20. Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

10 • Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

• Current and historic flow records for the Neosho River.

• A statement is made in the 5th paragraph of Enclosure 2 to WM 06-0046 (November 17, 2006) that the state of Kansas has not required entrainment monitoring and will not require it for the 316(b) determination. Please provide documentation from KDHE regarding this issue.

• Larval fish monitoring data as described in Paragraph 6 of Enclosure 2 to WM 06-0046 (November 17, 2006).

• If available, information on the location of the spawning areas for the various fish species in CCL.

• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

• Possible cold shock impacts to gizzard shad is mentioned in Section 2.2 of the ER (WCGS, 1990). If there have been any incidents of cold shock to gizzard shad or other fish, please provide supporting data.

• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

WATER TREATMENT CHEMICAL ADDITIVES EVALUATION LOG
(NPDES Permit Supplemental Condition 15.b and c)

Time	Chemical	Dosage	NOEL/LC_{50}	Comments
Duration and/or Frequency	Name & MSDS #	End of Pipe Concentration (mg/l) @ Outfall	Description Species & Lowest Identified Aquatic Toxicity (mg/l)	Acute Whole Effluent Toxicity Test (P)ass (F)ail
24/7	Thruguard 404 MSDS # 03185	5.0 @ 003 5.0 @ 006	Anti-scalent & Dispersant Bluegill Sunfish 96 hour exposure LC_{50} 868 Daphnia magna 48 hour exposure LC_{50} 527	WET Test 12/15/00 (P) WET Test 04/21/01 (P) WET Test 06/05/02 (P) WET Test 05/21/03 (P) WET Test 05/19/04 (P) WET Test 06/13/05 (P) WET Test 06/13/06 (P)
>2 Hrs/day 6 Hrs/day	NaOCl MSDS # 02654	≤ .2 TRO @ 003 1.0 TRO @ 006 *	Oxidizing Biocide Fathead Minnow 96 hour exposure LC_{50} 5.9 Bluegill Sunfish 96 hour exposure LC_{50} 0.6 Daphnia magna 48 hour exposure LC_{50} ~1.0	WET Test 12/15/00 (P) WET Test 06/13/05 (P) WET Test 06/13/06 (P)
>2 Hrs/day 6 Hrs/day	NaBr MSDS # 03262	≤ .2 TRO @ 003 1.0 TRO @ 006 *	Oxidizing Biocide Bluegill Sunfish 96 hour exposure LC_{50} 0.52 Daphnia magna 48 hour exposure LC_{50} 0.71	WET Test 12/15/00 (P) WET Test 06/13/05 (P) WET Test 06/13/06 (P)
3 X/yr 12 to 24 Hrs/day Service Water	H-130M MSDS # 03182	< 0.5 @ 003 <0.5 @ 006	Non-oxidizing Biocide Bluegill Sunfish 96 hour exposure LC_{50} 0.32 Daphnia magna 48 hour exposure LC_{50} 0.09	WET Test 04/21/01 (P) WET Test 05/21/03 (P) WET Test 05/19/04 (P)

Time	Chemical	Dosage	NOEL/LC_{50}	Comments
24/7 @ 0.7ml/min or 87 ml/min Fire Protection System	EVAC MSDS # 03740	Undetectable for Jockey Pump use @ any circ water flowrate 0.8-1.2 @ 003 **	Biocide Bluegill Sunfish 96 hour exposure LC_{50} 0.50 Fathead Minnow 96 hour exposure LC_{50} 0.25 Daphnia magna 48 hour exposure LC_{50} 0.10 (~45,000 gallons @ 10 ppm/565,000 gallons)**	WET Test 06/13/05 (P)
30 Minutes per Month	CuproSTAT MSDS # 03263	3.3 @ 003 ** 60 @ 006	Copper Corrosion Inhibitor Bluegill Sunfish 96 hour exposure LC_{50} 11.3 Daphnia magna 48 hour exposure LC_{50} 46.2 (~30,000 gallons @ 60 ppm/565,000 gallons)**	WET Test 06/05/02 (P)
Normally 24/7	Chemicals in Blowdown Ammonia ETA Hydrazine	Average S/G Chemistry (@ 003X) 11.2 (<5 ppb) 13.5 (<5 ppb) 0.027 (ND)	Steam Generator Blowdown Chemistry Outfall 003A to Outfall 003X Jollytail 96 hour exposure LC_{50} 1.6 Bluegill Sunfish 96 hour exposure LC_{50} 75 Daphnia magna 24 hour exposure LC_{50} 140 Bluegill Sunfish 96 hour exposure LC_{50} 1.08	WET Test 06/13/05 (P) WET Test 06/13/06 (P)
Intermittent	Lake Water Outfall 004	NA	NA	Chronic WET Test 0711-15/05 (P)

Note 1 The dosage concentration in the discharge should in no case exceed the NOEC for the most sensitive freshwater species provided in the MSDS sheet. If available toxicity data for Pimephales promelas (fathead minnow) and Ceriodaphnia dubia (water flea) should be used in such evaluation. Other surrogate species with similar sensitivity can also be utilized.

Note 2 Since synergistic effects of two or more chemicals may exist, whole effluent toxicity (WET) testing is recommended to confirm the discharge is not toxic to the receiving environment especially when effluent concentrations approach NOEC levels. WET testing must be conducted in accordance with the EPA document, Short-Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, third edition, July 1994, (EPA/600/4-91/002) using test organisms Pimephales promelas (fathead minnow) and Ceriodaphnia dubia (water flea).

* Allowed By NPDES Permit

** Calculated not measured

ENVIRONMENTAL MANAGEMENT & FIRE PROTECTION
ROUTING FORM

OUTGOING CORRESPONDENCE

A. Letter Number: RP 00-0354 **Date:** December 15, 2000

Responsible Person: Ralph Logsdon

TO: Misty Bosch-Hastings/KDHE **FROM:** John W. Johnson

B. Subject: NPDES Discharge Monitoring Report for November 2000.

Comments:

C. Records Management

File 21.1 (KDHE) [X]

File 21. [ ]

CC-DS [ ]

D. RESPONSIBLE PERSON REVIEW DATE W 12-15-00

E. Personal Copies

Name

J. W. Johnson (OB-RP)
R. L. Denton (OB-CH)
R. N. Calia (OB-OP)
S. E. Steen (OB-CH)

F. TE File Number: 42311

FORM APF 07-004-01 REV 1

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE 12-28-00 [x] Required [ ] Requested [ ] N/A

Responsible Individual Ralph Logsdon Extension 4730

Letter Number: RP 00-0354

Subject: NPDES Discharge Monitoring Report for November 2000

Commitments contained in letter [ ] Yes [X] No

IF answered "Yes", THEN a AIF 26D-001-01, COMMITMENT IDENTIFICATION AND RESPONSE form must be generated. Correspondence signature must comply with AI 26D-001, COMMITMENT MANAGEMENT SYSTEM requirements.

Comments:

Technical Review and Concurrence

Technical Review and Concurrence signature is not required of the individual signing the outgoing correspondence.

Review Required by	Signature	Date Signed
Licensing	Carol Kelling	12/12/00
Supervisor Environmental/Fire Protection or Designee	Daniel Williamson	12.12.2000
[X] Manager Resource Protection		
[ ] Vice President Operations Support		
[ ] Vice President Plant Operations & Plant Manager		
[ ] Vice President Engineering & Information Services		
[ ] Controller-Treasurer		
[ ] General Counsel/Secretary		
[ ] President and CEO		

WOLF CREEK
NUCLEAR OPERATING CORPORATION

December 15, 2000

RP 00-0354

Kansas Department of Health and Environment
Bureau of Water
Technical Services
Forbes Field, Building 283
Topeka, Kansas 66620-0001

Attention: Ms. Misty Bosch-Hastings

Subject: Wolf Creek Generating Station November National Pollutant Discharge Elimination System (NPDES) Monitoring Report, Permit I-NE07-PO02

Dear Ms. Bosch-Hastings:

This letter is a follow-up to the November 2000 electronic discharge monitoring report (EDMR) that was e-mailed to you earlier on December 15, 2000. There were no numerically limited NPDES parameters exceeded during the November 2000 reporting period.

Attached to this letter are the satisfactorily completed results of Wolf Creek's acute whole effluent toxicity (WET) testing (Attachment 1.0) and the associated NPDES permit Attachment B required analyses (Attachment 2.0). The Attachment B test results are identified as Sample ID 003 biomonitoring. These two reports meet the annual reporting requirement as specified in Supplemental Condition 1 of our current NPDES permit. Note: The WET test sample was taken at the point of discharge for outfall 003 while the circulating water was being brominated and wastewater was being released from outfall 003(A) and outfall 003(B). The WET test results reflect the synergistic effects of these three events occurring at the same time without factoring in any zone of initial dilution or mixing zone.

Also attached for your review are the required NPDES permit metal test results on outfall 004, Cooling Impoundment Discharge to Wolf Creek. The metal analysis test results are identified as Sample ID 004.

If you have any questions regarding this submittal, please contact Mr. Ralph Logsdon at (316) 364-8831, extension 4730.

Sincerely,

John W. Johnson

John W. Johnson

JWJ/jaf

Attachment

cc: Mr. Rex Heape, KDHE
Southeast District Office
1500 West 17th
Chanute, Kansas 66720-9701

Mr. Om Agrawal, KDHE
Bureau of Water
Forbes Field, Building 283
Topeka, Kansas 66620-0001

Attachment 1.0

Wolf Creek Generating Station

Whole Effluent Toxicity Testing Results

REFERENCE #00-11-528

QWAL LABORATORIES, INC.

2911 ROTARY TERRACE/P.O. BOX 562/PITTSBURG, KS 66762

LABORATORY REPORT:

CLIENT: Wolf Creek Generation Station **Attn: Ralph Logsdon** **P.O. Box 411** **Burlington, KS 66839**	**Date Reported: 11-28-00** **Date Initiated: 11-20-00** **Time Arrived: 1:00 pm** **Date Terminated: 10-22-00**

BIOMONITORING STUDY

ACUTE TOXICITY

Permit # I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the Wolf Creek Generating Station effluent discharge. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure. was **not detected in Ceriodaphnia exposed to the 100%** effluent **(AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, chlorine, and ammonia determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

A sample was collected at the Wolf Creek Generating Station effluent discharge by Wolf Creek Generating Station personnel. The sample was preserved with ice and transported to QWAL laboratories by Wolf Creek Generating Station personnel.

REFERENCE #00-11-528

INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the Wolf Creek Generating Station effluent on the freshwater invertebrate. Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at QWAL Laboratories, Inc., Pittsburg, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from USEPA, Newton, Ohio. Ceriodaphnia are cultured in house at QWAL Laboratories, Inc. Culture methods of Ceriodaphnia were obtained from EPA/600/4-90/027F, August 1993.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at QWAL Laboratories, Inc., Pittsburg, KS and were originally obtained from USEPA, Newton, Ohio. Fathead minnows are maintained at QWAL Laboratories until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA/600/4-90/027F, August 1993.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 1993).

The effluent tested was collected by Wolf Creek Generating Station personnel from the Wolf Creek Generating Station discharge. Testing was performed using 100% effluent along with a series of dilution's, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and upstream control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

REFERENCE #00-11-528

Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, ammonia nitrogen, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, conductance, and ammonia nitrogen were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

REFERENCE #00-11-528

RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was no significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
12.5%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
6.25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
Upstream	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) =0.0%

REFERENCE #00-11-528

THE **Pimephales** **RESULTS** - Minnows exposed to effluent collected at the Wolf Creek Generating Station effluent discharge by Wolf Creek Generating Station personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	9	9	10
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
12.5%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
6.25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
Upstream	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) =0.0%

REFERENCE #00-11-528

INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.06	8.50	280	<0.03	<0.1	24	104	60

Initial Measurements of 100% Effluent

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.49	8.20	575	0.12	<0.1	24	218	162

Initial Measurements of Upstream

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.31	8.60	575	0.09	<0.1	24	212	160

TEST WATER QUALITY:

24-hour Water Quality Measurements

EFFLUENT CONC (%)	pH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	8.02	8.00	24	310
100%	8.57	7.50	24	610
50%	8.36	7.60	24	480
25%	8.26	7.70	24	400
12.5%	8.24	7.80	24	345
6.25%	8.04	7.90	24	320
Upstream	8.61	7.70	24	610

48-hour Water Quality Measurements

EFFLUENT CONC (%)	pH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.93	7.70	24	340
100%	8.67	7.00	24	650
50%	8.46	7.20	24	500
25%	8.34	7.40	24	450
12.5%	8.22	7.50	24	380
6.25%	8.09	7.60	24	355
Upstream	8.79	7.30	24	650

REFERENCE #00-11-528

WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The effluent sample from the Wolf Creek Generating Station effluent discharge had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the effluent sample was 8.20 mg/l after being raised to the test temperature of 24° C. At termination D.O. was 7.00 mg/l in the effluent which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the effluent was 8.49 upon receipt in the laboratory and the synthetic control had a pH 8.06. At termination the pH measurement in the effluent sample was 8.67.

Conductance - The conductance of the effluent sample was 575 umhos and the synthetic control was 280 umhos.

Ammonia (NH3-N) - Ammonia Nitrogen content of the effluent in was 0.12 mg/l.

REFERENCE #00-11-528

QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	0	0
2.5 g/l	20	10	4
2.0 g/l	20	19	17
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.25 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	19	0
8.0 g/l	40	31	12
6.0 g/l	40	39	32
4.0 g/l	40	40	39
2.0 g/l	40	40	40

LC50 = 7.15 g/l NaCl

Submitted By: Timothy Harrell
Timothy Harrell
Staff Biologist

Approved By: [signature]
Terry Koester
Laboratory Director

Attachment 2.0

Wolf Creek Generating Station

NPDES Permit Attachment B Test Results

Outfall 003 [Sample ID 003 Biomonitoring] Concurrent with WET Testing
and
Outfall 004 [Sample ID 004] Metal Analyses

QWAL LABORATORIES, INC.

2911 ROTARY TERRACE, P.O. BOX 562/PITTSBURG, KS 66762/(316)232-1970

LABORATORY REPORT: **REFERENCE #: 0011528**

SENT TO: *WOLF CREEK NUCLEAR STATION*
PO BOX 411
BURLINGTON KANSAS 66839
RALPH LOGSDON

DATE REPORTED: **12/01/00**
DATE COLLECTED: **11/20/00**
DATE RECEIVED: **11/20/00**
P.O. #: 0709363/0

PROJECT: WOLF CREEK LAKE BIOMONITORING

Sample ID: 003 BIOMONITORING Sample Matrix: WATER
Sample Date Collected: **11/20/00**

TEST	METHOD	RESULT	UNITS	PQL	ANALYZED	BY
HEXAVALENT CHROMIUM	EPA 218.4	<0.05	MG/L	0.05	11/21/00	RDC
HARDNESS	EPA 130.2	218.0	MG/L	1.0	11/21/00	TH
PH	EPA 150.1	7.9	SU		11/21/00	SLR
AMMONIA AS N	EPA 350.1	0.12	MG/L	0.03	11/21/00	KW
METAL PREPARATION	EPA 3010	IL001127A			11/27/00	JH
SILVER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	
ARSENIC, TOTAL	EPA 206.2	0.002	MG/L	0.002	11/28/00	XM
BARIUM, TOTAL	EPA 200.7	0.154	MG/L	0.005	11/28/00	RDC
BERYLLIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	11/28/00	RDC
BORON, TOTAL	EPA 200.7	0.396	MG/L	0.01	11/28/00	RDC
CADMIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	11/28/00	RDC
CHROMIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
COPPER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
MERCURY, TOTAL	EPA 245.1	<0.0002	MG/L	0.0002	11/28/00	XM
NICKEL, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
LEAD, TOTAL	EPA 239.2	<0.001	MG/L	0.001	11/28/00	XM
ANTIMONY, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
SELENIUM, TOTAL	EPA 270.2	<0.002	MG/L	0.002	11/29/00	XM
THALLIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
ZINC, TOTAL	EPA 200.7	0.021	MG/L	0.005	11/28/00	RDC
BIOMONITORING 48 HRS		DONE	NA		11/28/00	TDH

Sample ID: 004 Sample Matrix: WATER
Sample Date Collected: **11/17/00**

TEST	METHOD	RESULT	UNITS	PQL	ANALYZED	BY
METAL PREPARATION	EPA 3010	IL001127A			11/27/00	JH
SILVER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	
ARSENIC, TOTAL	EPA 206.2	<0.002	MG/L	0.002	11/28/00	XM
BARIUM, TOTAL	EPA 200.7	0.153	MG/L	0.005	11/28/00	RDC
BERYLLIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	11/28/00	RDC
BORON, TOTAL	EPA 200.7	0.224	MG/L	0.01	11/28/00	RDC
CADMIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	11/28/00	RDC

;ample ID: 004 Sample Matrix: WATER

;ample Date Collected: **11/17/00**

:EST	**METHOD**	**RESULT**	**UNITS**	**PQL**	**ANALYZED**	**BY**
:HROMIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
:OPPER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
1ERCURY, TOTAL	EPA 245.1	<0.0002	MG/L	0.0002	11/28/00	XM
JICKEL, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
.EAD, TOTAL	EPA 239.2	<0.001	MG/L	0.001	11/28/00	XM
ANTIMONY, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
;ELENIUM, TOTAL	EPA 270.2	<0.002	MG/L	0.002	11/29/00	XM
:HALLIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	11/28/00	RDC
:INC, TOTAL	EPA 200.7	0.012	MG/L	0.005	11/28/00	RDC

JD=NONE DETECTED
PQL=PRACTICAL QUANTITATION LIMIT
;U=STANDARD UNITS
3=DETECTED IN METHOD BLANK

APPROVED BY: Terry Koester
TERRY KOESTER
LABORATORY DIRECTOR

ENVIRONMENTAL MANAGEMENT & FIRE PROTECTION ROUTING FORM

OUTGOING CORRESPONDENCE

A. Letter Number: RP 01-0133 **Date:** 05-11-01

Responsible Person: Ralph Logsdon

TO: Shelly Shores-Miller/KDHE **FROM:** John W. Johnson

B. Subject: NPDES Discharge Monitoring Report for April 2001.

Comments: This letter also addresses a sanitary sewer line collapse reported to KDHE and the WET testing results on outfall 003.

C. Records Management

File 21.1 (KDHE) [X]

File 21. [ ]

CC-DS [ ]

D. RESPONSIBLE PERSON REVIEW DATE 5-11-01

E. Personal Copies

Name

J. W. Johnson (OB-RP)
R. L. Denton (OB-CH)
R. N. Calia (OB-OP)
S. E. Steen (OB-CH)

F. TE File Number: 42311

FORM APF 07-004-01 REV 1

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE 05-28-01 [x] Required [ ] Requested [ ] N/A

Responsible Individual: Ralph Logsdon — Extension: 4730

Letter Number: RP 01-0133

Subject: NPDES Discharge Monitoring Report for April 2001

Commitments contained in letter [ ] Yes [X] No

IF answered "Yes", THEN a AIF 26D-001-01, COMMITMENT IDENTIFICATION AND RESPONSE form must be generated. Correspondence signature must comply with AI 26D-001, COMMITMENT MANAGEMENT SYSTEM requirements.

Comments:

Technical Review and Concurrence

Technical Review and Concurrence signature is not required of the individual signing the outgoing correspondence.

Review Required by	Signature	Date Signed
Licensing	C. Redding	5/10/01
Supervisor Environmental/Fire Protection or Designee	Daniel Williamson	5-10-01
[X] Manager Resource Protection	John W. Johnson	5-10-01
[ ] Vice President Operations Support		
[ ] Vice President Plant Operations & Plant Manager		
[ ] Vice President Engineering & Information Services		
[ ] Controller-Treasurer		
[ ] General Counsel/Secretary		
[ ] President and CEO		

WOLF CREEK
NUCLEAR OPERATING CORPORATION

May 11, 2001

RP 01-0133

Kansas Department of Health and Environment
Bureau of Water
Technical Services
Forbes Field, Building 283
Topeka, Kansas 66620-0001

Attention: Ms. Shelly Shores-Miller

Subject: Wolf Creek Generating Station April 2001 National Pollutant Discharge Elimination System (NPDES) Monitoring Report, Permit I-NE07-PO02

Dear Ms. Shores-Miller:

This letter is a follow-up to the April, 2001, electronic discharge monitoring report (EDMR) that was e-mailed to you earlier on May 11, 2001. There were no numerically limited NPDES parameters exceeded during the April, 2001, reporting period.

Enclosed with this letter are the satisfactorily completed results of Wolf Creek's acute whole effluent toxicity (WET) testing and the associated NPDES permit Attachment B required analyses for year 2001. The Attachment B test results are identified as Sample ID WC-003. These two reports meet the annual reporting requirement as specified in Supplemental Condition 1 of our current NPDES permit. Note: The WET test sample was taken at outfall 003 point of discharge in Wolf Creek Cooling Impoundment. This sample was taken while the circulating water was being treated with a non-oxidizing biocide (Calgon H-130M). Also, two wastewater releases were being made at the same time from outfall 003(A) and outfall 003(B). The WET test results reflect the synergistic effects of these three events without factoring in any zone of initial dilution or mixing zone.

Also attached for your review are the required NPDES permit metal test results on outfall 004, Cooling Impoundment Discharge to Wolf Creek, for year 2001. The metal analysis test results are identified as Sample ID WC-004.

On April 25, 2001, Don Carlson of Kansas Department of Health and Environment (KDHE) was notified that a sanitary sewer line had collapsed causing sewage to back up through a manhole cover and spill on the ground. Approximately 10 gallons of sewage was released. The sewage was contained on site with no release outside the plant boundary. Restrooms and sinks feeding this section of the sanitary sewer were place out of service while repairs were being made. The sewer line was placed back into service on April 30, 2001.

If you have any questions regarding this submittal, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

John W. Johnson

John W. Johnson

JWJ/jaf

Enclosure

cc: Mr. Rex Heape, KDHE
Southeast District Office
1500 West 17th
Chanute, Kansas 66720-9701

Mr. Om Agrawal, KDHE
Bureau of Water
Forbes Field, Building 283
Topeka, Kansas 66620-0001

Wolf Creek Generating Station

Whole Effluent Toxicity Testing Results

REFERENCE #01-04-472

QWAL LABORATORIES, INC.

2911 ROTARY TERRACE/P.O. BOX 562/PITTSBURG, KS 66762

LABORATORY REPORT:

CLIENT: Wolf Creek Generating Station **Attn: Ralph Logsdon** **P.O. Box 411** **Burlington, KS 66839**	**Date Reported: 05-03-01** **Date Initiated: 04-24-01** **Time Arrived: 1:00 pm** **Date Terminated: 04-26-01**

BIOMONITORING STUDY

ACUTE TOXICITY

Permit #I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the WOLF CREEK GENERATING STATION effluent discharge. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, was **not detected in Ceriodaphnia exposed to the 100%** effluent **(AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, chlorine, and ammonia determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

A sample was collected at the WOLF CREEK GENERATING STATION effluent discharge by WOLF CREEK GENERATING STATION personnel. The sample was preserved with ice and transported to QWAL laboratories by commercial carrier.

INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the WOLF CREEK GENERATING STATION effluent on the freshwater invertebrate, Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at QWAL Laboratories, Inc., Pittsburg, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from USEPA, Newton, Ohio. Ceriodaphnia are cultured in house at QWAL Laboratories, Inc. Culture methods of Ceriodaphnia were obtained from EPA/600/4-90/027F, August 1993.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at QWAL Laboratories, Inc., Pittsburg, KS and were originally obtained from USEPA, Newton, Ohio. Fathead minnows are maintained at QWAL Laboratories until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA/600/4-90/027F, August 1993.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 1993).

The effluent tested was collected by WOLF CREEK GENERATING STATION personnel from the WOLF CREEK GENERATING STATION discharge. Testing was performed using 100% effluent, a series of dilution's, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

REFERENCE #01-04-472

Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, ammonia nitrogen, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, conductance, and ammonia nitrogen were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

REFERENCE #01-04-472

RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was no significant mortality observed of the freshwater invertebrate. Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
12.5%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
6.25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
Upstream	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) =0.0%

REFERENCE #01-04-472

THE Pimephales RESULTS - Minnows exposed to effluent collected at the WOLF CREEK GENERATING STATION effluent discharge by WOLF CREEK GENERATING STATION personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
12.5%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
6.25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
Upstream	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

REFERENCE #01-04-472

WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The effluent sample from the WOLF CREEK GENERATING STATION effluent discharge had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the effluent sample was 8.10 mg/l after being raised to the test temperature of 24° C. At termination D.O. was 7.20 mg/l in the effluent which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the effluent was 8.22 upon receipt in the laboratory and the synthetic control had a pH 7.83. At termination the pH measurement in the effluent sample was 8.56.

Conductance - The conductance of the effluent sample was 600 umhos and the synthetic control was 290 umhos.

Ammonia (NH3-N) - Ammonia Nitrogen content of the effluent in was 0.22 mg/l.

REFERENCE #01-04-472

INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.83	8.60	290	<0.03	<0.1	24	126	74

Initial Measurements of 100% Effluent

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.22	8.10	600	0.22	<0.1	24	216	174

Initial Measurements of Upstream

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.26	8.40	550	0.15	<0.1	24	230	168

TEST WATER QUALITY:

24-hour Water Quality Measurements

EFFLUENT CONC (%)	pH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.95	8.00	24	300
100%	8.43	7.50	24	600
50%	8.42	7.60	24	600
25%	8.41	7.60	24	600
12.5%	8.41	7.70	24	600
6.25%	8.41	7.80	24	550
Upstream	8.38	7.80	24	550

48-hour Water Quality Measurements

EFFLUENT CONC (%)	pH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	8.27	7.70	24	300
100%	8.56	7.20	24	700
50%	8.56	7.30	24	700
25%	8.53	7.40	24	700
12.5%	8.54	7.60	24	700
6.25%	8.54	7.60	24	600
Upstream	8.51	7.60	24	600

REFERENCE #01-04-472

QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
<u>Ceriodaphnia</u>
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	2	0
2.5 g/l	20	11	1
2.0 g/l	20	16	8
1.5 g/l	20	20	19
1.0 g/l	20	20	20

LC50 = 1.91 g/l NaCl

REFERENCE TOXICANT (NaCl)
<u>Pimephales</u>
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	17	0
8.0 g/l	40	37	23
6.0 g/l	40	40	38
4.0 g/l	40	40	40
2.0 g/l	40	40	40

LC50 = 8.17 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Staff Biologist

Approved By: Terry Koester
Terry Koester
Laboratory Director

Wolf Creek Generating Station

NPDES Permit Attachment B Metal Analyses Test Results

Outfall 003 (Sample ID WC-003)
and
Outfall 004 (Sample ID WC-004)

QWAL LABORATORIES, INC.

