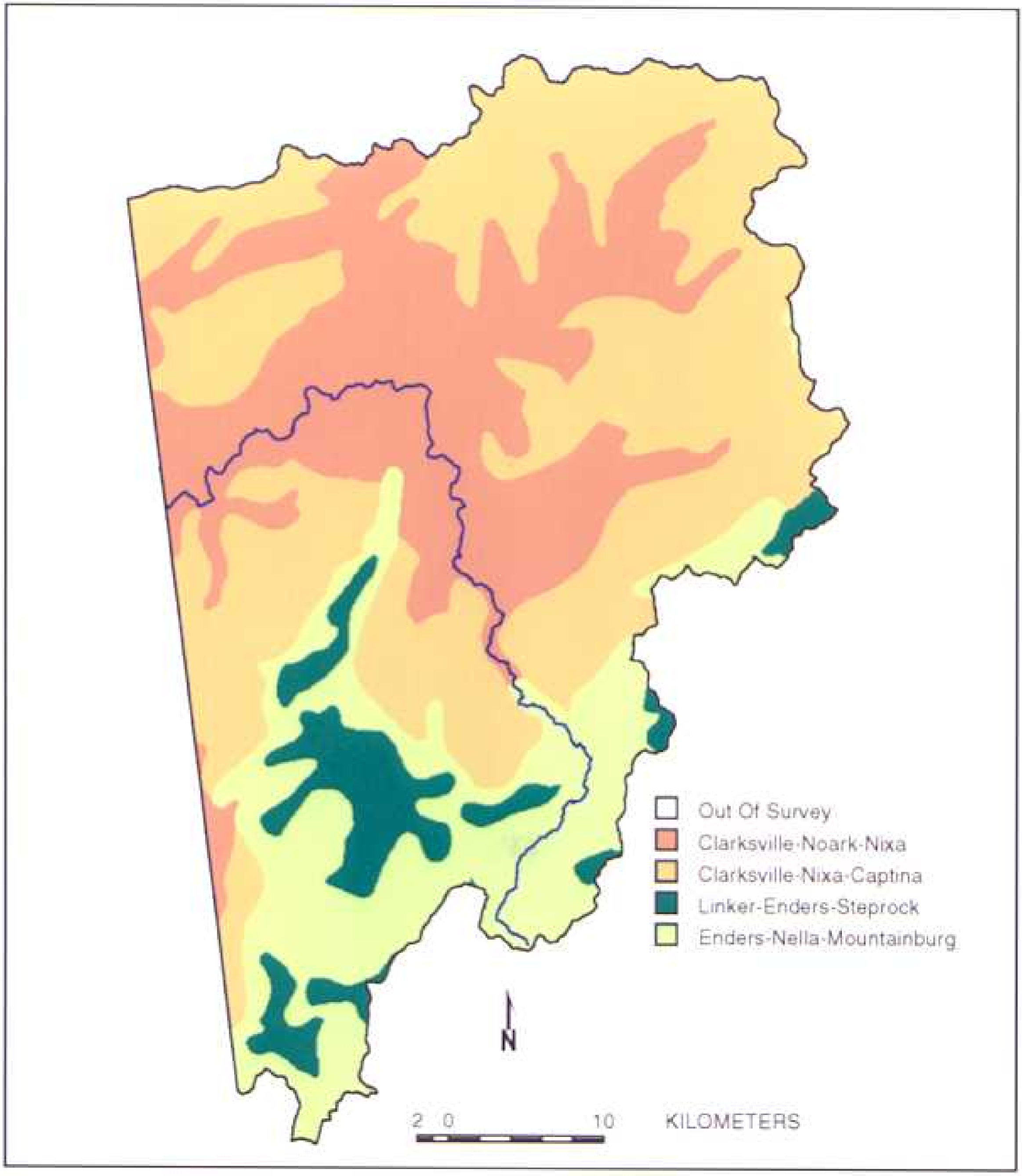


Figure 6. Soil Associations of the Illinois River Watershed. Map Based on 1:250,000 Scale State Map.

interbedded sandstone, siltstone, and shale. Nella soils formed in loamy colluvium weathered from sandstone or interbedded sandstone, siltstone, and shale.

There are 119 soil mapping units in the Illinois River Watershed (Figure 7). The dominant soil mapping units of the Illinois River Watershed include the Nixa, Captina, Clarksville, Tonti series and the Enders-Allegheny complex (Table 8). These five soil taxonomic units encompass over 50% of the watershed.

Table 10. Dominant soils mapping units of the Illinois River Watershed.

Mapping Unit	Acres	% Cover
Captina	58,886	12.21
Clarksville	54,613	11.32
Enders-Allegheny complex	45,001	9.33
Nixa	70,025	14.52
Tonti	19,661	4.07

The following series descriptions were taken from the Washington County, Soil Survey (1969). The Nixa series consists of cherty, moderately well drained, very slowly permeable soils that developed in residuum derived from cherty limestone. The Captina series consists of moderately well drained, slowly permeable soils that developed in silty material. They are found on uplands and stream terraces and their slope range is 1 to 6 percent. The Clarksville series consists of excessively drained, rapidly permeable, cherty

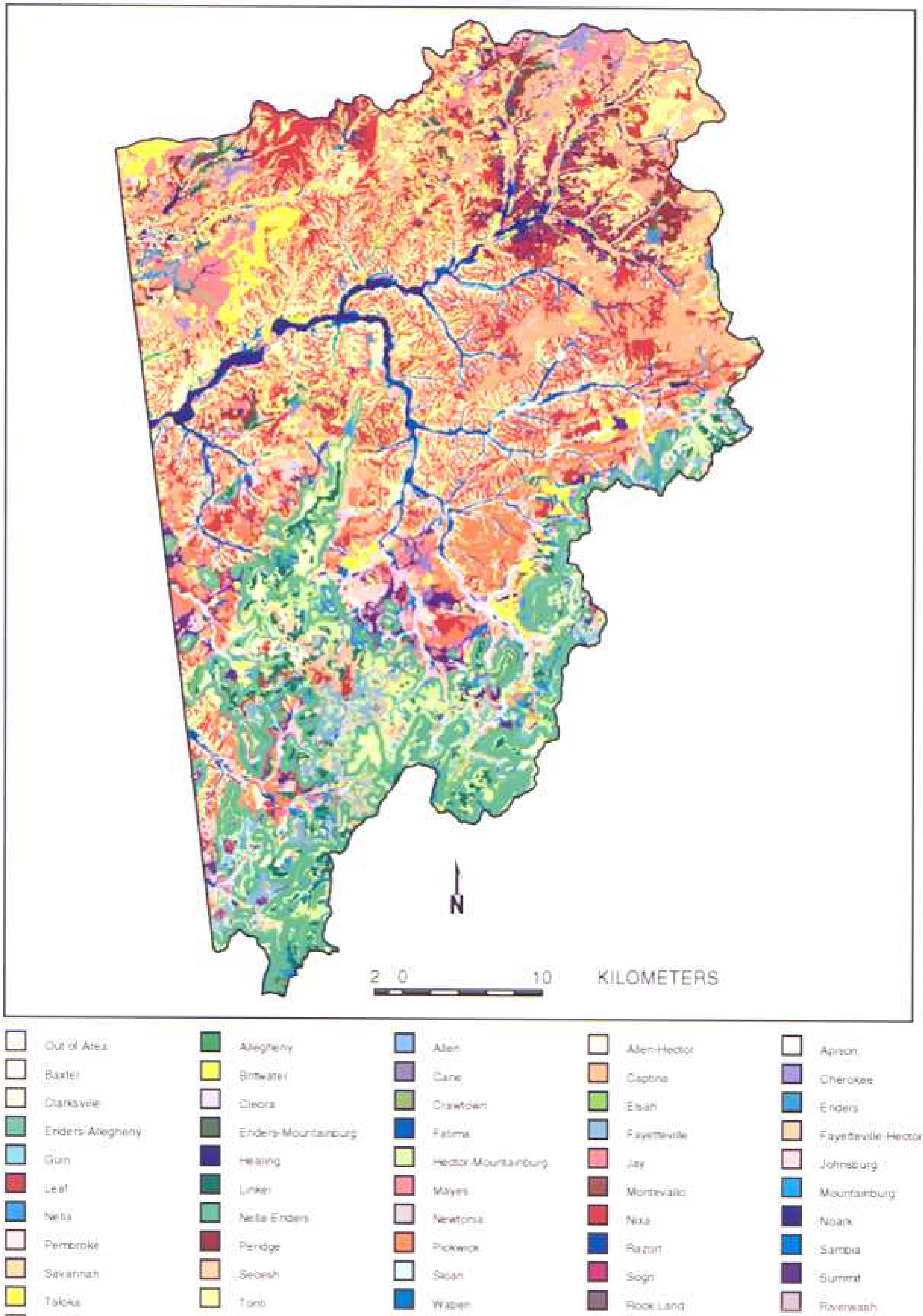


Figure 7. Soil Mapping Units of the Illinois River Watershed. Source Material Provided by the NRCS at a Scale of 1:24,000.

soils on hillsides. These soils developed in residuum derived from very cherty limestone. Their slopes range from 12 to 60 percent. Enders soils are moderately well-drained, very slowly permeable soils located on mountainsides in the Boston Mountains. Allegheny soils tend to be well-drained, moderately permeable and located on benches and footslopes of the Boston Mountains. The Tonti series consists of moderately well drained, gently sloping on ridges, broad uplands, and stream terraces. Tonti soils formed in loamy material overlying cherty limestone (USDA, 1977).

Elevation

Elevations in the watershed ranged from 286 to 579m (Figure 8). The steeper elevations occurred in the Boston Mountains whereas the lower elevations usually occurred in the Springfield Plateau. The 80m elevation data were used to generate statistics on the characterization of slopes in the watershed. The results found in Table 9 establish that a large percentage of the watershed is relatively flat, i.e. less than 2 degrees.

Table 9. Areal Distribution of slopes in the Illinois River Watershed.

Slope	Percent Cover
nearly level (0-2 degrees)	71
gently sloping (3-4 degrees)	12
strongly sloping (5-9 degrees)	10
moderately steep (10-16 degrees)	6
steep (17-30 degrees)	1

A coincidence report of landuse/landcover and slope was generated to determine the locations of pastures in the watershed (Table 10). The majority of pasture land in the watershed occurred on slopes less than 4 degrees.

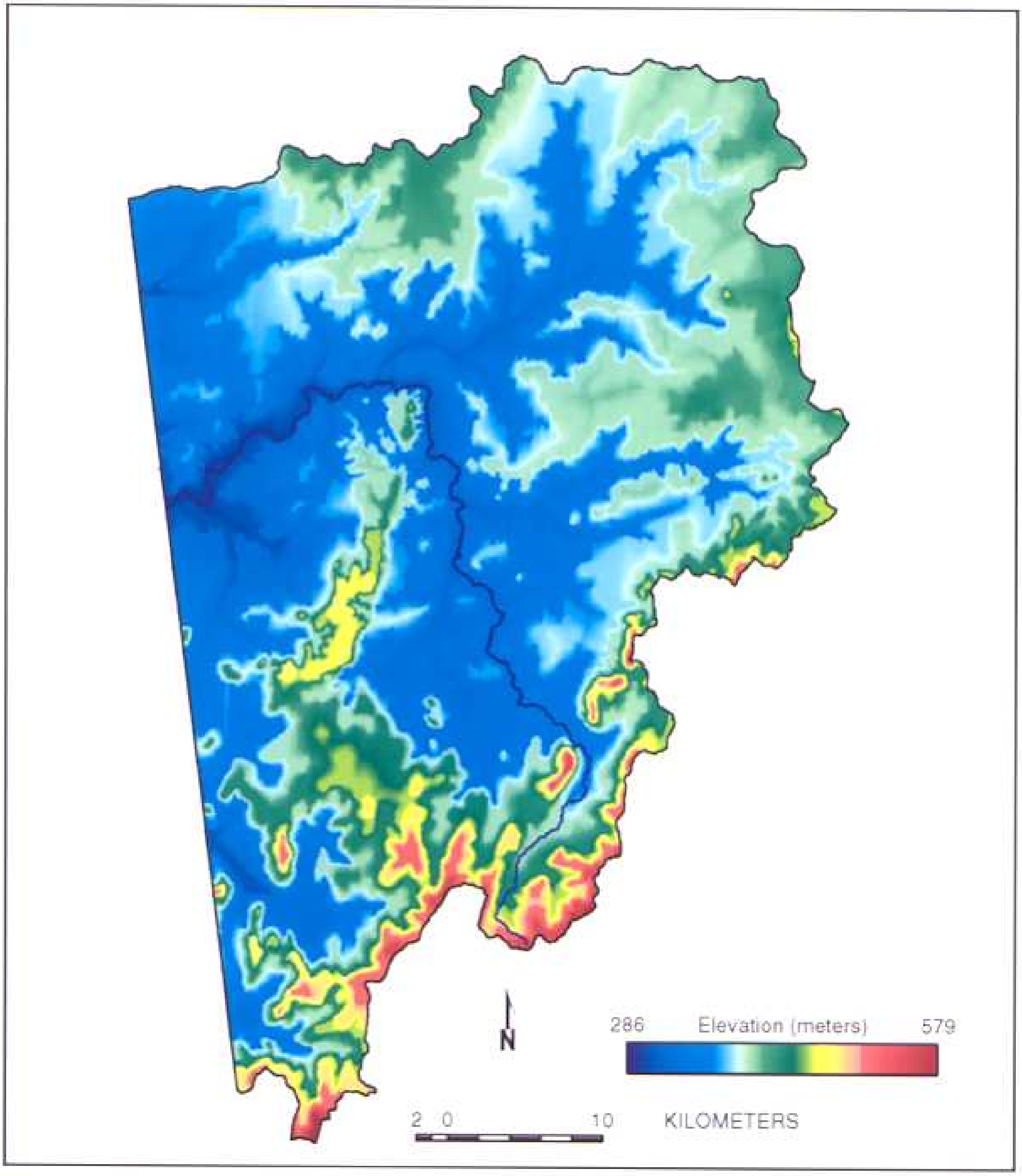


Figure 8. Elevation of the Illinois River Watershed. Map Based on 80m Elevation Data by the USGS.

Table 10. Areal extent of pasture land and slope (degrees) in the Illinois River Watershed.

Pasture slope	Hectares	% Cover
0	48,740	41.15
1	28,569	24.12
2	13,657	11.53
3	8,753	7.39
4	5,200	4.39
5	3,719	3.14
6	2,393	2.02
7	1,611	1.36
8	1,208	1.02
9	1,102	0.93
10	628	0.53
11	450	0.38
12	320	0.27
13	261	0.22
14	225	0.19
15	154	0.13
16	118	0.10
17	83	0.07
18	83	0.07
19	47	0.04
20	36	0.03
21	36	0.03
22	24	0.02
23	12	0.01
24	12	0.01
25	12	0.01

LITERATURE CITED

Avery, T.E., and G.L. Berlin. 1992. Fundamentals of Remote Sensing and airphoto interpretation. Macmillan Publishing Company, New York, NY.

Burrough, P.A. 1986. Principals of Geographical Information Systems for Land Resources Assessment. Clarendon Press, Oxford.

Hurn, Jeff. 189. GPS, A Guide to the next Utility. Trimble Navigation, Inc., Sunnyvale, CA.

McKimmey, J.M. 1994. Prediction of Sediment Load and Phosphorous in the Beaver Reservoir Watershead Using a Geographic Information System. M.S. Thesis. Department of Agronomy, University of Arkansas, Fayetteville.

Tomlin, C.D. 1990. Geographic Information System and Cartographic Modeling. Prentice Hall, Englewood Cliffs, NJ.

USDA, 1969. Soil Survey of Washington County, Arkansas. U.S. Gov. Print. Office, Washington, DC.

USDA, 1977. Soil Survey of Benton County, Arkansas. U.S. Gov. Print. Office, Washington, DC.

USDA, 1993. Soil Survey Manual: Agricultural Handboob No.18. U.S. Gov. Print. Office, Washington, DC.

USGS, 1989. Digital Line Graphs from 1:100,000 Scale Maps:Data Users Guide 2. Reston, VA.

USGS, 1989. Digital Elevation Models:Data Users Guide 5. Reston, VA.

APPENDIX B

SAMPLE RESULTS

Basin 110

Date	Lab #	ID	Cl mg/l	NO3-N mg/l	PO4-P mg/l	TP mg/l	NH3-N mg/l	TKN mg/l	TSS mg/l	TDS mg/l	Alk. mg/l	pH	Turb. NTU	E.coli. cfu/100ml	Cond. uS/cm	Temp deg C	D.O. mg/l	SO4 mg/L	NO2-N mg/l	CBOD5 mg/l	TOC mg/L
1/12/94	No Flow	110																			
10/15/93	No Flow	110																			
3/21/94	941882	110	6.65	2.3	0.02	0.018	0.0142	0.27	1	83.75	60	7.85	1.3	110	130	8	10.8	10.85	0	0.98	
8/5/93	No Flow	110																			
9/20/94	No Flow	110																			
		Min.	6.65	2.3	0.02	0.018	0.0142	0.27	1	83.75	60	7.85	1.3	110	130	8	10.8	10.85	0	0.98	
		Max	6.65	2.3	0.02	0.018	0.0142	0.27	1	83.75	60	7.85	1.3	110	130	8	10.8	10.85	0	0.98	
		Mean	6.65	2.3	0.02	0.018	0.0142	0.27	1	83.75	60	7.85	1.3	110	130	8	10.8	10.85	0	0.98	
		Median	6.65	2.3	0.02	0.018	0.0142	0.27	1	83.75	60	7.85	1.3	110	130	8	10.8	10.85	0	0.98	

Storm Samples

Date	Lab #	ID	Cl mg/l	NO3-N mg/l	PO4-P mg/l	TP mg/l	NH3-N mg/l	TKN mg/l	TSS mg/l	TDS mg/l	Alk. mg/l	pH	Turb. NTU	E.coli. cfu/100ml	Cond. uS/cm	SO4 mg/l	NO2-N mg/l	CBOD5 mg/l	TOC mg/l
3/7/95	952243	1101	2.32	0.35	<0.01	0.04	0.03	0.49	12.65	75.75	52	7.75	7	640	120	4.61			4.96
3/7/95	952246	1102	2.28	0.38	<0.01	0.05	0.02	0.48	11.1	80.75	54	7.82	5	1110	115	4.58			4.62
3/7/95	952249	1103	2.28	0.37	<0.01	0.03	0.03	0.46	10.35	81.25	52	7.77	5	850	118	4.55			4.54
3/8/95	952265	1104	2.48	0.33	<0.01	0.02	0.01	0.4	4	73.5	52	7.72	3	390	118	4.64			5.21
		Min	2.28	0.33	0	0.02	0.01	0.4	4	73.5	52	7.72	3	390	115	4.55			4.54
		Max	2.48	0.38	0	0.05	0.03	0.49	12.65	81.25	54	7.82	7	1110	120	4.64			5.21
		Mean	2.34	0.3575	0	0.035	0.0225	0.4525	9.525	77.813	52.5	7.765	5	747.5	117.75	4.595			4.8325
		Median	2.3	0.36	0	0.035	0.025	0.46	10.725	78.25	52	7.76	5	745	118	4.595			4.79

Basin 120

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/21/94	941881	120	5.35	2.23	0.01	0.054	0.016	0.35	10.7	138.25	80	7.84	6.9	200	225	12.5	10.2	10	0.005	0.83	
1/12/94	941546	120	8.57	2.36	0	0.02	<.01	0.21	1.6	147.3	110	8.18	2.7	30	270	6.5	14.2	11.97	0.02	0.44	
10/15/93	940932	120	8.61	2.52	0.04	0.06	<.01	0.18	6.7	114.8	116	7.92	5.3	10	275	14	9.15	12.6	0.009	1.12	
8/5/93	940432	120	10.89	1.818	0.024	0.06	0.03	0.35	2.8	116.3	126	7.84	4.2			22	6	5.27		0.8	
9/20/94	950771	120	11.5	0.96	0.02	0.05	0.05	1.06	6.45	178.25	134	7.98	4.6	40	305	20	8.4	5.12			2.49
		Min	5.35	0.96	0	0.02	0.016	0.18	1.6	114.8	80	7.84	2.7	10	225	6.5	6	5.12	0.005	0.44	2.49
		Max	11.5	2.52	0.04	0.06	0.05	1.06	10.7	178.25	134	8.18	6.9	200	305	22	14.2	12.6	0.02	1.12	2.49
		Mean	8.984	1.9776	0.0188	0.0488	0.032	0.43	5.65	138.98	113.2	7.952	4.74	70	268.75	15	9.59	8.992	0.0113	0.7975	2.49
		Median	8.61	2.23	0.02	0.054	0.016	0.35	6.45	138.25	116	7.92	4.6	35	272.5	14	9.15	10	0.009	0.815	2.49