2911 ROTARY TERRACE, P.O. BOX 562/PITTSBURG, KS 66762/(316)232-1970

LABORATORY REPORT: **REFERENCE #:** **0104472**

SENT TO: ***WOLF CREEK NUCLEAR STATION***
PO BOX 411
BURLINGTON KANSAS 66839
RALPH LOGSDON
PROJECT:LAKE-BIOMONITORING

DATE REPORTED: **05/04/01**
DATE COLLECTED: **04/24/01**
DATE RECEIVED: **04/24/01**
P.O. #: 709363/0

Sample ID: WCL Sample Matrix: WATER
Sample Date Collected: **04/24/01**

TEST	METHOD	RESULT	UNITS	PQL	ANALYZED	BY
BIOMONITORING 48 HRS		PASS	NA		05/02/01	TDH

Sample ID: WC-003 Sample Matrix: WATER
Sample Date Collected: **04/24/01**

TEST	METHOD	RESULT	UNITS	PQL	ANALYZED	BY
HEXAVALENT CHROMIUM	EPA 218.4	<0.05	MG/L	0.05	04/25/01	XM
HARDNESS	EPA 130.2	240.8	MG/L	1.0	05/02/01	KDH
PH	EPA 150.1	8.2	SU		04/25/01	SLR
AMMONIA AS N	EPA 350.1	0.15	MG/L	0.03	04/27/01	BEM
NITRATE/NITRITE AS N	EPA 353.1	< 0.10	MG/L	0.10	04/27/01	DB
METAL PREPARATION	EPA 3010	IL010426C			04/26/01	RDC
SILVER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
ARSENIC, TOTAL	EPA 206.2	<0.002	MG/L	0.002	04/30/01	XM
BARIUM, TOTAL	EPA 200.7	0.15	MG/L	0.005	04/30/01	RDC
BERYLLIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	04/30/01	RDC
BORON, TOTAL	EPA 200.7	0.45	MG/L	0.01	04/30/01	RDC
CADMIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	04/30/01	RDC
CHROMIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
COPPER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
MERCURY, TOTAL	EPA 245.1	<0.0002	MG/L	0.0002	04/27/01	XM
NICKEL, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
LEAD, TOTAL	EPA 239.2	0.001	MG/L	0.001	04/30/01	XM
ANTIMONY, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
SELENIUM, TOTAL	EPA 270.2	0.003	MG/L	0.002	04/30/01	XM
THALLIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
ZINC, TOTAL	EPA 200.7	0.01	MG/L	0.005	04/30/01	RDC

ample ID: **WC-004** Sample Matrix: WATER
ample Date Collected: **04/23/01**

EST	METHOD	RESULT	UNITS	PQL	ANALYZED	BY
ETAL PREPARATION	EPA 3010	IL010426C			04/26/01	RDC
ILVER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
RSENIC, TOTAL	EPA 206.2	<0.002	MG/L	0.002	04/30/01	XM
ARIUM, TOTAL	EPA 200.7	0.157	MG/L	0.005	04/30/01	RDC
ERYLLIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	04/30/01	RDC
ORON, TOTAL	EPA 200.7	0.24	MG/L	0.01	04/30/01	RDC
ADMIUM, TOTAL	EPA 200.7	<0.005	MG/L	0.005	04/30/01	RDC
HROMIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
OPPER, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
ERCURY, TOTAL	EPA 245.1	<0.0002	MG/L	0.0002	04/27/01	XM
ICKEL, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
EAD, TOTAL	EPA 239.2	0.003	MG/L	0.001	04/30/01	XM
NTIMONY, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
ELENIUM, TOTAL	EPA 270.2	<0.002	MG/L	0.002	04/30/01	XM
HALLIUM, TOTAL	EPA 200.7	<0.01	MG/L	0.01	04/30/01	RDC
INC, TOTAL	EPA 200.7	0.01	MG/L	0.005	04/30/01	RDC

ID=NONE DETECTED
QL=PRACTICAL QUANTITATION LIMIT
U=STANDARD UNITS
=DETECTED IN METHOD BLANK

APPROVED BY:
TERRY KOESTER
LABORATORY DIRECTOR

ENVIRONMENTAL MANAGEMENT ROUTING FORM

OUTGOING CORRESPONDENCE

A. Letter Number: RP 02-0072 **Date:** 07/12/02

Responsible Person: Ralph Logsdon

TO: Shelly Shores-Miller/KDHE **FROM:** John W. Johnson

B. Subject: NPDES Discharge Monitoring Report for June 2002.

Comments:

C. Records Management

File 21.1 (KDHE) [X]

File 21. [ ]

CC-DS [ ]

D. RESPONSIBLE PERSON REVIEW DATE L 7-12-02

E. Personal Copies

Name

J. W. Johnson (OB-RP)
R. L. Denton (OB-CH)
S. E. Steen (OB-CH)
M. J. Steinert (OB-OP)
T. E. Wilson (OB-OP)
D. L. Williamson (CC-EM)

F. TE File Number: 42311

FORM APF 07-004-01 REV 2

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE 07/28/02 [X] Required [ ] Requested [ ] N/A

Responsible Individual Ralph L. Logsdon Extension 4730

Letter Number: RP 02-0072

Subject: NPDES Discharge Monitoring Report for June 2002

Commitments contained in letter? [X] No [ ] Yes See Commitment Summary attached to letter

PIR associated with letter? [ ] No [X] Yes PIR No. 2002-1552

Comments:

Technical Review and Concurrence

Technical Review and Concurrence signature is not required of the individual signing the outgoing correspondence.

Review Required by:	Signature	Date Signed
Licensing	C. Redding	7/12/02
Supervisor Environmental or Designee	Daniel Williamson	7.12.02

- [X] Manager Resource Protection
- [ ] Plant Manager
- [ ] Vice President Operations
- [ ] Vice President Technical Services
- [ ] Controller-Treasurer
- [ ] General Counsel/Secretary
- [ ] President and CEO

WOLF CREEK
NUCLEAR OPERATING CORPORATION

July 12, 2002

RP 02-0072

Kansas Department of Health and Environment
Bureau of Water- Technical Services
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Attention: Ms. Shelly Shores-Miller

Subject: Wolf Creek Generating Station (WCGS) June 2002 National Pollutant Discharge Elimination System (NPDES) Monitoring Report, Permit I-NE07-PO02

Dear Ms. Shores-Miller:

This letter is a follow-up to the June 2002 electronic discharge monitoring report (EDMR) that was e-mailed to you earlier in the month. There were no numerically limited NPDES parameters exceeded during the June 2002 reporting period.

Enclosed with this letter are the satisfactorily completed results of Wolf Creek's acute whole effluent toxicity (WET) testing and the associated NPDES permit Attachment B required analyses for the year 2002. The Attachment B test results are identified as Sample ID WC003. These two reports meet the annual reporting requirement as specified in Supplemental Condition 1 of our current NPDES permit. Note: The WET test sample was taken at outfall 003 point of discharge in Wolf Creek Cooling Impoundment. This sample was taken while the circulating water was being treated with a copper corrosion inhibitor (CuproSTAT). Also, a wastewater release was being made at the same time from outfall 003(B). The WET test results reflect the synergistic effects of these two events without factoring in any zone of initial dilution or mixing zone.

Also enclosed for your review are the required NPDES permit metal test results on outfall 004, Cooling Impoundment Discharge to Wolf Creek for the year 2002. The metal analysis test results are identified as Sample ID WC004.

On June 25, 2002, Mr. Om Agrawal of the Kansas Department of Health and Environment (KDHE) was notified that outfall 007, Waste Stabilization Pond (WSP), had developed a leak around the discharge pipe. At the time of the phone call, it was thought that the leak was caused by a lawn mower running over the discharge pipe where it was close to the surface and cracking the pipe. It now appears upon excavation of the pipe, that the contractor who built the discharge structure had improperly laid the discharge pipe. This improperly laid pipe caused the WSP effluent to siphon around the discharge structure, pass through the berm and seep out by the end of the discharge pipe. To repair this problem the WSP is being released through outfall 007 to lower the north cell's level.

This event has been entered into Wolf Creek Generating Station correction action program as performance improvement report (PIR) 2002-1552. As corrective action for this event, a contractor will make necessary repairs to the discharge structure and berm once the north cell is lowered below the leakage point. If you have any questions regarding this submittal, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

John W. Johnson

John W. Johnson

JWJ/jaf

cc: Mr. Rex Heape, KDHE
Southeast District Office
1500 West 17th
Chanute, Kansas 66720-9701

Mr. Om Agrawal
KDHE-BOW
1100 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Wolf Creek Generating Station

Whole Effluent Toxicity Testing Results

Pace Analytical™

PACE # 6059499

Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: WCNOC **Attn: Ralph Logsdon** **P.O. Box 411** **Burlington, KS 66839** **1-620-364-8831**	**Date Reported: 06-20-02** **Date Initiated: 06-05-02** **Time Arrived: 1:00 pm** **Date Terminated: 06-07-02**

BIOMONITORING STUDY

ACUTE TOXICITY

Permit #I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the WCNOC effluent discharge. Acute toxicity, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, was **not detected in Ceriodaphnia exposed to the 100% effluent (AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, chlorine, and ammonia determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

WCNOC personnel collected a sample at the WCNOC effluent discharge. The sample was preserved with ice and transported to Pace Analytical by WCNOC personnel.

INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the WCNOC effluent on the freshwater invertebrate, Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA/600/4-90/027F, August 1993.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at Pace Analytical Services, Inc., Frontenac, KS and were originally obtained from a private breeder. Fathead minnows are maintained at Pace Analytical Services until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA/600/4-90/027F, August 1993.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 1993).

WCNOC personnel collected the effluent tested from the WCNOC discharge. Testing was performed using 100% effluent, a series of dilutions, upstream, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, ammonia nitrogen, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, conductance, and ammonia nitrogen were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was no significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
75%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
12.5%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
Upstream	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) =0.0%

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THE Pimephales RESULTS - Minnows exposed to effluent collected at the WCNOC effluent discharge by WCNOC personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
75%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
12.5%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
Upstream	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The effluent sample from the WCNOC effluent discharge had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the effluent sample was 7.10 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 6.60 mg/l in the effluent which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the effluent was 8.28 upon receipt in the laboratory and the synthetic control had a pH 7.75. At termination the pH measurement in the effluent sample was 8.11.

Conductance - The conductance of the effluent sample was 690 umhos and the synthetic control was 340 umhos.

Ammonia (NH3-N) - Ammonia Nitrogen content of the effluent in was <4.0 mg/l.

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PACE # 6059499

INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.75	7.80	340	<0.2	<0.1	25	128	68

Initial Measurements of 100% Effluent

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.28	7.10	690	<4.0	<0.1	25	246	170

Initial Measurements of Upstream

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.14	7.40	708	<4.0	<0.1	25	242	150

TEST WATER QUALITY:

24-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.71	7.00	25	330
100%	8.47	7.00	25	756
75%	8.47	7.10	25	754
50%	8.46	7.10	25	750
25%	8.45	7.00	25	750
12.5%	8.43	7.00	25	730
Upstream	8.41	7.00	25	704

48-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.73	6.70	25	415
100%	8.11	6.60	25	850
75%	8.19	6.60	25	850
50%	8.48	6.60	25	806
25%	8.41	6.50	25	801
12.5%	8.30	6.50	25	796
Upstream	8.23	6.60	25	775

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	7	0
2.5 g/l	20	12	4
2.0 g/l	20	20	18
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.28g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
12.0 g/l	40	0	0
10.0 g/l	40	0	0
8.0 g/l	40	37	24
6.0 g/l	40	40	39
4.0 g/l	40	40	40

LC50 = 8.22 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

Wolf Creek Generating Station

NPDES Permit Attachment B Metal Analysis Test Results

Outfall 003 (Sample ID WC003)
and
Outfall 004 (Sample ID WC004)

Pace Analytical™
www.pacelabs.com

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9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

Lab Project Number: 6059499
Client Project ID: S/A WET

Lab Sample No: 605159391 Project Sample Number: 6059499-002 Date Collected: 06/05/02 09:25
Client Sample ID: WC003 Matrix: Water Date Received: 06/05/02 17:15

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Metals								
Metals, Trace ICP, [illegible]	Prep/Method: EPA 3010 / EPA 6010							
Antimony	ND	ug/l	10.0	06/13/02	JLG	7440-36-0		
Arsenic	ND	ug/l	5.00	06/13/02	JLG	7440-38-2		
Barium	159.	ug/l	4.00	06/13/02	JLG	7440-39-3		
Beryllium	ND	ug/l	1.00	06/13/02	JLG	7440-41-7		
Cadmium	ND	ug/l	5.00	06/13/02	JLG	7440-43-9		
Chromium	ND	ug/l	7.00	06/13/02	JLG	7440-47-3		
Copper	ND	ug/l	10.0	06/13/02	JLG	7440-50-8		
Lead	ND	ug/l	5.00	06/13/02	JLG	7439-92-1		
Nickel	ND	ug/l	30.0	06/13/02	JLG	7440-02-0		
Selenium	15.5	ug/l	10.0	06/13/02	JLG	7782-49-2		
Silver	ND	ug/l	7.00	06/13/02	JLG	7440-22-4		
Thallium	ND	ug/l	10.0	06/13/02	JLG	7440-28-0		
Zinc	ND	ug/l	100.	06/13/02	JLG	7440-66-6		
Boron	250.	ug/l	30.0	06/13/02	JLG	7440-42-8		
Date Digested				06/10/02				
Mercury, CVAAS	Method: EPA 7470							
Mercury	ND	ug/l	0.200	06/12/02 10:57	SYW	7439-97-6		
Wet Chemistry								
Hardness, Total	Method: EPA 130.2							
Total Hardness	232.	mg/l	1.00	06/07/02	KMW			
pH	Method: EPA 150.1							
pH	8.56			06/06/02	AEP			
Anions, Ion Chromatography	Method: EPA 300.0							
Chloride	34.4	mg/l	2.00	06/06/02	AEP	16887-00-6		
Nitrate as N	ND	mg/l	1.00	06/06/02	AEP			
Ammonia in Water by 350.2	Method: EPA 350.2							
Nitrogen, Ammonia	ND	mg/l	0.200	06/14/02	KMW	7727-37-9		
Chromium, Hexavalent	Method: EPA 7196							
Chromium, Hexavalent	ND	mg/l	0.0100	06/05/02	KMW	18540-29-9		

REPORT OF LABORATORY ANALYSIS

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Phone: 913.599.5665
Fax: 913.599.1759

Lab Project Number: 6059499
Client Project ID: S/A WET

Lab Sample No: 605159409 Project Sample Number: 6059499-003 Date Collected: 06/04/02 14:30
Client Sample ID: WC004 Matrix: Water Date Received: 06/05/02 17:15

Parameters	Results	Units	Report Limit	Analyzed	By	CAS No.	Qual	RegLmt
Metals								
Metals, Trace ICP, [illegible]	Prep/Method: EPA 3010 / EPA 6010							
Antimony	ND	ug/l	10.0	06/13/02	JLG	7440-36-0		
Arsenic	ND	ug/l	5.00	06/13/02	JLG	7440-38-2		
Barium	171.	ug/l	4.00	06/13/02	JLG	7440-39-3		
Beryllium	ND	ug/l	1.00	06/13/02	JLG	7440-41-7		
Cadmium	ND	ug/l	5.00	06/13/02	JLG	7440-43-9		
Chromium	ND	ug/l	7.00	06/13/02	JLG	7440-47-3		
Copper	ND	ug/l	10.0	06/13/02	JLG	7440-50-8		
Lead	ND	ug/l	5.00	06/13/02	JLG	7439-92-1		
Nickel	ND	ug/l	30.0	06/13/02	JLG	7440-02-0		
Selenium	24.6	ug/l	10.0	06/13/02	JLG	7782-49-2		
Silver	ND	ug/l	7.00	06/13/02	JLG	7440-22-4		
Thallium	10.7	ug/l	10.0	06/13/02	JLG	7440-28-0		
Zinc	ND	ug/l	100.	06/13/02	JLG	7440-66-6		
Boron	269.	ug/l	30.0	06/13/02	JLG	7440-42-8		
Date Digested				06/10/02				
Mercury, CVAAS	Method: EPA 7470							
Mercury	ND	ug/l	0.200	06/12/02 10:55	SYW	7439-97-6		
Wet Chemistry								
Hardness, Total	Method: EPA 130.2							
Total Hardness	245.	mg/l	1.00	06/07/02	KMW			
pH	Method: EPA 150.1							
pH	8.57			06/06/02	AEP			
Anions, Ion Chromatography	Method: EPA 300.0							
Chloride	34.5	mg/l	2.00	06/06/02	AEP	16887-00-6		
Nitrate as N	ND	mg/l	1.00	06/06/02	AEP			
Ammonia in Water by 350.2	Method: EPA 350.2							
Nitrogen, Ammonia	ND	mg/l	0.200	06/14/02	KMW	7727-37-9		
Chromium, Hexavalent	Method: EPA 7196							
Chromium, Hexavalent	ND	mg/l	0.0100	06/05/02	KMW	18540-29-9		

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www.pacelabs.com

Lab Project Number: 6059499
Client Project ID: S/A WET

PARAMETER FOOTNOTES

ND	Not detected at or above adjusted reporting limit
NC	Not Calculable
J	Estimated concentration above the adjusted method detection limit and below the adjusted reporting limit
MDL	Adjusted Method Detection Limit

ENVIRONMENTAL MANAGEMENT ROUTING FORM

OUTGOING CORRESPONDENCE

A. Letter Number: RA 03-0083 **Date:** JUN 26 2003

Responsible Person: Ralph Logsdon

TO: Jennifer Martin/KDHE **FROM:** Kevin J. Moles

B. Subject: WCGS May 2003 NPDES Discharge Monitoring Report

Comments:

C. Records Management

File 21.1 (KDHE) [X]

File 21. [ ]

CC-DS [ ]

D. RESPONSIBLE PERSON REVIEW DATE 6-26-03

E. Personal Copies

Name

C. L. Palmer (OB-CH)
R. L. Denton (OB-CH)
M. J. Steinert (OB-OP)
T. E. Wilson (OB-OP)

F. TE File Number: 42311

FORM APF 07-004-01 REV 3

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE 06/28/03 ☐ Required ☐ Requested ☒ N/A

Responsible Individual: Ralph Logsdon Extension: 4730

Letter Number: RA 03-0083

Subject: WCGS May 2003 NPDES Discharge Monitoring Report

Commitments contained in letter? ☒ No ☐ Yes See Commitment Summary attached to letter

PIR associated with letter? ☒ No ☐ Yes PIR No. ______

Comments:

Peer Review DEH / 6/24/03

Technical Review and Concurrence

Review Required by:	Signature	Date Signed
Supervisor Regulatory Support or Designee	KDHughes	6-24-03
☒ Manager Regulatory Affairs		
☐ Plant Manager		
☐ Vice President Operations		
☐ Vice President Technical Services		
☐ Controller-Treasurer		
☐ General Counsel/Secretary		
☐ President and CEO		

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Kevin J. Moles
Manager Regulatory Affairs

JUN 26 2003

RA 03-0083

Kansas Department of Health and Environment
Attention: Ms. Jennifer Martin
Bureau of Water - Technical Services
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Subject: Wolf Creek Generating Station (WCGS) May 2003 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02 and WET Testing Results of Outfalls 003 and 006

Dear Ms. Martin:

This letter is a follow-up to the May 2003 electronic discharge monitoring report (EDMR) that was e-mailed to you earlier in the month. No numerically limited NPDES parameters were exceeded during the May 2003 reporting period.

Enclosed with this letter are the satisfactorily completed results of the 2003 Wolf Creek's acute whole effluent toxicity (WET) testing and the associated NPDES permit Attachment B required analyses for outfall 003. The Attachment B test results for outfall 003 are identified as sample ID WC-003 on Attachment 1. The WET test sample was taken at outfall 003 point of discharge in Wolf Creek Cooling Impoundment (WCCI). This sample was taken while the circulating water was being treated with a non-oxidizing biocide, Calgon H-130M. These two reports meet the annual reporting requirement as specified in Supplemental Condition 1 of our current NPDES permit.

In addition, a WET test was also performed on outfall 006 to determine the aquatic toxicity of Calgon H-130M at the point of discharge into WCCI. The non-oxidizing biocide concentration was raised in the plant to a level consistent with Calgon's treatment specifications of greater then 4 ppm. Environmental Management felt that the biocide would not be detectable at outfall 006, due to system demand and the long length of underground piping from the powerblock to the ultimate heat sink; a length of approximately 5400 feet. A sub-surface sampler was used to capture a sample of the discharge from outfall 006. The WET test results were satisfactory and the analytical test results for Calgon H-130M were undetectable. The test results are also enclosed with this letter.

Also enclosed for your review are the required NPDES permit metal test results on outfall 004, Cooling Impoundment Discharge to Wolf Creek, for year 2003. The metal analysis test results are identified as sample ID WC-004 on Attachment 1.

If you have any questions regarding this submittal, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

Kevin J. Moles

KJM/rlg

Attachment

Enclosures: WCGS Whole Effluent Toxicity Testing Results for Outfall 003
WCGS Whole Effluent Toxicity Testing Results for Outfall 006

cc: Mr. Om Agrawal, KDHE
Mr. Rex Heape, KDHE

Attachment 1.0

Heavy Metal and Other Analyses

Parameter	ID WC-003	ID WC-004	Outfall 006	Units
Antimony, total	<0.006	<0.006		mg/l
Arsenic, total	<0.010	<0.010		mg/l
Barium, total	0.18	0.18		mg/l
Beryllium, total	<0.004	<0.004		mg/l
Boron, total	0.3	0.2		mg/l
Cadmium, total	<0.001	<0.001		mg/l
Chromium, total	<0.010	<0.010		mg/l
Chromium (VI)	<0.02	<0.02		mg/l
Copper, total	<0.010	<0.010		mg/l
Lead, total	<0.003	<0.003		mg/l
Mercury, total	<0.0002	<0.0002		mg/l
Nickel, total	<0.010	<0.010		mg/l
Selenium, total	<0.005	<0.005		mg/l
Silver, total	<0.002	<0.002		mg/l
Thallium, total	<0.002	<0.002		mg/l
Zinc, total	<0.02	0.025		mg/l
Hardness as $CaCO_3$	126	128		mg/l
Ammonia	<0.2	<0.2		mg/l
Temperature	92	67.5		^{0}F
PH	8.4	8.4		
Calgon H-130M	<0.17*		4.7**/<0.5***	mg/l
Nitrate as N	<1.0	<1.0		mg/l
Chlorides	32.6	31.7		mg/l

*Calculated
**In plant concentration at the discharge side of the heat exchangers prior to mixing with ultimate heat sink waters
***Sample concentration at the discharge point of Outfall 006 into the lake using a sub-surface sampler

Enclosure 1

WCGS Whole Effluent Toxicity Testing Results for Outfall 003

Pace Analytical®
www.pacelabs.com

PACE # 6070841

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Phone: 913.599.5665
Fax: 913.599.1759

Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: WCNOC **Attn: Ralph Logsdon** **P.O. Box 411** **Burlington, KS 66839** **1-620-364-8831**	**Date Reported: 5-28-03** **Date Initiated: 5-21-03** **Time Arrived: 12:00** **Date Terminated: 5-23-03**

BIOMONITORING STUDY

ACUTE TOXICITY

Permit # I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the WCNOC 003 effluent discharge. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, was **not detected in Ceriodaphnia exposed to the 100% effluent (AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, chlorine, and ammonia determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

WCNOC personnel collected a sample at the WCNOC 003 effluent discharge. The sample was preserved with ice and transported to Pace Analytical by commercial carrier personnel.

REPORT OF LABORATORY ANALYSIS

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the WCNOC effluent on the freshwater invertebrate, Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA/600/4-90/027F, August 1993.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at Pace Analytical Services, Inc., Frontenac, KS and were originally obtained from a private breeder. Fathead minnows are maintained at Pace Analytical Services until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA/600/4-90/027F, August 1993.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 1993).

WCNOC personnel collected the effluent tested from the WCNOC 003 discharge. Testing was performed using 100% effluent, a series of dilutions, and Upstream, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, ammonia nitrogen, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, conductance, and ammonia nitrogen were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was no significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
12.5%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
6.25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) =0.0%

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THE Pimephales **RESULTS** - Minnows exposed to effluent collected at the WCNOC 003 effluent discharge by WCNOC personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
12.5%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
6.25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	12	0
2.5 g/l	20	15	15
2.0 g/l	20	20	18
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.31 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	0	0
8.0 g/l	40	37	34
6.0 g/l	40	40	38
4.0 g/l	40	40	40
2.0 g/l	40	40	39

LC50 = 8.64 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

Enclosure 2

WCGS Whole Effluent Toxicity Testing Results
for Outfall 006

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Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: WCNOC **Attn: Ralph Logsdon** **P.O. Box 411** **Burlington, KS 66839** **1-620-364-8831**	**Date Reported: 5-28-03** ***Date Initiated:* 5-21-03** **Time Arrived: 12:00** **Date Terminated: 5-23-03**

BIOMONITORING STUDY

ACUTE TOXICITY

Permit # I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the WCNOC 006 effluent discharge. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, was **not detected in Ceriodaphnia exposed to the 100% effluent (AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, chlorine, and ammonia determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

WCNOC personnel collected a sample at the WCNOC 006 effluent discharge. The sample was preserved with ice and transported to Pace Analytical by commercial carrier personnel.

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the WCNOC effluent on the freshwater invertebrate, Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA/600/4-90/027F, August 1993.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at Pace Analytical Services, Inc., Frontenac, KS and were originally obtained from a private breeder. Fathead minnows are maintained at Pace Analytical Services until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA/600/4-90/027F, August 1993.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 1993).

WCNOC personnel collected the effluent tested from the WCNOC 006 discharge. Testing was performed using 100% effluent, a series of dilutions, a upstream, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, ammonia nitrogen, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, conductance, and ammonia nitrogen were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was no significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
12.5%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
6.25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) =0.0%

REPORT OF LABORATORY ANALYSIS

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THE Pimephales **RESULTS** - Minnows exposed to effluent collected at the WCNOC 006 effluent discharge by WCNOC personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
12.5%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
6.25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

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PACE # 6070841-006

Pace Analytical Services, Inc.
9608 Loiret Blvd.
Lenexa, KS 66219
Phone: 913.599.5665
Fax: 913.599.1759

QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	12	0
2.5 g/l	20	15	15
2.0 g/l	20	20	18
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.31 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	0	0
8.0 g/l	40	37	34
6.0 g/l	40	40	38
4.0 g/l	40	40	40
2.0 g/l	40	40	39

LC50 = 8.64 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

REPORT OF LABORATORY ANALYSIS

ENVIRONMENTAL MANAGEMENT ROUTING FORM

OUTGOING CORRESPONDENCE

A. Letter Number: RA 04-0071 **Date:** JUN 1 7 2004

Responsible Person: Ralph L. Logsdon

TO: Jennifer Martin/KDHE **FROM:** Kevin J. Moles

B. Subject: WCGS May 2004 NPDES Discharge Monitoring Report

Comments:

C. Document Services (CC-DS)

File 21.1 (KDHE) [X]

File 21. [ ]

CC-DS [ ]

D. Environmental Disclosure

Does this letter address an issue subject to environmental disclosure? ☐ yes or X no
If yes, route a copy to: Western Resources, Inc., Great Plains Energy Inc. and KEPCo

E. RESPONSIBLE PERSON COMPLETION REVIEW: INITIAL/DATE RL 6-17-04

F. Personal Copies

Name

W. T. Muilenburg (CC-LI)
T. J. Jensen (OB-CH)
R. L. Denton (OB-CH)
M. J. Steinert (OB-OP)

G. TE File Number: 42311

FORM APF 07-004-01 REV 4

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE ______________ [ ] Required [ ] Requested [X] N/A

Responsible Individual: Ralph L. Logsdon Extension: 4730

Letter Number: RA 04-0071

Subject: WCGS May 2004 NPDES Discharge Monitoring Report

Commitments contained in letter? [X] No [ ] Yes See Commitment Summary attached to letter

PIR associated with letter? [X] No [ ] Yes PIR No. ______________

Comments: ______________

Peer Review QLR / 6-16-04

Technical Review and Concurrence

Review Required by:	Signature	Date Signed
Supervisor Regulatory Support or Designee	Robert Ham	6/16/04
Correspondence Signatory or Designee		
Manager Regulatory Affairs		

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Kevin J. Moles
Manager Regulatory Affairs

JUN 17 2004

RA 04-0071

Kansas Department of Health and Environment
Attention: Ms. Jennifer Martin
Bureau of Water - Technical Services
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Subject: Wolf Creek Generating Station (WCGS) May 2004 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02

Dear Ms. Martin:

This letter contains additional information that was not included in the May 2004 electronic discharge monitoring report (EDMR) that was e-mailed to you earlier in the month. Enclosed with this letter are the satisfactorily completed results of Wolf Creek's acute whole effluent toxicity (WET) testing and the associated NPDES permit Attachment B required analyses for year 2004. The Attachment B test results are identified as Sample ID WC-003 on Attachment 1. These two reports meet the annual reporting requirement as specified in Supplemental Condition 1 of our current NPDES permit. Note: The WET test sample was taken at outfall 003 point of discharge in Wolf Creek Cooling Impoundment. This sample was taken while the circulating water was being treated with a non-oxidizing biocide (Calgon H-130M). Also, two wastewater releases were being made at the same time from outfall 003(A) and outfall 003(B). The WET test results reflect the synergistic effects of these three events without factoring in any zone of initial dilution or mixing zone.

Also enclosed for your review are the required NPDES permit metal test results on outfall 004, Cooling Impoundment Discharge to Wolf Creek, for year 2004. The metal analysis test results are identified as Sample ID WC-004 on Attachment 1.

If you have any questions regarding this submittal, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

Kevin J. Moles

Kevin J. Moles

KJM/rll

Attachment: Heavy Metal and Other Analysis

Enclosure: WCGS Whole Effluent Toxicity Testing Results for Outfall 003

cc: Mr. Om Agrawal, KDHE
Mr. Rex Heape, KDHE

Attachment 1.0

Heavy Metal and Other Analyses

Parameter	ID WC-003	ID WC-004	Units
Antimony, total	<0.006	<0.006	mg/l
Arsenic, total	<0.010	<0.010	mg/l
Barium, total	0.17	0.16	mg/l
Beryllium, total	<0.004	<0.004	mg/l
Boron, total	0.3	0.3	mg/l
Cadmium, total	<0.001	<0.001	mg/l
Chromium, total	<0.010	<0.010	mg/l
Chromium (VI)	<0.020	<0.020	mg/l
Copper, total	<0.020	<0.020	mg/l
Lead, total	<0.003	<0.003	mg/l
Mercury, total	<0.0002	<0.0002	mg/l
Nickel, total	<0.040	<0.040	mg/l
Selenium, total	<0.005	<0.005	mg/l
Silver, total	<0.002	<0.002	mg/l
Thallium, total	<0.002	<0.002	mg/l
Zinc, total	<0.020	<0.020	mg/l
Hardness as CaC03	234	230	mg/l
Ammonia	<0.1	<0.1	mg/l
Temperature	92	69.4	^{0}F
PH	8.5	8.5	
Nitrate as N		0.1	mg/l
Chlorides		36	mg/l

WCGS Whole Effluent Toxicity Testing Results for Outfall 003

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Phone: 913.599.5665
Fax: 913.599.1759

Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: WCNOC **Attn: Ralph logsdon** **P.O. Box 411** **Burlington, KS 66839** **1-620-364-8831**	**Date Reported:** 5-27-04 **Date Initiated:** 5-19-04 **Time Arrived:** 10:30 **Date Terminated:** 5-21-04

BIOMONITORING STUDY

ACUTE TOXICITY

Permit # I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the WCNOC 003 effluent discharge. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, was **not detected in Ceriodaphnia exposed to the 100% effluent (AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, chlorine, and ammonia determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

WCNOC personnel collected a sample at the WCNOC 003 effluent discharge. The sample was preserved with ice and transported to Pace Analytical by WCNOC personnel.