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952232	1201	3.63	0.89	0.26	0.66	0.2	2.36	260.5	115.25	36	7.32	75	21000	106	8.38			16.5
3/7/95	952237	1202	3.47	1.01	0.19	0.5	0.13	2.16	127.35	104.25	36	7.57	63	27000	102	8.37			13.4
3/7/95	952242	1203	3.51	1.08	0.15	0.42	0.1	1.48	103.6	99.25	34	7.37	51	12500	108	8.46			11.88
3/8/95	952264	1204	4.1	1.49	0.05	0.14	0.03	0.8	24.85	100.25	48	7.64	26	2700	135	9.59			7.18
		Min	3.47	0.89	0.05	0.14	0.03	0.8	24.85	99.25	34	7.32	26	2700	102	8.37			7.18
		Max	4.1	1.49	0.26	0.66	0.2	2.36	260.5	115.25	48	7.64	75	27000	135	9.59			16.5
		Mean	3.6775	1.1175	0.1625	0.43	0.115	1.7	129.08	104.75	38.5	7.475	53.75	15800	112.75	8.7			12.24
		Median	3.57	0.545	0.17	0.46	0.115	1.84	115.48	102.25	38	7.47	57	16750	107	8.42			12.64

Basin 130																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/20/94	941868	130	5.41	2.77	0.01	0.044	0.0108	0.315	1.7	163	120	8.2	2.6	170	285	13.5	11.8	12.98	0.006	0.03	
1/11/94	941503	130	6.34	3	0	0.01	0.01	0.5	6.3	175.8	138	8.28	1	40	320	8	13.4	14.41	<.01	0.17	
9/20/94	950769	130	10.34	1.87	0.04	0.08	0.02	0.84	2.35	218	170	8.05	2.1	30	365	16.5	8.8	6.1			2.26
10/14/93	940921	130	7.72	2.89	0.01	0.03	<.01	0.14	3.9	219.3	156	8.23	2.1	80	325	14	10.8	14.84	0.005	0.03	
8/5/93	940439	130	9.47	2.89	0.032	0.06	0.02	0.18	5.4	329.8	152	8.1	2.7			20	6.9	5.17		0.88	
		Min	5.41	1.87	0.01	0.01	0.01	0.14	1.7	163	120	8.05	1	30	285	8	6.9	5.17	0.005	0.03	2.26
		Max	10.34	3	0.04	0.08	0.02	0.84	6.3	329.8	170	8.28	2.7	170	365	20	13.4	14.84	0.006	0.88	2.26
		Mean	7.856	2.684	0.0184	0.0448	0.0152	0.395	3.93	221.18	147.2	8.172	2.1	80	323.75	14.4	10.34	10.7	0.0055	0.2775	2.26
		Median	7.72	2.89	0.021	0.044	0.015	0.315	3.9	218	152	8.2	2.1	60	322.5	14	11.8	12.98	0.0055	0.1	2.26

Storm Samples																			
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/6/94	941993	1300	5.14	2.42	0.03	0.02	0.027	0.406	7.5	173.25	118	8.01	5.7	790	285	15.68	0.005	0.32	
4/6/94	942014	1300	4.46	1.75	0.04	0.04	<0.01	0.432	11.2	177.25	102	8.01	25	660	260	18.64	0.002	0.83	
4/6/94	941995	1300	4.43	1.63	0.05	0.08	0.0172	0.58	22.1	174.5	100	7.91	38	1900	260	18.9	0.002	0.23	
3/8/94	941795	1300	3.91	0.9	0.07	0.46	0.111	1.64	331	164.75	70	7.37	88	23000	180	19.01	0.005	1.64	
4/5/94	941980	1300	5.06	2.27	0.01	0.026	0.01	0.44	3.6	176.25	120	8.1	4	90	290	16.44	0.003	0.26	
4/6/94	941994	1300	5.09	2.29	0.02	0.04	0.0249	0.438	16.6	177.25	120	7.93	11	950	290	17.58	0.004	0.05	
11/4/94	951310	1301	5.8	1.92	0.07	0.2	0.03	0.66	13.1	190	144	7.71	17	9100	300	8.68			5.58
7/13/94	950056	1301	3.25	1.09	0.27	1.1	0.12	2.76	887	150	70	7.77	1080	80000	170	17.61	0.025	3.9	
3/7/95	952214	1301	2.98	1	0.1	0.33	0.06	1.76	67.35	134.5	48	7.56	69	10500	140	12.86			17.01
5/8/95	952751	1301	1.85	0.38	0.18	0.52	0.05	1.72	218.7	117.5	38	7.21	76	34000	93	4.73			13.07
7/21/94	950232	1301	6.33	2.37	0.05	0.12	0.04	0.51	25.1	206.5	144	8.06	17	7800	330	11.26	<0.010	1.15	
7/25/94	950271	1301	4.67	1.82	0.13	0.69	0.07	2.18	425.2	194.75	124	7.88	71	38000	290	13.26	0.016	3.17	
7/25/94	950276	1302	3.71	1.14	0.09	0.59	0.03	1.44	431.2	186	76	7.79	88	28000	230	30.19	0.013	2.56	
7/13/94	950064	1302	3.53	1.7	0.34	0.71	0.07	0.42	297.4	151.25	66	7.73	110	51000	180	12.45	0.026	3.6	
11/4/94	951322	1302	2.97	0.67	0.24	2.76	0.17	5.2	2011.2	138.5	96	7.68	650	81000	170	18.27			14.02
5/8/95	952760	1302	2.18	0.68	0.16	0.34	0.04	1.34	88.8	87.25	46	7.25	53	8400	116	5.92			12.19
3/7/95	952222	1302	3.52	1.36	0.08	0.13	0.52	1.6	32	146.5	58	7.8	53	8500	165	15.08			13.41
11/4/94	951330	1303	2.49	0.96	0.44	0.69	0.06	1.28	130.8	121.75	50	7.38	65	22000	125	10.61			13.8
5/9/95	952771	1303	3.01	1.24	0.12	0.24	0.03	1.04	41.1	117	62	7.32	34	5200	150	8.09			11.23
7/14/94	950071	1303	3.94	2.08	0.37	0.59	0.04	0.68	112.6	171.25	72	7.63	86	24000	200	12.33	0.02	3.6	
7/25/94	950279	1303	4.17	1.35	0.13	0.47	0.02	0.92	250	227.5	88	7.81	120	16000	255	26.56	0.01	2.23	
3/8/95	952269	1303	4.75	2.3	0.03	0.08	0.02	0.6	5.35	159.25	88	7.97	23	1300	215	17.78			8.02
11/6/94	951332	1304	2.82	1.19	0.39	0.55	0.03	1.08	51.1	128.5	56	7.1	44	26000	140	11.63			13.16
7/14/94	950078	1304	5.4	3.24	0.01	0.22	0.02	0.52	28.4	201.5	110	7.93	36	12000	280	15.4	<0.010	1.76	
5/9/95	952875	1304	4.88	2.48	0.07	0.11	0.03	0.58	6.92	146.5	90	7.93	14	2800	210	10.92			2.55
7/25/94	950281	1304	4.13	1.37	0.1	0.3	0.02	0.69	178.3	201	94	7.85	120	30000	260	22.9	<0.010	1.54	
7/26/94	950286	1305	4.46	1.51	0.12	0.28	0.02	0.67	104.2	206	100	7.86	85	34000	265	19.99	<0.010	1.59	
11/6/94	951340	1305	2.77	1.38	0.39	0.54	0.02	1.22	45.9	120	58	7.42	42	7000	140	9.99			12.58
11/7/94	951354	1306	4.59	3.27	0.13	0.16	0.02	0.62	9.5	170.75	100	7.79	18	3800	250	15.53			7.27
7/26/94	950288	1306	4.66	1.63	0.12	0.3	0.02	0.78	71.4	205	108	7.91	73	4600	280	20.59	<0.010	1.42	
		Min	1.85	0.38	0.01	0.02	0.01	0.406	3.6	87.25	38	7.1	4	90	93	4.73	0.002	0.05	2.55
		Max	6.33	3.27	0.44	2.76	0.52	5.2	2011.2	227.5	144	8.1	1080	81000	330	30.19	0.026	3.9	17.01
		Mean	4.0317	1.6463	0.145	0.4229	0.06	1.1402	197.49	164.07	87.2	7.7223	107.19	19079.667	217.3	15.296	0.0109	1.7559	11.068
		Median	4.15	1.57	0.11	0.3	0.03	0.735	59.225	171	89	7.795	53	9800	222.5	15.465	0.004	1.59	12.58

Basin 140

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
7/28/93	940307	140	11.09	0.281	0.003	0.16	0.38	1.52	43.8	164.8	640	7.98	32			27	4.7	13.8		3.35	
3/20/94	941866	140	5.01	1.47	0.01	0.032	0.0712	0.287	5.45	110.25	74	7.97	6.2	180	195	15	10.6	13.85	0.007	0.2	
10/14/93	940920	140	8.83	1.92	0	0.02	<.01	0.25	9.1	168.3	98	8.02	7.9	120	250	15.9	10.1	21.5	0.02	0.63	
1/11/94	941502	140	5.86	1.55	0	0.01	0.01	0.32	9.2	111	78	7.83	5	2400	220	4.5	13.2	19.67	<.01	0.26	
9/20/94	950768	140	12.84	0.01	<0.01	0.11	0.02	1.56	46.2	171.75	120	8.22	26	530	295	20.5	11.7	14.65			6.69
		Min	5.01	0.01	0	0.01	0.01	0.25	5.45	110.25	74	7.83	5	120	195	4.5	4.7	13.8	0.007	0.2	6.69
		Max	12.84	1.92	0.01	0.16	0.38	1.56	46.2	171.75	640	8.22	32	2400	295	27	13.2	21.5	0.02	3.35	
		Mean	8.726	1.0462	0.0065	0.0664	0.1203	0.7874	22.75	145.22	202	8.004	15.42	807.5	240	16.58	10.06	16.694	0.0135		
		Median	8.83	1.47	0.0065	0.032	0.0456	0.32	9.2	164.8	98	7.98	7.9	355	235	15.9	10.6	14.65	0.0135		

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/8/94	941794	1400	4.19	1.15	0.164	0.626	0.48	2.04	366.7	143.25	44	6.97	85	56000	140	14.16	0.031	2.32	
4/6/94	941998	1400	3.91	0.85	0.01	0.04	0.0254	0.46	16.2	109.75	58	7.79	18	2200	175	14.89	0.006	0.24	
4/6/94	941997	1400	4.06	1	0.02	0.06	0.03	0.43	27.4	113.75	68	7.82	22	2500	180	13.78	0.004	0.52	
4/6/94	942015	1400	3.82	0.87	0.02	0.02	<0.01	0.382	7.3	117.75	64	7.87	14	800	170	14.8	0.005	0.74	
4/6/94	941996	1400	3.84	0.85	0.02	0.06	0.0358	0.488	42.2	111	64	7.79	30	3000	170	14.07	0.004	0.47	
4/5/94	941979	1400	3.65	0.76	0.01	0.036	0.02	0.41	7.9	103.5	64	7.78	9.5	290	170	13.53	0.004	0.13	
7/21/94	950231	1401	7.09	0.16	0.01	0.15	0.1	0.81	42.6	155.75	106	7.92	27	350	260	14.93	0.011	2.34	
11/4/94	951309	1401	9.1	0.29	<0.01	0.06	0.05	0.7	15.2	165	104	7.53	14	520	270	22.51			4.87
3/7/95	952213	1401	2.87	0.75	0.18	0.23	0.14	2.16	95.2	100.25	38	7.57	59	11900	106	8.79			15.08
5/8/95	952750	1401	1.6	0.17	0.17	0.65	0.06	1.8	354.2	95.5	30	7.06	80	37000	70	3.66			12.78
7/13/94	950055	1401	6.17	0.29	0.06	0.44	0.09	1.17	349.2	156.25	84	8.04	310	26000	210	12.74	0.013	3.04	
7/25/94	950270	1401	3.43	0.5	0.28	1.01	0.18	2.84	612.2	104.25	32	7.25	64	48000	100	6.92	0.019	5.6	
5/8/95	952759	1402	1.6	0.21	0.19	0.47	0.04	1.26	141.6	89.25	30	7.14	65	9600	74	4.08			10.81
7/25/94	950275	1402	3.6	0.6	0.35	0.89	0.09	1.8	326.4	140	36	7.34	93	25000	115	8.22	0.02	4.62	
7/13/94	950063	1402	6.79	1.04	0.13	0.52	0.31	0.96	172.7	159.5	86	7.89	91	64000	220	10.05	0.049	4.48	
3/7/95	952221	1402	3.12	0.79	0.13	0.14	0.12	1.28	47.9	100.5	32	7.65	46	8000	100	9.23			12.15
11/4/94	951321	1402	6.99	0.48	0.24	0.92	0.23	2.4	490.4	156.25	90	7.34	88	112000	220	15.95			14.81
7/25/94	950278	1403	3.12	0.66	0.33	0.71	0.06	1.14	181.8	142.5	38	7.38	97	31000	123	9.79	0.02	3.54	
5/9/95	952770	1403	1.93	0.31	0.14	0.3	0.03	0.96	95.3	79	34	7.33	50	4900	90	5.33			10.38
3/8/95	952268	1403	3.52	1.08	0.02	0.08	0.02	0.8	10	88.5	40	7.7	26	2300	120	11.27			6.66
11/4/94	951329	1403	2.87	0.67	0.23	0.76	0.12	1.8	297.2	123	40	7.23	92	57000	95	7.79			14.45
7/14/94	950070	1403	5.12	0.65	0.11	0.42	0.15	0.8	183.8	153	64	7.65	115	30000	180	13.48	0.027	3.94	
5/9/95	952873	1404	2.95	0.73	0.06	0.11	0.03	0.7	20.25	87.5	50	7.6	23	1080	127	8.18			6.04
7/25/94	950280	1404	3.39	0.66	0.31	0.61	0.05	0.9	149.3	134.5	42	7.46	92	16000	129	11.26	0.018	3.34	
11/6/94	951331	1404	3.6	1.01	0.26	0.44	0.05	1.04	80	108.25	44	7.35	48	17000	110	9.14			12.61
7/14/94	950077	1404	5.95	0.66	0.06	0.24	1	0.85	60.6	147	76	7.63	58	4000	210	14.94	0.024	2.06	
7/26/94	950285	1405	3.49	0.69	0.27	0.49	0.04	0.82	105.5	136.5	46	7.47	85	20000	135	12.18	0.016	2.93	
11/6/94	951339	1405	3.36	1.09	0.26	0.42	0.05	1.2	77.6	98	42	7.3	47	10600	100	8.63			11.42
11/7/94	951352	1406	4.79	1.59	0.07	0.13	0.03	0.7	17.3	104	52	7.48	25	2600	140	12.48			7.64
7/26/94	950287	1406	3.77	0.75	0.23	0.43	0.04	1.16	84.4	142.5	50	7.54	75	15000	145	13.1	0.018	2.5	
		Min	1.6	0.16	0.01	0.02	0.02	0.382	7.3	79	30	6.97	9.5	290	70	3.66	0.004	0.13	4.87
		Max	9.1	1.59	0.35	1.01	1	2.84	612.2	165	106	8.04	310	112000	270	22.51	0.049	5.6	15.08
		Mean	4.123	0.7103	0.1494	0.3821	0.1266	1.142	149.28	122.19	54.933	7.529	64.95	20621.333	148.47	11.329	0.017	2.5182	10.746
		Median	3.625	0.71	0.135	0.42	0.05	0.96	89.8	115.75	48	7.535	58.5	11250	137.5	11.725	0.018	2.5	11.42

Basin 220																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
9/20/94	950773	220	15.26	1.27	0.02	0.03	0.03	0.7	3.9	185	134	8.22	4.1	660	310	18.5	7.7	5.06			0.83
3/20/94	941869	220	4.88	1.13	0.01	0.024	<0.01	0.379	0.8	84.25	64	7.65	1.4	0	160	10.5	10.4	4.87	0	0.18	
10/14/93	940922	220	8.21	0.57	0.01	0.01	<.01	0.05	2.2	122.8	88	7.36	0.4	<1	205	15.8	7.2	3.83	0.001	0.33	
1/11/94	941504	220	7.82	0.76	0.01	0.01	<.01	0.21	6.1	127.2	76	7.6	0.7	120	180	7	10.6	4.3	<.01	0.57	
8/5/93	940438	220	9.37	0.52	0.016	0.05	<.01	0.05	6.1	197	88	7.53	2.9			20	5.5	3.43		0.71	
		Min	4.88	0.52	0.01	0.01	0.03	0.05	0.8	84.25	64	7.36	0.4	0	160	7	5.5	3.43	0.001	0.18	0.83
		Max	15.26	1.27	0.02	0.05	0.03	0.7	6.1	197	134	8.22	4.1	660	310	20	10.6	5.06	0.001	0.71	0.83
		Mean	9.108	0.85	0.0132	0.0248	0.03	0.2778	3.82	143.25	90	7.672	1.9	260	213.75	14.36	8.28	4.298	0.001	0.4475	0.83
		Median	8.21	0.76	0.01	0.024	0	0.21	3.9	127.2	88	7.6	1.4	120	170	15.8	7.7	4.3	0.001	0.45	0.83
Storm Samples																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
3/7/95	952229	2201	4.48	1.08	0.13	0.42	0.1	1.62	106.5	151	50	7.49	81	8000	135	19.77			15.27		
3/7/95	952233	2202	4.28	1.32	0.12	0.3	0.11	1.92	79.5	140.25	54	7.56	69	8900	140	9.41			13.6		
3/7/95	952238	2203	4.62	1.51	0.1	0.16	0.09	1.52	51.3	134	56	7.74	55	2700	150	10.04			13.48		
3/8/95	952261	2204	5.37	1.98	0.04	0.11	0.03	0.64	8.7	148	76	7.73	24	1300	190	10.07			6.11		
		Min	4.28	1.08	0.04	0.11	0.03	0.64	8.7	134	50	7.49	24	1300	135	9.41			6.11		
		Max	5.37	1.98	0.13	0.42	0.11	1.92	106.5	151	76	7.74	81	8900	190	19.77			15.27		
		Mean	4.6875	1.4725	0.0975	0.2475	0.0825	1.425	61.5	143.31	59	7.63	57.25	5225	153.75	12.323			12.115		
		Median	4.55	1.415	0.11	0.23	0.095	1.56	65.4	144.13	55	7.645	62	5350	145	10.055			13.54		

Basin 221																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
10/15/93	940933	221	10.61	2.13	0.02	0.03	<.01	0.03	5.6	112	114	8	4.4	30	275	14.5	9.5	9.88	0.008	0.68	
9/20/94	950772	221	13.36	1.39	0.02	0.03	0.04	0.84	8.1	170.25	120	8.15	6.9	60	285	19.5	8.5	8			1.66
8/5/93	940433	221	13.95	1.983	0.016	0.04	0.02	0.34	2.3	202.3	110	7.97	6.5			22	6.7	9.55		0.62	
1/12/94	**941547**	221	10.19	2.37	0.01	0.02	<.01	0.22	6.4	150.7	110	7.99	3.9	0	270	7.5	11.2	10.26	0.01	0.03	
3/21/94	**941879**	221	8.43	2.48	0.01	0.036	0.0183	0.36	10.7	149.5	100	7.98	6.5	60	260	12	10	12.12	0.007	0.7	
		Min	**8.43**	**1.39**	**0.01**	**0.02**	**0.0183**	**0.03**	**2.3**	**112**	**100**	**7.97**	**3.9**	**0**	**260**	**7.5**	**6.7**	**8**	**0.007**	**0.03**	1.66
		Max	**13.95**	**2.48**	**0.02**	**0.04**	**0.04**	**0.84**	**10.7**	**202.3**	**120**	**8.15**	**6.9**	**60**	**285**	**22**	**11.2**	**12.12**	**0.01**	**0.7**	
		Mean	**11.308**	**2.0706**	**0.0152**	**0.0312**	**0.0261**	**0.358**	**6.62**	**156.95**	**110.8**	**8.018**	**5.64**	**37.5**	**272.5**	**15.1**	**9.18**	**9.962**	**0.0083**	**0.5075**	
		Median	**10.61**	**2.13**	**0.016**	**0.03**	**0.02**	**0.34**	**6.4**	**150.7**	**110**	**7.99**	**6.5**	**45**	**272.5**	**14.5**	**9.5**	**9.88**	**0.008**	**0.65**	

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952230	2211	5.46	1.24	0.09	0.52	0.12	1.8	231.8	144.75	54	7.69	95	7100	150	10.76			11.49
3/7/95	952235	2212	5.47	1.42	0.08	0.23	0.1	1.76	91.85	128	58	7.71	66	2000	160	9.92			11.03
3/7/95	**952239**	2213	5.37	1.61	0.06	0.22	0.1	1.16	61.75	134.5	62	7.84	53	4400	165	9.94			8.56
3/8/95	**952262**	**2214**	**6.96**	**2.15**	**0.03**	0.08	0.04	0.68	10.65	134.5	76	7.67	17	1070	190	11.09			4.71
		Min	**5.37**	**1.24**	**0.03**	**0.08**	**0.04**	**0.68**	10.65	128	54	7.67	17	1070	150	9.92			4.71
		Max	**6.96**	**2.15**	**0.09**	**0.52**	**0.12**	**1.8**	**231.8**	**144.75**	**76**	**7.84**	**95**	**7100**	**190**	**11.09**			**11.49**
		Mean	**5.815**	**1.605**	**0.065**	**0.2625**	**0.09**	**1.35**	**99.013**	**135.44**	**62.5**	**7.7275**	**57.75**	**3642.5**	**166.25**	**10.428**			**8.9475**
		Median	**5.465**	**1.515**	**0.07**	**0.225**	**0.1**	**1.46**	**76.8**	**134.5**	**60**	**7.7**	**59.5**	**3200**	**162.5**	**10.35**			**9.795**

Basin 310

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
1/12/94	941545	310	9.58	2.29	0.01	0.02	<.01	0.2	5.3	148.8	108	8.09	5.4	10	270	6.5	12.4	11.28	0.02	0.51	
10/15/93	940929	310	9.47	2.21	0.02	0.04	<.01	0.18	7.8	76	114	7.89	4.4	80	265	13	8.75	11.71	0.008	1.46	
3/21/94	941878	310	7	2.3	0.01	0.044	0.0131	0.36	15.35	141.5	100	7.84	8.4	60	230	12.5	9.8	10.9	0.005	0.71	
8/5/93	940431	310	12.57	1.76	0.025	0.05	0.02	0.32	14	146	116	7.86	5.2			22	5.6	7.87		0.88	
9/21/94	950806	310	12.78	1.15	0.02	0.04	0.03	0.58	11.25	177.5	120	8.08	7.4	60	280	20.3	8.9	7.09			1.32
		Min	7	1.15	0.01	0.02	0.0131	0.18	5.3	76	100	7.84	4.4	10	230	6.5	5.6	7.09	0.005	0.51	1.32
		Max	12.78	2.3	0.025	0.05	0.03	0.58	15.35	177.5	120	8.09	8.4	80	280	22	12.4	11.71	0.02	1.46	1.32
		Mean	10.26	1.942	0.017	0.0388	0.021	0.328	10.74	137.96	111.6	7.952	6.16	52.5	261.25	14.86	9.09	9.77	0.011	0.89	1.32
		Median	9.58	2.21	0.02	0.04	0.02	0.32	11.25	146	114	7.89	5.4	60	267.5	13	8.9	10.9	0.008	0.795	1.32

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952231	3101	4.27	0.95	0.26	0.8	0.21	2.72	315.8	131.75	42	7.4	89	19000	115	9.28			17.31
3/7/95	952236	3102	3.93	1.08	0.2	0.49	0.15	2.32	129.9	116.75	40	7.48	74	24000	120	8.82			14.49
3/7/95	952240	3103	4.25	1.2	0.16	0.4	0.13	1.92	112.9	110.5	40	7.61	62	9600	125	9.43			12.49
3/8/95	952263	3104	4.7	1.67	0.06	0.13	0.04	0.96	25.9	110.75	52	7.63	27	2400	140	9.95			6.62
		Min	3.93	0.95	0.06	0.13	0.04	0.96	25.9	110.5	40	7.4	27	2400	115	8.82			6.62
		Max	4.7	1.67	0.26	0.8	0.21	2.72	315.8	131.75	52	7.63	89	24000	140	9.95			17.31
		Mean	4.2875	1.225	0.17	0.455	0.1325	1.98	146.13	117.44	43.5	7.53	63	13750	125	9.37			12.728
		Median	4.26	1.14	0.18	0.445	0.14	2.11	121.4	113.63	41	7.545	68	14300	122.5	9.355			13.49

Basin 320

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
1/12/94	941530	320	8.96	2.22	0.06	0.01	<.01	0.32	1.3	159.3	112	7.69	2.5	10	270	6	10.8	10.32	0.01	0.54	
8/4/93	940414	320	13.3	1.548	0.038	0.06	<.01	0.3	7	156	114	7.89	4.7			25	7.5	9.73		0.26	
9/21/94	950793	320	11.55	0.93	0.03	0.04	0.02	0.64	8.6	168.25	118	8.05	6.8	20	290	20.8	9.6	8.13			<0.10
3/21/94	941873	320	6.3	2.21	0.01	0.046	0.0151	0.33	14.1	121.25	100	7.91	8.2	90	230	12.5	9.8	10.56	0.005	0.65	
10/15/93	940925	320	9.74	2.08	0.02	0.05	0.01	0.22	6.3	171	114	7.72	4.1	110	260	13.5	7.9	11.66	0.007	1.08	
		Min	6.3	0.93	0.01	0.01	0.01	0.22	1.3	121.25	100	7.69	2.5	10	230	6	7.5	8.13	0.005	0.26	0
		Max	13.3	2.22	0.06	0.06	0.02	0.64	14.1	171	118	8.05	8.2	110	290	25	10.8	11.66	0.01	1.08	0
		Mean	9.97	1.7976	0.0316	0.0412	0.015	0.362	7.46	155.16	111.6	7.852	5.26	57.5	262.5	15.56	9.12	10.08	0.0073	0.6325	
		Median	9.74	2.21	0.03	0.046	0.01	0.32	7	159.3	114	7.89	4.7	55	265	13.5	9.6	10.32	0.007	54.5	0

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952257	3201	3.86	0.99	0.21	0.61	0.16	2.16	171.8	119.25	40	7.56	83	16000	118	8.15			14.41
3/8/95	952278	3202	4.55	1.65	0.07	0.2	0.05	0.96	24.7	113.75	50	7.36	32	3600	150	9.41			8.21
5/8/95	952746	3202	5.7	0.72	0.08	0.12	0.03	0.74	17.8	130.75	52	7.7	17	4300	155	22.25			8.57
		Min	3.86	0.72	0.07	0.12	0.03	0.74	17.8	113.75	40	7.36	17	3600	118	8.15			8.21
		Max	5.7	1.65	0.21	0.61	0.16	2.16	171.8	130.75	52	7.7	83	16000	155	22.25			14.41
		Mean	4.7033	1.12	0.12	0.31	0.08	1.2867	71.433	121.25	47.333	7.54	44	7966.6667	141	13.27			10.397
		Median	4.55	0.99	0.08	0.2	0.05	0.96	24.7	119.25	50	7.56	32	4300	1560	9.41			8.57

Basin 330

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
1/12/94	941534	330	14.29	4.1	0.05	0.03	<.01	0.32	0	180.3	94	7.89	0.6	0	240	6.5	11.4	3.82	<.01	0.15	
10/15/93	940934	330	13.13	3.58	0.04	0.04	<.01	0.01	2.7	209.2	90	8.07	1.2	50	250	15	10.4	4.19	0.005	1.23	
8/4/93	940416	330	15.1	3.344	0.064	0.07	0.01	0.21	4	126.5	92	8.01	2			24	8.6	3.67		0.28	
3/21/94	941876	330	8.97	4.22	0.06	0.044	0.012	0.29	0.95	133	80	7.76	1.4	360	215	11	12.2	4.99	0.001	0.56	
9/21/94	950796	330	17.16	2.8	0.05	0.06	0.02	0.52	1.25	178.75	102	8.08	1.3	60	280	20.8	9.6	3.35			2.9
		Min	8.97	2.8	0.04	0.03	0.01	0.01	0	126.5	80	7.76	0.6	0	215	6.5	8.6	3.35	0.001	0.15	2.9
		Max	17.16	4.22	0.064	0.07	0.02	0.52	4	209.2	102	8.08	2	360	280	24	12.2	4.99	0.005	1.23	2.9
		Mean	13.73	3.6088	0.0528	0.0488	0.014	0.27	1.78	165.55	91.6	7.962	1.3	117.5	246.25	15.46	10.44	4.004	0.003	0.555	2.9
		Median	14.29	3.58	0.05	0.044	0.01	0.29	1.25	178.75	92	8.01	1.3	55	245	15	10.4	3.82	0.005	0.42	2.9

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/6/94	941987	3300	5.12	2.71	0.23	0.28	0.122	0.88	66.2	117.5	44	7.52	43	11300	140	4.38	0.009	0.84	
4/6/94	941990	3300	6.29	3.26	0.13	0.1	0.0178	0.52	80.2	112.5	54	7.54	21	3200	160	4.93	0.006	0.12	
3/8/94	941797	3300	6.56	3.22	0.19	0.36	0.095	1.08	130.2	137.5	54	7.43	67	6600	160	4.28	0.004	1.24	
4/6/94	942011	3300	5.92	3.35	0.04	0.06	<0.01	0.42	9.9	115.25	56	7.63	6.8	830	170	5.01	0.001	0.71	
4/5/94	941976	3300	8.85	3.86	0.04	0.044	0.02	0.31	5.2	143.75	72	7.73	6.5	20	210	4.66	0.001	0.19	
4/6/94	941984	3300	4.88	2.18	0.29	0.73	0.151	1.46	483.6	165	52	7.8	230	9700	160	3.78	0.009	2.92	
3/1/94	941723	3300	9.8	4.04	0.08	0.088	0.015	0.324	6.6	135	72	7.55	14	350	210	5.13	0.025	0.21	
3/1/94	941722	3300	9.51	4.07	0.07	0.084	0.0177	0.378	20.8	132.25	70	7.52	19	560	210	5.24	0.025	0.06	
3/7/95	952218	3301	7.28	3.62	0.14	0.13	0.04	1.12	22.05	117.75	52	7.72	23	11600	160	4.98			8.23
7/21/94	950236	3301	12.46	2.63	0.06	0.07	0.03	0.36	6.5	168	102	7.99	6	1900	275	4.21	<0.010	0.31	
7/13/94	950060	3301	10.59	2.66	0.17	0.22	0.05	0.66	38.3	168.5	92	7.88	32	10100	240	3.68	0.013	1.85	
5/8/95	952755	3301	2.99	1.39	0.59	0.94	0.07	2.36	346.9	121	34	7.04	90	37000	92	3.62			11.95
3/7/95	952226	3302	7.56	4.94	0.1	0.2	0.02	0.8	10.95	123.5	52	7.76	17	5800	170	4.93			7.51
5/8/95	952764	3302	3.63	1.87	0.48	0.67	0.05	1.52	158.4	98	38	7.07	61	17000	114	4.36			9.67
11/4/94	951318	3302	12.41	2.45	0.09	0.12	0.03	0.66	28.3	156	92	7.8	95	1700	250	3.99			4.28
7/13/94	950068	3302	10.49	2.58	0.11	0.17	0.02	0.34	16.6	154.5	88	7.99	20	2000	235	3.62	<0.010	1.64	
3/8/95	952274	3303	7.81	4.81	0.05	0.09	0.03	0.46	2.75	125.75	54	7.38	6.4	1600	190	5.4			4.97
5/9/95	952775	3303	4.27	2.36	0.27	0.38	0.03	0.94	53.6	95.5	44	7.12	32	7400	130	5.06			8.48
11/4/94	951326	3303	10.93	2.39	0.26	0.36	0.04	0.74	60.9	151.75	92	7.72	34	15000	225	3.9			5.58
7/14/94	905575	3303	10.64	2.52	0.08	0.13	0.02	0.41	8.6	159.75	90	7.83	11	3200	240	3.72	<0.010	0.19	
7/14/94	950082	3304	11.46	2.5	0.05	0.06	0.01	0.36	4.5	0.004	100	7.93	3.1	360	260	3.7	<0.010	0.18	
11/6/94	951336	3304	10.21	3.46	0.33	0.36	0.05	0.77	33.3	146.5	74	7.54	18	7100	200	5.2			6.95
5/9/95	952880	3304	5.08	3	0.11	0.12	0.02	0.44	11.56	96.25	50	7.35	10	1300	150	5.72			3.72
11/6/94	951344	3305	11.34	5.03	0.22	0.25	0.02	0.73	15.1	157.25	78	7.69	14	3800	230	5.7			6.52
11/7/94	951359	3306	12.77	5.81	0.09	0.08	0.01	0.52	5.4	169.75	74	7.78	4	290	250	6.16			3.22
		Min	2.99	1.39	0.04	0.044	0.01	0.31	2.75	0.004	34	7.04	3.1	20	92	3.62	0.001	0.06	3.22
		Max	12.77	5.81	0.59	0.94	0.151	2.36	483.6	169.75	102	7.99	230	37000	275	6.16	0.025	2.92	11.95
		Mean	8.354	3.2284	0.1708	0.2438	0.0408	0.7425	65.056	130.74	67.2	7.6124	35.352	6388.4	193.24	4.6144	0.0103	0.8046	6.7567
		Median	8.85	3	0.11	0.13	0.03	0.66	20.8	135	70	7.69	19	3200	200	4.66	0.004	0.31	6.735

Basin 340

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
9/21/94	950797	340	7.56	3.1	0.03	0.04	0.04	0.58	5.9	167.5	112	8.12	2.5	220	265	19.5	8.5	2.89			<0.10
8/4/93	940417	340	8.75	3.953	0.051	0.07	0.01	0.64	9.6	87	100	8.07	6.4			21	8.6	3.16		1.04	
1/12/94	941535	340	7.96	4.38	0.05	0.04	0.02	0.4	4.6	177.2	100	7.95	2.8	980	250	8.5	10.8	3.37	0.01	0.56	
3/21/94	941877	340	6.41	4.48	0.03	0.036	0.0137	0.26	4.5	145.25	80	7.85	2.3	180	230	11	11.2	4.12	0.004	0.21	
10/15/93	940935	340	7.86	4.05	0.05	0.05	<.01	0.16	3.3	207.5	102	8.09	2	570	250	14.5	9.7	3.81	0.006	0.92	
		Min	6.41	3.1	0.03	0.036	0.01	0.16	3.3	87	80	7.85	2	180	230	8.5	8.5	2.89	0.004	0.21	0
		Max	8.75	4.48	0.051	0.07	0.04	0.64	9.6	207.5	112	8.12	6.4	980	265	21	11.2	4.12	0.01	1.04	0
		Mean	7.708	3.9926	0.0422	0.0472	0.0209	0.408	5.58	156.89	98.8	8.016	3.2	487.5	248.75	14.9	9.76	3.47	0.0067	0.6825	
		Median	7.86	4.05	0.05	0.04	0.02	0.4	4.6	167.5	100	8.07	2.5	345	250	14.5	9.7	3.37	0.004	0.74	0

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/6/94	941991	3400	4.92	4.27	0.11	0.14	0.029	0.55	27.8	132.75	66	7.58	14	2400	175	5.04	0.011	0.19	
4/6/94	942012	3400	4.99	4.42	0.07	0.09	<0.01	0.466	16.1	132.75	64	7.74	8.6	700	185	5.11	0.005	0.78	
3/1/94	941724	3400	7.34	4.24	0.06	0.042	0.0378	0.356	0	135.25	84	7.8	5	410	220	4.55	0.39	0.18	
3/8/94	941796	3400	5.84	3.62	0.19	0.324	0.131	0.9	84.8	148.25	76	7.43	33	25000	190	4.19	0.01	0.87	
4/6/94	941988	3400	4.41	3.34	0.3	0.46	0.133	1.1	109.5	130	62	7.54	54	31000	170	4.53	0.017	1.33	
3/1/94	941725	3400	6.46	4.18	0.07	0.068	0.0345	0.418	9.9	139.75	84	7.74	10	1700	220	4.3	0.61	0.19	
4/5/94	941977	3400	5.69	3.97	0.03	0.038	0.02	0.41	8.1	139.5	84	7.75	4.5	600	220	4.03	0.006	1	
4/6/94	941985	3400	4.39	2.81	0.64	1.07	0.419	2.96	385.2	125.25	60	7.53	82	67000	165	3.74	0.018	3.83	
5/8/95	952756	3401	4.08	1.35	0.37	1.14	0.1	2.72	631.6	117.5	54	7.25	64	27000	135	3.52			11.29
7/21/94	950237	3401	6.89	3.1	0.05	0.09	0.03	0.4	17.2	156.25	100	7.94	7	8500	250	2.09	<0.010	0.83	
3/7/95	952219	3401	5.89	4.71	0.14	0.12	0.04	1.28	35.6	143.5	76	7.92	24	6300	210	4.66			6.25
11/4/94	951312	3401	7.29	2.93	0.18	0.3	0.06	1.02	64.8	154.25	104	7.64	26	8200	240	3.37			4.9
7/13/94	950061	3401	6.91	3.1	0.22	0.42	0.05	0.27	163.2	174	88	7.8	83	79000	225	3.47	0.025	2.63	
3/7/95	952227	3402	5.83	6.33	0.1	0.22	0.02	0.82	29.4	154	74	7.97	21	4800	210	4.74			5.57
11/4/94	951319	3402	6.81	3.05	0.06	0.1	0.04	0.64	35.5	157.75	110	7.88	23	2700	250	3.21			3.29
5/8/95	952765	3402	4.57	1.61	0.22	0.52	0.05	1.8	249.8	97.75	58	7.28	54	10500	150	3.74			8.5
7/13/94	950069	3402	6.78	3.14	0.12	0.22	0.02	0.39	46.1	161.5	96	7.97	35	11500	235	3.45	0.013	1.07	
11/4/94	951327	3403	6.26	2.86	0.28	0.53	0.06	1	158.1	156.75	96	7.81	61	35000	220	3.59			6.13
5/9/95	952776	3403	4.9	2.1	0.13	0.29	0.04	1.68	98.53	96	60	7.34	33	4900	150	4.08			7.48
7/14/94	950076	3403	6.92	3.29	0.05	0.11	0.01	0.36	23.3	160.5	94	7.94	12	4600	240	3.3	<0.010	0.49	
3/8/95	952276	3403	6.39	5.94	0.05	0.11	0.02	0.48	5.7	149.75	70	7.64	8.6	1060	220	5.31			3.82
7/14/94	950083	3404	7.38	3.36	0.03	0.06	<0.01	0.31	10.8	0.005	106	8.06	5.3	760	255	3.27	<0.010	1.13	
5/9/95	952881	3404	5.38	3.63	0.06	0.14	0.02	0.67	31.36	115	62	7.62	13	7500	170	4.82			3.28
11/6/94	951337	3404	6.91	4.49	0.25	0.36	0.03	0.84	81	148.75	90	7.69	32	5600	220	5.14			6.51
11/6/94	951345	3405	7.12	5.01	0.16	0.21	0.02	0.72	34.3	155.75	92	7.7	19	4500	230	5.54			7.92
11/7/94	951360	3406	7.32	5.49	0.07	0.08	0.01	0.52	11.85	160.75	84	7.76	6	550	240	5.8			8.17
		Min	4.08	1.35	0.03	0.038	0.01	0.27	0	0.005	54	7.25	4.5	410	135	2.09	0.005	0.18	3.28
		Max	7.38	6.33	0.64	1.14	0.419	2.96	631.6	174	110	8.06	83	79000	255	5.8	0.61	3.83	11.29
		Mean	6.0642	3.7054	0.1542	0.2789	0.0593	0.8877	90.367	136.28	80.538	7.7046	28.385	13530	207.5	4.1765	0.1105	1.1169	6.3931
		Median	6.325	3.49	0.115	0.175	0.0323	0.655	34.9	145.88	84	7.74	22	7500	220	4.135	0.011	0.87	6.25

Basin 351

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/21/94	941874	351	8.94	4.057	0.12	0.18	0.0134	0.28	14.4	143.25	100	7.96	4.5	90	250	11.5	9.8	6.49	0.003	1.2	
10/15/93	940926	351	15.28	3.39	0.12	0.06	<.01	0.22	8	181	112	7.81	2.4	80	295	14	8.1	12.75	0.007	1.25	
1/12/94	941531	351	13.59	3.93	0.31	0.34	<.01	0.4	2.7	187.5	110	7.79	1.4	70	290	7.5	10.4	10.37	<.01	0.39	
9/21/94	950794	351	25.56	2.27	0.49	0.5	0.02	0.58	6	218.5	122	8.15	2.5	150	360	19.8	9.9	18.76			1.39
8/4/93	**9**40413	351	16.78	3.199	0.704	0.69	<.01	0.23	11.3	168.5	114	7.9	4.5			22	7.8	11.39		0.1	
		Min	8.94	2.27	0.12	0.06	0.0134	0.22	2.7	143.25	100	7.79	1.4	70	250	7.5	7.8	6.49	0.003	0.1	1.39
		Max	25.56	4.057	0.704	0.69	0.02	0.58	14.4	218.5	122	8.15	4.5	150	360	22	10.4	18.76	0.007	1.25	1.39
		Mean	16.03	3.3692	0.3488	0.354	0.0167	0.342	8.48	179.75	111.6	7.922	3.06	97.5	298.75	14.96	9.2	11.952	0.005	0.735	1.39
		Median	16.78	3.39	0.31	0.34	0	0.28	8	181	112	7.9	2.5	85	292.5	14	9.8	11.39	0.003	0.745	1.39