REPORT OF LABORATORY ANALYSIS

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Phone: 913.599.5665
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INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the WCNOC 003 effluent on the freshwater invertebrate, Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA821-C-02-006 November 2001, 002, 003.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at Pace Analytical Services, Inc., Frontenac, KS and were originally obtained from a private breeder. Fathead minnows are maintained at Pace Analytical Services until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA821-C-02-006 November 2001, 002, 003.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA. 2001, 002, 003).

WCNOC. personnel collected the effluent tested from the WCNOC 003 discharge. Testing was performed using 6.25, 12.5, 25, 50 and 100% effluent, an Upstream, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, and conductance were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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PACE # 6082906-003

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Phone: 913.599.5665
Fax: 913.599.1759

RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was not significant mortality observed of the freshwater invertebrate. Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
Upstream	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
6.25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
12.5%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

REPORT OF LABORATORY ANALYSIS

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THE Pimephales RESULTS - Minnows exposed to effluent collected at the WCNOC 003 effluent discharge by WCNOC. personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
Upstream	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
6.25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
12.5%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

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WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The effluent sample from the WCNOC 003 effluent discharge had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the effluent sample was 9.00 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 7.20 mg/l in the effluent which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the effluent was 8.35 upon receipt in the laboratory and the synthetic control had a 7.82. At termination the pH measurement in the effluent sample was 8.35.

Conductance - The conductance of the effluent sample was 740 umhos and the synthetic control was 311 umhos.

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INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.82	8.30	311	<0.2	<0.1	25	126	74

Initial Measurements of 100% Effluent

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.35	9.00	740	N/A	<0.1	25	278	178

Initial Measurements of Upstream Effluent

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.26	8.90	724	N/A	<0.1	25	276	190

TEST WATER QUALITY:

24-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.89	7.60	25	380
Upstream	8.30	8.00	25	800
6.25%	7.95	7.90	25	400
12.5%	7.96	8.00	25	410
25%	8.05	7.90	25	462
50%	8.13	7.90	25	560
100%	8.32	7.80	25	770

48-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.98	7.20	25	395
Upstream	8.35	7.40	25	800
6.25%	8.01	7.20	25	425
12.5%	8.03	7.30	25	430
25%	8.07	7.40	25	470
50%	8.15	7.20	25	608
100%	8.35	7.20	25	800

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	0	0
2.5 g/l	20	20	7
2.0 g/l	20	20	20
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.40 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	0	0
8.0 g/l	40	37	32
6.0 g/l	40	40	39
4.0 g/l	40	40	40
2.0 g/l	40	40	40

LC50 = 8.57 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

REPORT OF LABORATORY ANALYSIS

Correspondence Verification Checklist (Rev. 06-11-04)

Section A – Cover Letter, Attachments and Enclosures

Letter Number: RA 04-0071

Yes	No	Objective	Comments/Questions
✓		The purpose of the correspondence is clear, understandable, simple and straightforward.	
✓		The text reads smoothly and the letter addresses the question, concern or requirement.	
✓		Each sentence and paragraph is complete.	
✓		The letterhead is correct for the signature authority.	
✓		With the exception of the coversheet, each page of the letter contains the letter number and page numbers.	
✓		The letter number is correct (i.e., correct year and Executive; e.g., WM, WO, RA, etc.), including attachments. WM – Rick Muench; WO – Donna Jacobs; CT – Mark Larson; ET – Kevin Scherich; RA – Kevin J. Moles	
✓		The addressee is correct.	
✓		The address is correct.	
N	A	The reference(s) are correct and correctly formatted, if applicable. (Example: Letter WM 01-0014, dated March 8, 2001, from Richard A. Muench, WCNOC, to USNRC.)	
✓		The subject statement is understandable and descriptive of the letter content.	
✓		The salutation is correct (Mr., Mrs., Miss, Ms., Gentlemen, Sir).	
✓		The telephone numbers are correct and formatted correctly, i.e., (620) 364-8831.	
✓		Attachment(s) and/or Enclosure(s) are identified on the cover letter, if applicable.	
✓		The cc list is correct and in alphabetical order.	
✓		The font of the correspondence matches this document (Arial, 11).	
✓		Attachment(s) contain letter number and page numbers.	

Section B – Concurrence Sign-off Sheet and Commitment Summary (If Section B is N/A, peer reviewer initials & dates here) ______________

Yes	No	Objective	Comments/Questions
✓		The Concurrence Sign-Off Sheet is the correct revision.	
✓		The submittal due date and associated box are correct.	
✓		The responsible individual and extension are correct.	
✓		The letter number and subject match the cover letter.	
✓		The appropriate box is checked regarding commitments.	
N	A	If commitments are contained in the letter, ensure that a Commitment Summary has been completed.	
✓		One box is checked regarding PIR question. Ensure that a PIR number is identified if a PIR is associated with the letter.	
✓		The Technical Review and Concurrence list is appropriate.	

An example of a properly formatted letter may be found in the "Peer Review Checklist" folder on the K:\ drive.

ENVIRONMENTAL MANAGEMENT ROUTING FORM

OUTGOING CORRESPONDENCE

A. Letter Number: RA 05-0096 **Date:** AUG 2 2 2005

Responsible Person: Ralph L. Logsdon

TO: Jennifer Martin/KDHE **FROM:** Kevin J. Moles

B. Subject: WCGS July 2005 NPDES Discharge Monitoring Report

Comments:

C. Document Services (CC-DS)

File 21.1 (KDHE) ☒

File 21. ☐

CC-DS ☐

D. Environmental Disclosure

Does this letter address an issue subject to environmental disclosure? ☐ yes or X no
If yes, route a copy to: Western Resources, Inc., Great Plains Energy Inc. and KEPCo

E. RESPONSIBLE PERSON COMPLETION REVIEW: INITIAL/DATE 8-22-05

F. Personal Copies

Name

W. T. Muilenburg (CC-LI)
T. J. Jensen (OB-CH)
R. L. Denton (OB-CH)

G. TE File Number: 42311

FORM APF 07-004-01 REV 4

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE ______ [ ] Required [ ] Requested [X] N/A

Responsible Individual Ralph L. Logsdon Extension 4730

Letter Number: RA 05-0096

Subject: WCGS JuLY 2005 NPDES Discharge Monitoring Report

Commitments contained in letter? [X] No [ ] Yes See Commitment Summary attached to letter

PIR associated with letter? [X] No [ ] Yes PIR No. ______

Comments:

Peer Review DRE / 8/18/05

Technical Review and Concurrence

Review Required by:	Signature	Date Signed
Supervisor Regulatory Support or Designee	Don Eulex	8/18/05
Correspondence Signatory or Designee		
Manager Regulatory Affairs		

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Kevin J. Moles
Manager Regulatory Affairs

AUG 22 2005

RA 05-0096

Kansas Department of Health and Environment
Attention: Ms. Jennifer Martin
Bureau of Water - Technical Services
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Subject: Wolf Creek Generating Station (WCGS) July 2005 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02

Dear Ms. Martin:

This letter contains additional information that was not included in the July 2005 electronic discharge monitoring report (EDMR), which was e-mailed to you earlier in the month. Enclosed with this letter are the satisfactorily completed results of Wolf Creek's chronic whole effluent toxicity (WET) testing. The WET test sample was taken at outfall 004A, Cooling Impoundment Discharge to Wolf Creek, point of discharge.

If you have any questions regarding the WET test results, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

Kevin J. Moles

Kevin J. Moles

KJM/rll

Enclosure: WCGS Whole Effluent Toxicity Testing Results for Outfall 004A

Enclosure to RA 05-0096
15 Pages

WCGS Whole Effluent Toxicity Testing Results for Outfall 004A

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CHRONIC TOXICITY TEST FOR WCNOC

PERMIT # I-NE07-PO02

PERFORMED ON:

Pimephales promelas

and

Ceriodaphnia dubia

PREPARED FOR:

WCNOC
Attn: Ralph Logsdon
P.O. Box 411
Burlington, KS 66839
1-620-364-8831

PREPARED BY:
Pace Analytical Services, INC.
808 West McKay
Frontenac, KS 66763
1-620-235-0003

July 20, 2005

REPORT OF LABORATORY ANALYSIS

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SUMMARY

A Chronic Whole Effluent Toxicity Test using the 7-day chronic fathead minnows (Pimephales promelas), static renewal larval survival and growth test, and three brood 7-day chronic Cladoceran (Ceriodaphnia dubia), static renewal survival and reproduction test, was conducted on effluent discharge water collected at the WCNOC effluent discharge from July 11, 2005 to July 15, 2005. All the test methods followed are as listed in EPA 821-R-02-013, "Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms."

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA 821-R-02-013, November 2002 and by use of Toxstat version 3.4.

In minnow section of testing, it was observed that the effluent had no significant effect on the survival of the larvae at the 100% concentration. No significant mortality was observed in the other effluent concentrations after the 7-day exposure period. The No Observed Effect Concentration (NOEC) was determined to be 100% for survival. The LC50 was estimated to be >100% effluent. No significant reduction in growth was observed in the 100% effluent concentration. The Toxic Units is <1. The IC25 is >100. The NOEC for growth in effluent was determined to be 100%.

In Cladoceran section of testing, it was observed that the effluent had no significant effect on the survival of the organisms in the 100% effluent concentration. No significant mortality was observed in the other effluent concentrations after the 7-day exposure period. The No Observed Effect Concentration (NOEC) was determined to be 100% for survival. The LC50 was estimated to be >100% effluent. No significant reduction in reproduction was observed in the 100% effluent concentrations. The Toxic Units is <1. The IC25 is >100. The NOEC for reproduction in effluent was determined to be 100%.

The chronic toxicity exhibited by the fathead minnows and the Ceriodaphnia treated by the effluent sampled from July 11 to July 15 from the WCNOC effluent discharge, is acceptable as described in EPA 821-R-02-013.

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INTRODUCTION

Pace Analytical was contracted to perform this chronic toxicity test on effluent from the WCNOC effluent discharge. Chronic toxicity was measured using the Pimephales promelas at larval for survival and growth test and the Ceriodaphnia dubia survival and reproduction test described in EPA 821-R-02-013, "Short Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms." The raw data of the study is stored at Pace Analytical Services, INC. 808 West McKay, Frontenac, KS 66763.

TEST MATERIAL

WCNOC personnel collected sampling of the effluent. A sample of the effluent was delivered to Pace by commercial carrier on 7-12-05. Subsequent samples followed by delivery on 7-14-05 and on 7-16-05. All samples were stored at 4° Celsius. Moderately Hard Synthetic Water was used as a control and also to make the required dilutions in the test as described in EPA 821-R-02-013.

TEST METHODS

Pace used EPA test method 1000.0 for conducting the Fathead Minnow, Pimephales promelas, Larval Survival and Growth Test. EPA test method 1002.0 was used for conducting the Cladoceran, Ceriodaphnia dubia, Survival and Reproduction Test. The tests were conducted to estimate the LC50, NOEC, and LOEC for survival, growth, and reproduction of these test species.

The Pimephales and Ceriodaphnia tests were initiated on 7-12-05 and carried out until 7-19-05. The Pimephales tests were conducted in 500 ml plastic jars with 250 ml of test solution. Ten larvae were placed in each of at least 4 replicates to make a total of 40 larvae per sample concentration. The Ceriodaphnia tests were carried out in 35ml vials containing 25 ml of test solution. One Neonate was placed in each of 10 replicates to make a total of 10 neonates per sample concentration.

TEST ORGANISMS

The organisms used in these tests were cultured at Pace under controlled temperature and photoperiod conditions. Pace maintains records of all culture techniques used in producing organisms.

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RESULTS

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TABLE 1

Permittee: WCNOC Effluent discharge.

Date Sampled — No. 1: 7-11-05

No. 2: 7-13-05

No. 3: 7-15-05

Test Initiated: 10:00 Date: 7-12-05

Dilution Water used: Moderately Hard Synthetic Water

FATHEAD MINNOW LARVAE GROWTH AND SURVIVAL
(Pimephales promelas)

DATA TABLE FOR GROWTH OF FATHEAD MINNOWS

Effluent Concentration (%)	Average Dry Weight in Milligrams in Replicate Chambers				Mean Dry Weight (mg)	CV% *
	A	B	C	D		
Control 0%	0.63	0.66	0.62	0.65	0.640	2.05
Dilution 1 25%	0.67	0.65	0.59	0.64	0.637	3.81
Dilution 2 50%	0.55	0.62	0.67	0.67	0.628	6.39
Dilution 3 75%	0.60	0.58	0.64	0.65	0.618	3.76
Dilution 4 100%	0.58	0.67	0.62	0.69	0.640	5.57

* Coefficient of Variation = Standard Deviation X 100 / Mean

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Permittee: WCNOC Effluent discharge.

FATHEAD MINNOW SURVIVAL

Conc. %	Percent Survival in Replicate Chambers				Mean Percent Survival			CV %
	A	B	C	D	24hr	48hr	7 day	
Control 0%	100	100	100	100	100	100	100	0.00
Dilution 1 25%	100	100	90	100	100	100	97.5	5.94
Dilution 2 50%	100	90	100	100	100	100	97.5	5.94
Dilution 3 75%	100	90	90	100	100	100	95.0	7.07
Dilution 4 100%	90	100	100	100	100	100	97.5	5.94

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Permittee: WCNOC Effluent discharge.

CERIODAPHNIA SURVIVAL AND REPRODUCTION

DATA TABLE FOR CERIODAPHNIA YOUNG PRODUCTION

Replicate	Control 0%	Dilution 1 25%	Dilution 2 50%	Dilution 3 75%	Dilution 4 100%
1	22	29	26	29	23
2	27	24	28	23	25
3	22	24	28	29	24
4	22	23	22	25	24
5	27	28	27	24	28
6	25	23	26	24	27
7	24	28	25	26	30
8	23	24	22	28	29
9	24	19	25	24	27
10	30	27	27	23	30
Mean	24.6	24.9	25.6	25.5	26.7
SD	2.675	3.071	2.171	2.369	2.584
CV %	10.87	12.33	8.48	9.29	9.68

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Permittee: WCNOC Effluent discharge.

CERIODAPHNIA MEAN PERCENT SURVIVAL

	Percent Effluent (%)					
Time Elapsed	Control 0%	Dilution 1 5.0%	Dilution 2 10%	Dilution 3 19%	Dilution 4 50%	Dilution 5 100%
24 hrs	100	100	100	100	100	100
48 hrs	100	100	100	100	100	100
7-day	100	100	100	100	100	100
SD	0.000	0.000	0.000	0.000	0.000	0.000
CV %	0.00	0.00	0.00	0.00	0.000	0.000

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TABLE 2
SUMMARY OF TEST CONDITIONS FOR THE FATHEAD MINNOW (Pimephales promelas) LARVAL SURVIVAL AND GROWTH TEST

1. Test type	Static renewal
2. Temperature	25 degrees Celsius
3. Light quality	Ambient laboratory light
4. Light intensity	Ambient laboratory levels
5. Photoperiod	16 hr light, 8 hr dark
6. Test chamber size	500 ml
7. Test solution volume	250 ml
8. Renewal of test concentrations	Daily
9. Age of test organism	< 24 hours
10. No. larvae/chamber	10
11. No. replicates/concentration	4
12. No. larvae/concentration	40
13. Feeding regime	Feed 0.1 ml newly hatched brine shrimp nauplii three times daily. Larvae are not fed 12 hours prior to termination of test.
14. Cleaning	Siphon daily, immediately before test solution renewal
15. Aeration	None

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TABLE 2 (CONT.)

16. Dilution Water	Moderately Hard Synthetic Water prepared with MILLI-Q deionized water and reagent grade chemicals
17. Effluent concentrations	0%, 25%, 50%, 75%, 100%
18. Test duration	7 days
19. Endpoints	Survival and growth
20. Test acceptability	90% or greater survival in the controls, Average dry weight in controls >0.25 mg, Coefficient of variation in the control must not exceed 40%.

TABLE 2 (CONT.)
SUMMARY OF TEST CONDITIONS FOR THE CLADOCERAN
(Ceriodaphnia dubia) SURVIVAL AND REPRODUCTION TEST

1. Test type	Static renewal
2. Temperature	25 degrees Celsius
3. Light quality	Ambient laboratory light
4. Light intensity	Ambient laboratory levels
5. Photoperiod	16 hr light, 8 hr dark
6. Test chamber size	30 ml
7. Test solution volume	25 ml

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TABLE 2 (CONT.)

8. Renewal of test concentrations	Daily
9. Age of test organism	< 24 hours
10. No. larvae/chamber	1
11. No. replicates/concentration	10
12. No. larvae/concentration	30
13. Feeding regime	Feed 0.1 ml YCT three times daily. Larvae are not fed 12 hours prior to termination of test.
14. Cleaning	Siphon daily, immediately before test solution renewal
15. Aeration	None
16. Dilution Water	Moderately Hard Synthetic Water prepared with MILLI-Q deionized water and reagent grade chemicals
17. Effluent concentrations	0%, 25%, 50%, 75%, 100%
18. Test duration	7 days - 10 days
19. Endpoints	Survival and Reproduction
20. Test acceptability	90% or greater survival in the controls, Average reproduction rate of 15 young / adult. Coefficient of variation in the control must not exceed 40%.

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TABLE 2 (SECTION 2)

BIOMONITORING CHRONIC TOXICITY REPORT
FATHEAD MINNOW (Pimephales promelas)
CHEMICAL PARAMETERS CHART

Permittee: WCNOC Effluent discharge.

ANALYSTS: Pace Analytical Services, INC.
Timothy Harrell
Mike Bollin

SAMPLE NO. 1 COLLECTED: DATE: 7-11-05

SAMPLE NO. 2 COLLECTED: DATE: 7-13-05

SAMPLE NO. 3 COLLECTED: DATE: 7-15-05

Arrival Temperature 4^{0} C

TABLE 2 (SECTION 2)
INITIAL WATER QUALITY
EFFLUENT CONCENTRATION

	Control	100%
PH	7.75	8.15
D.O.	8.20	8.00
Temp	25	25
Alk	76	160
Hard	134	228
Cond	314	797
NH3	<0.2	
Chlorine	<0.1	<0.1

* D.O. is reported as mg/l
Alkalinity is reported as mg/l $CaCO_3$
Hardness is reported as mg/l $CaCO_3$
Conductance is reported as umhos
Ammonia is reported as mg/l
Chlorine is reported as mg/l

REPORT OF LABORATORY ANALYSIS

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TEST WATER QUALITY

24-Hour Water Quality Measurements

Effluent Concentration (%)	PH	D.O. (mg/l)	Temperature (C)
0% Control	7.46	7.40	25
25% Effluent	7.84	7.30	25
50% Effluent	7.95	7.30	25
75% Effluent	8.05	7.20	25
100% Effluent	8.20	7.10	25

48-Hour Water Quality Measurements

Effluent Concentration (%)	PH	D.O. (mg/l)	Temperature (C)
0% Control	7.77	7.30	25
25% Effluent	7.89	7.30	25
50% Effluent	7.98	7.40	25
75% Effluent	8.06	7.40	25
100% Effluent	8.32	7.50	25

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FINAL WATER QUALITY

EFFLUENT CONCENTRATION

	Control	100%
pH	7.47	8.00
D.O.	7.00	6.70
Temp	25	25
Alk	90	188
Hard	178	302
Cond	450	924

* D.O. is reported as mg/l
Alkalinity is reported as mg/l CaCO3
Hardness is reported as mg/l CaCO3
Conductance is reported as umhos

REPORT OF LABORATORY ANALYSIS

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TEST VALIDITY

The Pimephales promelas control survival rate was 100%. The mean dry weight (growth) of the Pimephales promelas was determined at 0.640 mg/organism in the controls. The percent coefficient of variation (%CV) values for the fathead minnow control for survival and growth were 0.00 and 2.05. The Ceriodaphnia dubia survival rates were 100% in the control. The Ceriodaphnia in the control produced an average of 24.6 young over the seven-day exposure period. Percent CV values for Ceriodaphnia dubia control survival and reproduction was 0.00 and 10.87. Control data met or exceeded all criteria set out by EPA 821-R-02-013 for test acceptance.

CONCLUSIONS

The No Observed Effect Concentration (NOEC) for Pimephales promelas was 100% for survival and 100% for growth. The No Observed Effect Concentration (NOEC) for Ceriodaphnia dubia was 100% for Survival and 100% for Reproduction. The tests were ran using a synthetic control against effluent concentrations of 25%, 50%, 75%, and 100%. The effluent sampled on 7-11-05, 7-13-05, and 7-15-05 exhibited acceptable chronic toxicity in Pimephales promelas and in Ceriodaphnia dubia during the exposure period as described in EPA 821-R-02-013.

ENVIRONMENTAL MANAGEMENT ROUTING FORM

OUTGOING CORRESPONDENCE

A. Letter Number: RA 05-0084 **Date:** JUL 25 2005

Responsible Person: Ralph L. Logsdon

TO: Jennifer Martin/KDHE **FROM:** Kevin J. Moles

B. Subject: WCGS June 2005 NPDES Discharge Monitoring Report

Comments:

C. Document Services (CC-DS)

File 21.1 (KDHE) [X]

File 21. [ ]

CC-DS [ ]

D. Environmental Disclosure

Does this letter address an issue subject to environmental disclosure? ☐ yes or X no
If yes, route a copy to: Western Resources, Inc., Great Plains Energy Inc. and KEPCo

E. RESPONSIBLE PERSON COMPLETION REVIEW: INITIAL/DATE N 7-25-05

F. Personal Copies

Name

W. T. Muilenburg (CC-LI)
T. J. Jensen (OB-CH)
R. L. Denton (OB-CH)

G. TE File Number: 42311

FORM APF 07-004-01 REV 4

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE ________ ☐ Required ☐ Requested ☒ N/A

Responsible Individual Ralph L. Logsdon Extension 4730

Letter Number: RA 05-0084

Subject: WCGS June 2005 NPDES Discharge Monitoring Report

Commitments contained in letter? ☒ No ☐ Yes See Commitment Summary attached to letter

PIR associated with letter? ☒ No ☐ Yes PIR No. ________

Comments: ________

Peer Review DCW / 07.21.05

Technical Review and Concurrence

Review Required by:	Signature	Date Signed
Supervisor Regulatory Support or Designee	Robert Hammond	7/25/05
Correspondence Signatory or Designee		
Manager Regulatory Affairs		

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Kevin J. Moles
Manager Regulatory Affairs

JUL 25 2005
RA 05-0084

Kansas Department of Health and Environment
Attention: Ms. Jennifer Martin
Bureau of Water - Technical Services
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Subject: Wolf Creek Generating Station (WCGS) June 2005 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02

Dear Ms. Martin:

This letter contains additional information that was not included in the June 2005 electronic discharge monitoring report (EDMR) that was e-mailed to you earlier in the month. Enclosed with this letter are the satisfactorily completed results of Wolf Creek's acute whole effluent toxicity (WET) testing. The WET test sample was taken at outfall 003X point of discharge in Wolf Creek Cooling Impoundment and included three commingled discharges.

The three commingled discharges consisted of the disinfection of the circulating water system with an oxidizing biocide, the release of steam generator blowdown from outfall 003(A), and the treatment of the fire protection system with Calgon EVAC, a molluscicide. The WET test results reflect the synergistic effects of these three events without factoring in any zone of initial dilution or mixing zone.

If you have any questions regarding the WET test results, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

Robert Hammond
For

Kevin J. Moles

KJM/rll

Enclosure: WCGS Whole Effluent Toxicity Testing Results for Outfall 003X

WCGS Whole Effluent Toxicity Testing Results for Outfall 003X

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Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: Ralph Logsdon Wolf Creek P.O. Box 411 Burlington, KS 66839 1-620-364-8831	Date Reported: 6-20-05 Date Initiated: 6-13-05 Time Arrived: 12:20 Date Terminated: 6-15-05

BIOMONITORING STUDY

ACUTE TOXICITY

Permit # I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the WOLF CREEK effluent discharge. **Acute toxicity**, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, was **not detected in Ceriodaphnia exposed to the 100% effluent (AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, and chlorine determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

Wolf Creek personnel collected a sample at the WOLF CREEK effluent discharge. The sample was preserved with ice and transported to Pace Analytical by Wolf Creek personnel.

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INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the WOLF CREEK effluent on the freshwater invertebrate, Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA821-C-02-006 November 2002.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at Pace Analytical Services, Inc., Frontenac, KS and were originally obtained from a private breeder. Fathead minnows are maintained at Pace Analytical Services until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA821-C-02-006 November 2002.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 2002).

Wolf Creek personnel collected the effluent tested from the WOLF CREEK discharge. Testing was performed using an 100% effluent, a series of dilution, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, and conductance were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was no significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
75%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
90%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

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THE **Pimephales** **RESULTS** - Minnows exposed to effluent collected at the Wolf Creek effluent discharge by WOLF CREEK personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
75%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
90%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

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WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The effluent sample from the WOLF CREEK effluent discharge had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the effluent sample was 7.90 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 7.40 mg/l in the effluent which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the effluent was 8.17 upon receipt in the laboratory and the synthetic control had a 7.75. At termination the pH measurement in the effluent sample was 8.25.

Conductance - The conductance of the effluent sample was 654 umhos and the synthetic control was 333 umhos.

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INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.75	8.60	333	<0.2	<0.1	25	128	70

Initial Measurements of 100% Effluent

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.17	7.90	654	N/A	<0.1	25	272	160

TEST WATER QUALITY:

24-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.87	8.00	25	400
25%	7.88	7.90	25	430
50%	8.05	7.90	25	520
75%	8.13	7.80	25	600
90%	8.21	7.60	25	675
100%	8.28	7.50	25	725

48-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.77	7.60	25	410
25%	7.86	7.60	25	450
50%	8.06	7.60	25	525
75%	8.14	7.50	25	590
90%	8.20	7.50	25	690
100%	8.25	7.40	25	740

REPORT OF LABORATORY ANALYSIS

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	0	0
2.5 g/l	20	17	10
2.0 g/l	20	20	19
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.45 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	15	0
8.0 g/l	40	38	28
6.0 g/l	40	39	39
4.0 g/l	40	40	40
2.0 g/l	40	40	39

LC50 = 8.40 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

42

ENVIRONMENTAL MANAGEMENT ROUTING FORM

OUTGOING CORRESPONDENCE

A. **Letter Number:** RA 06-0097 **Date:** 07/24/06

Responsible Person: Ralph L. Logsdon

TO: Matthew Matheis/KDHE **FROM:** Kevin J. Moles

B. **Subject:** WCGS June 2006 NPDES Discharge Monitoring Report

Comments:

C. **Document Services (CC-DS)**

File 21.1 (KDHE) [X]

File 21. [ ]

CC-DS [ ]

D. **Environmental Disclosure**

Does this letter address an issue subject to environmental disclosure? Yes ☐ **No** ☒
If yes, route a copy to: Western Resources, Inc., Great Plains Energy Inc. and KEPCo

E. **RESPONSIBLE PERSON COMPLETION REVIEW: INITIAL/DATE** RLL 07/25/06

F. **Personal Copies**

Name

W. T. Muilenburg (CC-LI) w/o attachment
R. L. Denton (OB-CH) w/o attachment
M. De La Cruz (OB-OP) w/o attachment

G. **TE File Number:** 42311

FORM APF 07-004-01 REV 4

CONCURRENCE SIGN-OFF SHEET

SUBMITTAL DUE DATE ____________ [ ] Required [ ] Requested [X] N/A

Responsible Individual: Ralph L. Logsdon Extension: 4730

Letter Number: RA 06-0097

Subject: WCGS June 2006 NPDES Discharge Monitoring Report

Commitments contained in letter? [X] No [ ] Yes See Commitment Summary attached to letter

PIR associated with letter? [X] No [ ] Yes PIR No. ____________

Comments: ____________

Peer Review DLR / 7-21-06

Technical Review and Concurrence

Review Required by:	Signature	Date Signed
Supervisor Regulatory Support or Designee	Robert Hammond	7/21/06
Correspondence Signatory or Designee		
Manager Regulatory Affairs		

WOLF CREEK
NUCLEAR OPERATING CORPORATION

Kevin J. Moles
Manager Regulatory Affairs

JUL 2 4 2006
RA 06-0097

Kansas Department of Health and Environment
Bureau of Water - Technical Services
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Attention: Mr. Matthew Matheis

Subject: Wolf Creek Generating Station (WCGS) June 2006 National Pollutant Discharge Elimination System (NPDES) Discharge Monitoring Report, Permit I-NE07-PO02

Dear Mr. Matheis:

This letter contains additional information that was not included in the June 2006 electronic discharge monitoring report (EDMR) that was e-mailed to you earlier in the month. Enclosed with this letter are the satisfactorily completed results of Wolf Creek's acute whole effluent toxicity (WET) testing. The WET test sample was taken at outfall 003X point of discharge in Wolf Creek Cooling Impoundment and included three commingled discharges.