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
4/20/95	952636	3511	5.46	1.38	0.27	0.7	0.11	1.68	278.67	150.5	50	7.26	270	10200	130	4.94			7.52		
4/20/95	952639	3512	5.91	1.73	0.26	0.59	0.08	1.5	119.4	140.75	56	7.47	86	12100	140	5.5			7.2		
		Min	5.46	1.38	0.26	0.59	0.08	1.5	119.4	140.75	50	7.26	86	10200	130	4.94			7.2		
		Max	5.91	1.73	0.27	0.7	0.11	1.68	278.67	150.5	56	7.47	270	12100	140	5.5			7.52		
		Mean	5.685	1.555	0.265	0.645	0.095	1.59	199.04	145.63	53	7.365	178	11150	135	5.22			7.36		
		Median	5.685	1.555	0.265	0.645	0.095	1.59	199.04	145.63	53	7.365	178	11150	135	5.22			7.36		

Basin 352

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
8/5/93	940428	352	21.16	3.723	0.419	0.46	0.03	0.43	2.8	135.8	118	7.74	4.4			18	7.1	11.85		0.73	
1/12/94	941539	352	14.22	4.04	0.49	0.47	0.02	0.2	1.9	191.7	116	7.98	1.6	190	300	9	11	7.72	0.01	0.61	
9/21/94	950801	352	27.68	3.19	0.42	0.44	0.03	0.52	2.2	228	128	8.2	2.6	2300	365	18.7	9.5	15.98			1.23
3/21/94	941887	352	12.53	1.61	0.25	0.21	0.0148	0.36	5.65	176	100	8.04	2.8	0	270	13	12.8	14.92	0.005	0.46	
10/15/93	940938	352	20.45	3.67	0.11	0.1	0.01	0.02	2.2	242.2	124	8.04	1.2	290	310	15.5	10.4	11.7	0.006	0.6	
		Min	12.53	1.61	0.11	0.1	0.01	0.02	1.9	135.8	100	7.74	1.2	0	270	9	7.1	7.72	0.005	0.46	1.23
		Max	27.68	4.04	0.49	0.47	0.03	0.52	5.65	242.2	128	8.2	4.4	2300	365	18.7	12.8	15.98	0.01	0.73	1.23
		Mean	19.208	3.2466	0.3378	0.336	0.021	0.306	2.95	194.74	117.2	8	2.52	695	311.25	14.84	10.16	12.434	0.007	0.6	1.23
		Median	20.45	3.67	0.419	0.44	0.02	0.36	2.2	191.7	118	8.04	2.6	240	305	18	10.4	11.85	0.005	0.605	1.23

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
4/20/95	952616	3521	9.55	1.26	0.23	0.47	0.04	1.48	90.5	131.75	52	7.22	73	19000	130	5.7			8.87		
4/20/95	952617	3522	9.7	1.5	0.17	0.36	0.04	1.32	61.6	137.75	52	7.39	65	10000	140	5.74			8.79		
		Min	9.55	1.26	0.17	0.36	0.04	1.32	61.6	131.75	52	7.22	65	10000	130	5.7			8.79		
		Max	9.7	1.5	0.23	0.47	0.04	1.48	90.5	137.75	52	7.39	73	19000	140	5.74			8.87		
		Mean	9.625	1.38	0.2	0.415	0.04	1.4	76.05	134.75	52	7.305	69	14500	135	5.72			8.83		
		Median	9.625	1.38	0.2	0.415	0.04	1.4	76.05	134.75	52	7.305	69	14500	135	5.72			8.83		

Basin 360

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
10/15/93	940927	360	5.85	3.06	0.05	0.02	0.02	0	11.5	135.2	100	7.76	5.4	920	240	12	8.2	3.03	0.008	1.32	
1/12/94	941532	360	4.43	3.05	0.08	0.03	0.01	0.36	0	145.5	92	7.75	1.7	620	220	8.5	10.4	2.95	0.01	0.14	
8/5/93	No Flow	360																			
3/21/94	941875	360	7.81	3.59	0.12	0.03	0.0121	0.24	1.3	108	80	7.8	1.1	540	180	9	11.4	6.82	0.001	0.87	
9/21/94	950795	360	5.52	2.1	0.02	0.04	0.05	0.74	8.45	123.5	70	8.99	4	540	170	23.6	13.8	2.03			2.16
		Min	4.43	2.1	0.02	0.02	0.01	0	0	108	70	7.75	1.1	540	170	8.5	8.2	2.03	0.001	0.14	2.16
		Max	7.81	3.59	0.12	0.04	0.05	0.74	11.5	145.5	100	8.99	5.4	920	240	23.6	13.8	6.82	0.01	1.32	2.16
		Mean	5.8525	2.95	0.0675	0.03	0.023	0.335	5.3125	128.05	85.5	8.075	3.05	655	202.5	13.275	10.95	3.7075	0.0063	0.7767	2.16
		Median	5.685	3.055	0.065	0.03	0.0161	0.3	0.4	129.35	86	7.78	2.85	580	200	10.5	10.7	2.99	0.008	0.87	2.16

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/5/94	941982	3600	3.69	2.89	0.02	0.04	0.02	0.3	4.9	111.5	70	7.76	4.4	6700	175	3.54	0.002	0.16	
4/6/94	942003	3600	3.88	2.89	0.03	0.01	0.0122	0.24	3.6	112	70	7.74	2.4	730	170	3.81	0.001	0.27	
4/6/94	942000	3600	4.45	2.89	0.03	0.02	0.0139	0.304	4.4	115.5	72	7.77	1.4	970	180	3.99	0.002	0.28	
3/1/94	941727	3600	4.48	3.43	0.02	0.024	0.0185	0.23	2.15	115.25	74	7.7	4	1500	190	3.79	0.32	0.47	
3/1/94	941726	3600	4.51	3.29	0.04	0.044	0.0187	0.286	8.8	113.75	68	7.73	15	7200	180	3.84	0.31	0.35	
3/8/94	941798	3600	3.09	2.81	0.07	0.17	0.047	0.076	142	119.25	60	7.45	55	11400	160	3.57	0.002	0.76	
4/5/94	941974	3600	3.72	2.97	0.02	0.022	0.02	0.3	0.7	117.25	70	7.65	1.1	2200	180	3.6	0.002	0.56	
3/7/95	952216	3601	4.36	3.14	0.02	0.02	0.02	0.68	5.6	121.25	72	8.03	7	1250	180	3.25			3.56
7/13/94	950058	3601	3.75	1.52	0.28	0.39	0.11	0.52	25.9	119.25	66	7.91	20	112000	160	2.33	0.026	4.22	
7/25/94	950273	3601	5.05	2.08	0.01	0.03	0.03	0.37	9.8	140.75	94	7.81	5	24000	220	2.32	0.014	0.87	
7/21/94	950234	3601	4.93	2.04	0.01	0.03	0.03	0.41	11.5	134.25	92	8.14	7	27000	215	2.68	0.011	0.72	
5/8/95	952753	3601	2.91	2.21	0.2	0.55	0.05	1.48	537.6	129.5	50	7.28	120	19000	107	3.95			9.99
7/13/94	950066	3602	4.32	2.1	0.11	0.17	0.04	0.39	10	128.25	90	7.96	9	35000	210	2.7	0.016	2.1	
5/8/95	952762	3602	3.25	2.7	0.15	0.4	0.03	0.9	274.7	106.75	50	7.33	90	8000	140	4.27			7.77
11/4/94	951316	3602	4.42	1.77	0.11	0.3	0.09	1.2	112.3	130.75	80	7.83	58	41000	190	2.03			4.19
3/7/95	952224	3602	4.15	3.18	0.02	0.02	0.02	0.62	3.9	122	74	8.11	7	830	180	3.3			3.27
11/4/94	951324	3603	3.99	1.97	0.15	0.24	0.08	0.76	46.7	116.5	78	7.6	33	21000	170	2.21			4.97
3/8/95	952272	3603	3.87	3.34	0.02	0.04	0.02	0.4	2.8	108.25	58	7.87	6	1400	150	3.92			4.04
5/9/95	952773	3603	3.48	2.92	0.12	0.22	0.03	0.84	102.31	100.5	42	7.31	70	3600	140	4.36			6.96
7/14/94	950073	3603	4.66	2.16	0.05	0.07	0.02	0.46	12.4	145	94	7.94	9	10200	220	2.73	0.011	1.61	
11/6/94	951334	3604	3.93	3.18	0.06	0.12	0.05	0.56	30.7	126.75	76	7.46	17	6700	175	3.71			5.61
7/14/94	950080	3604	5.27	2.32	0.01	0.03	0.02	0.32	2.6	149.5	98	7.9	4.6	3000	220	2.98	0.01	0.72	
5/9/95	952878	3604	3.82	3.4	0.06	0.15	0.02	0.48	43.52	101.25	58	7.48	23	830	150	4.39			3.68
11/6/94	951342	3605	4.5	4.51	0.08	0.26	0.03	0.92	145.2	125.25	52	7.37	68	8000	155	4.73			5.73
11/7/94	951357	3606	4.43	4.31	0.03	0.06	0.02	0.57	32.8	131.75	80	7.7	13	1700	190	4.16			3.57
		Min	2.91	1.52	0.01	0.01	0.0122	0.076	0.7	100.5	42	7.28	1.1	730	107	2.03	0.001	0.16	3.27
		Max	5.27	4.51	0.28	0.55	0.11	1.48	537.6	149.5	98	8.14	120	112000	220	4.73	0.32	4.22	9.99
		Mean	4.1164	2.8008	0.0688	0.1372	0.0345	0.5448	63.075	121.6	71.44	7.7132	25.996	14208.4	176.28	3.4384	0.0559	1.0069	5.2783
		Median	4.15	2.89	0.04	0.06	0.02	0.46	11.5	119.25	72	7.74	9	6700	180	3.6	0.011	0.72	4.58

Basin 371																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/21/94	941885	371	8.16	2.44	0.01	0.026	0.0145	0.3	3.45	129.75	80	7.92	1.5	0	190	12	11.8	11.76	0.002	0.56	
8/5/93	940430	371	5.77	2.498	0.015	<0.01	0.02	0.24	8.8	71.8	98	7.68	2.2			18	6.9	3.09		0.74	
10/15/93	940936	371	5.86	2.8	0.01	<0.02	0.01	0	3.8	189.3	94	7.89	1.6	40	220	18	10.4	3.36	0.006	0.37	
1/12/94	941533	371	4.82	3.18	0.04	0.01	0.01	0.3	1.3	152.5	88	7.82	0.9	90	210	9	11	3.03	<.01	0.39	
9/21/94	950798	371	6.28	2.32	0.01	0.02	0.04	0.64	8.05	160.5	112	8.1	3.2	850	245	22.2	8.4	2.37			1.14
		Min	4.82	2.32	0.01	0.01	0.01	0	1.3	71.8	80	7.68	0.9	0	190	9	6.9	2.37	0.002	0.37	1.14
		Max	8.16	3.18	0.04	0.026	0.04	0.64	8.8	189.3	112	8.1	3.2	850	245	22.2	11.8	11.76	0.006	0.74	1.14
		Mean	6.178	2.6476	0.017	0.0172	0.0189	0.296	5.08	140.77	94.4	7.882	1.88	245	216.25	15.84	9.7	4.722	0.004	0.515	1.14
		Median	5.86	2.498	0.01	0.02	0.0145	0.3	3.8	152.5	94	7.89	1.6	65	215	18	10.4	3.09	0.002	0.475	1.14

Storm Samples																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
4/20/95	952635	3711	4.14	2.39	0.03	0.06	0.02	0.6	5.5	130	68	7.67	12	1640	160	3.61			3.83		
4/20/95	952638	3712	4.27	2.49	0.03	0.08	0.02	0.7	18.3	133.25	72	7.68	44	700	165	3.17			3.88		
		Min	4.14	2.39	0.03	0.06	0.02	0.6	5.5	130	68	7.67	12	700	160	3.17			3.83		
		Max	4.27	2.49	0.03	0.08	0.02	0.7	18.3	133.25	72	7.68	44	1640	165	3.61			3.88		
		Mean	4.205	2.44	0.03	0.07	0.02	0.65	11.9	131.63	70	7.675	28	1170	162.5	3.39			3.855		
		Median	4.205	2.44	0.03	0.07	0.02	0.65	11.9	131.63	70	7.675	28	1170	162.5	3.39			3.855		

Basin 372	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/21/94	941886	372	5.34	2.24	0.01	0.04	0.0153	0.32	4.65	158.75	80	8.08	2.8	0	225	13	12.4	9.99	0.006	0.51	
10/15/93	940937	372	7.65	4.45	0.005	0.03	0.02	0	2.6	219	112	8.25	1.4	90	260	15	11.2	2.67	0.009	0.9	
9/21/94	950799	372	6.43	3.34	0.02	0.04	0.04	0.66	5.7	176	116	8.25	2.6	470	270	20.1	10.1	1.7			0.25
8/5/93	940429	372	7.43	4.319	0.024	0.05	0.02	0.34	14.4	102	114	7.9	4.3			17	7.8	2.37		0.65	
1/12/94	941538	372	7.41	4.52	0.16	0.06	0.01	0.34	3.2	180.7	112	8.01	1.7	200	270	9.5	11.4	2.8	0.01	0.44	
		Min	**5.34**	**2.24**	**0.005**	**0.03**	**0.01**	**0**	**2.6**	**102**	**80**	**7.9**	**1.4**	**0**	**225**	**9.5**	**7.8**	**1.7**	**0.006**	**0.44**	**0.25**
		Max	**7.65**	**4.52**	**0.16**	**0.06**	**0.04**	**0.66**	**14.4**	**219**	**116**	**8.25**	**4.3**	**470**	**270**	**20.1**	**12.4**	**9.99**	**0.01**	**0.9**	**0.25**
		Mean	**6.852**	**3.7738**	**0.0438**	**0.044**	**0.0211**	**0.332**	**6.11**	**167.29**	**106.8**	**8.098**	**2.56**	**190**	**256.25**	**14.92**	**'0.58**	**3.906**	**0.0083**	**0.625**	**0.25**
		Median	**7.41**	**4.319**	**0.02**	**0.04**	**0.02**	**0.34**	**4.65**	**176**	**112**	**8.08**	**2.6**	**200**	**265**	**15**	**11.2**	**2.67**	**0.009**	**58**	**0.25**

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/20/95	952634	3721	4.14	1.28	0.28	0.52	0.16	1.82	114.4	134	50	7.3	65	28000	125	4.48			10.4
4/20/95	952637	3722	4.62	1.84	0.25	0.43	0.12	1.4	36.85	144	56	7.41	44	22000	140	5.16			9.97
		Min	4.14	1.28	0.25	0.43	0.12	1.4	36.85	134	50	7.3	44	22000	125	4.48			9.97
		Max	4.62	1.84	0.28	0.52	0.16	1.82	114.4	144	56	7.41	65	28000	140	5.16			10.4
		Mean	4.38	1.56	0.265	0.475	0.14	1.61	75.625	139	53	7.355	54.5	25000	132.5	4.82			10.185
		Median	4.38	1.56	0.265	0.475	0.14	1.61	75.625	139	53	7.355	54.5	25000	132.5	4.82			10.185

Basin 380

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
8/5/93	940427	380	42.81	4.552	5.19	5.33	0.55	1.34	2.1	253.5	120	7.73	2.8			20	5.7	42.9		0.7	
1/12/94	941536	380	28.57	4.27	1.71	1.71	0.03	0.58	3.5	267.3	118	8.02	1.3	70	410	8.5	11.2	33.98	0.02	0.02	
9/21/94	950802	380	57.26	3.18	1.47	0.8	0.03	0.74	2.65	342.25	120	8.32	2	190	550	20.8	8.8	60.04			3.53
3/21/94	941888	380	12.45	3.6	0.22	0.242	0.0129	0.33	4.55	182.75	120	8.5	1.7	0	300	14	13.6	12.24	0.007	1.36	
10/15/93	940939	380	31.14	3.61	0.29	0.29	0.01	0.14	1.6	292.8	126	8.35	0.9	90	390	16.5	10.6	35.13	0.007	0.47	
		Min	12.45	3.18	0.22	0.242	0.01	0.14	1.6	182.75	118	7.73	0.9	0	300	8.5	5.7	12.24	0.007	0.02	3.53
		Max	57.26	4.552	5.19	5.33	0.55	1.34	4.55	342.25	126	8.5	2.8	190	550	20.8	13.6	60.04	0.02	1.36	3.53
		Mean	34.446	3.8424	1.776	1.6744	0.12658	0.626	2.88	267.72	120.8	8.184	1.74	87.5	412.5	15.96	9.98	36.858	0.011	0.6375	3.53
		Median	31.14	3.61	1.47	0.8	0.03	0.58	2.65	267.3	120	8.32	1.7	80	400	16.5	10.6	35.13	0.007	0.585	3.53

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
4/20/95	952618	3801	8.6	2.35	0.45	0.58	0.12	1.2	76.8	136.25	70	7.46	59	12000	180	12.71			8.49		
4/20/95	952619	3802	9.7	2.91	0.55	0.63	0.1	0.96	34.6	169	76	7.5	40	9600	210	14.72			6.5		
		Min	8.6	2.35	0.45	0.58	0.1	0.96	34.6	136.25	70	7.46	40	9600	180	12.71			6.5		
		Max	9.7	2.91	0.55	0.63	0.12	1.2	76.8	169	76	7.5	59	12000	210	14.72			8.49		
		Mean	9.15	2.63	0.5	0.605	0.11	1.08	55.7	152.63	73	7.48	49.5	10800	195	13.72			7.495		
		Median	9.15	2.63	0.5	0.605	0.11	1.08	55.7	152.63	73	7.48	49.5	10800	195	13.72			7.495		

Basin 391

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
9/21/94	950803	391	7.45	2.11	0.03	0.04	0.02	0.5	10.3	204.5	156	7.88	2.6	60	325	18.8	6.4	2.22			<0.10
10/15/93	940941	391	7.14	3.36	0.05	0.02	<.01	0.19	2.9	218.2	136	7.73	1.2	110	325	17.5	8.8	3.02	0.006	0.7	
1/12/94	941540	391	6.88	3.55	0.09	0.01	0.01	0.04	3.2	184.8	138	7.85	0.9	30	300	9	10.4	2.56	<.01	0.51	
8/5/93	940426	391	6.94	2.635	0.011	0.03	0.03	0.36	7	154.3	152	7.57	2.5			18	7.1	2.31		0.86	
3/21/94	941889	391	5.37	3.91	0.03	0.024	0.0145	0.33	3.85	176.5	120	7.85	1.1	110	270	14	11.9	3.32	0.005	0.96	
		Min	5.37	2.11	0.011	0.01	0.01	0.04	2.9	154.3	120	7.57	0.9	30	270	9	6.4	2.22	0.005	0.51	0
		Max	7.45	3.91	0.09	0.04	0.03	0.5	10.3	218.2	156	7.88	2.6	110	325	18.8	11.9	3.32	0.006	0.96	0
		Mean	6.756	3.113	0.0422	0.0248	0.018625	0.284	5.44	187.66	140.4	7.776	1.66	77.5	305	15.46	8.92	2.686	0.0055	0.7575	0
		Median	6.94	3.36	0.03	0.024	0.0145	0.33	3.85	184.8	138	7.85	1.2	85	312.5	17.5	8.8	2.56	0.005	0.78	0

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/5/94	941978	3910	0.16	0.09	0.03	0.026	0.02	0.36	0.8	170.25	114	7.53	0.7	320	270	0.01	<0.001	0.98	
4/6/94	941986	3910	2.04	1.43	0.48	1.77	0.42	5.18	1816	202	50	7.33	260	30000	120	2.66	0.013	3.43	
4/6/94	941989	3910	4.24	1.28	0.81	1.97	0.76	6.04	911	183.5	40	7.09	255	86000	110	3.28	0.027	7.47	
4/6/94	941992	3910	4.58	3.57	0.11	0.16	0.053	0.57	21.3	151.25	84	7.54	24	7600	200	3.74	0.014	0.67	
4/6/94	942013	3910	4.67	3.88	0.08	0.08	0.0167	0.39	19.9	156.5	92	7.68	15	1600	220	3.93	0.007	0.75	
7/13/94	950062	3911	5.81	2.27	<0.01	0.02	0.02	1.1	5.9	195.5	146	8	3	600	315	2.2	<0.010	0.89	
5/8/95	952757	3911	3.05	0.96	0.79	1.16	0.17	2.8	221	121.5	40	7.12	57	65000	106	2.42			17.69
7/21/94	950238	3911	5.34	2.15	0.02	0.06	0.03	0.42	14.2	188	140	7.85	15	5100	305	2.23	0.01	0.95	
11/4/94	951313	3911	5.49	1.95	0.22	0.48	0.08	1.18	138	176.25	108	7.77	89	71000	235	2.46			6.28
3/7/95	952220	3911	5.84	4.01	0.06	0.06	0.04	0.82	9.5	182	118	7.91	17	3800	280	2.97			4.9
3/7/95	952228	3912	5.97	4.2	0.03	0.08	0.02	0.6	5.8	180.5	120	7.8	12	1170	275	3.27			2.44
5/8/95	952766	3912	3.63	1.44	0.53	0.84	0.1	2	86.9	108.25	44	7.15	40	28000	123	2.98			15.12
11/4/94	951320	3912	4.34	1.65	0.1	0.42	0.08	1.28	189	185	108	7.86	140	20000	220	2.46			6.63
5/9/95	952777	3913	4.7	2.55	0.39	0.46	0.08	1.64	39.9	123.5	62	7.2	30	11700	160	3.57			11.18
11/4/94	951328	3913	4.48	1.64	1.01	1.36	0.18	1.36	112	171.5	96	7.61	80	45000	200	3.38			12.94
3/8/95	952277	3913	7.64	4.68	0.01	0.03	0.02	0.33	1.85	178	116	7.61	3.4	300	190	3.25			1.41
5/9/95	952882	3914	6.44	4.74	0.07	0.09	0.03	0.64	9.72	154.75	92	7.38	0.3	9800	230	4.36			0.15
11/6/94	951338	3914	4.3	2.02	0.4	0.47	0.04	0.84	51.2	151.75	90	7.54	52	7200	210	3			9.96
11/6/94	951346	3915	4.84	2.42	0.38	0.46	0.03	0.71	24.1	160.5	112	7.58	32	5300	240	3.26			5.64
11/7/94	951361	3916	5.69	2.87	0.08	0.05	0.02	0.54	6.35	169	114	7.65	9	950	270	3.25			3.5
		Min	0.16	0.09	0.01	0.02	0.0167	0.33	0.8	108.25	40	7.09	0.3	300	106	0.01	0.007	0.67	0.15
		Max	7.64	4.74	1.01	1.97	0.76	6.04	1816	202	146	8	260	86000	315	4.36	0.027	7.47	17.69
		Mean	4.663	2.49	0.2947	0.5023	0.110485	1.44	184	165.48	94.3	7.58	56.7	20022	214	2.934	0.014	2.163	7.5262
		Median	4.685	2.21	0.105	0.29	0.04	0.83	22.7	170.88	102	7.595	27	7400	220	3.125	0.01	0.95	6.28

Basin 392																						
Base Flow																						
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC	
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L	
8/5/93	940425	392	10.97	5.56	0.038	0.04	0.03	0.86	6.2	152.5	142	7.76	3.7			17	8.4	5.56		1.26		
9/21/94	950805	392	15.7	3.6	0.04	0.04	0.05	0.52	6.65	238.75	146	8.04	4.9	24000	350	20.2	9.8	9.43			0.91	
10/15/93	940942	392	10.17	3.77	0.03	0.04	<.01	0.24	0.8	215	130	8.12	1.5	110	310	17.5	10.5	6.78	0.006	0.7		
3/21/94	941890	392	8.73	4.26	0.02	0.03	0.0136	0.25	4.1	194	120	8.09	2.1	40	295	13	11.6	8.63	0.004	0.84		
1/12/94	941541	392	9.62	3.96	0.1	0.04	<.01	0.09	3.1	182.5	130	8.06	2	340	290	9.5	11.4	6.01	<.01	0.85		
		Min	8.73	3.6	0.02	0.03	0.0136	0.09	0.8	152.5	120	7.76	1.5	40	290	9.5	8.4	5.56	0.004	0.7	0.91	
		Max	15.7	5.56	0.1	0.04	0.05	0.86	6.65	238.75	146	8.12	4.9	24000	350	20.2	11.6	9.43	0.006	1.26	0.91	
		Mean	11.038	4.23	0.0456	0.038	0.0312	0.392	4.17	196.55	133.6	8.014	2.84	6122.5	311.25	15.44	10.34	7.282	0.005	0.9125	0.91	
		Median	10.17	3.96	0.038	0.04	0.0136	0.25	4.1	194	130	8.06	2.1	225	300	17	10.5	6.78	0.004	0.845	0.91	
Storm Samples																						
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC			
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l			
4/20/95	952620	3921	5.83	2.4	0.37	0.51	0.05	1.2	58.8	208.25	76	7.61	48	8800	180	7.96			8.5			
4/20/95	952621	3922	6.65	3.06	0.24	0.35	0.04	0.94	17.9	178	84	7.75	34	10400	200	7.96			7.73			
		Min	5.83	2.4	0.24	0.35	0.04	0.94	17.9	178	76	7.61	34	8800	180	7.96			7.73			
		Max	6.65	3.06	0.37	0.51	0.05	1.2	58.8	208.25	84	7.75	48	10400	200	7.96			8.5			
		Mean	6.24	2.73	0.305	0.43	0.045	1.07	38.3	193.13	80	7.68	41	9600	190	7.96			8.115			
		Median	6.24	2.73	0.305	0.43	0.045	1.07	38.3	193.13	80	7.68	41	9600	190	7.96			8.115			

Basin 410																				
Base Flow																				
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
1/12/94	941543	410	8.71	2.35	0.03	0.04	0.01	0.23	1.9	160.7	118	7.97	3.4	180	280	6.5	11.8	13.26	0.03	0.45	
9/20/94	950766	410	11.86	1.09	0.03	0.07	0.05	0.84	5.6	189.3	142	8.19	4.1	200	320	17.1	6.9	6.86			4.08
10/15/93	940930	410	8.33	2.58	0.05	0.08	<.01	0.22	8.8	103	118	7.72	5.6	40	280	13	8.3	12.11	0.013	1.62	
3/21/94	941884	410	8.23	2.43	0.01	0.07	0.0135	0.5	12.4	144.3	80	7.99	4.1	290	220	12.5	10.3	11.75	0.007	0.95	
8/5/93	940434	410	10.81	1.9	0.039	0.09	0.03	0.58	17	231.8	134	7.82	3.9			20	5.5	6.07		0.94	
		Min	8.23	1.09	0.01	0.04	0.01	0.22	1.9	103	80	7.72	3.4	40	220	6.5	5.5	6.07	0.007	0.45	4.08
		Max	11.86	2.58	0.05	0.09	0.05	0.84	17	231.8	142	8.19	5.6	290	320	20	11.8	13.26	0.03	1.62	4.08
		Mean	9.588	2.07	0.0318	0.07	0.025875	0.474	9.13	165.8	118.4	7.938	4.22	177.5	275	13.82	8.56	10.01	0.017	0.99	4.08
		Median	8.71	2.35	0.03	0.07	0.0135	0.5	8.8	160.7	118	7.97	4.1	190	280	12.5	8.3	11.75	0.013	0.945	4.08

Storm Samples																			
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l		mg/l	mg/l
4/20/95	952629	4101	3.38	0.72	0.22	0.48	0.12	1.52	110	100.8	34	7.14	56	17600	94	7.92			
4/20/95	952633	4102	3.47	0.79	0.17	0.39	0.1	1.2	83.7	102.8	32	7.16	56	[illegible]	98	[illegible]			
		Min	3.38	0.72	0.17	0.39	0.1	1.2	83.7	100.8	32	7.14	56	3600	94	7.92			9.19
		Max	3.47	0.79	0.22	0.48	0.12	1.52	110	102.8	34	7.16	56	17600	98	7.94			9.68
		Mean	3.425	0.755	0.195	0.44	0.11	1.36	96.6	101.8	33	7.15	56	10600	96	7.93			9.435
		Median	3.425	0.755	0.195	0.44	0.11	1.36	96.6	101.8	33	7.15	56	10600	96	7.93			9.435

Basin 420																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
10/14/93	940919	420	7.56	1.8	0.01	0.04	0.02	0.4	9	179.7	114	7.54	7.25	210	275	15.2	8.1	18.16	0.02	0.35	
7/28/93	940306	420	9.66	1.569	0.007	0.07	0.05	0.6	15.9	252	144	7.97	7.2			24	7	17.29		1.45	
9/20/94	950767	420	11.4	0.35	0.01	0.09	1.9	2	15.35	244.75	202	8.05	9.3	110	420	16.5	3.3	12.43			6.4
1/11/94	941501	420	4.77	1.25	0	0.01	0.02	0.42	7.1	110.3	86	7.75	2.2	330	220	6	12.6	17.07	<.01	0.91	
3/20/94	941865	420	5.42	1.3	0	0.044	0.0131	0.369	7.3	112.5	72	7.87	5.4	190	190	13.5	10.6	13.15	0.006	0.59	
		Min	4.77	0.35	0	0.01	0.0131	0.369	7.1	110.3	72	7.54	2.2	110	190	6	3.3	12.43	0.006	0.35	6.4
		Max	11.4	1.8	0.01	0.09	1.9	2	15.9	252	202	8.05	9.3	330	420	24	12.6	18.16	0.02	1.45	6.4
		Mean	7.762	1.2538	0.0054	0.0508	0.40062	0.7578	10.93	179.85	123.6	7.836	6.27	210	276.25	15.04	8.32	15.62	0.013	0.825	6.4
		Median	7.56	1.3	0.01	0.044	0.02	0.42	9	179.7	114	7.87	7.2	200	247.5	15.2	8.1	17.07	0.006	0.91	6.4

Storm Samples																			
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	ma/l	mg/l	mg/l
4/20/95	952626	4201	3.31	0.52	0.06	0.16	0.06	0.96	36.45	93	40	7.39	34	3300	106	9.83			9.21
4/20/95	952630	4202	3.01	0.48	0.06	0.17	0.07	1.1	34.75	91.75	40	7.37	37	5400	106	8.69			7.31
		Min	3.01	0.48	0.06	0.16	0.06	0.96	34.75	91.75	40	7.37	34	3300	106	8.69			7.31
		Max	3.31	0.52	0.06	0.17	0.07	1.1	36.45	93	40	7.39	37	5400	106	9.83			9.21
		Mean	3.16	0.5	0.06	0.165	0.065	1.03	35.6	92.375	40	7.38	35.5	4350	106	9.26			8.26
		Median	3.16	0.5	0.06	0.165	0.065	1.03	35.6	92.375	40	7.38	35.5	4350	106	9.26			8.26

Basin 430 Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
8/5/93	940436	430	7.32	1.453	0.072	0.13	0.04	0.57	8.8	209.3	110	7.77	5.8			21	4.3	6.14		1.05	
9/20/94	950764	430	6.26	1.07	0.05	0.11	0.14	1.28	4.1	137.75	94	8.23	5.1	40	230	17	5.4	6.88			6.38
3/20/94	941864	430	5.57	2.59	0.01	0.072	0.0142	0.445	6.7	111	72	8.04	6.5	490	195	14	10.4	9.66	0.008	0.69	
10/14/93	940918	430	7.08	2.51	0	0.03	<.01	0.38	10.6	157.5	96	8.02	5.2	650	235	14.5	10.1	11.25	0.017	0.74	
1/11/94	941500	430	6.09	2.33	0.01	0.02	0.03	0.5	7	133	100	7.96	3.6	30	260	5.5	12.2	13.4	0.02	0.73	
		Min	5.57	1.07	0	0.02	0.0142	0.38	4.1	111	72	7.77	3.6	30	195	5.5	4.3	6.14	0.008	0.69	6.38
		Max	7.32	2.59	0.072	0.13	0.14	1.28	10.6	209.3	110	8.23	6.5	650	260	21	12.2	13.4	0.02	1.05	6.38
		Mean	6.464	1.9906	0.0284	0.0724	0.05605	0.635	7.44	149.71	94.4	8.004	5.24	302.5	230	14.4	8.48	9.466	0.015	0.8025	6.38
		Median	6.26	2.33	0.01	0.072	0.014	0.5	7	137.75	96	8.02	5.2	265	232.5	14.5	10.1	9.66	0.017	0.735	6.38

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/20/95	952627	4301	4.93	1.64	0.19	0.36	0.1	1.28	61.7	109.75	32	7.08	55	16800	102	7.13			9.37
4/20/95	952631	4302	4.77	1.24	0.13	0.24	0.07	1.28	48	93.75	28	7.16	44	8200	94	7.39			9.92
		Min	4.77	1.24	0.13	0.24	0.07	1.28	48	93.75	28	7.08	44	8200	94	7.13			9.37
		Max	4.93	1.64	0.19	0.36	0.1	1.28	61.7	109.75	32	7.16	55	16800	102	7.39			9.92
		Mean	4.85	1.44	0.16	0.3	0.085	1.28	54.9	101.75	30	7.12	49.5	12500	98	7.26			9.645
		Median	4.77	1.24	0.13	0.24	0.07	1.28	48	93.75	28	7.12	44	8200	94	7.26			9.645

Basin 440																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
8/5/93	940437	440	4.03	0.027	0.078	0.16	0.03	0.84	9.6	89	28	7.37	4			20	6.4	5.2		0.97	
9/20/94	950763	440	4.2	0.03	0.05	0.09	0.63	1.6	6.35	57.25	30	7.36	5.5	10	91	18.2	7.8	5.96			7.49
10/14/93	940917	440	4.26	0.91	0.01	0.05	0.08	0.78	8.4	52.5	22	7.6	4	30	85	17.5	9	6.22	0.025	1.95	
3/20/94	941863	440	4.95	0.97	0.03	0.112	<0.01	0.685	6.5	52	18	7.3	5.8	0	79	12	9.3	8.1	0.012	2.43	
1/11/94	941499	440	5.24	0.96	0.06	0.06	0.23	0.72	6.3	35	20	7.11	5.4	1010	81	3	12	8.52	0.04	0.08	
		Min	4.03	0.027	0.01	0.05	0.03	0.685	6.3	35	18	7.11	4	0	79	3	6.4	5.2	0.012	0.08	7.49
		Max	5.24	0.97	0.078	0.16	0.63	1.6	9.6	89	30	7.6	5.8	1010	91	20	12	8.52	0.04	2.43	7.49
		Mean	4.536	0.5794	0.0456	0.0944	0.2425	0.925	7.43	57.15	23.6	7.348	4.94	262.5	84	14.14	8.9	6.8	0.026	1.3575	7.49
		Median	4.26	0.91	0.05	0.09	0.03	0.78	6.5	52.5	22	7.36	5.4	20	83	17.5	9	6.22	0.025	1.46	7.49
Storm Samples																					

Basin 450

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
9/20/94	950765	450	10.68	1.49	0.06	0.07	0.08	0.72	6.15	180	132	8.23	3	2500	295	16.8	8.7	3.06			2.81
3/21/94	941883	450	8.47	2.49	0.01	0.056	0.015	0.31	5	122	80	7.91	3.3	660	180	12	11.1	11.99	0.003	0.47	
8/5/93	940435	450	9.54	2.135	0.047	0.08	0.03	0.31	6	218	116	7.92	3.2			17	6.8	2.94		0.88	
1/12/94	941542	450	6.78	2.27	0.09	0.08	0.03	0.36	3.3	136.2	104	8	2.3	500	240	10	10.8	5.37	0.02	0.65	
10/15/93	940931	450	7.77	2.38	0.04	0.05	0.01	0.03	3.7	87	104	7.89	2	940	250	13	9.4	4.55	0.006	1.59	
		Min	6.78	1.49	0.01	0.05	0.01	0.03	3.3	87	80	7.89	2	500	180	10	6.8	2.94	0.003	0.47	2.81
		Max	10.68	2.49	0.09	0.08	0.08	0.72	6.15	218	132	8.23	3.3	2500	295	17	11.1	11.99	0.02	1.59	2.81
		Mean	8.648	2.153	0.0494	0.0672	0.033	0.346	4.83	148.64	107.2	7.99	2.76	1150	241.25	13.76	9.36	5.582	0.01	0.8975	2.81
		Median	8.47	2.27	0.047	0.07	0.03	0.31	5	136.2	104	7.92	3	800	245	13	9.4	4.55	0.006	76.5	2.81

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/20/95	952628	4501	5.05	1.14	0.35	0.53	0.19	1.92	30.3	151	68	6.91	28	30000	150	6.08			40.24
4/20/95	952632	4502	2.36	0.8	0.26	0.44	0.09	1.22	50.5	92	28	7.14	57	33000	75	4.81			8.64
		Min	2.36	0.8	0.26	0.44	0.09	1.22	30.3	92	28	6.91	28	30000	75	4.81			8.64
		Max	5.05	1.14	0.35	0.53	0.19	1.92	50.5	151	68	7.14	57	33000	150	6.08			40.24
		Mean	3.705	0.97	0.305	0.485	0.14	1.57	40.4	121.5	48	7.03	42.5	31500	112.5	5.445			24.44
		Median	2.36	0.8	0.26	0.44	0.09	1.22	40.4	92	28	7.03	42.5	31500	75	4.81			8.64

Basin 510

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
1/11/94	941491	510	9.88	1.48	0.01	0	0.01	0.25	5.1	101.5	86	7.11	0.6	20	230	10.5	9.3	8.35	<.01	0.85	
9/20/94	950754	510	16.93	0.97	<0.01	<0.02	0.01	0.42	1.15	180.5	120	7.14	1.1	20	310	15.7	7	7.35			0.91
8/4/93	940408	510	14.08	1.434	0.006	0.02	<.01	<.01	0.5	153.3	204	7.12	0.5			16	7.5	8.28		1.15	
3/20/94	941854	510	5.21	1.17	0.01	0.015	<0.01	<0.01	0.65	85.75	64	7.56	1.1	110	165	9.5	10.8	7.96	<0.01	1.05	
10/14/93	940909	510	13.55	1.24	0.01	0.01	<.01	0.04	1.2	121	98	7.2	0.3	10	255	16	7.7	9.2	0.006	1.19	
		Min	5.21	0.97	0.006	0	0.01	0.04	0.5	85.75	64	7.11	0.3	10	165	9.5	7	7.35	0.006	0.85	0.91
		Max	16.93	1.48	0.01	0.02	0.01	0.42	5.1	180.5	204	7.56	1.1	110	310	16	10.8	9.2	0.006	1.19	0.91
		Mean	11.93	1.2588	0.009	0.01125	0.01	0.24	1.72	128.41	114.4	7.226	0.72	40	240	13.54	8.46	8.228	0.006	1.06	0.91
		Median	13.55	1.24	0.01	0.01	0	0.04	1.15	121	98	7.14	0.6	20	242.5	15.7	7.7	8.28	0	1.1	0.91

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
5/8/95	952742	5101	3.22	0.63	0.03	0.4	0.02	1.44	344	108.75	50	7.32	81	3200	107	7.01			9.32
5/8/95	952744	5102	3.68	0.71	0.03	0.17	0.01	0.86	205	106	52	7.65	65	2800	113	7.02			7.29
		Min	3.22	0.63	0.03	0.17	0.01	0.86	205	106	50	7.32	65	2800	107	7.01			7.29
		Max	3.68	0.71	0.03	0.4	0.02	1.44	344	108.75	52	7.65	81	3200	113	7.02			9.32
		Mean	3.45	0.67	0.03	0.285	0.015	1.15	274	107.375	51	7.485	73	3000	110	7.015			8.305
		Median	3.45	0.67	0.03	0.17	0.01	0.86	205	106	51	7.485	65	2800	110	7.015			7.29

Basin 520																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
9/20/94	950755	520	18.98	1.37	0.18	0.17	0.01	0.52	9.3	189.75	118	7.89	6	10	320	18.5	7.2	13.59			1.76
8/4/93	940409	520	13.01	2.319	0.227	0.22	<.01	0.06	6.7	164	110	7.81	5.7			23	6.6	8.98		0.65	
3/20/94	941855	520	7.02	3.07	0.08	0.128	<0.01	0.113	18.8	116.75	86	7.82	8.1	100	225	13.5	9.4	8.17	0.003	0.81	
10/14/93	940910	520	11.29	2.57	0.07	0.08	0.01	0.09	4	134.5	110	7.95	2.8	80	270	14.2	9.4	10.63	0.01	1.43	
1/11/94	941492	520	9.62	3.1	0.12	0.1	0.02	0.08	8.4	128.8	106	7.77	1.6	40	270	5.5	11.2	9.14	<.01	0.1	
		Min	7.02	1.37	0.07	0.08	0.01	0.06	4	116.75	86	7.77	1.6	10	225	5.5	6.6	8.17	0.003	0.1	1.76
		Max	18.98	3.1	0.227	0.22	0.02	0.52	18.8	189.75	118	7.95	8.1	100	320	23	11.2	13.59	0.01	1.43	1.76
		Mean	11.984	2.4858	0.1354	0.1396	0.013	0.1726	9.43	146.76	106	7.848	4.84	57.5	271.25	14.94	8.76	10.102	0.0065	0.7475	1.76
		Median	11.29	2.57	0.12	0.128	0.01	0.09	8.4	134.5	110	7.82	5.7	60	270	14.2	9.4	9.14	0.003	0.73	1.76