The three commingled discharges consisted of the disinfection of the circulating water system with an oxidizing biocide, the release of steam generator blowdown from outfall 003(A), and the treatment of the fire protection system with Nalco EVAC, a molluscicide. The WET test results reflect the synergistic effects of these three events without factoring in any zone of initial dilution or mixing zone.

Also enclosed is a revision to the "Microfouling, Asiatic Clam and Zebra Mussel Control Program" document. This document contains WCGS's plan on controlling biofouling agents' attacks on the WCGS's heat exchanger and condensers. The document is being sent per Supplemental Condition No. 6 to our previous NPDES permit (issued May 25, 2000) which requested subsequent updates to the plan be sent to Kansas Department of Health and Environment.

If you have any questions regarding the WET test results or the bio-control plan, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

Kevin J. Moles

Kevin J. Moles

KJM/rll

Enclosures: WCGS Whole Effluent Toxicity Testing Results for Outfall 003X
Microfouling, Asiatic Clam and Zebra Mussel Control Plan

WCGS Whole Effluent Toxicity Testing Results for Outfall 003X

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June 23, 2006

Mr. Ralph Logsdon
Wolf Creek Nuclear Op Corp
PO Box 411
Burlington, KS 66839

RE: Project: Wet Test
Pace Project No.: 609662

Dear Mr. Logsdon:

Enclosed are the analytical results for sample(s) received by the laboratory on June 13, 2006. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any questions concerning this report, please feel free to contact me.

Sincerely,

Angie Brown

Angie.Brown@pacelabs.com
Project Manager

Arkansas Certification Number: 05-008-0
California Certification Number: 02109CA
Illinois Certification Number: 001191
Iowa Certification Number: 118
Kansas/NELAP Certification Number: E-10116
Louisiana Certification Number: 03055
Minnesota Certification Number: 020-999-394
Oklahoma Certification Number: 9205/9935
Utah Certification Number: 9135995665

Enclosures

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Phone: 913.599.5665
Fax: 913.599.1759

June 21, 2006

Ralph Logsdon
Wolf Creek
P.O. Box 411
Burlington, KS 66839

Re: Lab Project Number: 609662
Client Project ID: Wet Test

Dear Ralph Logsdon:

Enclosed are the analytical results for sample(s) received by the laboratory. Results reported herein conform to the most current NELAC standards, where applicable, unless otherwise narrated in the body of the report.

If you have any question concerning this report, please feel free to contact me.

Sincerely,

Tim Harrell

Tim Harrell
Tim.Harrell@pacelabs.com
Technical Director

Kansas/ NELAP Certification Number E-10116

Enclosures

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Pace Analytical Services, Inc.

808 West McKay, Frontenac, KS 66763

LABORATORY REPORT:

CLIENT: Ralph Logsdon **Wolf Creek** **P.O. Box 411** **Burlington, KS 66839** 1-620-364-8831	**Date Reported: 6-21-06** **Date Initiated: 6-13-06** **Time Arrived: 12:20** **Date Terminated: 6-15-06**

BIOMONITORING STUDY

ACUTE TOXICITY

Permit # I-NE07-PO02

FINDING AND CONCLUSIONS:

Acute toxicity testing was performed on duplicate samples of effluent collected from the WOLF CREEK effluent discharge. Acute toxicity, as defined by significant mortality for at least one of two aquatic test species during a 48 hour period of exposure, was **not detected in Ceriodaphnia exposed to the 100% effluent (AEC), and was not detected in fathead minnows exposed to the 100% effluent. The LC50 for the Ceriodaphnia was >100% and >100% for the Pimephales.** The test species utilized in this test were the water flea, Ceriodaphnia dubia and the fathead minnow, Pimephales promelas. Detailed results of the toxicity testing are provided in the Acute Toxicity Reports. In addition to the acute toxicity testing, water temperature, pH, dissolved oxygen, total hardness, total alkalinity, conductivity, and chlorine determinations were performed on the effluent and control samples.

SAMPLING PROCEDURES:

Wolf Creek personnel collected a sample at the WOLF CREEK effluent discharge. The sample was preserved with ice and transported to Pace Analytical by Wolf Creek personnel.

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Fax: 913.599.1759

INTRODUCTION:

The purpose of this test was to determine the acute toxicity of the WOLF CREEK effluent on the freshwater invertebrate, Ceriodaphnia dubia and the fathead minnow, Pimephalas promelas. These tests were conducted at Pace Analytical Services, Inc., Frontenac, KS.

TEST ORGANISMS:

Ceriodaphnia dubia - The genetic stock of Ceriodaphnia dubia used in this acute toxicity Test were originally obtained from a private breeder. Ceriodaphnia are cultured in house at Pace Analytical Services, Inc. Culture methods of Ceriodaphnia were obtained from EPA821-C-02-006 November 2002.

Pimephales promelas - The fathead minnows used in this acute toxicity test were cultured in-house at Pace Analytical Services, Inc., Frontenac, KS and were originally obtained from a private breeder. Fathead minnows are maintained at Pace Analytical Services until use for acute toxicity between the ages of 1 and 14 days. Information for culturing fathead minnows was taken from EPA821-C-02-006 November 2002.

MATERIALS AND METHODS:

Procedures used in the acute toxicity tests are described in Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (USEPA, 2002).

Wolf Creek personnel collected the effluent tested from the WOLF CREEK discharge. Testing was performed using an 100% effluent, a series of dilutions, an upstream, and a synthetic control. **The toxicity test was initiated within 36 hours of sample collection.**

Effluent and synthetic control test solutions were not aerated during the testing period.

Ceriodaphnia *ACUTE METHODS:*

This static test was ran using 40 ml glass vials containing 25 ml of test solution. Food was administered before the test. Five Ceriodaphnia neonates (<24 hr old) were randomly selected and placed in each of 4 replicates of test solution. A total of 20 organisms per concentration were tested. Observations of mortality were made at 24 and 48 hours of exposure.

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Fax: 913.599.1759

Pimephales *ACUTE METHODS:*

This static toxicity test was conducted using 1000 ml mason jars as test chambers containing 250 ml of test solution. Food was administered prior to test initiation, but not during the testing period. Ten Pimephales, 1 – 14 days old, from a single spawn, were randomly selected and placed in each of 4 test chambers. A total of 40 organisms were exposed to each test concentration. Observations of mortality were made at 24 and 48 hours of exposure.

WATER QUALITY METHODS:

Prior to test initiation, temperature, dissolved oxygen, pH, total alkalinity, total hardness, and total residual chlorine were measured in the effluent and in the controls. At 24 and 48 hours of exposure, temperature, dissolved oxygen, pH, and conductance were measured in the effluent sample and the controls.

DATA ANALYSIS:

Statistically significant ($p<0.05$) mortality is determined by Dunnet's procedure using average percent survival of each test concentration versus the average survival of the controls. If significant mortality occurs, median lethal concentrations (LC50) are calculated using effluent concentrations and their corresponding percent mortality data. The LC50's and the 95% confidence intervals are calculated where appropriate by the Spearman-Karber method. Statistical analysis is accomplished by following steps in EPA/600/4-90/027F, August 1993 and by use of Toxstat version 3.4.

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RESULTS:

THE Ceriodaphnia MORTALITY RESULTS - There was no significant mortality observed of the freshwater invertebrate, Ceriodaphnia dubia, during the 48 hour exposure period to the 100% effluent concentrations. There was no significant mortality in the synthetic control. The LC50 value of the sample to Ceriodaphnia is approximately >100%.

Ceriodaphnia MORTALITY DATA

 # ALIVE

CONC.	REP #	O HOURS	24 HOURS	48 HOURS	% MORT.
SYNTHETIC	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
Upstream	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
25%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
50%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
75%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0
100%	1	5	5	5	0
"	2	5	5	5	0
"	3	5	5	5	0
"	4	5	5	5	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0%

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THE Pimephales **RESULTS** - Minnows exposed to effluent collected at the Wolf Creek effluent discharge by WOLF CREEK personnel exhibited no significant mortality in the 100% effluent concentration during the 48 hr exposure period. The synthetic control showed no significant mortality during the testing period. The LC50 value of the effluent to fathead minnows is estimated to be >100%.

CONC.	REP #	0 HOURS	24 HOURS	48 HOURS	% MORTALITY
SYNTHETIC	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
Upstream	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
25%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
50%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
75%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0
100%	1	10	10	10	0
"	2	10	10	10	0
"	3	10	10	10	0
"	4	10	10	10	0

AVG. MORTALITY @ AEC (100% EFFLUENT) = 0.0 %

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WATER CHEMISTRY RESULTS:

Total residual chlorine (Cl2) - The effluent sample from the WOLF CREEK effluent discharge had <0.1 mg/l detectable level of total residual chlorine upon receipt in the laboratory.

Dissolved Oxygen (D.O.) - Dissolved oxygen reading of the effluent sample was 8.00 mg/l after being raised to the test temperature of 25° C. At termination D.O. was 7.10 mg/l in the effluent which falls into acceptable limits. Aeration was not required in this test.

pH - The pH of the effluent was 8.34 upon receipt in the laboratory and the synthetic control had a 7.81. At termination the pH measurement in the effluent sample was 8.52.

Conductance - The conductance of the effluent sample was 590 umhos and the synthetic control was 350 umhos.

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INITIAL WATER QUALITY:

Initial Measurements Synthetic Water

pH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
7.81	8.40	350	<0.2	<0.1	25	128	76

Initial Measurements of 100% Effluent

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.34	8.00	590	N/A	<0.1	25	342	186

Initial Measurements of Upstream

PH	D.O. (mg/l)	Cond. (umhos)	NH3-N (mg/l)	Cl2 (mg/l)	Temp (C)	Hard (mg/l)	Alk (mg/l)
8.31	8.30	580	N/A	<0.1	25	272	196

TEST WATER QUALITY:

24-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	7.90	7.70	25	360
Upstream	8.35	7.50	25	622
25%	8.38	7.50	25	459
50%	8.38	7.50	25	452
75%	8.40	7.40	25	450
100%	8.37	7.40	25	410

48-hour Water Quality Measurements

EFFLUENT CONC (%)	PH	D.O. (mg/l)	TEMP (C)	COND. (umhos)
Synthetic	8.07	7.40	25	428
Upstream	8.50	7.00	25	975
25%	8.51	7.00	25	930
50%	8.52	7.00	25	926
75%	8.53	7.10	25	920
100%	8.52	7.10	25	928

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QUALITY ASSURANCE:

The absence of control mortality during this test indicated the health of the organisms and indicated that any significant mortality in the test concentrations is not due to contaminants or variations in test conditions. Reference toxicity tests are routinely performed by staff members of our Toxicology Department.

REFERENCE TOXICANT (NaCl)
Ceriodaphnia
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
3.0 g/l	20	3	0
2.5 g/l	20	17	3
2.0 g/l	20	20	17
1.5 g/l	20	20	20
1.0 g/l	20	20	20

LC50 = 2.23 g/l NaCl

REFERENCE TOXICANT (NaCl)
Pimephales
 # OF LIVE ORGANISMS

CONC OF TOXICANT	TEST INITIATION	24 HOUR EXPOSURE	48 HOUR EXPOSURE
10.0 g/l	40	11	0
8.0 g/l	40	37	26
6.0 g/l	40	40	37
4.0 g/l	40	40	40
2.0 g/l	40	40	39

LC50 = 8.31 g/l NaCl

Submitted By: Tim Harrell
Timothy Harrell
Technical Director

Microfouling, Asiatic Clam and Zebra Mussel Control Plan

21. Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

Data provided w. #30

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

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• Current and historic flow records for the Neosho River.

• A statement is made in the 5th paragraph of Enclosure 2 to WM 06-0046 (November 17, 2006) that the state of Kansas has not required entrainment monitoring and will not require it for the 316(b) determination. Please provide documentation from KDHE regarding this issue.

• Larval fish monitoring data as described in Paragraph 6 of Enclosure 2 to WM 06-0046 (November 17, 2006).

• If available, information on the location of the spawning areas for the various fish species in CCL.

• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

• Possible cold shock impacts to gizzard shad is mentioned in Section 2.2 of the ER (WCGS, 1990). If there have been any incidents of cold shock to gizzard shad or other fish, please provide supporting data.

• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

22. Current and historic flow records for the Neosho River.

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

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• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

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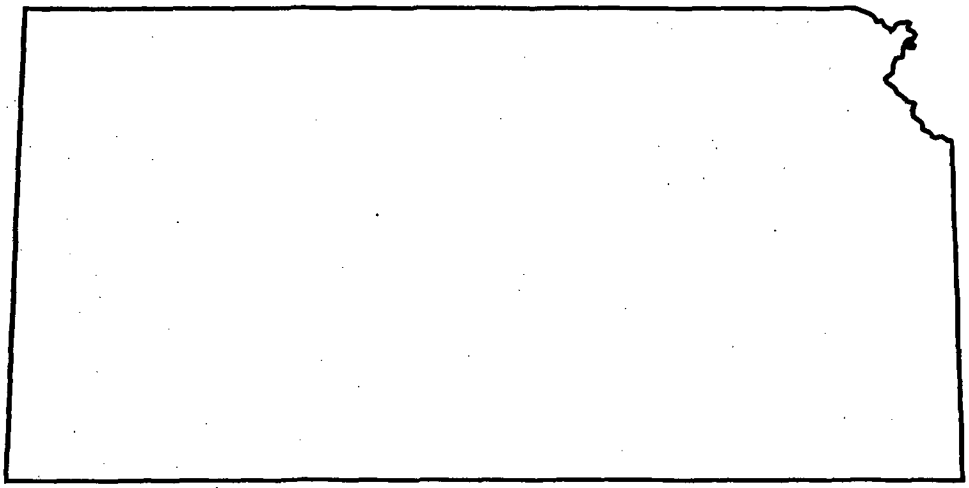
Putnam and Schneider 2005
used in Sections 2.2, 4.1, + 4.6

Water Resources Data
Kansas
Water Year 2004



Water-Data Report KS-04-1

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the
State of Kansas and with other agencies

Calendar for Water Year 2004

2003

October

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

November

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

December

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

2004

January

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

February

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29						

March

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

April

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

May

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

June

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

July

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

August

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

September

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

Water Resources Data Kansas Water Year 2004

By J.E. Putnam and D.R. Schneider

Prepared in cooperation with the State of Kansas and with other agencies

Water-Data Report KS-04-1

U.S. Department of the Interior
U.S. Geological Survey

U.S. DEPARTMENT OF THE INTERIOR
GALE A. NORTON, Secretary

U.S. GEOLOGICAL SURVEY
Charles G. Groat, Director

For information on the USGS water programs in Kansas contact:
Director, Kansas Water Science Center
U.S. Geological Survey
4821 Quail Crest Place
Lawrence, Kansas 66049-3839
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http://ks.water.usgs.gov/

2005

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2005

PREFACE

This volume of the annual hydrologic data report for Kansas is one of a series of annual reports that document hydrologic data gathered from the U.S. Geological Survey's surface- and ground-water data-collection networks in each State, Puerto Rico, and the Trust Territories. These records of streamflow, ground-water levels, and water quality provide the hydrologic information needed by local, State, and Federal agencies, and the private sector for developing and managing our Nation's land and water resources.

This report is the culmination of a concerted effort by dedicated personnel of the U.S. Geological Survey who collected, compiled, analyzed, verified, and organized the data, and who typed, edited, and assembled the report. The authors had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to Geological Survey policy and established guidelines.

The data were collected, computed, and processed by the following personnel:

J.R. Barnard	L.J. Kellenberger
T.J. Bennett	C.J. Lee
A.L. Bewsher	B.L. Loving
T.W. Bird	M.K. Lysaught
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M.P. Holt	R.A. Swanson
S.R. Hughes	G.W. Troutman
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This report was prepared in cooperation with the State of Kansas and with other agencies under the general supervision of James E. Putnam, Hydrologic Data Management Section Chief, and Walter R. Aucott, Director, USGS, Kansas Water Science Center.

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13. ABSTRACT (Maximum 200 words)

Water-resources data for the 2004 water year for Kansas consist of records of stage, discharge, and water quality of streams; elevation and contents of lakes and reservoirs; and water levels of ground-water wells. This report contains records for water discharge at 155 complete-record gaging stations; elevation and contents at 17 lakes and reservoirs; water-quality records at 2 precipitation stations, water-level data at 14 observation wells; and records of specific conductance, pH, water temperature, dissolved oxygen, and turbidity at 16 gaging stations and 2 lakes with water-quality monitors. Also included are discharge data for 29 high-flow partial-record stations. These data represent that part of the National Water Information System collected by the U.S. Geological Survey in cooperation with local, State, and Federal agencies in Kansas.

14. SUBJECT TERMS
*Kansas, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Water temperatures, Sampling sites, Water levels, Water analyses

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Unclassified			Unclassified

07179500 NEOSHO RIVER AT COUNCIL GROVE, KS

LOCATION.--Lat 38°39'57", long 96°29'36", in NE ¼ NE ¼ NW ¼ sec.14, T.16 S., R.8 E., Morris County, Hydrologic Unit 11070201, on right bank at downstream side of bridge, 300 ft downstream from Mozler Creek, 1.0 mi upstream from Elm Creek, 1.7 mi downstream from Council Grove Lake, and at mile 448.0.

DRAINAGE AREA.--250 mi^2.

PERIOD OF RECORD.--October 1938 to current year.

REVISED RECORDS.--WSP 1117: Drainage area. WSP 1341: 1939-40(M), 1942.

GAGE.--Water-stage recorder. Concrete control since Jan. 8, 1997. Datum of gage is 1,205.63 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to June 7, 1940, nonrecording gage at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow completely regulated since 1964 by Council Grove Lake (station 07179400), 1.7 mi upstream. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in 1903 reached a stage of 37.3 ft at water plant, from information by U.S. Army Corps of Engineers.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	6.5	7.5	3.3	1.7	0.64	1.6	83	88	22	1,560	1,220	3.7
2	6.5	7.8	3.3	1.7	0.80	126	82	88	22	e131	832	1.8
3	6.7	7.8	3.7	1.6	0.58	234	84	91	23	e498	249	2.1
4	6.7	7.2	3.0	1.6	0.62	e200	87	91	22	1,330	12	3.9
5	6.6	5.3	2.6	1.4	0.70	e10	88	43	21	1,320	11	5.1
6	6.7	4.4	3.0	1.3	0.62	e3.0	89	5.6	21	1,320	8.8	4.5
7	6.8	4.3	2.6	1.3	0.56	912	69	5.4	19	1,310	4.7	3.9
8	7.0	4.5	2.6	1.4	0.53	1,630	7.3	4.8	16	1,120	4.6	3.9
9	7.4	4.6	2.7	1.3	0.56	1,620	7.2	4.8	18	e257	4.5	4.0
10	6.9	4.8	1.9	1.3	0.55	1,610	6.8	5.2	20	9.9	3.7	4.0
11	7.3	4.6	1.9	1.4	0.55	1,300	6.4	5.1	20	6.7	4.0	4.1
12	7.1	4.4	1.9	1.3	0.50	1,010	7.1	4.4	20	427	3.9	4.2
13	7.2	4.4	2.2	1.2	0.43	1,010	7.4	4.8	22	710	3.8	4.0
14	6.8	4.6	2.1	1.2	0.48	992	6.3	4.1	20	704	3.5	3.9
15	6.2	4.5	2.2	1.1	0.49	601	5.5	3.9	e20	702	3.7	4.2
16	5.8	4.3	2.1	1.2	0.45	274	5.8	3.8	609	293	3.5	3.9
17	5.7	4.4	2.1	1.3	0.47	270	6.8	4.1	1,190	8.9	3.3	3.9
18	5.9	3.9	1.9	0.99	0.59	266	7.2	6.2	e885	8.4	3.2	4.2
19	5.9	3.5	1.9	0.90	1.2	265	6.1	49	452	8.3	3.3	4.2
20	5.9	3.6	1.9	0.84	1.5	258	11	86	956	8.3	3.4	3.8
21	6.3	3.5	2.1	0.93	1.2	261	25	87	1,660	8.6	3.0	3.9
22	7.3	3.5	2.4	1.0	1.1	112	26	88	2,320	9.1	3.0	4.5
23	6.8	3.3	2.3	1.1	1.1	5.0	26	87	2,300	9.7	3.5	4.6
24	7.1	3.4	2.3	1.1	0.92	4.4	26	89	2,270	e11	2.7	4.6
25	7.2	3.7	2.3	1.2	0.79	4.2	25	90	2,220	e10	5.7	4.7
26	6.9	3.7	1.9	0.93	0.78	4.0	61	153	2,070	1,050	11	4.7
27	7.1	3.6	1.8	0.94	0.73	9.6	89	186	1,390	1,900	11	4.7
28	7.0	3.2	1.7	0.75	0.73	16	90	113	686	1,890	9.8	4.8
29	7.3	3.3	1.6	0.63	1.3	5.1	89	24	1,320	1,870	10	5.0
30	7.6	3.5	1.6	0.56	---	4.4	88	22	1,690	1,590	10	4.6
31	7.3	---	1.7	0.51	---	47	---	22	---	1,230	8.5	---
MEAN	6.76	4.50	2.28	1.15	0.74	421	40.6	50.3	744	687	79.5	4.11
MAX	7.6	7.8	3.7	1.7	1.5	1,630	90	186	2,320	1,900	1,220	5.1
MIN	5.7	3.2	1.6	0.51	0.43	1.6	5.5	3.8	16	6.7	2.7	1.8
AC-FT	416	268	140	71	43	25,920	2,420	3,090	44,280	42,270	4,890	245

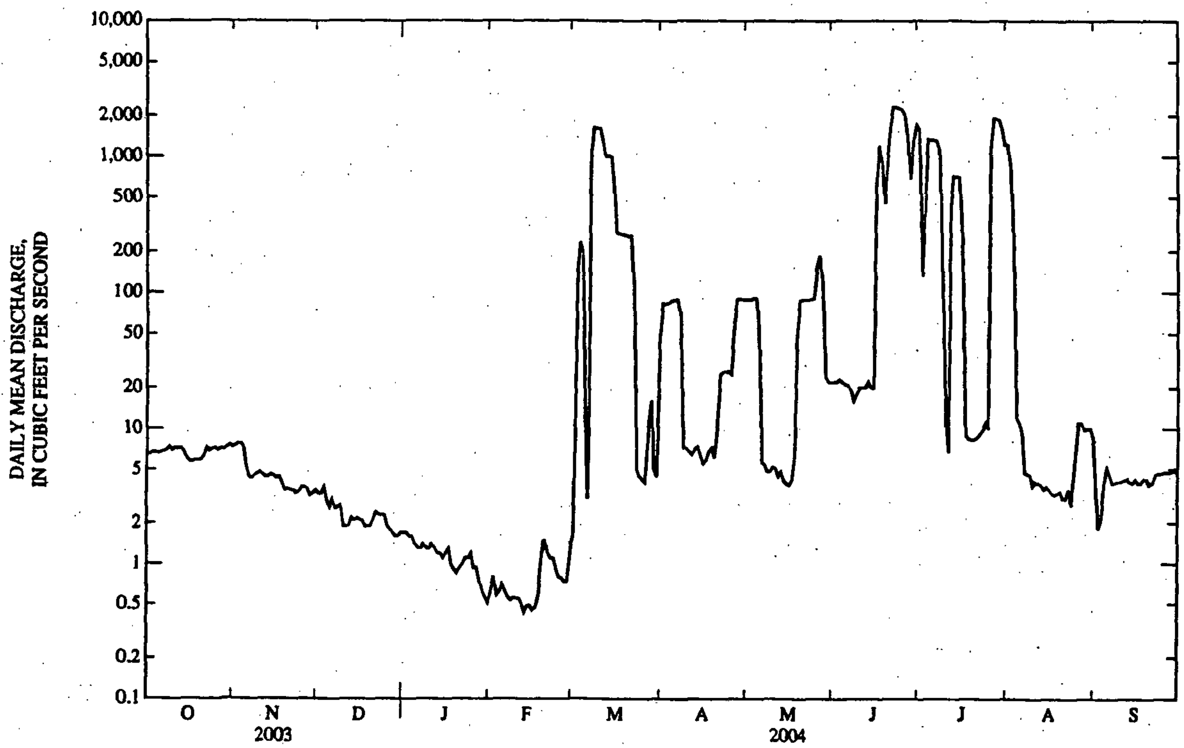
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1939 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	107	62.0	57.5	52.0	60.3	121	192	219	248	216	71.6	74.6
MAX	1,387	852	718	503	579	702	1,424	1,387	1,656	2,858	1,103	984
(WY)	(1974)	(1999)	(1945)	(1973)	(1949)	(1973)	(1944)	(1993)	(1995)	(1951)	(1993)	(1951)
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.03	0.00	0.00	0.00
(WY)	(1939)	(1939)	(1939)	(1939)	(1939)	(1940)	(1940)	(1954)	(1956)	(1940)	(1939)	(1939)

07179500 NEOSHO RIVER AT COUNCIL GROVE, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1939 - 2004	
ANNUAL MEAN	20.5		171		124	
HIGHEST ANNUAL MEAN					498	1951
LOWEST ANNUAL MEAN					5.37	1953
HIGHEST DAILY MEAN	677	Jul 1	2,320	Jun 22	34,000	Jul 11, 1951
LOWEST DAILY MEAN	0.43	Mar 10	0.43	Feb 13	0.00	Oct 1, 1938
ANNUAL SEVEN-DAY MINIMUM	0.48	Mar 9	0.48	Feb 11	0.00	Oct 1, 1938
MAXIMUM PEAK FLOW			2,390	Jun 25	121,000	Jul 11, 1951
MAXIMUM PEAK STAGE			13.13	Jun 25	36.29	Jul 11, 1951
INSTANTANEOUS LOW FLOW			0.34	Feb 13	0.00	at times
ANNUAL RUNOFF (AC-FT)	14,840		124,000		89,610	
10 PERCENT EXCEEDS	33		703		227	
50 PERCENT EXCEEDS	6.2		5.4		13	
90 PERCENT EXCEEDS	0.95		1.1		0.84	

e Estimated



07179730 NEOSHO RIVER NEAR AMERICUS, KS

LOCATION.--Lat 38°28'01", long 96°15'01", in SW 1/4 SW 1/4 NW 1/4 sec.24, T.18 S., R.10 E., Lyon County, Hydrologic Unit 11070201, on right bank, 0.1 mi below Ruggles Dam, 2.0 mi south of Americus, 12.5 mi upstream from Allen Creek, and 24.0 mi upstream from Cottonwood River.

DRAINAGE AREA.--622 mi^2.

PERIOD OF RECORD.--June 1963 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,106.99 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Apr. 10, 1989, to Nov. 1990 at site 0.4 mi upstream at present datum. Aug. 8, 1963, to Apr. 11, 1989, and Nov. 21, 1990, to current year, water-stage recorder at present site and datum.

REMARKS.--Records good. Flow moderately regulated since 1964 by Council Grove Lake (station 07179400). Low flow occasionally regulated by Ruggles Dam 0.1 mi upstream. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

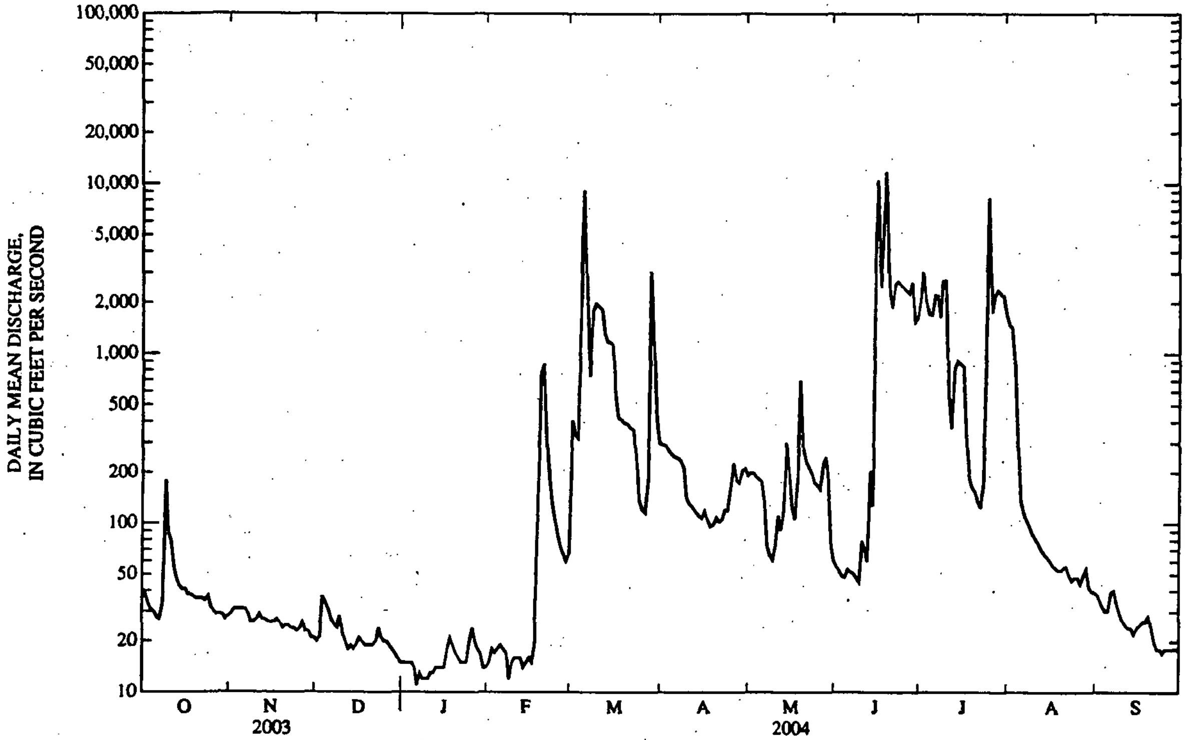
DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	36	29	20	15	15	405	294	200	56	2,090	1,480	38
2	39	31	21	15	18	335	290	198	53	3,020	1,430	35
3	34	31	37	15	17	320	269	188	49	2,030	826	32
4	31	31	34	15	18	2,650	255	182	48	1,710	284	30
5	30	31	31	14	19	9,120	247	176	54	1,680	135	30
6	28	31	27	11	18	3,130	244	136	52	2,210	115	39
7	27	29	25	13	17	738	236	74	51	2,200	104	40
8	33	26	24	12	12	1,780	214	65	48	1,640	96	34
9	178	26	28	12	15	1,970	142	61	45	2,670	87	30
10	88	27	22	12	16	1,900	130	74	79	2,700	82	27
11	79	29	20	13	16	1,830	124	111	71	566	77	25
12	56	27	18	13	16	1,320	117	91	60	366	71	24
13	48	27	19	14	14	1,180	111	119	204	824	67	24
14	43	26	18	14	15	1,170	107	300	127	907	64	22
15	41	26	19	14	16	1,130	118	187	3,320	870	61	24
16	41	26	21	14	15	575	105	124	10,500	844	57	25
17	38	27	20	18	19	424	96	106	2,470	334	55	26
18	38	26	19	21	97	409	98	178	5,640	184	53	26
19	37	24	19	19	769	394	108	691	11,700	163	53	28
20	36	25	19	17	869	391	102	273	2,330	154	55	24
21	36	25	19	16	325	371	105	232	1,860	136	56	20
22	36	24	20	15	190	361	120	213	2,570	124	50	18
23	35	24	24	15	132	216	119	197	2,670	171	46	18
24	37	23	21	15	104	136	161	174	2,550	2,460	48	17
25	32	24	20	20	85	121	227	168	2,460	8,240	48	18
26	30	26	20	24	73	116	180	159	2,360	1,750	44	18
27	29	23	19	20	66	177	174	223	2,260	2,220	49	18
28	29	23	18	18	60	3,060	205	246	2,640	2,370	54	18
29	29	21	17	17	67	1,150	211	176	1,540	2,260	42	18
30	27	21	16	14	—	409	191	75	1,610	2,190	40	18
31	28	—	15	14	—	300	—	61	—	1,720	39	—
MEAN	42.9	26.3	21.6	15.5	107	1,213	170	176	1,983	1,639	186	25.5
MAX	178	31	37	24	869	9,120	294	691	11,700	8,240	1,480	40
MIN	27	21	15	11	12	116	96	61	45	124	39	17
AC-FT	2,640	1,560	1,330	950	6,170	74,560	10,120	10,830	118,000	100,800	11,440	1,520

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1964 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	259	215	162	125	200	369	521	592	654	435	161	170
MAX	2,278	2,304	916	854	1,048	2,100	2,258	3,285	2,761	3,127	1,498	1,526
(WY)	(1974)	(1999)	(1974)	(1973)	(1973)	(1973)	(1999)	(1995)	(1995)	(1993)	(1993)	(1973)
MIN	2.41	6.90	5.87	3.73	3.64	6.87	11.1	24.4	15.9	12.5	12.5	10.7
(WY)	(1965)	(1967)	(1967)	(1967)	(1967)	(1967)	(1989)	(1967)	(1989)	(1964)	(1978)	(1980)

07179730 NEOSHO RIVER NEAR AMERICUS, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1964 - 2004	
ANNUAL MEAN	127		468		322	
HIGHEST ANNUAL MEAN					1,106	1993
LOWEST ANNUAL MEAN					28.2	1989
HIGHEST DAILY MEAN	4,270	Aug 31	11,700	Jun 19	14,700	Nov 2, 1998
LOWEST DAILY MEAN	11	Mar 16	11	Jan 6	0.00	Oct 2, 1963
ANNUAL SEVEN-DAY MINIMUM	12	Mar 10	12	Jan 6	0.24	Oct 26, 1964
MAXIMUM PEAK FLOW			15,600	Jun 19	17,400	Jul 22, 1993
MAXIMUM PEAK STAGE			27.68	Jun 19	27.84	Jul 22, 1993
INSTANTANEOUS LOW FLOW			1.7	Feb 8	0.00	at times
ANNUAL RUNOFF (AC-FT)	91,680		339,800		233,400	
10 PERCENT EXCEEDS	240		1,730		856	
50 PERCENT EXCEEDS	28		53		61	
90 PERCENT EXCEEDS	15		17		11	



07179795 NORTH COTTONWOOD RIVER BELOW MARION LAKE, KS

LOCATION.--Lat 38°22'00", long 97°05'00", in SE 1/4 NW 1/4 SE 1/4 sec.27, T.19 S., R.3 E., Marion County, Hydrologic Unit 11070202, on left bank, 0.25 mi downstream from outlet of dam, 1.6 mi upstream from South Cottonwood River, 3.0 mi northwest of Marion, and at mile 126.5.

DRAINAGE AREA.--200 mi^2.

PERIOD OF RECORD.--July 1968 to current year. Prior to Oct. 1, 1991, published as "Cottonwood River."

REVISED RECORDS.--WDR KS-77-1: 1976.

GAGE.--Water-stage recorder. Datum of gage is 1,296.57 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow completely regulated since 1968 by Marion Lake (station 07179794), 0.25 mi upstream. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	9.6	9.0	1.0	4.8	2.5	1.9	91	4.7	8.3	94	1,300	13
2	14	9.0	0.97	4.8	2.7	2.2	92	4.8	8.3	95	507	13
3	10	9.0	0.64	5.3	2.7	2.3	92	4.5	8.4	92	13	13
4	10	5.5	2.1	5.8	3.0	e4.0	92	4.3	8.4	93	13	13
5	9.9	2.9	2.6	5.3	3.6	e3.0	40	4.4	8.4	93	13	13
6	10	2.7	2.1	4.6	3.7	2.3	5.0	4.6	8.7	97	13	13
7	10	3.1	1.9	5.0	3.6	563	5.2	4.6	9.2	95	12	13
8	12	3.2	1.8	4.6	3.6	827	5.4	4.5	9.2	478	12	13
9	e10	3.1	2.4	4.3	3.4	504	5.4	4.5	9.3	294	13	12
10	7.8	2.4	2.5	4.0	3.0	639	5.6	4.4	9.4	16	13	13
11	8.5	2.2	1.8	3.9	2.4	810	5.5	4.4	9.4	4.6	13	13
12	8.5	2.4	1.6	4.0	2.4	925	5.5	6.1	9.7	58	13	13
13	8.6	2.4	1.7	3.6	2.4	919	5.4	9.2	11	93	13	13
14	9.5	2.2	1.7	3.4	2.4	915	5.3	9.1	11	92	12	12
15	9.0	1.4	1.9	3.5	2.4	385	5.2	8.9	13	49	12	13
16	9.2	1.4	2.2	3.4	2.2	34	5.3	8.8	11	18	12	11
17	9.9	1.4	1.8	3.5	2.2	34	5.4	8.8	16	18	12	11
18	11	2.0	1.6	3.7	2.2	33	5.5	9.0	16	18	13	11
19	11	1.9	1.7	3.2	2.3	33	5.5	8.9	12	18	13	12
20	11	1.9	1.4	3.4	2.3	33	5.5	8.8	12	18	13	8.3
21	11	2.2	1.4	3.4	2.3	33	5.2	9.1	13	18	13	7.8
22	10	2.3	4.7	3.4	2.2	33	5.0	9.0	13	18	13	9.8
23	10	3.1	5.4	3.3	2.2	33	5.0	8.8	399	19	13	11
24	10	2.4	5.0	3.1	1.8	34	5.0	8.6	645	e23	13	11
25	10	1.6	4.3	3.3	2.2	34	4.4	9.0	351	e24	13	11
26	9.9	1.6	4.3	3.9	2.3	34	4.3	8.9	89	1,230	14	11
27	9.4	1.7	4.2	3.8	1.9	34	4.4	8.6	91	2,230	13	11
28	9.9	1.5	5.1	1.8	0.84	34	4.3	8.3	91	2,200	14	12
29	9.6	2.0	5.0	2.6	0.97	34	4.3	8.4	92	2,180	13	11
30	9.5	1.1	4.5	2.8	—	69	4.7	8.6	94	1,650	13	9.7
31	9.2	—	4.6	2.6	—	92	—	8.3	—	1,310	13	—
MEAN	9.94	2.95	2.71	3.81	2.47	230	17.8	7.19	69.6	411	70.3	11.7
MAX	14	9.0	5.4	5.8	3.7	925	92	9.2	645	2,230	1,300	13
MIN	7.8	1.1	0.64	1.8	0.84	1.9	4.3	4.3	8.3	4.6	12	7.8
AC-FT	611	176	166	234	142	14,150	1,060	442	4,140	25,260	4,320	697

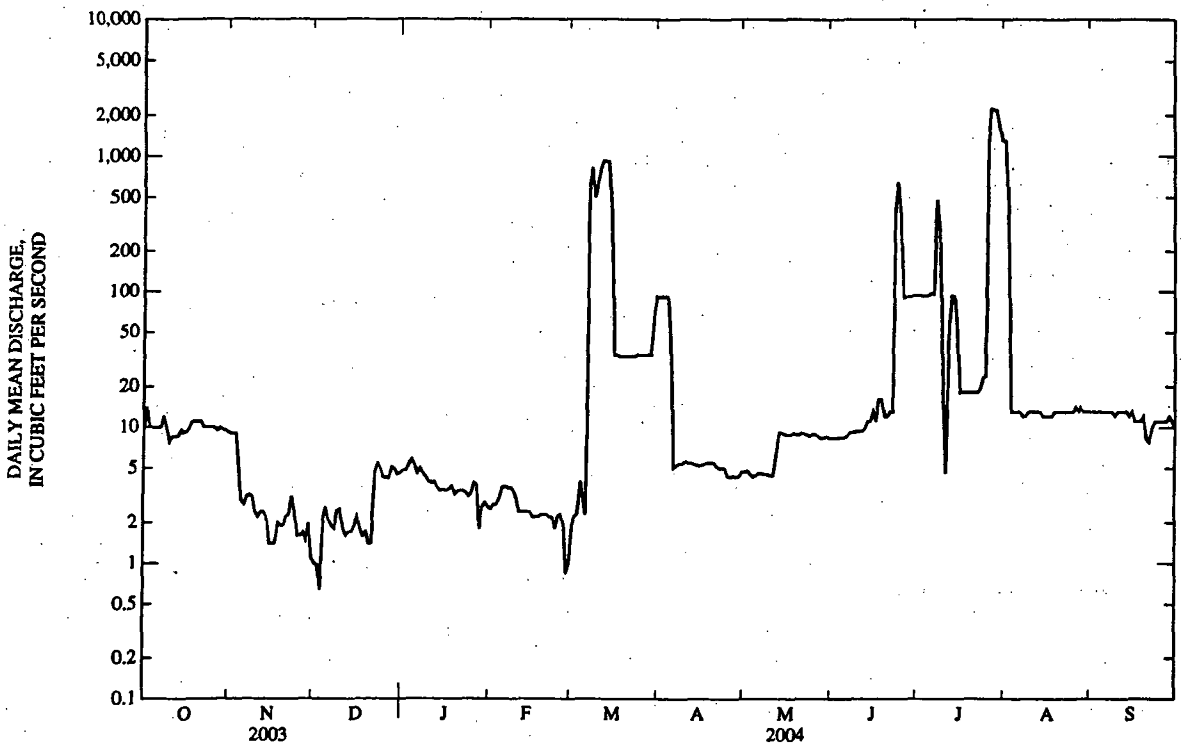
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1969 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	55.3	62.6	43.1	28.0	53.2	82.5	103	135	132	116	36.9	26.6
MAX	692	549	469	229	411	703	559	1,035	860	997	528	191
(WY)	(1974)	(1999)	(1999)	(1973)	(1973)	(1973)	(1973)	(1993)	(1995)	(1993)	(1993)	(1985)
MIN	0.99	1.04	0.67	0.77	1.05	0.70	0.54	1.61	2.00	3.85	1.87	1.74
(WY)	(1969)	(1969)	(1969)	(1992)	(1992)	(1969)	(1969)	(1992)	(1992)	(1992)	(1992)	(1992)

07179795 NORTH COTTONWOOD RIVER BELOW MARION LAKE, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1969 - 2004	
ANNUAL MEAN	27.2		70.8		72.8	
HIGHEST ANNUAL MEAN					322	1993
LOWEST ANNUAL MEAN					1.98	1992
HIGHEST DAILY MEAN	853	May 1	2,230	Jul 27	4,000	May 26, 1993
LOWEST DAILY MEAN	0.64	Dec 3	0.64	Dec 3	0.00	Oct 3, 1984
ANNUAL SEVEN-DAY MINIMUM	0.83	Mar 10	1.3	Nov 27	0.25	Mar 30, 1969
MAXIMUM PEAK FLOW			2,280	Jul 26	4,530	May 26, 1993
MAXIMUM PEAK STAGE			11.28	Jul 26	22.58	Dec 4, 1998
INSTANTANEOUS LOW FLOW			0.48	Nov 30	0.00	Oct 3, 1984
ANNUAL RUNOFF (AC-FT)	19,700		51,400		52,770	
10 PERCENT EXCEEDS	11		92		100	
50 PERCENT EXCEEDS	8.6		8.8		7.6	
90 PERCENT EXCEEDS	1.1		2.2		1.9	

e Estimated



07180400 COTTONWOOD RIVER NEAR FLORENCE, KS

LOCATION.--Lat 38°14'10", long 96°52'37", in NW 1/4 SW 1/4 sec.10, T.21 S., R.5 E., Marion County, Hydrologic Unit 11070202, on left bank at downstream side of county highway bridge, 0.4 mi upstream from Martin Creek, 2.5 mi east of Florence, 3.3 mi downstream from Doyle Creek, and at mile 102.4.

DRAINAGE AREA.--754 mi^2.

PERIOD OF RECORD.--June 1961 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,231.49 ft above NGVD of 1929. Since Aug. 10, 1965, auxiliary water-stage recorder 2.8 mi downstream at datum 1,219.49 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow moderately regulated since 1968 by Marion Lake (station 07179794), 24 mi upstream. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage known since at least 1872, 32.5 ft, July 11, 1951, from information by local residents.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	58	78	57	58	e46	78	228	88	59	200	1,390	84
2	57	77	57	60	e45	90	216	88	57	251	1,190	82
3	57	79	63	61	e43	103	208	83	56	517	223	81
4	54	82	61	59	e43	3,540	202	81	55	1,750	168	78
5	53	78	60	55	e43	12,100	195	76	55	985	156	80
6	51	72	60	49	e43	5,680	132	75	55	1,140	145	87
7	51	68	59	e49	e42	910	117	73	56	886	139	79
8	57	66	60	53	e42	1,360	114	69	54	431	134	76
9	5,530	66	66	53	e45	779	110	67	53	1,820	130	72
10	3,950	68	70	52	49	751	112	65	60	1,480	136	72
11	423	69	64	54	50	799	110	65	61	340	150	71
12	231	67	61	53	47	1,060	107	65	56	199	130	71
13	176	65	e60	53	48	1,060	106	e118	486	225	127	69
14	146	62	e58	53	50	1,040	102	e118	201	214	118	67
15	129	63	62	52	54	925	98	115	260	199	110	68
16	119	62	62	53	56	194	99	108	656	138	107	71
17	111	63	61	60	59	158	97	98	2,570	118	110	67
18	105	64	60	67	88	142	96	95	3,260	111	107	65
19	103	61	59	66	156	132	95	94	4,000	108	108	64
20	100	60	60	61	182	125	97	91	454	99	118	61
21	96	60	60	58	182	116	95	87	774	94	108	60
22	93	60	63	57	122	112	95	81	619	90	101	58
23	89	61	71	55	94	108	95	77	297	592	212	62
24	87	59	67	55	81	109	111	e69	688	6,690	215	65
25	84	58	64	57	74	109	112	e66	638	14,700	116	64
26	81	59	62	59	72	107	104	e64	219	5,620	101	63
27	82	59	62	48	68	117	91	67	185	2,160	95	62
28	81	58	61	e47	65	619	84	65	1,190	1,960	89	62
29	83	56	60	e46	67	499	81	63	433	1,880	87	63
30	80	58	59	e45	—	248	81	63	239	1,770	84	62
31	78	—	58	e45	—	242	—	61	—	1,420	84	—
MEAN	403	65.3	61.5	54.6	70.9	1,078	120	80.5	595	1,554	203	69.5
MAX	5,530	82	71	67	182	12,100	228	118	4,000	14,700	1,390	87
MIN	51	56	57	45	42	78	81	61	53	90	84	58
AC-FT	24,780	3,880	3,780	3,360	4,080	66,270	7,120	4,950	35,400	95,580	12,470	4,140

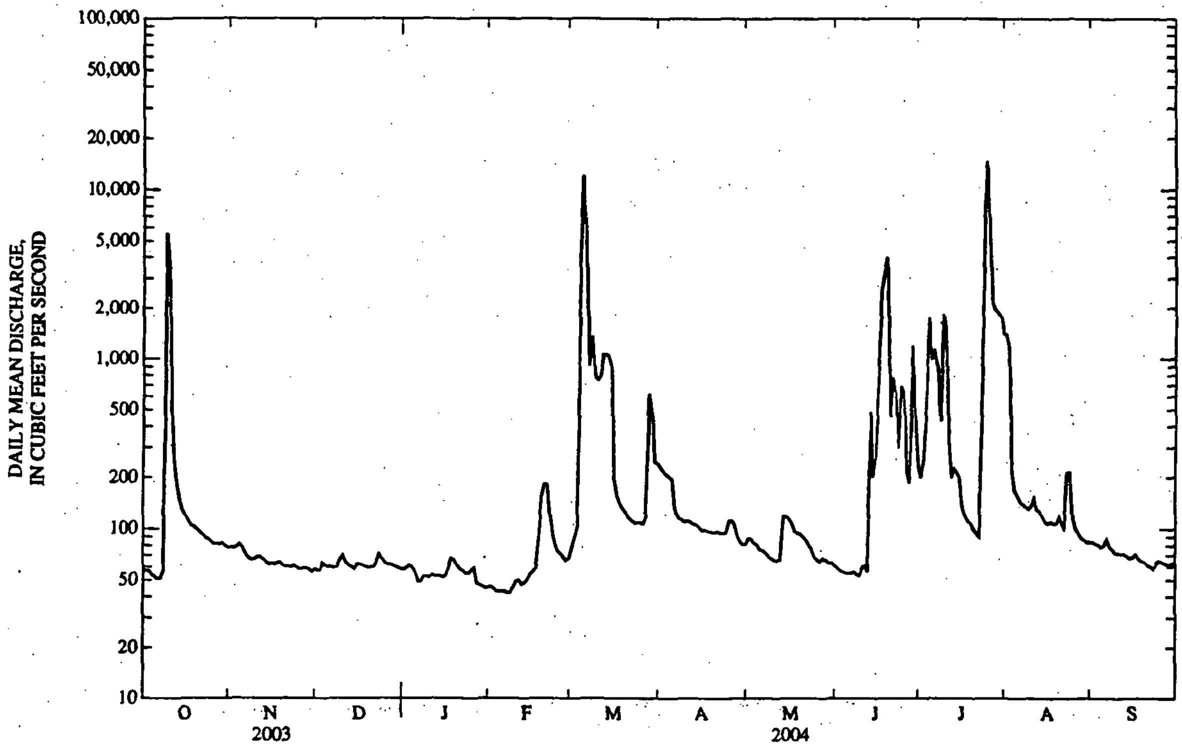
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1962 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	273	303	156	131	220	390	409	541	678	383	149	217
MAX	2,203	4,356	755	728	1,308	3,251	1,533	4,981	3,691	4,044	833	1,755
(WY)	(1986)	(1999)	(1999)	(1962)	(1973)	(1973)	(1983)	(1993)	(1965)	(1993)	(1985)	(1962)
MIN	11.5	19.8	18.2	20.4	19.8	26.9	25.6	23.0	53.4	22.8	16.9	21.8
(WY)	(1965)	(1967)	(1992)	(1967)	(1967)	(1981)	(1981)	(1967)	(1991)	(1966)	(1991)	(1966)

07180400 COTTONWOOD RIVER NEAR FLORENCE, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1962 - 2004	
ANNUAL MEAN	199		366		321	
HIGHEST ANNUAL MEAN					1,298	1993
LOWEST ANNUAL MEAN					39.9	1991
HIGHEST DAILY MEAN	5,530	Oct 9	14,700	Jul 25	47,800	Nov 2, 1998
LOWEST DAILY MEAN	18	Aug 26	42	Feb 7	4.8	Jun 28, 1991
ANNUAL SEVEN-DAY MINIMUM	20	Aug 20	43	Feb 2	6.9	Oct 8, 1964
MAXIMUM PEAK FLOW			15,700	Jul 25	73,700	Nov 2, 1998
MAXIMUM PEAK STAGE			24.90	Jul 25	28.81	Nov 2, 1998
INSTANTANEOUS LOW FLOW			31	Jan 27	4.4	Jun 28, 1991
ANNUAL RUNOFF (AC-FT)	144,000		265,800		232,400	
10 PERCENT EXCEEDS	342		666		645	
50 PERCENT EXCEEDS	61		81		81	
90 PERCENT EXCEEDS	29		54		28	

e Estimated



07180500 CEDAR CREEK NEAR CEDAR POINT, KS

LOCATION.--Lat 38°11'47", long 96°49'27", in NE 1/4 SE 1/4 NE 1/4 sec.25, T.21 S., R.5 E., Chase County, Hydrologic Unit 11070202, on right bank at upstream side of county highway bridge, 4.0 mi south of Cedar Point, and at mile 9.4.

DRAINAGE AREA.--110 mi^2.

PERIOD OF RECORD.--October 1938 to current year. Monthly discharge only for some periods, published in WSP 1311.

REVISED RECORDS.--WSP 1211: 1944(M). WSP 1341: 1940-41, 1942(M), 1943, 1945(M).

GAGE.--Water-stage recorder. Datum of gage is 1,262.50 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to Sept. 28, 1944, nonrecording gage at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in July 1929 reached a stage of 24.63 ft from floodmarks on house on left bank where flood in 1951 reached a stage of 25.7 ft.

PEAK DISCHARGES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 3,600 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Mar 4	1900	6,510	15.97	Jul 9	1545	*12,200	*20.49
Jul 4	1000	5,070	13.49				

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	20	23	11	11	30	85	60	38	14	27	51	17
2	17	19	11	11	35	45	55	34	14	340	45	17
3	15	18	15	11	32	40	50	31	13	225	41	16
4	15	18	18	10	31	2,760	47	30	13	2,230	38	16
5	14	18	15	9.6	33	1,740	45	30	13	352	36	16
6	14	17	14	8.7	32	243	43	28	13	372	35	17
7	13	17	13	8.6	29	128	43	27	12	199	33	16
8	14	16	14	8.9	29	100	41	27	12	91	33	15
9	1,250	16	15	9.3	31	85	39	26	11	4,810	31	14
10	128	16	14	9.1	30	78	40	26	16	489	35	13
11	63	17	13	9.5	32	72	40	27	19	257	40	13
12	48	18	12	9.7	31	66	37	27	15	162	33	13
13	41	16	e11	9.7	29	65	36	70	26	112	31	12
14	39	16	e12	9.5	31	62	35	78	32	88	29	12
15	37	16	14	9.5	55	60	34	64	178	76	27	13
16	35	16	14	9.9	54	59	35	37	102	66	27	15
17	34	17	14	14	72	56	34	31	249	61	28	13
18	34	16	13	76	151	54	33	28	680	54	26	13
19	33	15	13	54	128	51	34	29	161	50	27	12
20	31	14	13	36	60	50	41	27	46	45	32	12
21	29	14	12	32	42	46	51	24	277	40	27	11
22	30	14	14	31	34	45	37	21	125	37	24	11
23	28	14	16	30	30	45	36	20	42	112	25	10
24	29	13	13	30	27	45	52	19	30	1,080	26	10
25	27	12	12	32	25	45	54	19	26	319	24	11
26	28	13	12	37	24	45	37	18	23	138	22	10
27	28	13	12	33	24	107	32	19	68	89	20	11
28	29	12	12	31	23	677	31	18	463	70	22	11
29	26	11	11	29	26	120	29	16	55	77	20	10
30	27	12	11	28	—	79	33	17	33	93	19	10
31	30	—	10	28	—	67	—	15	—	60	18	—
MEAN	71.2	15.6	13.0	21.8	41.7	233	40.5	29.7	92.7	394	29.8	13.0
MAX	1,250	23	18	76	151	2,760	60	78	680	4,810	51	17
MIN	13	11	10	8.6	23	40	29	15	11	27	18	10
AC-FT	4,380	926	801	1,340	2,400	14,320	2,410	1,830	5,520	24,240	1,830	774

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1939 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	46.6	39.9	30.0	26.0	41.9	73.0	89.9	85.4	119	67.4	29.0	38.8
MAX	392	542	264	195	260	449	554	507	814	594	179	414
(WY)	(1986)	(1999)	(1945)	(1949)	(2001)	(1973)	(1944)	(1993)	(1965)	(1951)	(1995)	(1941)
MIN	0.00	0.00	0.00	0.00	0.00	0.44	0.58	0.01	0.00	0.00	0.00	0.00
(WY)	(1940)	(1954)	(1955)	(1940)	(1957)	(1956)	(1954)	(1955)	(1955)	(1954)	(1954)	(1953)

07180500 CEDAR CREEK NEAR CEDAR POINT, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1939 - 2004	
ANNUAL MEAN	47.7		83.7		57.2	
HIGHEST ANNUAL MEAN					159	1993
LOWEST ANNUAL MEAN					0.91	1954
HIGHEST DAILY MEAN	1,290	Apr 24	4,810	Jul 9	10,900	Jun 29, 1951
LOWEST DAILY MEAN	0.80	Aug 28	8.6	Jan 7	0.00	Jul 12, 1939
ANNUAL SEVEN-DAY MINIMUM	1.1	Aug 22	9.1	Jan 5	0.00	Jul 12, 1939
MAXIMUM PEAK FLOW			12,200	Jul 9	52,400	Jun 29, 1951
MAXIMUM PEAK STAGE			20.49	Jul 9	23.70	Jun 29, 1951
INSTANTANEOUS LOW FLOW			8.6	Jan 6	0.00	at times
ANNUAL RUNOFF (AC-FT)	34,500		60,760		41,460	
10 PERCENT EXCEEDS	60		92		76	
50 PERCENT EXCEEDS	15		29		16	
90 PERCENT EXCEEDS	4.7		12		2.0	

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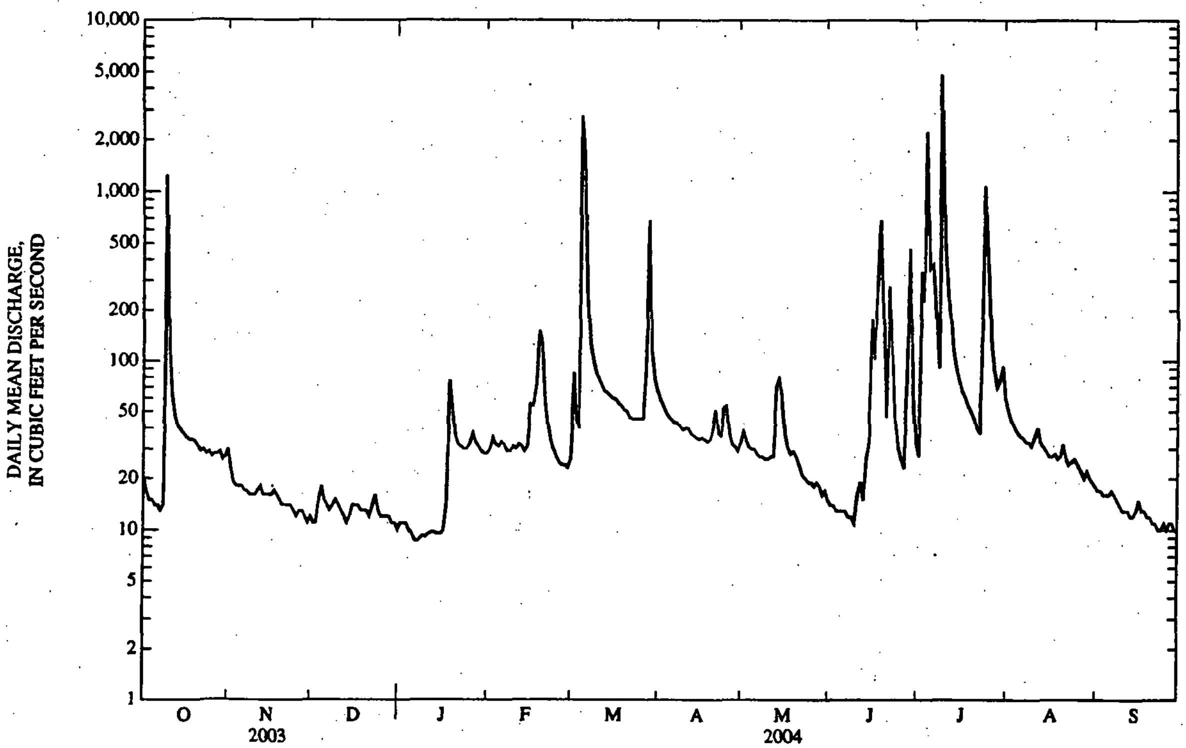


07182250 COTTONWOOD RIVER NEAR PLYMOUTH, KS

LOCATION.--Lat 38°23'51", long 96°21'21", in NE 1/4 NE 1/4 SE 1/4 sec.13, T.19 S., R.9 E., Chase County, Hydrologic Unit 11070203, on right bank at upstream side of county highway bridge, 0.8 mi downstream from Buckeye Creek, 1.5 mi southwest of Plymouth, and at mile 39.2.