Storm Samples																			
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952255	5201	8.85	2.03	0.2	0.55	0.1	2.16	310	142.25	76	7.88	73	12000	200	10.3			7.8
3/7/95	952259	5202	7.08	1.43	0.27	0.93	0.2	3.16	491	146.5	38	7.76	89	25000	160	10.89			12.59
3/8/95	952282	5203	4.33	1.59	0.05	0.09	0.02	0.47	7.4	101.5	54	7.52	13	5400	151	6.06			5.03
		Min	4.33	1.43	0.05	0.09	0.02	0.47	7.4	101.5	38	7.52	13	5400	151	6.06			5.03
		Max	8.85	2.03	0.27	0.93	0.2	3.16	491	146.5	76	7.88	89	25000	200	10.89			12.59
		Mean	6.7533	1.6833	0.1733	0.5233	0.107	1.93	270	130.08	56	7.72	58.33	14133.333	170.33	9.083			8.4733
		Median	7.08	1.59	0.27	0.55	0.1	2.16	310	142.25	54	7.76	73	12000	160	10.3			7.8

Basin 530

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/21/94	941871	530	3.84	1.63	0.01	0.032	0.0105	0.23	1.2	87.25	60	7.77	1.7	180	150	10.5	11.3	4.87	0	0.88	
10/15/93	940923	530	7.51	1.39	0.03	0.02	<.01	0.04	1.6	135	94	7.73	0.2	120	215	13	8.1	5.16	0.001	0.94	
8/4/93	940412	530	8.08	0.737	0.04	0.04	<.01	0.09	0.3	104	94	7.8	0.4			22	7.4	3.77		0.25	
		530	8.12	0.42	0.04	0.04	0.02	0.52	<0.20	154.8	108	7.96	0.4	500	240	18.5	8.1	3.01			2.78
		530	7.74	1.43	0.03	0.03	0.01	0.35	0.9	146	90	7.55	0.5	0	220	6.5	11	5.51	<.01	0.42	
		Min	3.84	0.42	0.01	0.02	0.01	0.04	0.3	87.25	60	7.55	0.2	0	150	6.5	7.4	3.01	0	0.25	2.78
		Max	8.12	1.63	0.04	0.04	0.02	0.52	1.6	154.8	108	7.96	1.7	500	240	22	11.3	5.51	0.001	0.94	2.78
		Mean	7.058	1.1214	0.03	0.0324	0.0135	0.246	1	125.4	89.2	7.762	0.64	200	206.25	14.1	9.18	4.464	0.0005	0.6225	2.78
		Median	7.74	1.39	0.03	0.032	0.01	0.23	1.2	135	94	7.77	0.4	150	217.5	13	8.1	4.87	0	0.65	2.

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952256	5301	4.24	1.38	0.09	0.19	0.04	0.96	18.4	103.5	56	7.84	26	3100	140	6.19			7.04
3/7/95	**952260**	5302	4.2	1.37	0.08	0.19	0.03	0.84	18.35	104.3	54	7.67	23	6400	140	5.93			7.42
3/8/95	**952280**	5303	4.32	1.6	0.04	0.09	0.01	0.44	3.8	103	54	7.58	13	390	150	5.91			4.3
		Min	4.2	1.37	0.04	0.09	0.01	0.44	3.8	103	54	7.58	13	390	140	5.91			4.3
		Max	4.32	1.6	0.09	0.19	0.04	0.96	18.4	104.3	56	7.84	26	6400	150	6.19			7.42
		Mean	4.253	1.45	0.07	0.1567	0.0267	0.747	13.52	103.6	54.67	7.697	20.67	3296.66667	143.33	6.01			6.2533
		Median	4.24	1.38	0.08	0.19	0.03	0.84	18.35	103.5	54	7.67	23	3100	140	5.93			7.04

Basin 540																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
10/15/93	940924	540	5.06	0.46	0.05	0.05	0.02	0.24	5.1	128.8	104	7.56	1.7	1400	205	13	7.3	3.16	0.012	1.56	
1/12/94	941529	540	3.51	0.52	0.05	0.06	0.03	0.34	0.7	124.7	94	7.52	1	600	190	8	9.2	3.45	0.01	0.27	
8/4/93	940415	540	4.46	0.437	0.093	0.11	0.05	0.6	8.2	100.3	96	7.74	3.5			23	7.4	2.92		0.62	
9/21/94	950791	540	4.67	0.35	0.05	0.08	0.03	0.66	3.5	134.75	108	8.02	2.1	420	230	20.2	6.6	2.48			1.15
3/21/94	941872	540	2.08	0.6	0.04	0.034	0.0203	0.28	6.6	62.5	60	7.74	2.5	870	140	9	11	4.55	0	0.67	
		Min	2.08	0.35	0.04	0.034	0.02	0.24	0.7	62.5	60	7.52	1	420	140	8	6.6	2.48	0	0.27	1.15
		Max	5.06	0.6	0.093	0.11	0.05	0.66	8.2	134.75	108	8.02	3.5	1400	230	23	11	4.55	0.012	1.56	1.15
		Mean	3.956	0.4734	0.0566	0.0668	0.03006	0.424	4.82	110.21	92.4	7.716	2.16	822.5	191.25	14.64	8.3	3.312	0.007	0.78	1.15
		Median	4.46	0.46	0.05	0.06	0.03	0.34	5.1	124.7	96	7.74	2.1	735	197.5	13	7.4	3.16	0.01	0.645	1.15

Storm Samples																			
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/6/94	942001	5400	1.39	0.35	0.05	0.07	0.0211	0.43	26.9	81.25	52	7.5	18	9000	119	4.28	0.001	0.48	
4/6/94	942017	5400	1.76	0.37	0.03	0.02	0.013	0.298	8.3	75	46	7.55	7	47000	110	4.5	0	0.59	
4/5/94	941975	5400	1.86	0.42	0.03	0.024	0.02	0.33	1.8	83.5	60	7.78	3.8	820	140	4.48	0	0.41	
4/6/94	942004	5400	1.84	0.34	0.02	0.01	<0.01	0.232	8	68	44	7.52	8	1500	107	4.48	0	0.38	
4/5/94	941983	5400	2.72	0.68	0.46	0.708	0.33	1.8	78.4	96.25	56	7.5	48	190000	140	4.34	0.028	2.64	
7/21/94	950235	5401	4.56	0.81	0.16	0.3	0.1	0.62	29.8	144.75	98	8.07	35	53000	220	5.77	0.032	1.08	
7/25/94	950274	5401	4.51	0.81	0.19	0.28	0.07	0.55	17.3	145.25	100	7.61	18	56000	230	6.51	0.027	1.52	
7/13/94	950059	5401	4.13	1.2	0.74	0.93	0.16	0.84	50.5	141	76	7.55	46	1160000	190	4.63	0.055	3.42	
5/8/95	952754	5401	1.3	0.38	0.06	0.21	0.02	1.02	232	80	30	7	63	2400	72	4.07			6.79
3/7/95	952217	5401	2.29	0.77	0.07	0.13	0.06	1.2	66.2	89.5	56	7.68	23	7000	120	4.9			5.69
7/13/94	950067	5402	4.23	0.88	0.19	0.28	0.07	0.62	20	136	96	7.7	13	23000	220	4.3	0.019	2.19	
5/8/95	952763	5402	1.51	0.53	0.06	0.17	0.02	0.68	100	65	34	7.13	43	2200	84	4.01			5.05
3/7/95	952225	5402	2.24	0.81	0.06	0.14	0.04	0.8	17.7	93	56	7.72	18	3700	130	4.81			4.62
11/4/94	951317	5402	4.54	2.05	0.59	1.2	0.18	2.88	253	184.25	62	7.63	95	57000	220	27.92			13.76
7/14/94	950074	5403	3.99	0.92	0.08	0.13	0.04	0.37	10.9	135.75	98	7.7	7	9500	215	3.38	0.011	1.22	
3/8/95	952273	5403	2.7	0.97	0.04	0.08	0.05	0.54	7.2	82.25	52	7.81	11	2300	120	4.63			3.88
11/4/94	951325	5403	5.21	2.18	0.45	0.94	0.15	1.06	92	200.25	72	7.45	59	150000	285	56.43			9.93
5/9/95	952774	5403	1.75	0.71	0.05	0.08	0.02	0.6	44.1	60.5	40	7.14	25	860	94	4.13			5.63
11/6/94	951335	5404	4.7	2.93	0.42	0.73	0.18	1.4	131	175.25	64	7.29	43	25000	240	44.27			8.39
7/14/94	950081	5404	4.18	0.75	0.08	0.14	0.07	0.89	23.2	0.019	100	7.66	8.4	42000	220	3.38	0.019	1.32	
5/9/95	952879	5404	2.26	1.04	0.03	0.04	0.02	0.34	10.8	69.5	48	7.33	8	390	111	4.85			3.3
11/6/94	951343	5405	5.17	3.34	0.16	0.27	0.05	0.92	33.4	154.75	78	7.47	15	7700	220	20.95			5.72
11/7/94	951358	5406	4.14	2.22	0.06	0.09	0.03	0.64	16.3	124.5	70	7.1	7	2700	180	8.31			3.6
		Min	1.3	0.34	0.02	0.01	0.013	0.232	1.8	0.019	30	7	3.8	390	72	3.38	0	0.38	3.3
		Max	5.21	3.34	0.74	1.2	0.33	2.88	253	200.25	100	8.07	95	1160000	285	56.43	0.055	3.42	13.76
		Mean	3.177	1.107	0.1774	0.3031	0.07791	0.829	55.6	108.07	64.7	7.517	27.05	80568.2609	164.65	10.41	0.017	1.386	6.363
		Median	2.72	0.81	0.07	0.14	0.05	0.64	26.9	93	60	7.55	18	9000	140	4.63	0.019	1.22	5.66

Basin 550

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/21/94	941870	550	7.72	2.59	0.03	0.05	0.0115	0.21	0.65	114.5	80	7.86	1.1	20	195	9.5	11.7	4.61	0.002	0.58	
10/15/93	No Flow	550																			
1/12/94	No Flow	550																			
8/4/93	No Flow	550																			
9/21/94	No Flow	550																			
		Min	7.72	2.59	0.03	0.05	0.0115	0.21	0.65	114.5	80	7.86	1.1	20	195	9.5	11.7	4.61	0.002	0.58	0
		Max	7.72	2.59	0.03	0.05	0.0115	0.21	0.65	114.5	80	7.86	1.1	20	195	9.5	11.7	4.61	0.002	0.58	0
		Mean	7.72	2.59	0.03	0.05	0.0115	0.21	0.65	114.5	80	7.86	1.1	20	195	9.5	11.7	4.61	0.002	0.58	
		Median	7.72	2.59	0.03	0.05	0.0115	0.21	0.65	114.5	80	7.86	1.1	20	195	9.5	11.7	4.61	0.002	0.58	

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952254	5501	8.53	1.98	0.05	0.15	0.03	0.62	11.9	130.3	66	7.79	24	4200	170	4.29			6.17
3/7/95	952258	5502	12.2	2.24	0.05	0.14	0.02	0.8	11.2	134.5	70	7.86	20	1900	190	4.61			5.32
3/8/95	952279	5503	13.6	3.76	0.07	0.1	0.02	0.42	2.75	148	76	7.35	6.5	1200	240	5.66			3.34
		Min	8.53	1.98	0.05	0.1	0.02	0.42	2.75	130.3	66	7.35	6.5	1200	170	4.29			3.34
		Max	13.6	3.76	0.07	0.15	0.03	0.8	11.9	148	76	7.86	24	4200	240	5.66			6.17
		Mean	11.4	2.66	0.057	0.13	0.0233	0.61	8.58	137.6	70.67	7.67	16.83	2433.3333	200	4.853			4.943
		Median	12.2	2.24	0.05	0.14	0.02	0.62	11.2	134.5	70	7.79	20	1900	190	4.61			5.32

Basin 610

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
10/14/93	940906	610	7.88	2.52	0.01	0.02	<.01	0.17	4.4	126	102	7.76	2.6	30	230	14.1	7.2	5.17	0.01	0.33	
3/20/94	941852	610	5.72	3.74	0.01	0.048	0.0113	0.167	7.25	99.25	65	7.79	3.7	30	170	14	10.2	6.37	0.007	0.96	
1/11/94	941488	610	6.92	2.97	0	0.02	<.01	0.2	5.9	94.5	88	7.67	1.6	170	210	4	11.2	4.98	<.01	0.56	
9/20/94	950751	610	12.36	0.14	0.01	<0.02	0.01	0.4	1.35	197.5	80	7.67	0.9	350	320	20	7.4	55.06			2.29
8/4/93	940406	610	8.31	1.639	0.04	0.07	<.01	0.08	2	127.5	94	7.53	2.7			23	5.2	4.34		0.65	
		Min	5.72	0.14	0	0.02	0.01	0.08	1.35	94.5	65	7.53	0.9	30	170	4	5.2	4.34	0.007	0.33	2.29
		Max	12.36	3.74	0.04	0.07	0.0113	0.4	7.25	197.5	102	7.79	3.7	350	320	23	11.2	55.06	0.01	0.96	2.29
		Mean	8.238	2.2018	0.014	0.0395	0.01065	0.2034	4.18	128.95	85.8	7.684	2.3	145	232.5	15.02	8.24	15.184	0.0085	0.625	2.29
		Median	7.88	2.52	0.01	0.02	0	0.2	4.4	126	88	7.67	2.6	100	220	14.1	7.4	5.17	0.007	0.605	2.29

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
5/8/95	952749	6101	5.15	2.08	0.09	0.16	0.03	1.02	51.9	120.25	54	7.56	32	9100	139	4.72			8.05		
5/8/95	952748	6102	4.37	1.85	0.24	0.5	0.07	1.78	181	129.5	46	7.63	85	17000	119	4.47			11.58		
		Min	4.37	1.85	0.09	0.16	0.03	1.02	51.9	120.25	46	7.56	32	9100	119	4.47			8.05		
		Max	5.15	2.08	0.24	0.5	0.07	1.78	181	129.5	54	7.63	85	17000	139	4.72			11.58		
		Mean	4.76	1.965	0.165	0.33	0.05	1.4	117	124.88	50	7.595	58.5	13050	129	4.595			9.815		
		Median	4.76	1.965	0.165	0.33	0.05	1.4	117	124.88	50	7.595	58.5	13050	129	4.595			9.815		

Little Flint

Basin 620																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
10/14/93	940905	620	10.9	0.2	0.008	0.02	<.01	0.09	1.7	178.5	96	7.99	0.7	200	310	18.2	7.8	50.29	0.002	0.38	
8/4/93	940405	620	10.9	0.2	0.015	0.03	<.01	<.01	2.6	187.3	96	7.85	2.4			23	7.1	50.02		0.71	
1/11/94	941487	620	9.68	0.73	0	0.01	0.01	0.02	2.5	131.5	100	7.77	1	380	320	7	9.3	50.99	<.01	0.9	
9/20/94	950752	620	8.79	0.88	0.02	0.02	0.03	0.44	2.65	136.5	98	7.43	2.1	50	230	17.2	6.1	3.53			2.13
3/20/94	941851	620	9	0.75	0.01	0.02	0.0131	0.053	2.4	162.75	92	7.95	1.2	50	310	16	10	44.84	0.002	0.06	
		Min	8.79	0.2	0	0.01	0.01	0.02	1.7	131.5	92	7.43	0.7	50	230	7	6.1	3.53	0.002	0.06	2.13
		Max	10.9	0.88	0.02	0.03	0.03	0.44	2.65	187.3	100	7.99	2.4	380	320	23	10	50.99	0.002	0.9	2.13
		Mean	9.854	0.552	0.0106	0.02	0.0177	0.15075	2.37	159.31	96.4	7.798	1.48	170	292.5	16.28	8.06	39.934	0.002	0.5125	2.13
		Median	9.68	0.73	0.01	0.02	0.01	0.053	2.5	162.75	96	7.85	1.2	125	310	17.2	7.8	50.02	0.002	0.545	2.13

Storm Samples																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
5/8/95	952747	6201	5.16	0.62	0.09	0.26	0.04	1	122	124.5	62	7.81	42	7000	145	20.12			10.15		
		Min	5.16	0.62	0.09	0.26	0.04	1	122	124.5	62	7.81	42	7000	145	20.12			10.15		
		Max	5.16	0.62	0.09	0.26	0.04	1	122	124.5	62	7.81	42	7000	145	20.12			10.15		
		Mean	5.16	0.62	0.09	0.26	0.04	1	122	124.5	62	7.81	42	7000	145	20.12			10.15		
		Median	5.16	0.62	0.09	0.26	0.04	1	122	124.5	62	7.81	42	7000	145	20.12			10.15		

Basin 630

Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBCD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
8/4/93	940407	630	13.1	1.622	0.036	0.05	<.01	0.1	1.3	177	102	7.81	0.8			22	7	7.92		1.05	
3/20/94	941853	630	6.57	2.45	0.05	0.062	0.013	0.153	2.05	96.5	72	7.95	2.4	30	190	14	10.4	7.83	0.006	0.14	
10/14/93	940907	630	9.48	2.97	0.05	0.02	<.01	0.12	2.6	130	100	7.96	1.2	40	250	12.8	8.9	7.96	0.009	0.67	
1/11/94	941489	630	7.87	3.13	0.05	0.02	0.01	0.08	3.4	112.5	96	7.65	0.8	50	240	6	10.3	7.82	<.01	0.23	
9/20/94	950753	630	11.9	1.39	0.04	0.03	0.01	0.54	0.55	163.25	116	7.8	0.9	70	290	16.8	6.9	7.16			1.91
		Min	6.57	1.39	0.036	0.02	0.01	0.08	0.55	96.5	72	7.65	0.8	30	190	6	6.9	7.16	0.006	0.14	1.91
		Max	13.1	3.13	0.05	0.062	0.013	0.54	3.4	177	116	7.96	2.4	70	290	22	10.4	7.96	0.009	1.05	1.91
		Mean	9.77	2.3124	0.0452	0.0364	0.011	0.1986	1.98	135.85	97.2	7.834	1.22	47.5	242.5	14.32	8.7	7.738	0.0075	0.5225	1.91
		Median	9.48	2.45	0.05	0.03	0.01	0.12	2.05	130	100	7.81	0.9	45	245	14	8.9	7.83	0.006	0.45	1.91