DRAINAGE AREA.--1,740 mi^2.

PERIOD OF RECORD.--March 1963 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,109.04 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow partially regulated since 1968 by Marion Lake (station 07179794), 87.3 mi upstream. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage since at least 1903, 37.8 ft, July 11, 1951, from information by local residents, discharge not determined.

PEAK DISCHARGES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 4,900 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Oct 11	0700	7,110	22.24	Jul 2	1000	5,240	18.09
Mar 5	0800	*19,700	*33.18	Jul 5	1900	6,250	20.09
Mar 28	1400	5,310	18.23	Jul 10	0600	18,900	33.10
Jun 15	1600	13,600	31.88	Jul 27	1700	12,400	30.21
Jun 19	0800	13,000	31.08				

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	259	259	141	157	e240	750	1,060	469	206	1,150	2,190	205
2	268	259	140	155	e240	594	981	459	195	3,570	2,010	198
3	249	257	184	158	e220	531	907	423	186	1,930	1,820	189
4	233	257	201	162	e240	5,640	845	396	181	3,440	951	184
5	222	256	182	152	e260	18,100	806	381	176	5,840	683	180
6	209	250	164	e145	e253	18,000	773	363	174	4,290	618	193
7	197	238	154	e138	240	15,700	714	340	170	3,140	575	189
8	194	227	152	138	227	7,600	645	321	164	2,370	542	182
9	4,010	219	156	137	227	2,910	608	304	163	7,570	517	169
10	6,060	216	157	138	222	2,090	595	384	203	16,400	501	160
11	6,280	218	e157	134	228	1,750	588	e450	228	11,000	487	153
12	1,680	219	e153	136	e230	1,680	564	342	216	3,570	502	149
13	882	211	e154	135	e240	1,810	539	e427	1,170	1,830	472	146
14	746	202	156	134	254	1,780	515	e1,140	894	1,430	440	143
15	655	198	168	134	467	1,730	491	1,060	8,500	1,230	408	145
16	583	192	171	134	403	1,650	471	664	6,820	1,090	383	145
17	524	193	168	154	409	1,040	455	531	6,320	972	361	146
18	481	196	162	348	826	871	437	462	10,800	841	348	144
19	450	189	161	395	1,370	806	426	480	12,600	762	341	138
20	430	185	157	355	1,050	765	465	441	9,090	697	347	133
21	399	177	157	287	732	705	524	384	3,530	628	340	129
22	373	171	167	256	593	660	480	340	2,790	575	320	126
23	354	168	232	239	488	640	459	310	1,950	884	298	121
24	341	163	212	233	404	619	717	286	1,220	4,040	300	119
25	317	162	205	287	358	608	868	280	1,290	10,100	490	119
26	297	159	195	e260	330	603	655	268	1,240	10,800	332	121
27	289	156	189	e235	312	785	556	259	893	12,100	271	119
28	289	153	179	e220	296	4,350	497	259	2,740	8,110	260	118
29	282	150	172	e200	308	3,240	447	239	2,710	3,360	251	116
30	277	146	165	e220	---	1,790	427	230	1,550	2,910	235	115
31	268	---	159	e230	---	1,220	---	218	---	2,710	217	---
MEAN	906	202	170	200	402	3,259	617	416	2,612	4,172	575	150
MAX	6,280	259	232	395	1,370	18,100	1,060	1,140	12,600	16,400	2,190	205
MIN	194	146	140	134	220	531	426	218	163	575	217	115
AC-FT	55,730	11,990	10,450	12,310	23,140	200,400	36,720	25,610	155,400	256,500	35,330	8,910

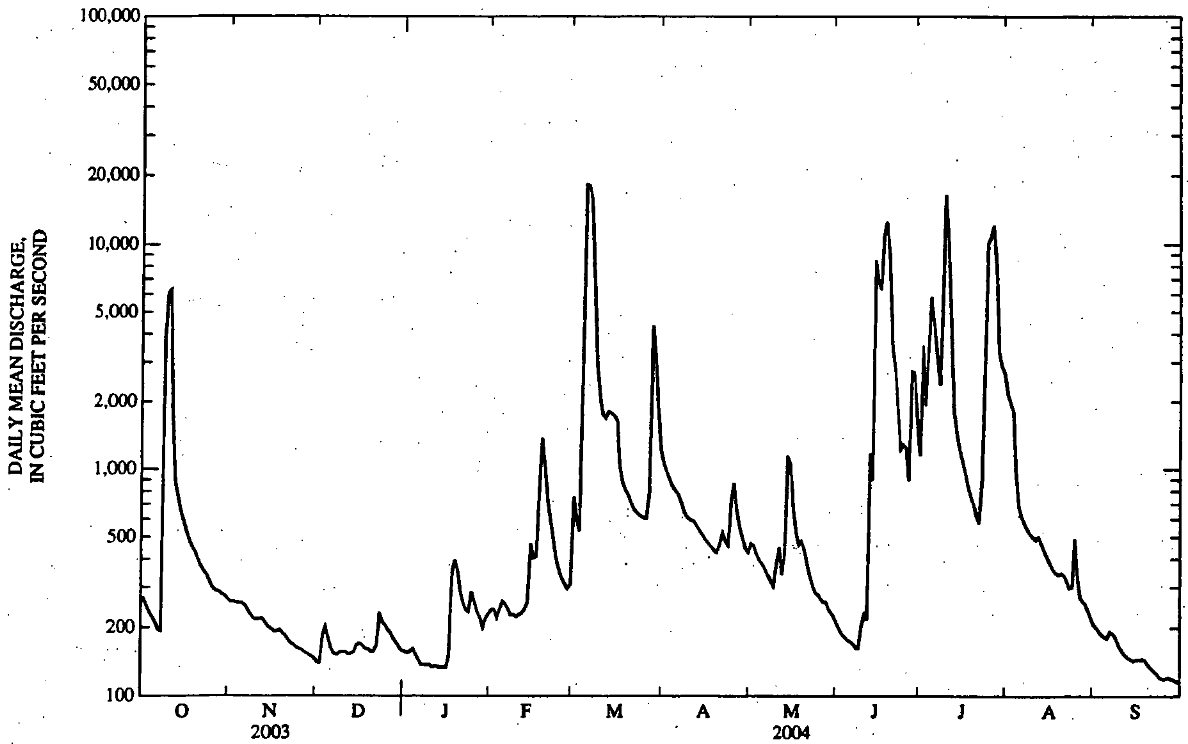
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1964 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	710	755	452	361	657	1,144	1,339	1,442	1,850	934	412	478
MAX	6,370	8.861	2,389	1,727	2,948	7,548	5,588	8,608	9,568	7,881	2,199	2,654
(WY)	(1986)	(1999)	(1993)	(1974)	(1973)	(1973)	(1999)	(1993)	(1965)	(1993)	(1985)	(1965)
MIN	12.3	29.5	31.9	38.0	31.9	43.0	48.2	51.2	127	42.0	21.4	20.6
(WY)	(1992)	(1981)	(1992)	(1981)	(1967)	(1981)	(1989)	(1967)	(1980)	(1980)	(1991)	(1980)

07182250 COTTONWOOD RIVER NEAR PLYMOUTH, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1964 - 2004	
ANNUAL MEAN	612		1,147		877	
HIGHEST ANNUAL MEAN					2,701	1993
LOWEST ANNUAL MEAN					121	1991
HIGHEST DAILY MEAN	12,600	Apr 25	18,100	Mar 5	73,500	Nov 2, 1998
LOWEST DAILY MEAN	26	Aug 27	115	Sep 30	8.7	Oct 21, 1964
ANNUAL SEVEN-DAY MINIMUM	32	Aug 22	118	Sep 24	11	Oct 18, 1964
MAXIMUM PEAK FLOW			19,700	Mar 5	92,900	Nov 2, 1998
MAXIMUM PEAK STAGE			33.18	Mar 5	36.78	Nov 2, 1998
INSTANTANEOUS LOW FLOW			114	Sep 30	8.7	Oct 21, 1964
ANNUAL RUNOFF (AC-FT)	443,300		832,600		635,300	
10 PERCENT EXCEEDS	1,270		2,720		1,890	
50 PERCENT EXCEEDS	197		331		259	
90 PERCENT EXCEEDS	56		153		46	

e Estimated



07182510 NEOSHO RIVER AT BURLINGTON, KS

LOCATION.--Lat 38°11'40", long 95°44'10", in SE 1/4 NW 1/4 sec.26, T.21 S., R.15 E., Coffey County, Hydrologic Unit 11070204, on right bank at upstream side of county highway bridge at Burlington, 0.3 mi upstream from Rock Creek, and at mile 338.4.

DRAINAGE AREA.--3,042 mi^2, includes that of Rock Creek.

PERIOD OF RECORD.--June 1961 to current year.

GAGE.--Water-stage recorder. Datum of gage is 983.56 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Flow completely regulated since 1963 by John Redmond Reservoir (station 07182450), 5.3 mi upstream. Records include flow of Rock Creek. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	40	64	134	225	56	1,540	3,230	1,320	574	8,660	8,240	572
2	47	63	222	222	56	1,710	3,490	1,320	156	5,220	8,870	409
3	59	64	698	226	56	1,700	3,410	620	118	2,780	9,250	264
4	59	225	887	231	57	2,960	3,300	256	67	6,240	8,720	263
5	60	368	213	513	57	2,000	3,240	780	71	6,210	5,900	266
6	60	366	210	760	55	196	3,140	774	69	6,200	2,970	264
7	60	366	207	766	56	3,760	3,040	767	68	6,330	2,880	261
8	61	365	203	748	56	9,130	2,420	760	69	6,710	2,820	261
9	66	362	122	415	55	11,600	1,250	755	74	6,390	2,710	160
10	1,140	362	59	55	56	13,200	706	760	77	7,400	2,660	60
11	3,050	358	58	54	272	12,800	706	1,210	71	8,910	2,750	61
12	3,210	358	59	55	496	12,400	704	938	70	9,190	1,410	61
13	3,320	361	61	55	494	12,100	705	480	90	10,100	437	101
14	3,300	361	59	285	490	11,700	703	469	72	10,500	437	251
15	2,020	358	320	485	496	11,600	701	468	891	10,000	437	287
16	661	357	574	413	494	11,300	701	475	4,040	8,580	440	281
17	294	213	519	428	744	10,800	700	873	6,990	7,470	437	282
18	294	57	514	445	1,110	10,300	703	1,870	7,830	7,080	435	277
19	294	57	511	426	1,650	8,250	696	1,850	8,160	6,680	529	276
20	297	56	507	737	1,870	6,620	714	1,820	8,510	6,240	691	178
21	297	57	502	1,010	1,880	6,310	1,140	1,350	9,460	4,400	684	63
22	583	58	410	1,270	1,890	5,980	1,530	945	11,600	2,420	678	63
23	874	63	218	1,860	1,880	5,340	1,050	942	12,800	1,750	673	63
24	555	173	56	1,810	1,870	3,890	746	946	12,400	1,810	716	62
25	258	310	56	1,800	1,850	2,380	639	997	11,900	1,890	816	62
26	258	208	55	1,450	1,840	1,190	1,030	955	11,300	4,610	542	62
27	257	58	55	876	1,660	316	1,350	1,060	10,800	7,620	264	62
28	256	58	55	801	1,360	521	1,350	1,010	10,200	8,100	264	63
29	255	57	56	e64	1,360	1,100	1,340	1,070	9,580	8,460	263	62
30	254	55	56	57	—	1,900	1,340	1,070	9,120	8,580	266	62
31	167	—	136	56	—	2,720	—	1,060	—	8,440	329	—
MEAN	723	208	251	600	837	6,042	1,526	967	4,908	6,612	2,210	182
MAX	3,320	368	887	1,860	1,890	13,200	3,490	1,870	12,800	10,500	9,250	572
MIN	40	55	55	54	55	196	639	256	67	1,750	263	60
AC-FT	44,440	12,370	15,460	36,890	48,130	371,500	90,790	59,450	292,000	406,600	135,900	10,830

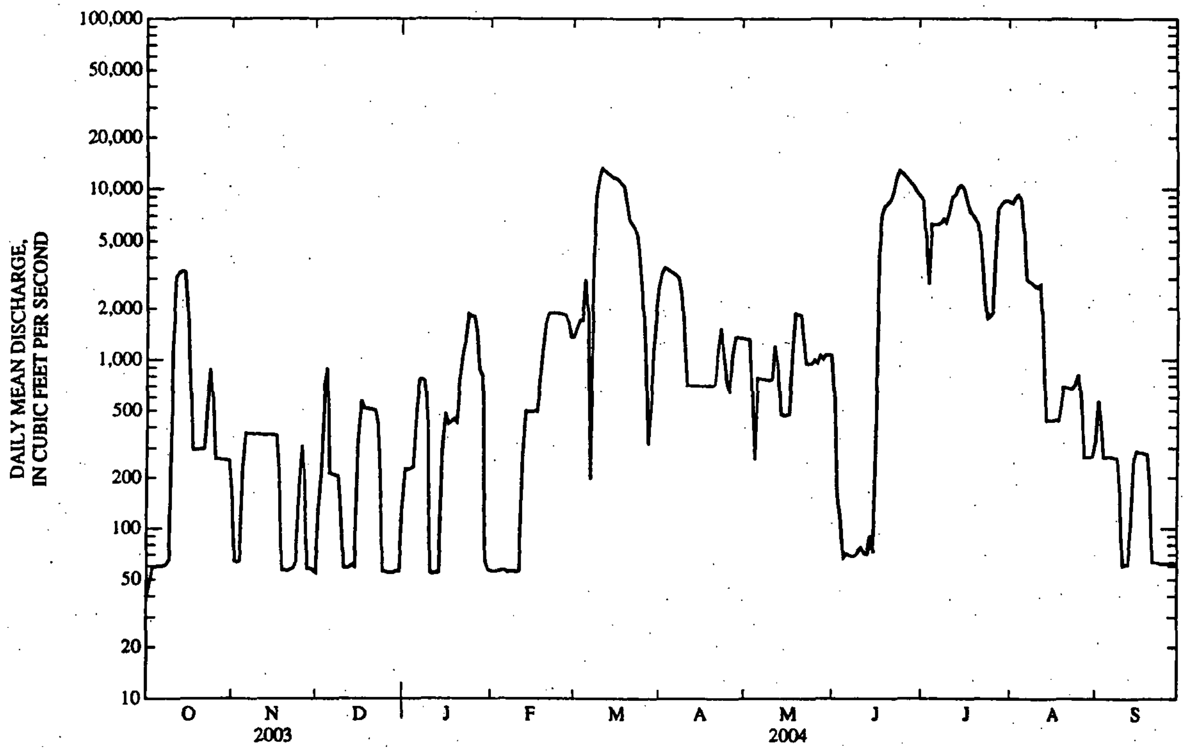
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1962 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	1,297	1,402	1,005	754	976	1,852	2,208	2,403	3,426	2,113	939	855
MAX	11,540	15,410	6,925	3,578	5,363	7,637	8,191	9,790	12,890	7,332	10,330	6,599
(WY)	(1974)	(1999)	(1993)	(1973)	(1973)	(1973)	(1984)	(1999)	(1995)	(1969)	(1993)	(1962)
MIN	22.4	12.0	12.4	17.7	17.1	13.8	21.5	44.5	162	66.0	44.3	30.8
(WY)	(1989)	(1991)	(1991)	(1989)	(1989)	(1981)	(1981)	(1989)	(1988)	(1966)	(2002)	(1963)

07182510 NEOSHO RIVER AT BURLINGTON, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1962 - 2004	
ANNUAL MEAN	933		2,100		1,603	
HIGHEST ANNUAL MEAN					4,982	1993
LOWEST ANNUAL MEAN					190	1991
HIGHEST DAILY MEAN	9,940	Apr 29	13,200	Mar 10	23,900	Sep 28, 1962
LOWEST DAILY MEAN	27	Feb 2	40	Oct 1	0.86	Nov 28, 1980
ANNUAL SEVEN-DAY MINIMUM	28	Feb 2	55	Oct 1	1.3	Sep 14, 1963
MAXIMUM PEAK FLOW			13,400	Mar 10	26,200	Sep 13, 1961
MAXIMUM PEAK STAGE			20.14	Mar 10	31.53	Sep 13, 1961
INSTANTANEOUS LOW FLOW			38	Oct 1	0.00	Nov 28, 1980
ANNUAL RUNOFF (AC-FT)	675,200		1,524,000		1,161,000	
10 PERCENT EXCEEDS	3,310		8,240		5,110	
50 PERCENT EXCEEDS	234		630		392	
90 PERCENT EXCEEDS	29		59		28	

e Estimated



07183000 NEOSHO RIVER NEAR IOLA, KS

LOCATION.--Lat 37°53'27", long 95°25'50", in SW 1/4 NE 1/4 NE 1/4 sec.9, T.25 S., R.18 E., Allen County, Hydrologic Unit 11070204, on left bank 1.0 mi downstream from Elm Creek, 3.0 mi southwest of Iola, and at mile 287.4.

DRAINAGE AREA.--3,818 mi^2.

PERIOD OF RECORD.--August 1895 to December 1903 (published as "at Iola"), October 1917 to current year. Monthly discharge only for some periods, published in WSP 1311. Figures of daily discharge for August 1895 to January 1898, published in previous reports, have been found to be unreliable and should not be used.

REVISED RECORDS.--WSP 1037: 1819-24, 1926-29, 1935(M). WSP 1117: Drainage area. WSP 1311: 1895-98. WSP 1391: 1896(M), 1899, 1901-02(M), 1903-04.

GAGE.--Water-stage recorder. Datum of gage is 914.77 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to Oct. 1, 1917, nonrecording gage at tailgate of flume at mill dam, 4.8 mi upstream at datum 12.2 ft higher.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Considerable regulation since 1963 by John Redmond Reservoir (station 07182450), 59.3 mi upstream. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	113	247	67	123	183	1,440	3,100	1,360	948	8,590	7,770	280
2	76	132	74	257	171	1,760	3,250	1,350	579	9,110	7,610	474
3	64	94	246	263	181	1,800	3,360	1,300	228	4,680	8,460	394
4	64	93	634	271	220	9,910	3,260	697	183	7,590	8,350	254
5	75	135	793	262	197	27,500	3,160	353	121	9,520	7,780	250
6	76	357	287	456	181	22,400	3,060	746	98	7,650	4,230	300
7	75	368	239	683	162	3,900	2,970	752	94	6,770	3,050	253
8	75	367	235	656	150	7,040	2,860	733	87	6,470	2,970	243
9	89	e369	255	765	152	9,660	2,070	718	124	8,730	2,890	242
10	88	e368	220	472	146	11,100	1,100	712	2,050	9,630	2,780	208
11	1,320	e372	104	151	165	12,000	775	716	2,150	8,660	2,800	106
12	2,820	e368	75	95	355	11,600	770	1,150	6,020	8,650	2,830	73
13	2,960	e361	82	83	738	11,300	747	897	4,510	8,710	1,120	66
14	3,020	e361	84	80	693	11,000	722	788	2,090	9,560	456	65
15	2,960	e367	85	164	669	10,700	703	906	662	9,530	427	178
16	1,540	e367	221	457	739	10,600	696	725	1,150	9,060	419	266
17	663	e380	692	468	669	10,300	687	608	5,800	7,480	420	253
18	339	e328	615	1,790	892	9,850	676	2,320	8,190	6,900	411	251
19	318	e134	560	1,750	1,510	9,270	672	2,950	8,670	6,550	415	250
20	315	e79	531	828	2,280	7,020	789	1,930	7,960	6,180	479	245
21	313	70	522	908	2,440	6,250	1,060	1,750	8,350	5,700	604	214
22	309	69	521	1,060	2,090	5,960	1,560	1,180	9,550	3,620	604	106
23	529	81	455	1,430	1,960	5,650	1,600	899	11,100	2,220	595	71
24	806	73	315	1,820	1,900	4,870	5,060	868	11,500	1,930	626	65
25	562	90	155	1,840	1,860	3,070	6,540	935	11,200	2,900	640	64
26	295	287	113	2,870	1,830	2,270	1,990	977	10,700	2,700	716	65
27	284	274	113	1,740	1,800	988	1,510	1,370	10,600	5,940	515	64
28	284	128	119	1,040	1,550	3,970	1,460	1,470	10,900	7,280	299	65
29	279	75	154	926	1,350	4,600	1,370	1,120	9,610	7,670	259	63
30	283	69	132	335	---	2,230	1,330	1,040	8,870	7,920	252	63
31	282	---	114	271	---	2,190	---	981	---	7,930	250	---
MEAN	686	229	284	784	939	7,813	1,964	1,106	5,136	6,962	2,291	183
MAX	3,020	380	793	2,870	2,440	27,500	6,540	2,950	11,500	9,630	8,460	474
MIN	64	69	67	80	146	988	672	353	87	1,930	250	63
AC-FT	42,200	13,610	17,480	48,230	54,020	480,400	116,800	68,040	305,600	428,100	140,900	10,890

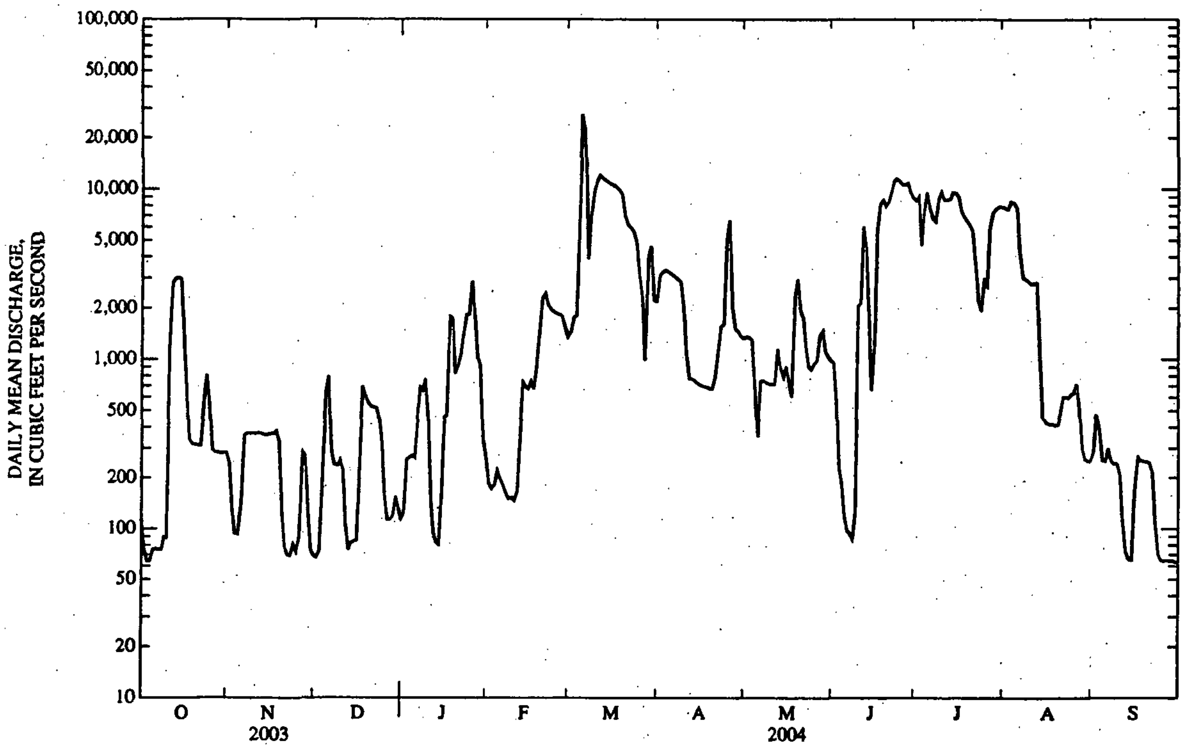
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1899 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	1,512	1,433	988	801	1,020	1,993	2,864	3,005	3,670	2,594	1,133	1,346
MAX	15,890	18,520	9,116	4,773	6,994	11,010	19,580	14,270	15,390	43,540	10,700	11,140
(WY)	(1942)	(1999)	(1993)	(1993)	(1949)	(1973)	(1944)	(1938)	(1995)	(1951)	(1993)	(1951)
MIN	0.21	0.52	1.39	1.33	3.24	11.4	19.8	82.3	126	10.8	1.10	0.64
(WY)	(1957)	(1957)	(1957)	(1957)	(1957)	(1956)	(1981)	(1967)	(1933)	(1954)	(1936)	(1956)
						5	3	2	1	4		

07183000 NEOSHO RIVER NEAR IOLA, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1899 - 2004	
ANNUAL MEAN	1,064		2,378		1,865	
HIGHEST ANNUAL MEAN					6,635	1951
LOWEST ANNUAL MEAN					141	1956
HIGHEST DAILY MEAN	13,900	Sep 1	27,500	Mar 5	344,000	Jul 13, 1951
LOWEST DAILY MEAN	23	Jan 24	63	Sep 29	0.00	Aug 19, 1936
ANNUAL SEVEN-DAY MINIMUM	26	Jan 7	64	Sep 24	0.00	Aug 19, 1936
MAXIMUM PEAK FLOW			28,500	Mar 5	436,000	Jul 13, 1951
MAXIMUM PEAK STAGE			25.71	Mar 5	43.00	Jul 13, 1951
INSTANTANEOUS LOW FLOW			59	Sep 30	0.00	at times
ANNUAL RUNOFF (AC-FT)	770,600		1,726,000		1,351,000	
10 PERCENT EXCEEDS	3,720		8,380		5,240	
50 PERCENT EXCEEDS	279		716		400	
90 PERCENT EXCEEDS	31		90		35	

e Estimated



07183500 NEOSHO RIVER NEAR PARSONS, KS

LOCATION.--Lat 37°20'24", long 95°06'35", in NE ¼ NW ¼ NE ¼ sec.21, T.31 S., R.21 E., Labette County, Hydrologic Unit 11070205, on right bank at downstream side of bridge on U.S. Highway 160, 0.4 mi upstream from Hickory Creek, 2.7 mi upstream from dam of Kansas Army Ammunition Plant, 8.0 mi east of Parsons, and at mile 204.1.

DRAINAGE AREA.--4,905 mi^2.

PERIOD OF RECORD.--October 1921 to current year. Monthly discharge only October 1921, published in WSP 1311.

REVISED RECORDS.--WSP 807: 1922-23. WSP 1391: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 810.25 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to Oct. 1, 1929, nonrecording gage at bridge 0.5 mi downstream at datum 0.04 ft lower. Oct. 1, 1929, to Feb. 7, 1935, nonrecording gage, and Feb. 8, 1935, to Dec. 7, 1966, water-stage recorder at present site and datum. Dec. 8, 1966, to June 8, 1987, water-stage recorder 2.7 mi downstream at present datum.

REMARKS.--Records good. Flow moderately regulated since 1963 by John Redmond Reservoir (station 07182450), 139.6 mi upstream. Small diversion by the Kansas Army Ammunition Plant. Records include flow of Hickory Creek. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2003 TO SEPTEMBER 2004
DAILY MEAN VALUES

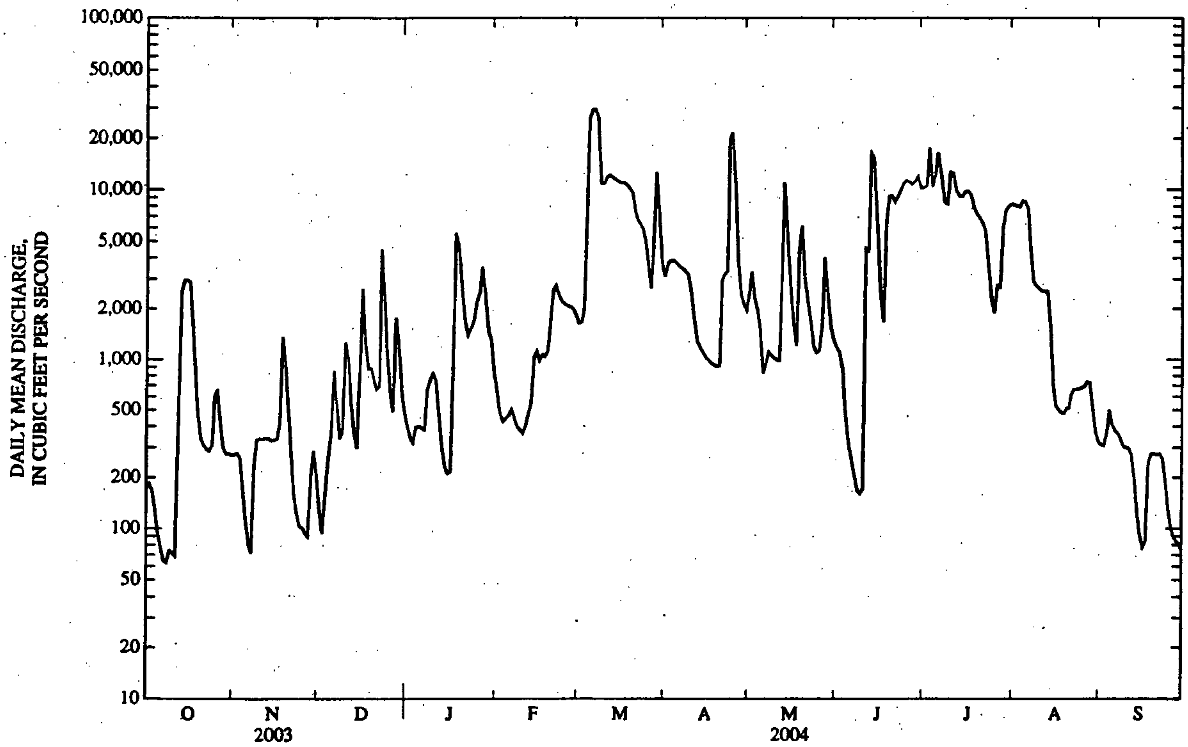
DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	175	272	130	397	642	1,640	3,110	2,470	1,190	10,200	8,200	312
2	184	277	94	342	478	1,660	3,720	3,320	1,110	10,500	8,030	308
3	167	260	151	320	427	2,010	3,850	2,310	886	17,600	7,920	367
4	128	176	260	395	444	8,710	3,870	1,960	473	10,400	8,590	500
5	95	110	370	402	466	25,800	3,730	1,490	318	12,100	8,510	409
6	77	81	860	390	505	29,200	3,590	830	262	16,500	7,830	381
7	65	72	547	380	445	29,400	3,480	930	210	12,700	4,400	365
8	63	237	339	662	397	26,400	3,360	1,110	169	8,500	2,920	341
9	74	331	367	760	381	10,800	3,230	1,060	161	8,230	2,740	309
10	72	338	1,260	822	362	10,800	2,570	1,020	171	12,700	2,650	300
11	69	338	1,030	746	403	11,800	1,790	990	4,540	12,500	2,550	299
12	348	339	533	467	477	12,200	1,300	981	4,390	9,870	2,530	273
13	2,550	341	372	309	540	11,800	1,200	2,730	16,500	9,200	2,540	196
14	2,950	329	297	233	1,020	11,500	1,110	11,000	15,600	9,150	1,560	124
15	2,960	331	854	211	1,120	11,200	1,040	5,380	7,390	9,770	701	90
16	2,880	335	2,620	214	982	11,000	993	2,630	2,550	9,790	529	77
17	1,750	419	1,250	855	1,070	11,000	952	1,600	1,680	9,280	500	84
18	903	1,360	882	5,570	1,040	10,700	929	1,210	6,410	7,880	482	246
19	461	978	889	4,730	1,120	10,200	904	4,330	9,140	7,230	478	275
20	339	463	739	3,030	1,740	9,590	918	6,110	9,220	6,840	510	277
21	309	266	663	1,690	2,560	7,540	2,950	3,010	8,480	6,440	513	272
22	294	163	686	1,400	2,760	6,650	3,220	2,200	9,130	5,780	613	276
23	285	125	4,480	1,530	2,420	6,320	3,350	1,640	9,960	3,700	661	257
24	310	103	2,610	1,700	2,230	5,920	19,400	1,210	10,900	2,300	659	190
25	604	101	1,070	2,190	2,140	5,050	21,600	1,100	11,300	1,890	671	132
26	659	94	651	2,490	2,090	3,550	11,300	1,130	11,100	2,740	683	104
27	416	90	491	3,540	2,050	2,670	3,800	1,590	10,700	2,680	735	90
28	300	206	1,770	2,450	2,010	6,650	2,410	4,020	11,200	5,980	726	85
29	276	285	1,270	1,480	1,840	12,700	2,140	2,460	12,000	7,540	521	81
30	276	202	656	1,310	---	7,270	1,960	1,580	10,200	7,980	374	75
31	269	---	484	809	---	3,610	---	1,320	---	8,210	326	---
MEAN	655	301	925	1,349	1,178	10,490	3,926	2,410	6,245	8,586	2,602	236
MAX	2,960	1,360	4,480	5,570	2,760	29,400	21,600	11,000	16,500	17,600	8,590	500
MIN	63	72	94	211	362	1,640	904	830	161	1,890	326	75
AC-FT	40,280	17,900	56,880	82,960	67,750	645,300	233,600	148,200	371,600	528,000	160,000	14,070

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1922 - 2004, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	2,256	2,228	1,456	1,255	1,676	3,016	4,276	4,416	5,202	3,617	1,357	1,909
MAX	25,520	20,340	12,760	7,762	9,492	18,100	25,520	22,110	20,610	52,780	11,140	15,030
(WY)	(1987)	(1999)	(1993)	(1973)	(1949)	(1973)	(1927)	(1961)	(1995)	(1951)	(1993)	(1951)
MIN	0.00	0.00	0.00	0.00	0.00	8.10	18.6	282	210	10.8	0.00	0.90
(WY)	(1957)	(1957)	(1957)	(1957)	(1957)	(1957)	(1981)	(1967)	(1980)	(1954)	(1936)	(1956)

07183500 NEOSHO RIVER NEAR PARSONS, KS—Continued

SUMMARY STATISTICS	FOR 2003 CALENDAR YEAR		FOR 2004 WATER YEAR		WATER YEARS 1922 - 2004	
ANNUAL MEAN	1,419		3,260		2,722	
HIGHEST ANNUAL MEAN					8,611	1993
LOWEST ANNUAL MEAN					173	1953
HIGHEST DAILY MEAN	15,100	Sep 2	29,400	Mar 7	366,000	Jul 14, 1951
LOWEST DAILY MEAN	24	Aug 22	63	Oct 8	0.00	Aug 26, 1934
ANNUAL SEVEN-DAY MINIMUM	30	Aug 19	74	Oct 5	0.00	Aug 26, 1934
MAXIMUM PEAK FLOW			30,600	Mar 8	410,000	Jul 14, 1951
MAXIMUM PEAK STAGE			25.65	Mar 8	40.20	Jul 14, 1951
INSTANTANEOUS LOW FLOW			62	Oct 7	0.00	at times
ANNUAL RUNOFF (AC-FT)	1,027,000		2,366,000		1,972,000	
10 PERCENT EXCEEDS	4,570		10,200		8,030	
50 PERCENT EXCEEDS	370		1,110		588	
90 PERCENT EXCEEDS	50		182		42	



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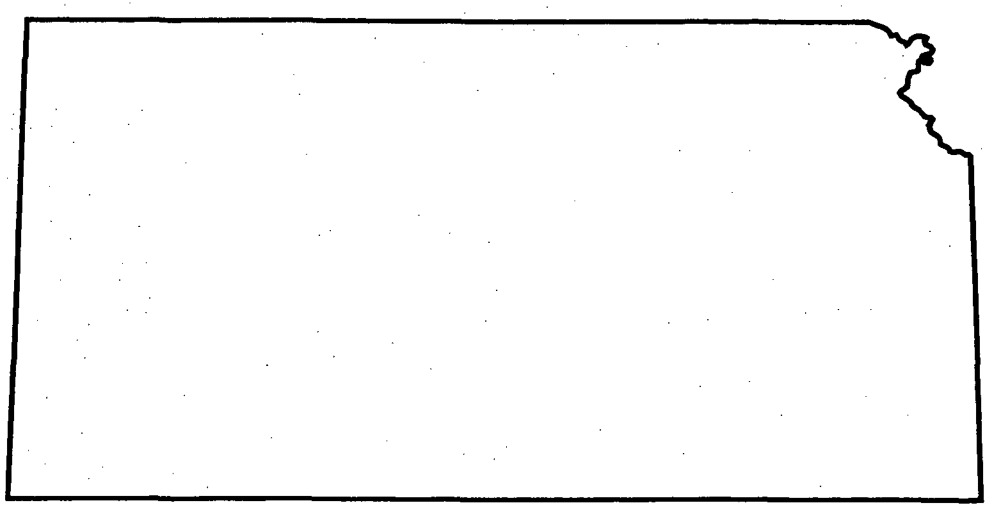
Water Resources Data
Kansas
Water Year 2005



Water-Data Report KS-05-1

U.S. Department of the Interior
U.S. Geological Survey

Prepared in cooperation with the State of Kansas and with other agencies

Calendar for Water Year 2005

2004

October

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

November

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

December

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

2005

January

S	M	T	W	T	F	S
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

February

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28					

March

S	M	T	W	T	F	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

April

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

May

S	M	T	W	T	F	S
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

June

S	M	T	W	T	F	S
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

July

S	M	T	W	T	F	S
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

August

S	M	T	W	T	F	S
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	18	20
21	22	23	24	25	26	27
28	29	30	31			

September

S	M	T	W	T	F	S
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	

Water Resources Data Kansas Water Year 2005

By J.E. Putnam and D.R. Schneider

Prepared in cooperation with the State of Kansas and with other agencies

Water-Data Report KS-05-1

U.S. Department of the Interior
U.S. Geological Survey

U.S. DEPARTMENT OF THE INTERIOR
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2006

PREFACE

This volume of the annual hydrologic data report for Kansas is one of a series of annual reports that document hydrologic data gathered from the U.S. Geological Survey's surface- and ground-water data-collection networks in each State, Puerto Rico, and the Trust Territories. These records of streamflow, ground-water levels, and water quality provide the hydrologic information needed by local, State, and Federal agencies, and the private sector for developing and managing our Nation's land and water resources.

This report is the culmination of a concerted effort by dedicated personnel of the U.S. Geological Survey who collected, compiled, analyzed, verified, and organized the data, and who typed, edited, and assembled the report. The authors had primary responsibility for assuring that the information contained herein is accurate, complete, and adheres to Geological Survey policy and established guidelines.

The data were collected, computed, and processed by the following personnel:

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This report was prepared in cooperation with the State of Kansas and with other agencies under the general supervision of James E. Putnam, Hydrologic Data Management Section Chief, and Walter R. Aucott, Director, USGS, Kansas Water Science Center.

February 2006

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13. ABSTRACT (Maximum 200 words)
Water-resources data for the 2005 water year for Kansas consist of records of stage, discharge, and water quality of streams; elevation and contents of lakes and reservoirs; and water levels of ground-water wells. This report contains records for water discharge at 154 complete-record gaging stations; elevation and contents at 14 lakes and reservoirs; water-quality records at 2 precipitation stations, water-level data at 15 observation wells; and records of specific conductance, pH, water temperature, dissolved oxygen, and turbidity at 13 gaging stations and 2 lakes with water-quality monitors. Also included are discharge data for 29 high-flow partial-record stations. These data represent that part of the National Water Information System collected by the U.S. Geological Survey in cooperation with local, State, and Federal agencies in Kansas.

14. SUBJECT TERMS
*Kansas, *Hydrologic data, *Surface water, *Ground water, *Water quality, Flow rate, Gaging stations, Lakes, Reservoirs, Chemical analyses, Water temperatures, Sampling sites, Water levels, Water analyses

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ILLUSTRATIONS

TABLES

SURFACE-WATER STATIONS, IN DOWNSTREAM ORDER, FOR WHICH RECORDS ARE PUBLISHED IN THIS VOLUME

[Letters in parentheses () after station name designate type of data: (d) discharge, (c) chemical, (t) temperature, and (e) elevation]

* * * * * * * * * * * * * * * * * *

07179500 NEOSHO RIVER AT COUNCIL GROVE, KS

LOCATION.--Lat 38°39'57", long 96°29'36", in NE 1/4 NE 1/4 NW 1/4 sec.14, T.16 S., R.8 E., Morris County, Hydrologic Unit 11070201, on right bank at downstream side of bridge, 300 ft downstream from Mozler Creek, 1.0 mi upstream from Elm Creek, 1.7 mi downstream from Council Grove Lake, and at mile 448.0.

DRAINAGE AREA.--250 mi^2.

PERIOD OF RECORD.--October 1938 to current year.

REVISED RECORDS.--WSP 1117: Drainage area. WSP 1341: 1939-40(M), 1942.

GAGE.--Water-stage recorder. Concrete control since Jan. 8, 1997. Datum of gage is 1,205.63 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to June 7, 1940, nonrecording gage at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow completely regulated since 1964 by Council Grove Lake (station 07179400), 1.7 mi upstream. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in 1903 reached a stage of 37.3 ft at water plant, from information by U.S. Army Corps of Engineers.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	4.6	6.1	5.0	2.8	86	86	6.4	e7.8	54	92	12	2,630
2	4.5	5.9	5.0	2.5	87	87	6.9	7.5	9.6	91	12	2,600
3	4.6	6.1	5.0	4.6	195	61	7.0	5.9	e18	95	11	2,560
4	4.6	6.1	5.2	3.1	279	29	7.3	6.4	e14	80	7.8	2,530
5	4.9	6.0	4.4	2.4	280	28	8.0	6.2	13	60	8.0	2,490
6	5.0	6.1	4.2	1.7	285	28	19	6.1	1,050	92	7.9	2,210
7	5.4	6.5	3.9	1.7	285	27	55	5.7	2,340	93	7.6	963
8	4.9	6.9	4.0	1.7	671	28	102	5.3	2,220	93	7.6	12
9	4.7	6.9	3.9	1.7	450	27	96	4.8	883	93	7.6	33
10	5.1	7.6	3.6	1.7	8.0	27	95	4.8	1,640	93	7.6	90
11	5.2	6.6	3.8	1.7	7.0	27	95	4.6	303	93	7.8	91
12	5.1	6.7	3.7	1.6	6.6	27	93	e8.4	e25	110	7.8	91
13	4.8	6.8	3.5	1.4	10	27	93	e19	e16	85	9.6	90
14	4.7	6.8	3.8	1.3	363	27	94	791	e15	154	8.4	90
15	5.0	6.8	3.9	1.3	669	27	95	1,970	14	263	7.5	147
16	5.0	6.8	3.9	1.3	668	27	95	2,390	13	231	7.5	227
17	5.1	6.8	3.9	1.4	422	27	96	2,250	651	232	7.5	227
18	5.0	6.8	3.8	1.4	7.6	26	96	2,330	1,130	231	7.5	227
19	5.4	6.8	3.7	1.7	6.9	26	95	1,670	1,130	237	8.0	226
20	5.4	6.8	3.8	2.9	6.6	27	95	910	1,120	389	9.8	118
21	5.3	6.9	3.5	2.5	6.3	20	95	797	1,120	693	7.6	27
22	5.1	6.9	3.5	1.5	45	6.6	94	365	1,120	691	368	27
23	5.1	7.1	3.3	1.5	88	6.2	95	40	1,110	689	741	27
24	5.0	6.9	3.3	1.5	86	6.4	95	41	1,480	416	936	27
25	4.6	6.9	3.2	1.6	86	6.1	96	99	1,670	77	e900	27
26	7.7	5.9	3.2	1.5	87	6.1	44	99	1,660	15	e26	20
27	6.0	5.1	3.2	1.5	87	6.1	9.3	99	1,850	14	1,310	6.7
28	6.1	5.2	3.2	1.5	86	6.4	8.6	99	2,090	14	2,550	6.5
29	6.0	5.2	3.0	1.5	---	6.7	7.2	98	1,640	13	2,670	6.5
30	5.6	5.0	2.6	1.6	---	6.5	e8.1	98	1,010	13	2,690	6.6
31	5.9	---	2.7	43	---	6.4	---	99	---	13	2,670	---
MEAN	5.21	6.43	3.76	3.20	192	25.1	63.4	462	914	179	485	594
MAX	7.7	7.6	5.2	43	671	87	102	2,390	2,340	693	2,690	2,630
MIN	4.5	5.0	2.6	1.3	6.3	6.1	6.4	4.6	9.6	13	7.5	6.5
AC-FT	320	383	231	197	10,640	1,550	3,770	28,440	54,360	11,020	29,830	35,370

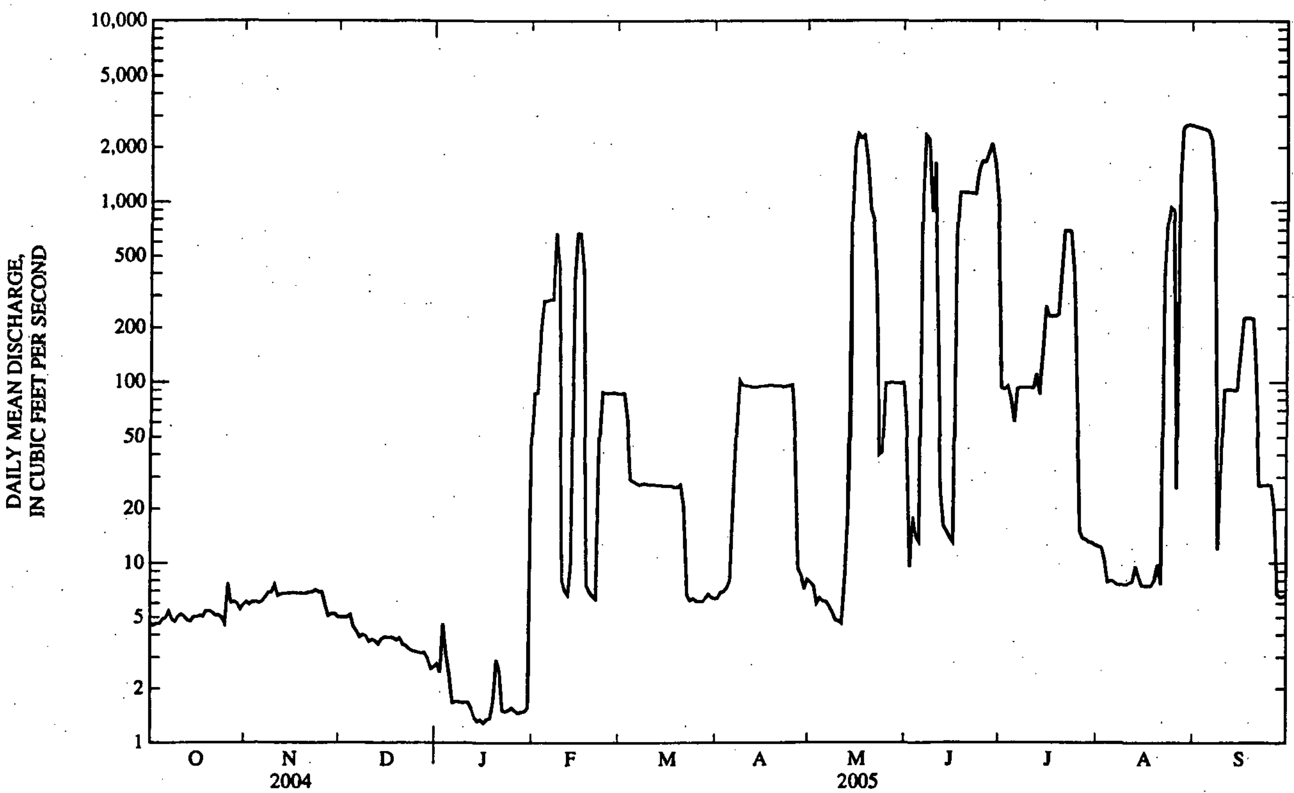
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1939 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	106	61.2	56.7	51.3	62.2	119	190	223	258	215	77.7	82.3
MAX	1,387	852	718	503	579	702	1,424	1,387	1,656	2,858	1,103	984
(WY)	(1974)	(1999)	(1945)	(1973)	(1949)	(1973)	(1944)	(1993)	(1995)	(1951)	(1993)	(1951)
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.03	0.00	0.00	0.00
(WY)	(1939)	(1939)	(1939)	(1939)	(1939)	(1940)	(1940)	(1954)	(1956)	(1940)	(1939)	(1939)

07179500 NEOSHO RIVER AT COUNCIL GROVE, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1939 - 2005	
ANNUAL MEAN	171		243		125	
HIGHEST ANNUAL MEAN					498	1951
LOWEST ANNUAL MEAN					5.37	1953
HIGHEST DAILY MEAN	2,320	Jun 22	2,690	Aug 30	34,000	Jul 11, 1951
LOWEST DAILY MEAN	0.43	Feb 13	1.3	Jan 14	0.00	Oct 1, 1938
ANNUAL SEVEN-DAY MINIMUM	0.48	Feb 11	1.4	Jan 12	0.00	Oct 1, 1938
MAXIMUM PEAK FLOW			2,730	Aug 29	121,000	Jul 11, 1951
MAXIMUM PEAK STAGE			13.49	Aug 29	36.29	Jul 11, 1951
INSTANTANEOUS LOW FLOW			1.2	Jan 14	0.00	at times
ANNUAL RUNOFF (AC-FT)	124,200		176,100		90,900	
10 PERCENT EXCEEDS	703		904		230	
50 PERCENT EXCEEDS	5.4		9.8		13	
90 PERCENT EXCEEDS	1.1		3.3		0.90	

e Estimated



07179730 NEOSHO RIVER NEAR AMERICUS, KS

LOCATION.--Lat 38°28'01", long 96°15'01", in SW 1/4 SW 1/4 NW 1/4 sec.24, T.18 S., R.10 E., Lyon County, Hydrologic Unit 11070201, on right bank, 0.1 mi below Ruggles Dam, 2.0 mi south of Americus, 12.5 mi upstream from Allen Creek, and 24.0 mi upstream from Cottonwood River.

DRAINAGE AREA.--622 mi^2.

PERIOD OF RECORD.--June 1963 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,106.99 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Apr. 10, 1989, to Nov. 1990, at site 0.4 mi upstream at present datum. Aug. 8, 1963, to Apr. 11, 1989, and Nov. 21, 1990, to current year, water-stage recorder at present site and datum.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow moderately regulated since 1964 by Council Grove Lake (station 07179400). Low flow occasionally regulated by Ruggles Dam 0.1 mi upstream. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	18	34	52	28	179	238	105	74	206	e603	47	2,750
2	16	38	50	28	224	231	99	70	161	226	42	2,700
3	16	44	49	128	227	229	96	67	1,320	212	39	2,660
4	15	45	48	465	342	204	101	66	6,370	337	38	2,610
5	15	46	51	724	394	162	113	65	5,500	269	34	2,570
6	23	39	73	166	706	153	410	65	1,410	192	32	2,520
7	41	36	73	e110	2,030	164	1,340	64	2,220	201	33	2,110
8	32	34	66	e100	1,280	142	513	68	2,730	188	33	620
9	32	33	60	115	1,310	138	362	66	4,800	180	33	135
10	31	42	57	259	571	139	312	59	3,650	171	32	132
11	32	73	52	245	400	135	275	56	6,710	171	31	180
12	34	51	50	154	566	130	258	59	7,620	159	37	170
13	33	43	47	119	1,600	124	239	7,770	8,880	399	48	171
14	30	40	44	70	1,420	118	228	8,850	2,350	182	92	163
15	29	38	42	e50	1,070	116	222	2,780	962	219	58	554
16	29	37	42	38	1,070	116	218	2,960	638	275	39	715
17	28	37	42	64	995	117	215	2,810	509	270	35	393
18	27	37	42	62	553	126	213	2,660	1,360	268	33	383
19	27	36	41	89	242	108	220	2,530	1,510	1,930	32	345
20	27	35	40	540	266	103	210	1,510	1,460	2,110	602	306
21	27	35	39	1,250	270	109	204	996	1,430	736	377	181
22	26	34	35	456	238	149	195	901	1,410	743	98	102
23	25	35	28	192	250	264	183	356	1,380	691	769	93
24	24	50	17	182	272	213	177	231	1,370	668	1,260	86
25	23	64	28	138	262	170	176	296	1,880	325	2,920	84
26	45	55	29	134	253	149	179	266	1,890	141	10,600	81
27	132	48	29	134	250	137	132	242	1,870	78	7,270	75
28	72	47	30	121	246	130	82	229	2,200	65	2,730	60
29	42	49	30	110	—	136	79	253	2,090	58	2,960	55
30	31	50	31	113	—	138	76	226	1,810	53	2,880	54
31	30	—	30	140	—	116	—	211	—	50	2,820	—
MEAN	32.6	42.8	43.5	210	624	152	241	1,189	2,590	393	1,163	769
MAX	132	73	73	1,250	2,030	264	1,340	8,850	8,880	2,110	10,600	2,750
MIN	15	33	17	28	179	103	76	56	161	50	31	54
AC-FT	2,010	2,550	2,670	12,940	34,680	9,330	14,340	73,100	154,100	24,140	71,510	45,740

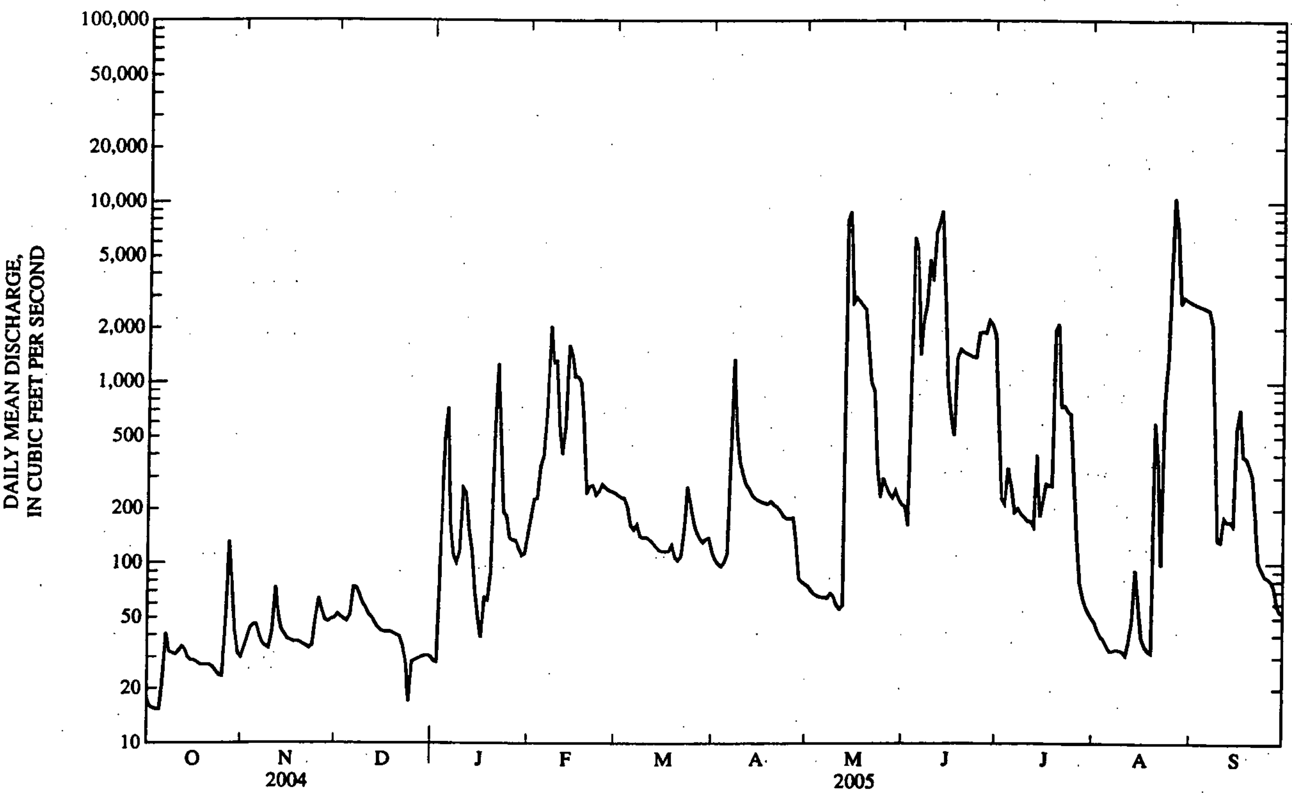
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1964 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	253	211	160	127	210	364	515	606	700	434	185	184
MAX	2,278	2,304	916	854	1,048	2,100	2,258	3,285	2,761	3,127	1,498	1,526
(WY)	(1974)	(1999)	(1974)	(1973)	(1973)	(1973)	(1999)	(1995)	(1995)	(1993)	(1993)	(1973)
MIN	2.41	6.90	5.87	3.73	3.64	6.87	11.1	24.4	15.9	12.5	12.5	10.7
(WY)	(1965)	(1967)	(1967)	(1967)	(1967)	(1967)	(1989)	(1967)	(1989)	(1964)	(1978)	(1980)

07179730 NEOSHO RIVER NEAR AMERICUS, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1964 - 2005	
ANNUAL MEAN	470		618		329	
HIGHEST ANNUAL MEAN					1,106	1993
LOWEST ANNUAL MEAN					28.2	1989
HIGHEST DAILY MEAN	11,700	Jun 19	10,600	Aug 26	14,700	Nov 2, 1998
LOWEST DAILY MEAN	11	Jan 6	15	Oct 4	0.00	Oct 2, 1963
ANNUAL SEVEN-DAY MINIMUM	12	Jan 6	21	Oct 1	0.24	Oct 26, 1964
MAXIMUM PEAK FLOW			13,400	Aug 26	17,400	Jul 22, 1993
MAXIMUM PEAK STAGE			26.98	Aug 26	27.84	Jul 22, 1993
INSTANTANEOUS LOW FLOW			1.2	Dec 24	0.00	at times
ANNUAL RUNOFF (AC-FT)	341,500		447,100		238,500	
10 PERCENT EXCEEDS	1,730		1,910		877	
50 PERCENT EXCEEDS	56		138		62	
90 PERCENT EXCEEDS	17		32		12	

e Estimated



07179795 NORTH COTTONWOOD RIVER BELOW MARION LAKE, KS

LOCATION.--Lat 38°22'00", long 97°05'00", in SE ¼ NW ¼ SE ¼ sec.27, T.19 S., R.3 E., Marion County, Hydrologic Unit 11070202, on left bank, 0.25 mi downstream from outlet of dam, 1.6 mi upstream from South Cottonwood River, 3.0 mi northwest of Marion, and at mile 126.5.