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
4/6/94	941999	6300	3.63	0.85	0.13	0.35	0.21	1.56	129	98.5	46	7.4	59	62000	123	5.92	0.011	3.31	
4/5/94	941973	6300	6.88	2.34	0.04	0.072	0.04	0.54	15.1	147.25	74	7.55	8.8	140	210	8.45	0.012	1.49	
4/6/94	942016	6300	6.27	1.2	0.15	0.31	0.162	1.4	22.4	128.5	54	7.52	36	29000	150	7.52	0.01	2.85	
4/6/94	942002	6300	5.34	1	0.19	0.37	0.183	1.52	34.9	119.25	58	7.41	44	19000	140	6.06	0.01	2.55	
4/5/94	941981	6300	6.67	2.39	0.05	0.134	0.04	0.75	35.1	126.25	76	7.76	16	390	205	8.18	0.011	0.53	
7/13/94	950057	6301	8.58	1.59	0.05	0.17	0.11	0.62	59.7	131.5	78	7.76	20	98000	210	7.62	0.027	2.2	
7/21/94	950233	6301	9.4	1.69	0.05	0.06	0.02	0.5	2.9	150.25	98	7.94	2	1070	255	7.02	<0.010	0.8	
7/25/94	950272	6301	8.4	1.76	0.04	0.14	0.04	0.61	36.6	147.5	92	7.86	14	4600	240	7.05	0.02	1.31	
5/8/95	952752	6301	2.79	0.29	0.57	0.74	0.13	2.16	118	100.75	34	7.14	42	51000	84	2.58			16.32
11/4/94	951311	6301	9.98	1.74	0.09	0.2	0.15	0.8	10.1	148	104	7.75	11	90000	245	7.68			4.9
3/7/95	952215	6301	8.06	0.95	0.55	0.46	0.39	2.8	51.9	123	36	7.9	48	31000	135	5.68			21.96
3/7/95	952223	6302	9.01	1.16	0.56	0.44	0.39	1.46	37.1	128	46	7.58	45	70000	145	6.94			19.96
5/8/95	952761	6302	3.31	0.37	0.64	0.92	0.11	2	50.5	83.75	40	7.22	30	47000	101	3.12			17.18
7/13/94	950065	6302	7.54	1.17	0.1	0.18	0.09	0.88	24.1	113.75	68	7.78	13	117000	180	7.51	0.02	2.28	
7/25/94	950277	6302	8.41	1.86	0.05	0.08	0.04	0.47	12	143.5	86	7.84	6	39000	225	7.49	0.022	1.13	
11/4/94	951315	6302	7.83	1.64	0.17	0.52	0.14	1.88	114	135.75	92	7.65	43	210000	225	7.28			6.56
11/4/94	951323	6303	3.14	0.59	0.3	0.67	0.15	1.68	197	95.5	46	7.2	79	86000	100	4.42			10.19
3/8/95	952270	6303	8.99	1.83	0.3	0.45	0.12	1.44	11.2	142.25	64	7.63	30	6400	170	8.94			11.95
5/9/95	952772	6303	4.29	0.51	0.36	0.93	0.17	0.92	23.7	85	46	7.16	22	46000	118	4.09			17.66
7/14/94	950072	6303	8.05	1.67	0.05	0.07	0.03	0.34	5.5	134.75	80	7.83	6	50000	215	7.19	0.011	1.31	
7/14/94	950079	6304	9.09	2.11	0.03	0.05	0.01	0.26	2.3	157.5	100	7.92	2	710	250	7.33	0.01	0.55	
11/6/94	951333	6304	2.44	0.74	0.44	0.79	0.12	1.17	52.8	88.5	44	7.7	34	35000	95	4.31			11.54
5/9/95	952876	6304	7.27	1.17	0.44	0.5	0.19	1.92	7.96	124.25	66	7.7	12	18000	170	7.03			9.39
11/6/94	951341	6305	3.1	0.86	0.63	0.7	0.07	1.22	38.5	92	48	7.37	32	25000	100	5.19			10.98
11/7/94	951355	6306	5.05	1.86	0.4	0.51	0.06	1.02	9.1	127.75	72	7.59	21	10000	125	8.92			11.14
		Min	2.44	0.29	0.03	0.05	0.01	0.26	2.3	83.75	34	7.14	2	140	84	2.58	0.01	0.53	4.9
		Max	9.98	2.39	0.64	0.93	0.39	2.8	197	157.5	104	7.94	79	210000	255	8.94	0.027	3.31	21.96
		Mean	6.54	1.3338	0.2552	0.3926	0.127	1.1968	44.1	122.92	65.92	7.606	27.03	45852.4	168.6	6.541	0.015	1.693	13.056
		Median	7.27	1.2	0.17	0.37	0.12	1.17	34.9	127.75	66	7.65	22	35000	170	7.05	0.011	1.4	11.54

Basin 710

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
10/14/93	940912	710	8.33	2.9	0.05	0.04	<.01	0.18	2	152.7	122	7.96	0.25	310	285	14.8	9.6	8.6	0.003	1.02	
3/20/94	941858	710	5.69	3.49	0.03	0.056	0.0111	0.097	1.85	131.75	104	8.05	1.6	40	260	13.5	10	8.61	0.003	0.1	
9/20/94	950757	710	10.15	0.7	0.05	0.04	0.02	0.4	1.2	164	128	7.59	0.9	30	285	18.8	5.5	4.96			1.46
1/11/94	941494	710	8.8	3.48	0.03	0.02	0.01	0.05	8.4	148.5	120	7.78	0.4	20	290	5	11.4	9.4	<.01	0.42	
8/4/93	940410	710	9.22	1.792	0.066	0.06	<.01	0.1	3	156	118	7.79	0.8			24	6	5.25		0.59	
		Min	5.69	0.7	0.03	0.02	0.01	0.05	1.2	131.75	104	7.59	0.25	20	260	5	5.5	4.96	0.003	0.1	1.46
		Max	10.15	3.49	0.066	0.06	0.02	0.4	8.4	164	128	8.05	1.6	310	290	24	11.4	9.4	0.003	1.02	1.46
		Mean	8.438	2.4724	0.0452	0.0432	0.0137	0.1654	3.29	150.59	118.4	7.834	0.79	100	280	15.22	8.5	7.364	0.003	0.5325	1.46
		Median	8.8	2.9	0.05	0.04	0.01	0.1	2	152.7	120	7.79	0.8	35	285	14.8	9.6	8.6	0.003	50.5	1.46

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
3/7/95	952245	7101	3.7	1.98	0.21	0.4	0.1	1.3	116	120.25	48	7.71	58	17000	135	7.47			12.92
3/7/95	952248	7102	3.84	2.22	0.18	0.34	0.1	1.24	34.7	117	52	7.8	39	7500	125	7.7			10.05
3/7/95	952252	7103	4.13	2.36	0.16	0.31	0.07	1.12	56.1	122.75	54	7.92	33	6200	150	7.97			9.08
3/8/95	952267	7104	4.96	2.88	0.09	0.13	0.03	0.72	9.7	124.75	66	7.83	14	1900	175	8.39			4.9
		Min	3.7	1.98	0.09	0.13	0.03	0.72	9.7	117	48	7.71	14	1900	125	7.47			4.9
		Max	4.96	2.88	0.21	0.4	0.1	1.3	116	124.75	66	7.92	58	17000	175	8.39			12.92
		Mean	4.158	2.36	0.16	0.295	0.075	1.095	54.2	121.19	55	7.815	36	8150	146.3	7.883			9.238
		Median	3.985	2.29	0.17	0.325	0.085	1.18	45.4	121.5	53	7.815	36	6850	142.5	7.835			9.565

Wedington

Basin 720																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
1/11/94	941493	720	7.19	3.39	0.06	0.03	0.02	0.07	10.9	141.2	116	7.77	0.7	40	280	7	10.6	6.3	<.01	0.06	
8/4/93	940411	720	9.07	2.418	0.062	0.07	<.01	0.18	0.6	185	122	7.83	0.4			22	7.4	4.5		0.11	
10/14/93	940911	720	8.63	3.4	0.06	0.04	<.01	0.05	1.6	148.5	120	7.93	0.2	30	280	14.8	10.1	5.99	0.006	0.9	
3/20/94	941857	720	6.43	3.56	0.04	0.052	0.0125	0.111	2.05	141.75	102	8.05	1.4	100	235	14	10.3	6.5	0.003	0.68	
9/20/94	950756	720	9.75	1.36	0.06	0.04	0.02	0.36	0.85	180	130	7.75	0.4	20	300	18.1	6.5	3.79			0.91
		Min	6.43	1.36	0.04	0.03	0.0125	0.05	0.6	141.2	102	7.75	0.2	20	235	7	6.5	3.79	0.003	0.06	0.91
		Max	9.75	3.56	0.062	0.07	0.02	0.36	10.9	185	130	8.05	1.4	100	300	22	10.6	6.5	0.006	0.9	0.91
		Mean	8.214	2.8256	0.0564	0.0464	0.0175	0.1542	3.2	159.29	118	7.866	0.62	47.5	273.75	15.18	8.98	5.416	0.0045	0.4375	0.91
		Media	8.63	3.39	0.06	0.04	0.0125	0.111	1.6	148.5	120	7.83	0.4	35	280	14.8	10.1	5.99	0.003	0.395	0.91
Storm Samples																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
3/7/95	952244	7201	3.91	1.81	0.18	0.32	0.07	1.36	43.3	111.25	46	8.02	37	15000	125	7.11			12.22		
3/7/95	952247	7202	4.14	2.15	0.14	0.39	0.05	1.58	31.7	116.5	50	7.84	29	7100	140	7.46			12.2		
3/7/95	952250	7203	4.48	2.38	0.11	0.28	0.04	0.98	51.7	118.25	52	7.85	28	6500	150	7.94			8.99		
3/8/95	952266	7204	5.18	2.97	0.07	0.11	0.02	0.6	14.6	131	54	7.88	12	1200	160	7.7			5.71		
		Min	3.91	1.81	0.07	0.11	0.02	0.6	14.6	111.25	46	7.84	12	1200	125	7.11			5.71		
		Max	5.18	2.97	0.18	0.39	0.07	1.58	51.7	131	54	8.02	37	15000	160	7.94			12.22		
		Mean	4.428	2.3275	0.125	0.275	0.045	1.13	35.3	119.25	50.5	7.898	26.5	7450	143.75	7.553			9.78		
		Median	4.31	2.265	0.125	0.3	0.045	1.17	37.5	117.38	51	7.865	28.5	6800	145	7.58			10.595		

Basin 810

	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
7/28/93	940305	810	11.93	3.242	0.049	0.06	0.04	0.26	2.1	248	105	7.65	2.3			22	5.6	10.56		0.52	
9/20/94	950758	810	11.27	1.88	0.09	0.07	0.04	0.56	5.15	235	178	7.82	3	380	395	16.2	5.9	9.89			1.82
10/14/93	940913	810	10.12	3.78	0	0.05	0.01	0.3	4	179	126	7.73	3.6	130	315	13.8	10.1	15.61	0.017	0.82	
3/20/94	941859	810	8.04	3.41	0.04	0.06	0.0171	0.425	2.9	136	98	7.85	4.9	330	260	14.5	11.2	12.98	0.012	0.74	
1/11/94	**941495**	**810**	**10.27**	**3.27**	**0.01**	**0.02**	**0.02**	**0.21**	**10.1**	**154.5**	**138**	**7.62**	**1.8**	**10**	**320**	**6**	10.4	16.43	0.03	0.52	
		Min	**8.04**	1.88	0	0.02	0.01	0.21	2.1	136	98	7.62	1.8	10	260	6	5.6	9.89	0.012	0.52	1.82
		Max	11.93	3.78	0.09	0.07	0.04	0.56	10.1	248	178	7.85	4.9	380	395	22	11.2	16.43	0.03	0.82	1.82
		Mean	10.326	3.1164	0.0378	0.052	0.02542	0.351	4.85	190.5	129	7.734	3.12	212.5	322.5	14.5	8.64	13.094	0.02	0.65	1.82
		Median	10.27	3.27	0.04	0.06	0.02	0.3	4	179	126	7.73	3	230	317.5	14.5	10.1	12.98	0.017	0.63	1.82

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
5/8/95	952743	8101	2.21	0.34	0.5	0.67	0.07	1.52	101	87	26	7.19	47	56000	61	3.55			14.05
5/8/95	952745	8102	2.55	0.48	0.48	0.69	0.06	1.28	66.7	89	28	7.22	37	28000	72	4.16			13.84
		Min	2.21	0.34	0.48	0.67	0.06	1.28	66.7	87	26	7.19	37	28000	61	3.55			13.84
		Max	2.55	0.48	0.5	0.69	0.07	1.52	101	89	28	7.22	47	56000	72	4.16			14.05
		Mean	2.38	0.41	0.49	0.68	0.065	1.4	83.7	88	27	7.205	42	42000	66.5	3.855			13.95
		Median	2.38	0.41	0.49	0.68	0.065	1.4	83.7	88	27	7.205	42	42000	66.5	3.855			13.95

Basin 820																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/20/94	941861	820	4.91	2.57	0.01	0.046	0.0161	0.165	4.55	134	110	8.09	2.6	190	260	14	11.3	12.5	0.015	0.36	
1/11/94	941497	820	6.03	2.9	0.01	0.02	0.02	0.2	7.4	156.3	124	7.83	1.6	660	300	5	10.6	14.95	0.02	0.65	
10/14/93	940915	820	8.31	2.64	0.05	0.06	0.01	0.22	3.4	170.5	136	7.97	1.8	280	310	15	9.6	16.24	0.008	0.64	
9/20/94	950761	820	9.76	0.04	0.01	0.03	0.03	0.76	6.25	178	140	7.82	3.9	180	310	19.2	6.7	10.86			2.25
7/28/93	940303	820	8.76	0.787	0.025	0.05	0.04	0.22	3.2	197.3	128	7.78	3.9			26.5	6.3	10.44		0.96	
		Min	4.91	0.04	0.01	0.02	0.01	0.165	3.2	134	110	7.78	1.6	180	260	5	6.3	10.44	0.008	0.36	2.25
		Max	9.76	2.9	0.05	0.06	0.04	0.76	7.4	197.3	140	8.09	3.9	660	310	26.5	11.3	16.24	0.02	0.96	2.25
		Mean	7.554	1.7874	0.021	0.0412	0.02322	0.313	4.96	167.22	127.6	7.898	2.76	327.5	295	15.94	8.9	12.998	0.014	0.6525	2.25
		Median	8.31	2.57	0.01	0.046	0.02	0.22	4.55	170.5	128	7.83	2.6	235	305	15	9.6	12.5	0.015	0.645	2.25

Storm Samples																			
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
5/8/95	952737	8201	1.91	0.44	0.3	0.6	0.06	2	137	93.5	32	7.3	65	13800	73	4.59			11.84
5/8/95	952740	8202	2.51	0.71	0.25	0.4	0.04	1.12	79.7	97.75	40	7.33	51	11000	74	8.02			11.96
		Min	1.91	0.44	0.25	0.4	0.04	1.12	79.7	93.5	32	7.3	51	11000	73	4.59			11.84
		Max	2.51	0.71	0.3	0.6	0.06	2	137	97.75	40	7.33	65	13800	74	8.02			11.96
		Mean	2.21	0.575	0.275	0.5	0.05	1.56	108	95.625	36	7.315	58	12400	73.5	6.305			11.9
		Median	2.21	0.575	0.275	0.5	0.05	1.56	108	95.625	36	7.315	58	12400	73.5	6.305			11.9

Basin 830
Base Flow

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
9/20/94	950760	830	5.2	0.01	<0.01	0.04	0.04	0.68	4.95	134.5	108	8.01	1.5	40	230	17.5	9.4	6.9			1.9
1/11/94	941496	830	3.3	0.95	0.01	0	0.01	0.04	10.3	76	76	7.83	1.2	2000	180	5	12.4	7.5	<.01	1	
7/28/93	940302	830	5.4	0.707	0.018	0.03	0.01	0.26	0.7	158	108	7.9	3			25	7.2	6.81		0.16	
10/14/93	940914	830	4.8	0.6	0.01	0	<.01	0.09	2.4	92.2	82	8.15	1.25	200	195	15.2	10.6	6.83	0.003		
3/20/94	941860	830	2.06	0.64	0.01	0.026	<0.01	0.069	2	76.75	68	7.97	4.5	170	155	13	10.6	6.1	0.001	0.15	
		Min	2.06	0.01	0.01	0	0.01	0.04	0.7	76	68	7.83	1.2	40	155	5	7.2	6.1	0.001	0.15	1.9
		Max	5.4	0.95	0.018	0.04	0.04	0.68	10.3	158	108	8.15	4.5	2000	230	25	12.4	7.5	0.003	1	1.9
		Mean	4.152	0.5814	0.012	0.0192	0.02	0.2278	4.07	107.49	88.4	7.972	2.29	602.5	190	15.14	10.04	6.828	0.002	0.4367	1.9
		Median	4.8	0.64	0.01	0.026	0.01	0.09	2.4	92.2	82	7.97	1.5	185	187.5	15.2	10.6	6.83	0.001	0.16	1.9

Storm Samples

Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l
5/8/95	952738	8301	0.7	0.09	0.09	0.21	0.03	0.92	80.4	64	20	7.08	49	5700	38	1.5			9.14
5/8/95	952739	8302	1.89	0.34	0.07	0.16	0.03	0.84	58.1	65	22	7.14	40	3100	45	6.14			8.1
		Min	0.7	0.09	0.07	0.16	0.03	0.84	58.1	64	20	7.08	40	3100	38	1.5			8.1
		Max	1.89	0.34	0.09	0.21	0.03	0.92	80.4	65	22	7.14	49	5700	45	6.14			9.14
		Mean	1.295	0.215	0.08	0.185	0.03	0.88	69.3	64.5	21	7.11	44.5	4400	41.5	3.82			8.62
		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			8.62

Basin 840																					
Base Flow																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	Temp	D.O.	SO4	NO2-N	CBOD5	TOC
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	deg C	mg/l	mg/L	mg/l	mg/l	mg/L
3/20/94	941862	840	4.91	2.6	0.02	0.048	0.0165	0.137	3.6	128.5	96	8.16	2.3	1310	240	14.5	11.6	12.16	0.006	0.57	
7/28/93	940304	840	8.15	2.236	0.076	0.11	0.17	0.47	6.9	212.8	146	7.74	6			24	5.1	8.22		0.07	
1/11/94	941498	840	5.66	2.65	0.05	0.03	0.02	0.2	6.9	133	110	7.81	1.5	30	280	6	11.2	15.66	0.01	1.62	
10/14/93	940916	840	8.89	3.9	0.08	0.08	0.02	0.32	3.3	182.7	140	7.72	2.9	800	330	14.6	8.1	15.6	0.014	1.12	
9/20/94	950762	840	9.01	0.47	<0.01	0.05	0.19	1.04	4.6	195.25	162	8.29	4	190	335	18.2	4.9	7.53			3.71
		Min	4.91	0.47	0.02	0.03	0.0165	0.137	3.3	128.5	96	7.72	1.5	30	240	6	4.9	7.53	0.006	0.07	3.71
		Max	9.01	3.9	0.08	0.11	0.19	1.04	6.9	212.8	162	8.29	6	1310	335	24	11.6	15.66	0.014	1.62	3.71
		Mean	7.324	2.3712	0.0565	0.0636	0.0833	0.4334	5.06	170.45	130.8	7.944	3.34	582.5	296.25	15.46	8.18	11.834	0.01	0.845	3.71
		Median	8.15	2.6	0.05	0.05	0.02	0.32	4.6	182.7	140	7.81	2.9	495	305	14.6	8.1	12.16	0.01	0.845	3.71
Storm Samples																					
Date	Lab #	ID	Cl	NO3-N	PO4-P	TP	NH3-N	TKN	TSS	TDS	Alk.	pH	Turb.	E.coli.	Cond.	SO4	NO2-N	CBOD5	TOC		
			mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		NTU	cfu/100ml	uS/cm	mg/l	mg/l	mg/l	mg/l		
5/8/95	952736	8401	1.84	0.4	0.35	0.56	0.06	1.76	155	95	34	7.38	67	26000	75	4.64			11		
5/8/95	952741	8402	2.11	0.59	0.27	0.36	0.04	1.08	60.9	96.25	36	7.59	42	9100	84	5.95			11.65		
		Min	1.84	0.4	0.27	0.36	0.04	1.08	60.9	95	34	7.38	42	9100	75	4.64			11		
		Max	2.11	0.59	0.35	0.56	0.06	1.76	155	96.25	36	7.59	67	26000	84	5.95			11.65		
		Mean	1.975	0.495	0.31	0.46	0.05	1.42	108	95.625	35	7.485	54.5	17550	79.5	5.295			11.33		
		Median	1.975	0.495	0.31	0.46	0.05	1.42	108	95.625	35	7.485	54.5	17550	79.5	5.295			11.33		

APPENDIX C

MODEL DEVELOPMENT

Model Development

As explained in the report, multiple linear regression was used to estimate average annual concentrations of nutrients in sub-basins with contributions from other upstream basins and/or wastewater treatment plants. The relationships were developed using percent land use of the following types: urban, pasture, forest, confined animal and roads. The coefficients determined were applied to the sub-basins using an equation in the form

$$Concentration = C_0 + C_1(U_1) + C_2(U_2).\quad C_n(U_n)$$

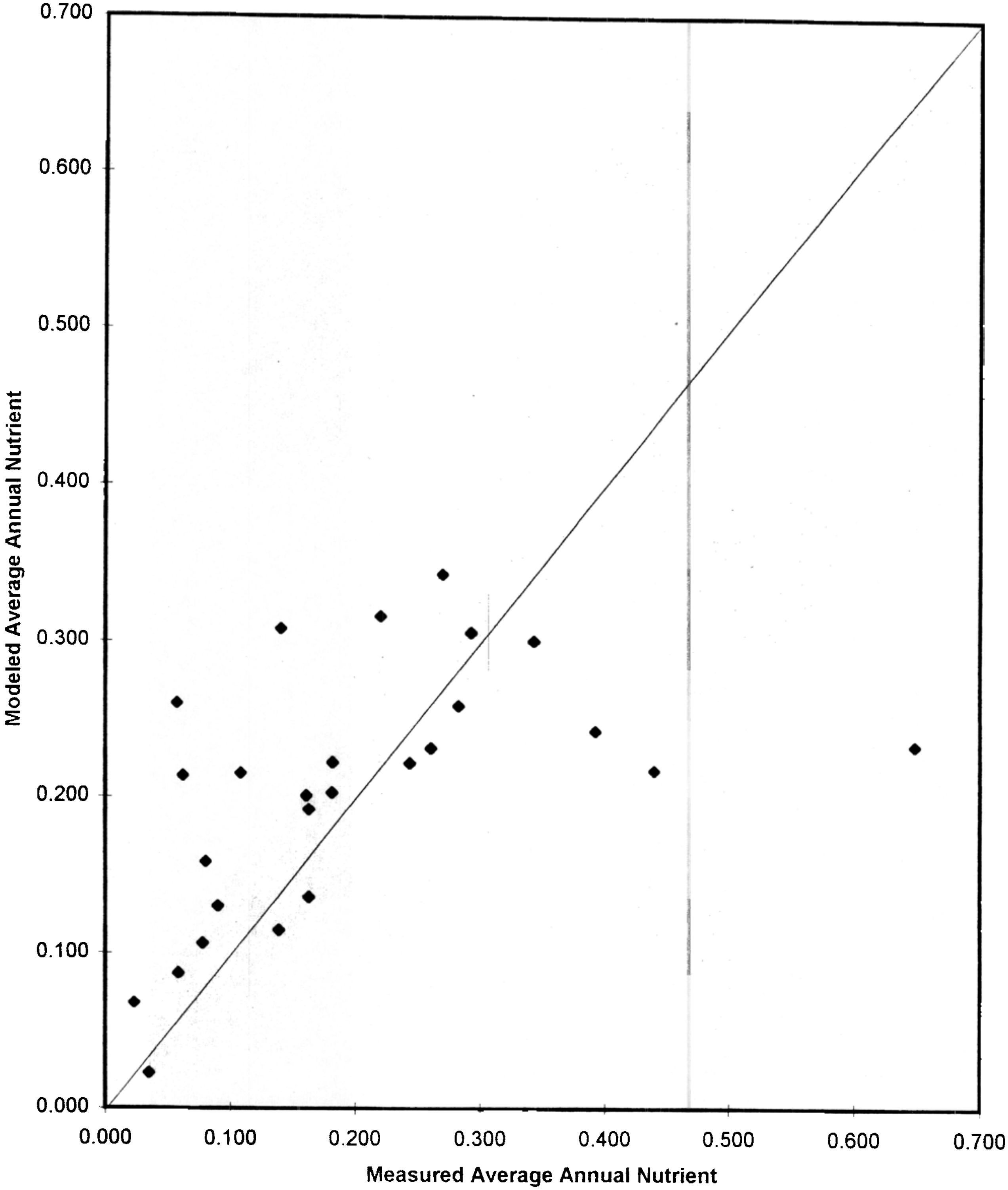
Where. $C0$ = *Intercept / Constant*
$C1_{..n}$ = *Coefficient for each type of land use*
$U1_{..n}$ = *Percentage of each type of land use*

The coefficients developed for total phosphorous, nitrate-nitrogen , total Kjeldahl nitrogen and total suspended solids are listed in the following table.

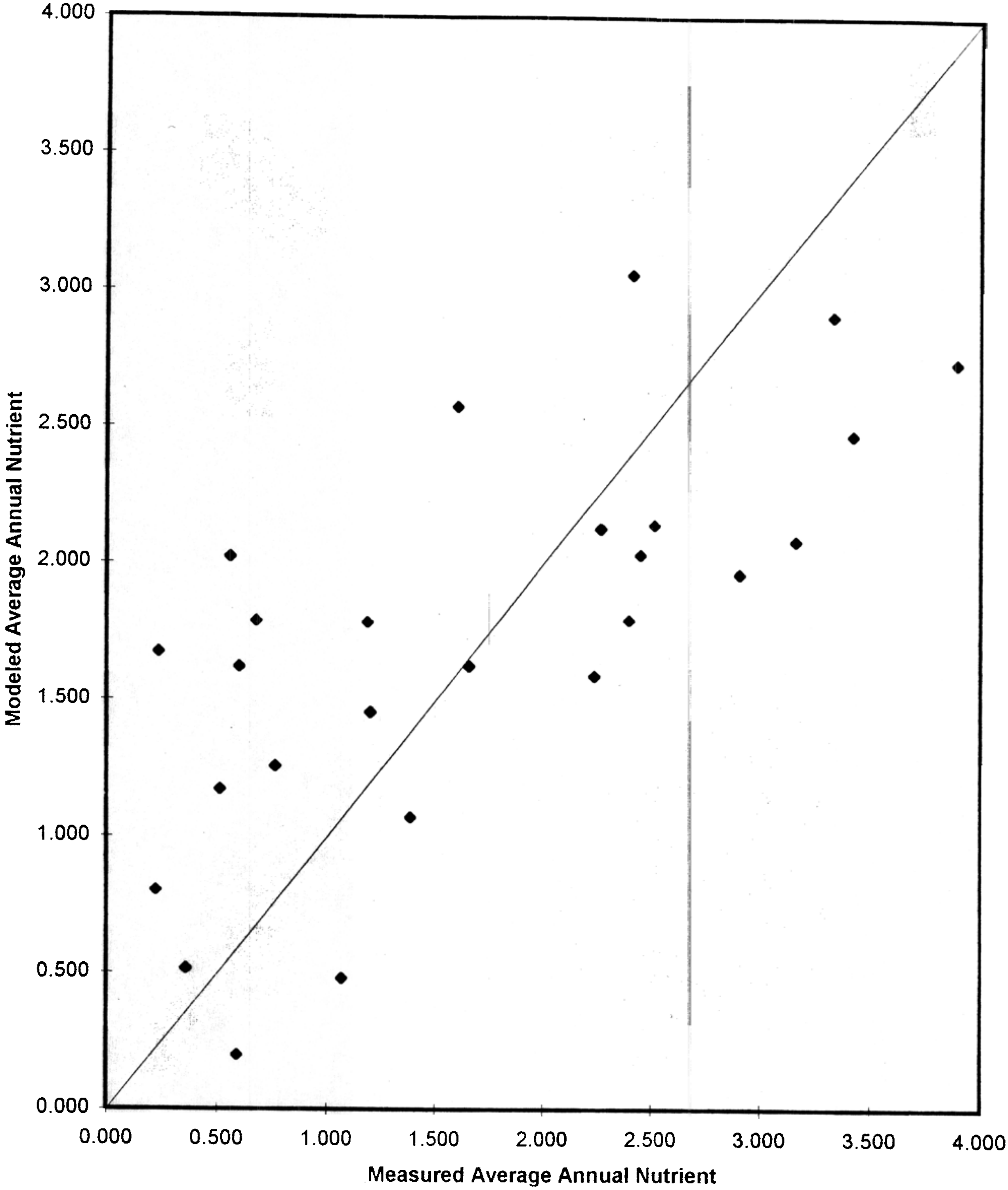
Total P Land Use	*Coefficients* (C_n)	*NO3 - N* Land Use	*Coefficients* (C_n)	*TKN* Land Use	*Coefficients* (C_n)	*TSS* Land Use	*Coefficients* (C_n)
C_0	-5.103	C_0	-9.565	C_0	-17.866	C_0	515.033
Urban	0.054	Urban	0.124	Urban	0.192	Urban	-5.011
Pasture	0.060	Pasture	0.138	Pasture	0.218	Pasture	-4.819
Forest	0.054	Forest	0.096	Forest	0.183	Forest	-4.865
Confined	-0.038	Confined	1.072	Confined	0.128	Confined	-28.394
Roads	0.000	Roads	-0.242	Roads	0.014	Roads	-1.626

The following figures illustrate the correlation between modeled values and measured values for each of the constituents listed above. Measured values are plotted on the abscissa and modeled values on the ordinate in each case. The diagonal line represents a one to one correlation.

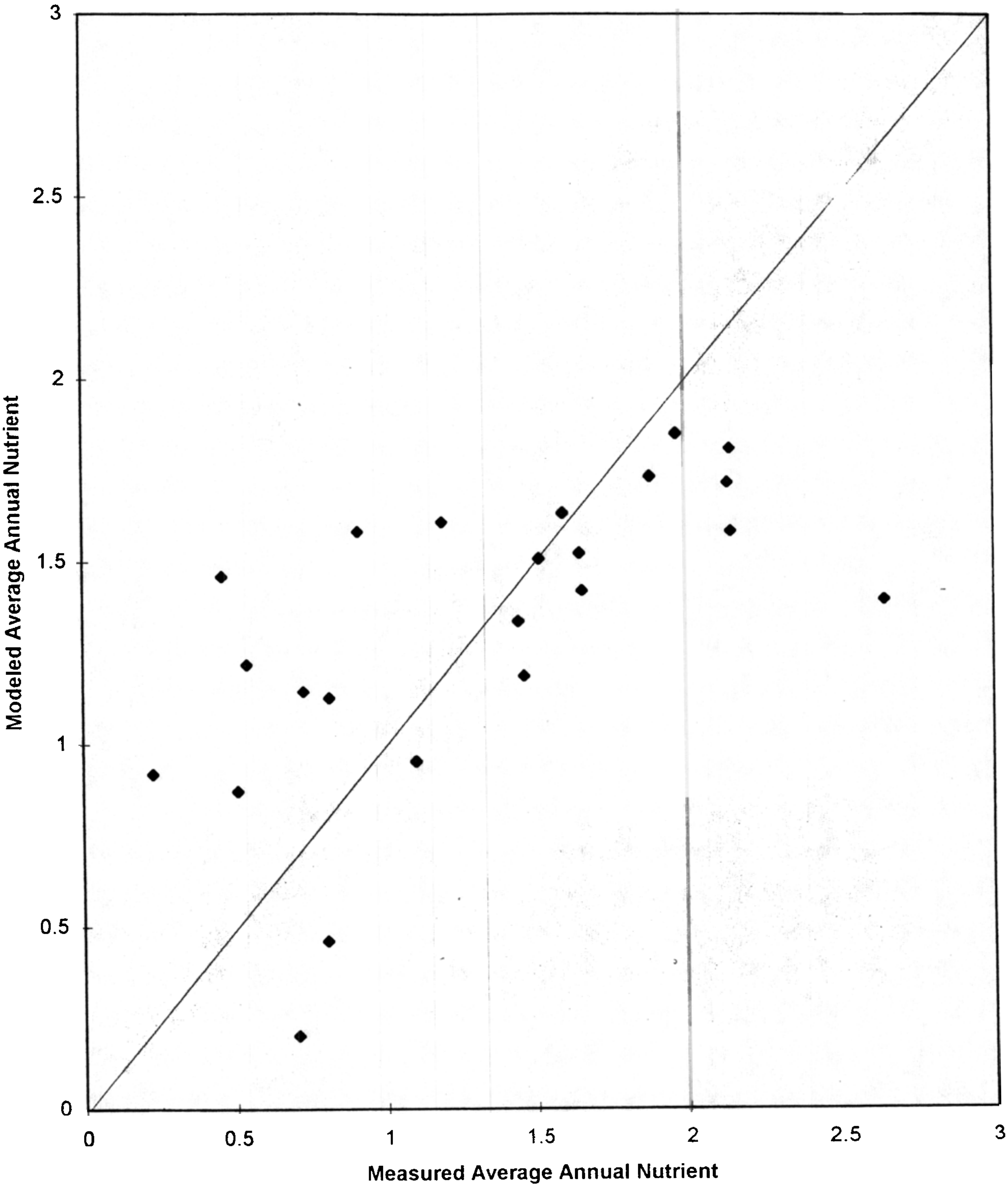
Total Phosphorous Model Correlation



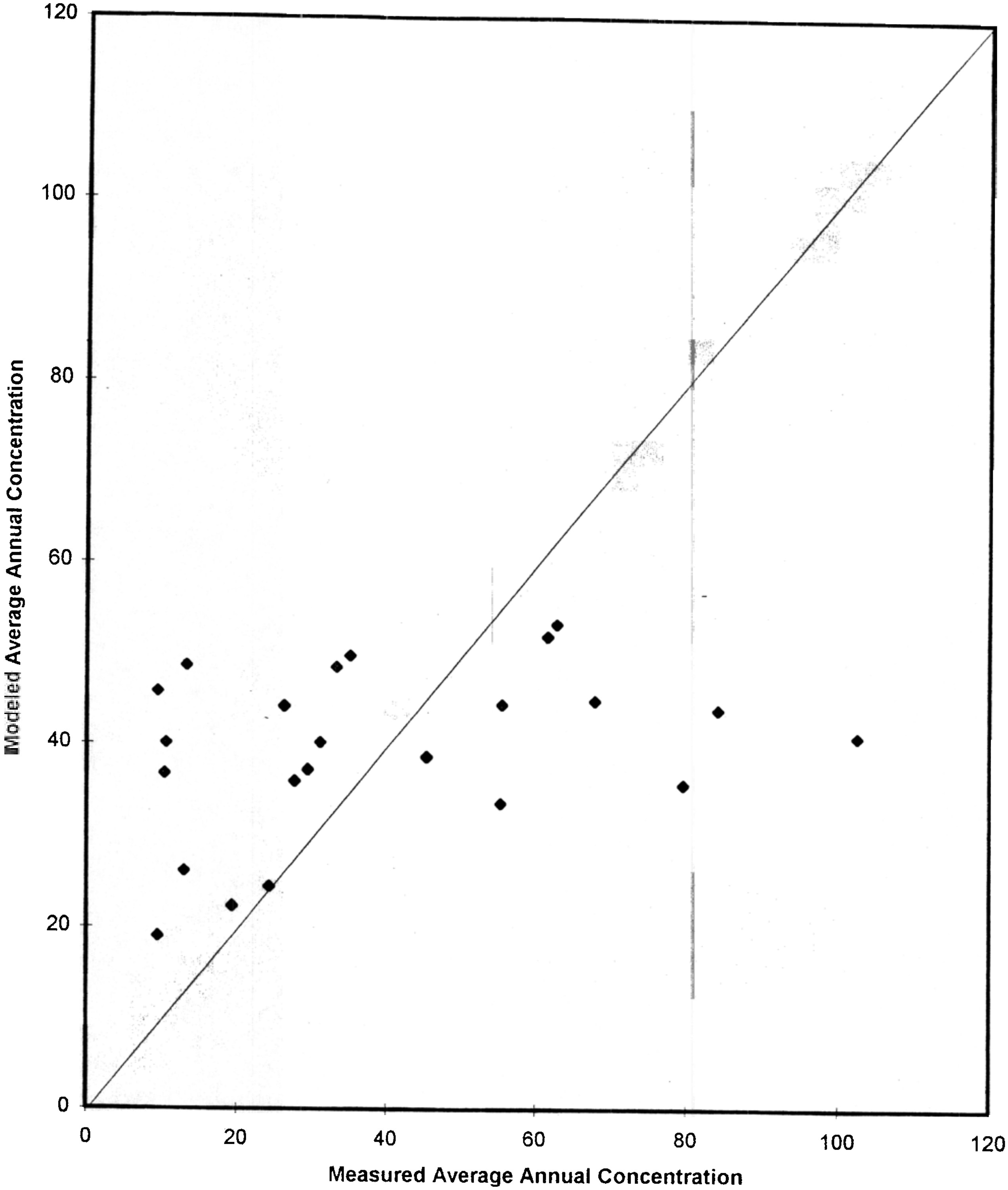
Nitrate Model Correlation



TKN Model Correlation



Total Suspended Solids Model Correlation



APPENDIX D

DATA QUALITY AND SAMPLING PROCEDURES

DATA QUALITY AND SAMPLING PROCEDURES

The results of the data collected was used to evaluate the water quality of the thirty-seven sub-basins of the Illinois River in Arkansas and to prioritize the sub-basins for later implementation of non-point source pollution control programs. No regulatory decisions will be made based on these results. However, the quality of the data will be sufficient for use in development of standards and Total Maximum Daily Load (TMDL) development.

1 Precision and Accuracy:
Estimates of chemical characteristics of water at any time or site within 10% were considered satisfactory.

Representativeness:
Sufficient data was collected during low and high flow conditions so that the data represented the variation in base flow and storm nutrient runoff. Adequate sampling of storm hydrographs was conducted to evaluate the data from the rising, crest and falling stages.

3 Completeness:
At least 73% of the data as intended in the design was collected (66% required), it should be sufficient to estimate representative nutrient concentrations and transport rates.

Comparability:
Comparability of data is assured by reporting all data in a standard format. Field personnel were trained in the use of necessary instrumentation, sampling procedures and sample handling.

Data Quality Objectives:
The results of sampling operations combined with the GIS databases developed are considered to be sufficient to evaluate the overall quality of the Arkansas portion of the Illinois River basin and the associated sub-basins and the effects of land use practices upon water quality in the region.

Sampling Procedures:
Four hundred and ninety one (491 samples were collected over a period of two years.

Base Flow Water Quality Samples: One hundred ninety one (191) water quality samples (grab samples) were collected during five seasonal sampling periods within the two year sampling window. At least one sample was taken at each of the thirty-seven sub-basins during representative, seasona low or base flow conditions. In addition to the stream samples, seven (7) point source contributors were sampled and where possible, plant records of permitted effluent characteristics for at least two years were acquired. Flo rate measurements (where applicable) were determined with the use of an appropriate flow meter. Existing gauging stations were utilized wherever possible. Stream cross sections were surveyed and gauging staffs installed at the intensively sampled basins in order to obtain better estimates of flow.

Storm Event Water Quality Samples: Water quality samples (grab samples) were collected at eight selected sites during storm events. Water elevations were measured and flow rates were estimated at the selected sites during these storm events. A total of 293 storm samples were taken. Basins, not including reservoir outlets, were sampled at least twice during storm flow events.

General Sampling Procedures: Samples were manually collected grab samples from surface water streams. Temperature, dissolved oxygen and pH were measured at the time of sampling for base flow samples. Instruments used for field measurements were calibrated immediately before use according to standard procedures. The water quality parameters measured and units for reporting are listed in Table 1. Grab samples were collected directly into or decanted into clean, 1/2 gallon (1.89 liter) disposable, virgin polyethylene sample bottles with screw type caps. Samples for nutrient analysis were preserved by the additio of sulfuric acid to pH < 2. Samples for microbiological examination were collected in pre-sterilized disposable containers. Investigators followed procedures for sample collection and transport as outlined in the 16th Edition of Standard Methods, sections 105 and 906. Samples were stored on ice and transported to the lab within six hours. Immediately upon receipt of samples at the lab, lab personnel preserved and stored samples in accordance with Standard Methods (16th Edition) sections 105 and 906. Samples remained in the custody of the investigator until delivered to the laboratory. No more samples were collecte at one time than could analyzed by the laboratory within the required holding time (7-14 days).

TABLE 1
Water Quality Parameters

Parameter	Units
Alkalinity	mg $CaCO_3$/L
Chlorides	mg Cl^-/L
Conductivity	:mhos/cm
Ammonia	mg NH_3-N/L
Nitrate/Nitrite	mg N/L
TKN	mg N/L
pH	pH units
Orthophosphate	mg PO_4^{3-}-P/L
Total Phosphorous	mg P/L
Total Suspended Solids	mg/L
Total Dissolved Solids	mg/L
CBOD	mg CBOD/L
Turbidity	NTU
Coliform, Escherichia	Colonies/100 ml
Dissolved Oxygen	mg O/L
Temperature	degrees C

A bound field notebook was used to record all information about each sample. Table 2 lists information that was included for each sample taken. At the time of collection, samples were labeled with the information listed in Table 3

A copy of the field notebook(s) was kept in the investigator's office to avoid accidental loss of data. Copies of analysis results were kept in the investigator's office and on file at the laboratory.

Table 2

Information to be Recorded in Field Notebook

1. Sample identification number (unique for each sample).
2. Sample location.
3. Date and time of sample collection.
4. Results of field instrument calibration.
5. Sample collection method
6. Results of parameters measured in the field
7. Name and signature of person collecting the sample.
8. Comments, including any problems or irregularities.

Table 3

Information to be recorded on sample bottle

1. Sample identification number.
2. Date and time of sample collection.
3. Initials of sample collector.

Responsibility for Sampling:
Rodney Williams, research assistant, or persons designated and trained by him will collect all samples, insure sample custody and deliver the samples to the Water Quality Laboratory.

Training Procedures:
All persons participating in sampling operations were trained in the following procedures:

1. Sampling procedures.
2. Calibration of and use of instrumentation used for acquisition of field data.
3. Sample handling, transport and chain-of-custody procedures:

Internal Quality Control Checks And Frequency

Field Quality Control Checks:

1. Grab samples were split every twenty-five 25 samples.

2. For every twenty-five (25) samples collected a field blank was made up by decanting reagent grade water into a sample container in the field.

Laboratory Quality Control Checks:

1. These checks, splits, spiked samples, etc. were the responsibility of the AWRC Water Quality Laboratory.

Laboratory Review of QA/QC

Enclosed is a MEMO from Dr. Paul F. Vendrell the Arkansas Water Resources Center Water Quality Lab Director. This letter states that "the water quality data generated from laboratory analysis of water samples collected from the Illinois River and tributaries is of sufficient quality to accomplish the project objectives".