DRAINAGE AREA.--200 mi^2.

PERIOD OF RECORD.--July 1968 to current year. Prior to Oct. 1, 1991, published as "Cottonwood River."

REVISED RECORDS.--WDR KS-77-1: 1976.

GAGE.--Water-stage recorder. Datum of gage is 1,296.57 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow completely regulated since 1968 by Marion Lake (station 07179794), 0.25 mi upstream. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	8.3	8.8	2.0	3.7	2.9	2.5	87	13	9.4	14	15	14
2	7.7	8.7	1.4	4.0	2.8	2.1	88	13	9.5	14	15	14
3	6.1	7.9	0.42	4.4	2.6	2.4	88	13	e21	15	15	14
4	8.6	6.0	0.25	4.2	2.6	2.7	88	13	e50	15	16	14
5	11	4.3	0.23	4.2	2.4	2.7	89	13	9.1	14	16	14
6	9.6	4.3	0.14	3.0	2.8	2.8	89	13	1,110	14	15	14
7	9.3	4.7	3.8	3.8	2.4	3.6	89	13	2,380	14	15	14
8	9.6	4.8	3.5	4.2	2.0	3.1	89	13	2,220	14	15	12
9	9.9	4.9	2.6	4.5	1.9	2.9	89	13	605	14	15	9.4
10	9.6	5.3	3.0	4.3	1.7	3.4	90	13	935	14	14	9.4
11	11	4.8	1.9	4.2	1.8	3.3	93	13	370	14	14	9.3
12	10	4.4	2.6	4.1	1.7	3.3	92	14	67	15	14	8.9
13	11	4.2	3.7	4.3	2.2	3.4	91	172	371	15	14	8.9
14	12	4.2	2.6	4.3	1.8	3.4	60	381	12	15	14	8.7
15	11	4.3	2.3	4.3	3.8	2.9	37	831	5.1	15	13	10
16	11	4.4	3.0	4.3	3.3	2.9	37	1,010	3.4	15	13	9.3
17	10	5.0	3.3	4.0	2.7	2.8	37	e1,000	337	15	13	8.8
18	11	5.4	2.8	3.6	3.4	2.8	37	e1,000	588	15	13	9.0
19	10	5.2	2.3	3.6	3.8	3.0	24	e1,000	586	14	14	9.4
20	9.3	5.0	3.1	3.6	3.3	2.8	14	e750	583	14	15	9.7
21	9.1	5.1	3.8	4.5	3.3	4.3	15	e500	580	14	14	9.4
22	9.2	5.4	3.0	3.5	3.3	4.8	16	e500	578	14	14	9.6
23	9.1	5.9	2.3	2.2	5.1	56	16	e500	579	14	16	10
24	8.8	5.9	2.3	2.3	5.3	89	15	244	879	14	14	10
25	10	3.4	2.1	2.8	4.3	89	15	8.2	1,090	14	50	10
26	10	2.4	1.8	2.9	3.8	88	15	8.4	1,080	15	14	10
27	8.5	2.9	2.0	3.0	4.1	89	14	8.4	1,080	15	13	10
28	8.9	2.4	2.0	3.1	4.2	88	14	8.5	1,070	14	13	10
29	8.7	2.6	2.0	3.0	---	89	14	9.0	1,040	14	13	9.8
30	8.7	2.5	2.0	2.9	---	88	14	9.3	573	14	13	9.3
31	8.6	---	2.7	2.9	---	87	---	9.4	---	15	13	---
MEAN	9.54	4.84	2.29	3.67	3.05	26.8	51.9	261	627	14.4	15.3	10.6
MAX	12	8.8	3.8	4.5	5.3	89	93	1,010	2,380	15	50	14
MIN	6.1	2.4	0.14	2.2	1.7	2.1	14	8.2	3.4	14	13	8.7
AC-FT	586	288	141	226	169	1,650	3,090	16,080	37,330	885	942	633

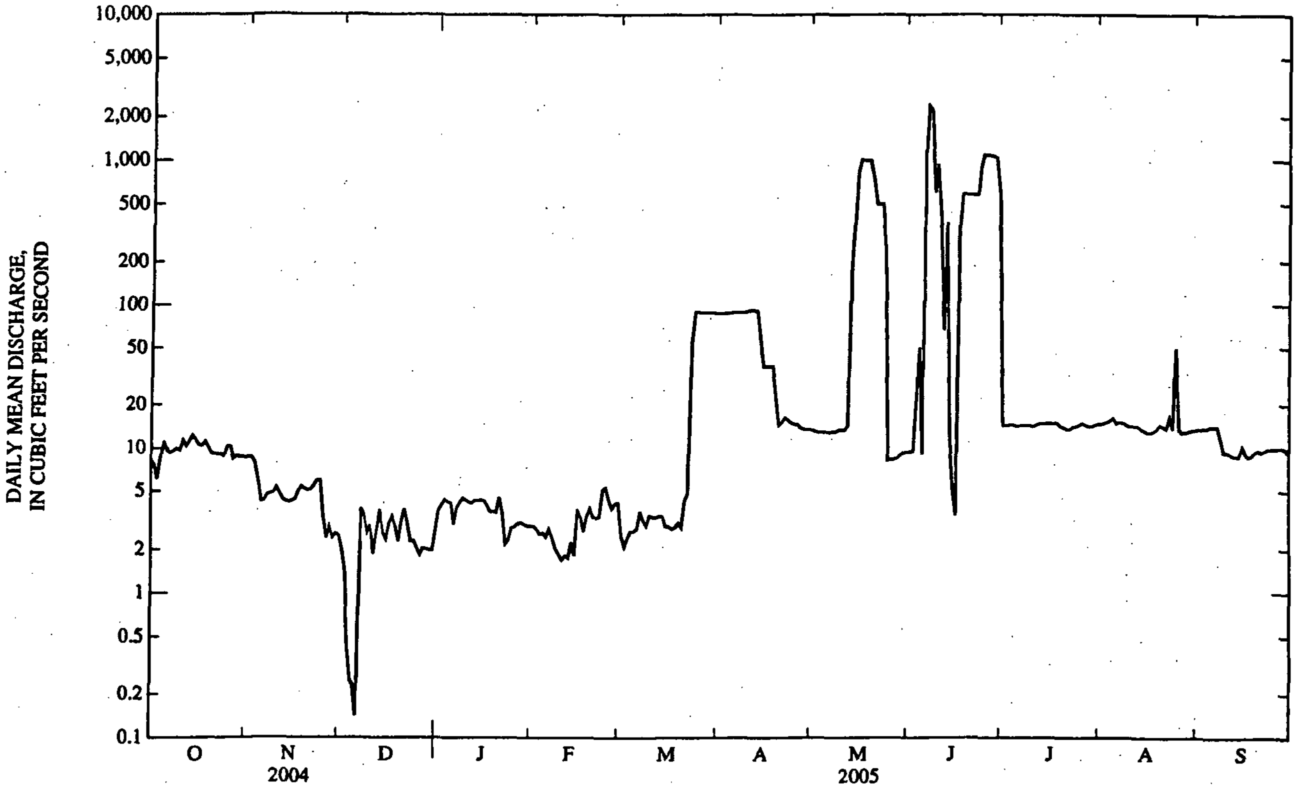
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1969 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	54.1	61.1	42.0	27.3	51.8	81.0	102	138	145	113	36.3	26.2
MAX	692	549	469	229	411	703	559	1,035	860	997	528	191
(WY)	(1974)	(1999)	(1999)	(1973)	(1973)	(1973)	(1973)	(1993)	(1995)	(1993)	(1993)	(1985)
MIN	0.99	1.04	0.67	0.77	1.05	0.70	0.54	1.61	2.00	3.85	1.87	1.74
(WY)	(1969)	(1969)	(1969)	(1992)	(1992)	(1969)	(1969)	(1992)	(1992)	(1992)	(1992)	(1992)

07179795 NORTH COTTONWOOD RIVER BELOW MARION LAKE, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1969 - 2005	
ANNUAL MEAN	70.9		85.7		73.2	
HIGHEST ANNUAL MEAN					322	1993
LOWEST ANNUAL MEAN					1.98	1992
HIGHEST DAILY MEAN	2,230	Jul 27	2,380	Jun 7	4,000	May 26, 1993
LOWEST DAILY MEAN	0.14	Dec 6	0.14	Dec 6	0.00	Oct 3, 1984
ANNUAL SEVEN-DAY MINIMUM	0.99	Nov 30	0.99	Nov 30	0.25	Mar 30, 1969
MAXIMUM PEAK FLOW			2,410	Jun 6	4,530	May 26, 1993
MAXIMUM PEAK STAGE			12.79	Jun 6	22.58	Dec 4, 1998
INSTANTANEOUS LOW FLOW			0.10	Dec 6	0.00	Oct 3, 1984
ANNUAL RUNOFF (AC-FT)	51,460		62,010		53,020	
10 PERCENT EXCEEDS	92		90		99	
50 PERCENT EXCEEDS	8.7		9.6		7.6	
90 PERCENT EXCEEDS	2.4		2.6		1.9	

e Estimated



07180400 COTTONWOOD RIVER NEAR FLORENCE, KS

LOCATION.--Lat 38°14'10", long 96°52'37", in NW 1/4 SW 1/4 sec.10, T.21 S., R.5 E., Marion County, Hydrologic Unit 11070202, on left bank at downstream side of county highway bridge, 0.4 mi upstream from Martin Creek, 2.5 mi east of Florence, 3.3 mi downstream from Doyle Creek, and at mile 102.4.

DRAINAGE AREA.--754 mi^2.

PERIOD OF RECORD.--June 1961 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,231.49 ft above NGVD of 1929. Since Aug. 10, 1965, auxiliary water-stage recorder 2.8 mi downstream at datum 1,219.49 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow moderately regulated since 1968 by Marion Lake (station 07179794), 24 mi upstream. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage known since at least 1872, 32.5 ft, July 11, 1951, from information by local residents.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	60	68	81	65	143	128	237	112	174	267	69	e183
2	56	67	79	64	157	123	228	107	155	146	67	e183
3	55	67	77	83	135	120	223	104	1,210	137	63	e176
4	55	70	75	192	125	119	219	104	9,890	186	61	e163
5	54	68	75	1,000	113	116	219	102	8,100	198	1,830	e151
6	59	67	78	413	131	112	314	105	1,240	154	412	e144
7	65	66	77	313	871	111	518	101	2,540	135	121	e138
8	65	65	77	142	678	109	319	100	2,550	131	91	e125
9	62	67	77	144	294	106	266	106	3,030	124	81	e117
10	64	75	74	254	194	102	252	98	1,930	118	73	e107
11	69	93	71	162	193	100	251	96	8,900	114	67	e105
12	70	82	71	142	337	100	245	97	11,200	111	65	e106
13	67	75	67	121	762	98	234	2,720	9,050	110	93	e106
14	62	72	66	99	1,060	96	226	4,090	3,820	109	199	e105
15	60	71	65	e80	400	96	178	1,070	1,040	103	96	e349
16	61	71	65	e70	242	94	166	1,150	715	100	82	565
17	63	73	66	85	192	93	165	1,060	607	96	78	e187
18	63	76	67	83	169	94	163	1,000	1,050	97	77	e153
19	63	75	66	99	166	94	159	982	990	101	75	e130
20	64	72	66	439	167	93	141	903	936	98	197	e115
21	64	71	66	1,100	166	133	129	602	901	93	239	e110
22	66	70	66	617	157	2,290	122	581	885	87	112	e107
23	64	73	70	322	150	3,170	118	567	865	81	1,400	e107
24	62	107	65	236	148	820	115	554	931	78	756	e111
25	61	119	62	140	143	466	119	170	1,360	77	7,830	e112
26	85	101	62	130	139	368	123	127	1,350	80	7,000	e112
27	106	88	64	119	135	319	120	116	1,340	86	2,660	e111
28	97	79	64	112	133	291	118	110	1,320	81	691	e110
29	83	78	65	107	---	273	115	105	1,310	77	384	e103
30	75	81	65	102	---	264	113	209	1,220	72	258	e102
31	69	---	65	113	---	251	---	162	---	70	e207	---
MEAN	66.7	76.9	69.5	231	275	347	197	565	2,687	113	820	150
MAX	106	119	81	1,100	1,060	3,170	518	4,090	11,200	267	7,830	565
MIN	54	65	62	64	113	93	113	96	155	70	61	102
AC-FT	4,100	4,580	4,270	14,180	15,270	21,320	11,730	34,730	159,900	6,980	50,450	8,910

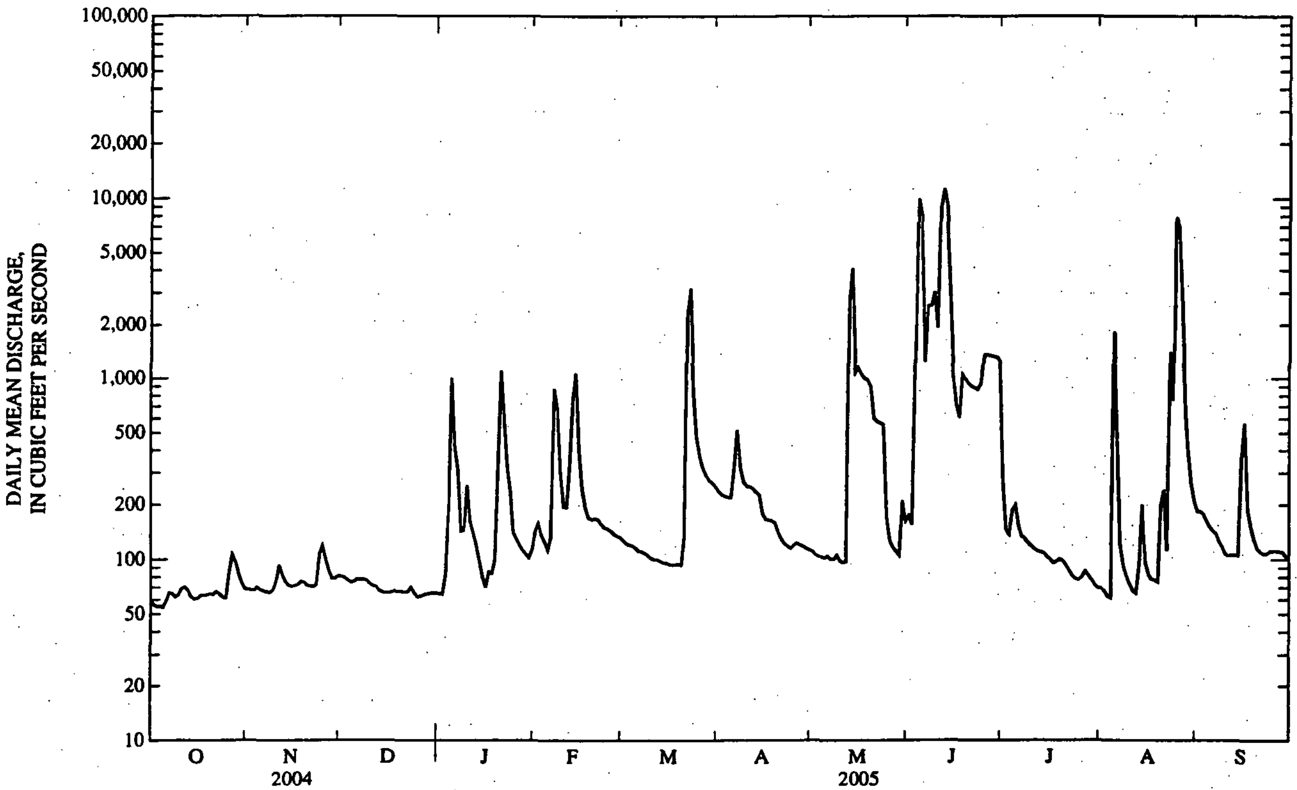
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1962 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	269	298	154	133	221	389	404	542	724	377	165	216
MAX	2,203	4,356	755	728	1,308	3,251	1,533	4,981	3,691	4,044	833	1,755
(WY)	(1986)	(1999)	(1999)	(1962)	(1973)	(1973)	(1983)	(1993)	(1965)	(1993)	(1985)	(1962)
MIN	11.5	19.8	18.2	20.4	19.8	26.9	25.6	23.0	53.4	22.8	16.9	21.8
(WY)	(1965)	(1967)	(1992)	(1967)	(1967)	(1981)	(1981)	(1967)	(1991)	(1966)	(1991)	(1966)

07180400 COTTONWOOD RIVER NEAR FLORENCE, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1962 - 2005	
ANNUAL MEAN	339		465		324	
HIGHEST ANNUAL MEAN					1,298	1993
LOWEST ANNUAL MEAN					39.9	1991
HIGHEST DAILY MEAN	14,700	Jul 25	11,200	Jun 12	47,800	Nov 2, 1998
LOWEST DAILY MEAN	42	Feb 7	54	Oct 5	4.8	Jun 28, 1991
ANNUAL SEVEN-DAY MINIMUM	43	Feb 2	58	Oct 1	6.9	Oct 8, 1964
MAXIMUM PEAK FLOW			15,200	Jun 4	73,700	Nov 2, 1998
MAXIMUM PEAK STAGE			24.81	Jun 4	28.81	Nov 2, 1998
INSTANTANEOUS LOW FLOW			53	Oct 5	4.4	Jun 28, 1991
ANNUAL RUNOFF (AC-FT)	246,300		336,400		234,800	
10 PERCENT EXCEEDS	625		994		651	
50 PERCENT EXCEEDS	78		112		82	
90 PERCENT EXCEEDS	55		65		28	

e Estimated



07180500 CEDAR CREEK NEAR CEDAR POINT, KS

LOCATION.--Lat 38°11'47", long 96°49'27", in NE 1/4 SE 1/4 NE 1/4 sec.25, T.21 S., R.5 E., Chase County, Hydrologic Unit 11070202, on right bank at upstream side of county highway bridge, 4.0 mi south of Cedar Point, and at mile 9.4.

DRAINAGE AREA.--110 mi^2.

PERIOD OF RECORD.--October 1938 to current year. Monthly discharge only for some periods, published in WSP 1311.

REVISED RECORDS.--WSP 1211: 1944(M). WSP 1341: 1940-41, 1942(M), 1943, 1945(M).

GAGE.--Water-stage recorder. Datum of gage is 1,262.50 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to Sept. 28, 1944, nonrecording gage at present site and datum.

REMARKS.--Records good. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Flood in July 1929 reached a stage of 24.63 ft from floodmarks on house on left bank where flood in 1951 reached a stage of 25.7 ft.

PEAK DISCHARGES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 3,600 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Jun 3	1900	*11,000	*19.82	Jun 12	1145	7,160	16.07
Jun 9	0300	7,110	16.02	Aug 25	1200	9,630	18.08
Jun 11	1000	5,690	14.45				

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

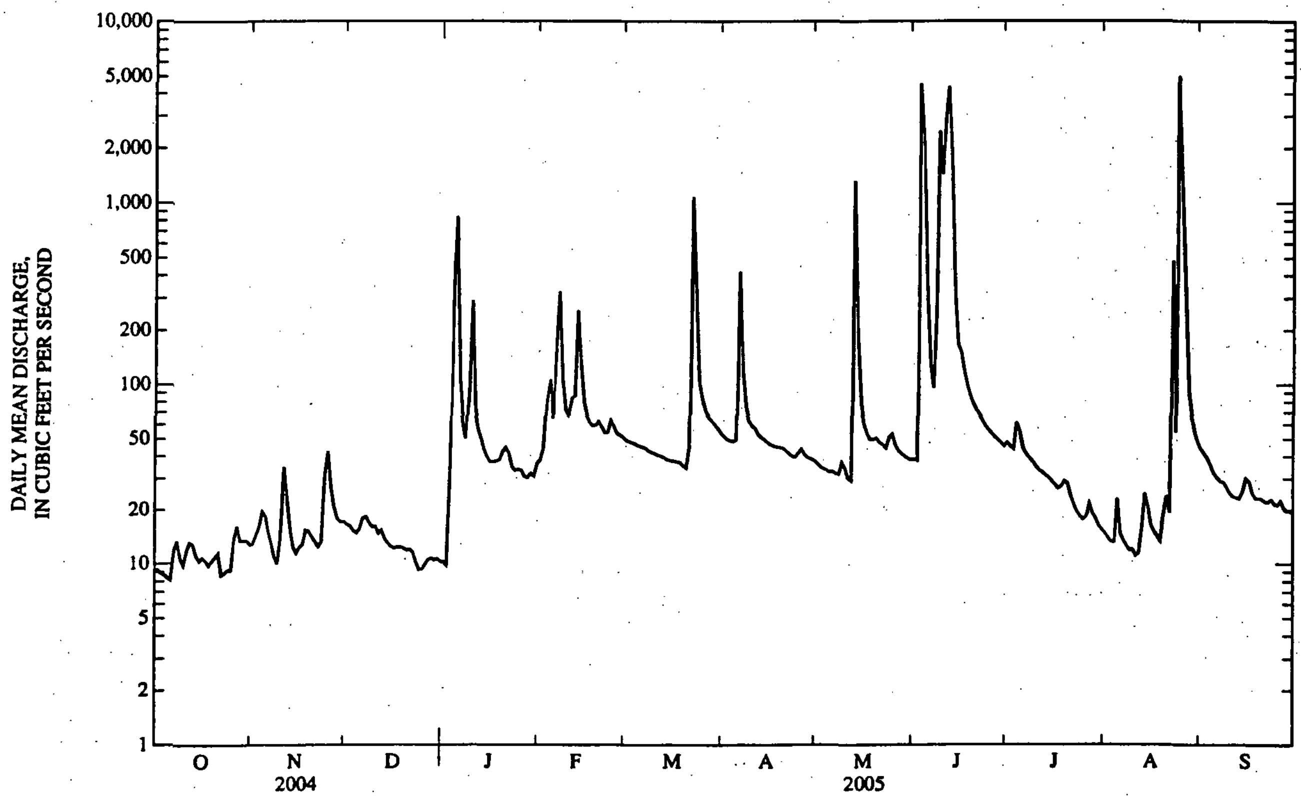
DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	9.1	13	17	10	38	49	52	37	39	48	15	44
2	9.2	14	16	9.8	44	48	50	35	38	45	14	41
3	8.8	16	15	31	82	48	49	34	4,540	44	13	39
4	8.7	20	15	372	106	47	48	34	2,330	61	13	35
5	8.4	18	16	834	65	46	49	33	325	55	23	32
6	8.1	15	18	106	165	45	417	33	129	44	15	30
7	12	13	18	62	323	45	117	32	96	41	13	29
8	13	11	17	50	106	43	75	32	257	39	13	29
9	11	10	16	93	72	42	63	37	2,480	37	12	27
10	9.8	14	16	288	68	42	59	34	1,430	35	12	25
11	12	35	15	75	84	41	57	30	2,920	33	11	24
12	13	24	15	57	87	40	53	29	4,370	32	11	23
13	13	16	14	51	255	39	51	1,310	1,850	31	16	23
14	11	12	13	44	132	38	50	178	323	30	25	25
15	10	11	13	40	80	38	48	78	166	29	21	30
16	11	12	12	37	67	38	47	61	150	28	16	29
17	10	13	12	37	62	37	46	54	118	26	15	25
18	9.8	15	12	37	59	37	45	50	98	27	14	23
19	10	15	12	38	59	35	45	49	86	29	13	23
20	11	14	12	42	62	34	44	51	78	28	19	23
21	11	13	12	45	58	46	43	48	72	24	24	22
22	8.7	12	12	42	54	1,070	41	46	68	21	19	22
23	8.9	13	10	35	54	259	40	44	63	20	479	23
24	9.2	32	9.2	33	63	103	39	51	59	18	54	21
25	9.2	42	9.3	34	59	83	42	53	56	18	5,000	21
26	14	27	9.9	33	54	72	44	46	54	18	775	23
27	16	21	10	31	52	66	41	43	51	22	215	21
28	13	18	11	30	51	63	39	41	49	19	89	20
29	13	17	10	32	---	61	39	40	47	18	65	20
30	13	17	11	31	---	58	38	39	45	16	54	19
31	13	---	10	36	---	55	---	38	---	15	48	---
MEAN	10.9	17.4	13.2	87.0	87.9	89.3	62.4	87.7	746	30.7	230	26.4
MAX	16	42	18	834	323	1,070	417	1,310	4,540	61	5,000	44
MIN	8.1	10	9.2	9.8	38	34	38	29	38	15	11	19
AC-FT	670	1,040	810	5,350	4,880	5,490	3,710	5,400	44,400	1,890	14,130	1,570

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1939 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	46.1	39.6	29.8	26.9	42.6	73.3	89.5	85.4	129	66.9	32.0	38.6
MAX	392	542	264	195	260	449	554	507	814	594	230	414
(WY)	(1986)	(1999)	(1945)	(1949)	(2001)	(1973)	(1944)	(1993)	(1965)	(1951)	(2005)	(1941)
MIN	0.00	0.00	0.00	0.00	0.00	0.44	0.58	0.01	0.00	0.00	0.00	0.00
(WY)	(1940)	(1954)	(1955)	(1940)	(1957)	(1956)	(1954)	(1955)	(1955)	(1954)	(1954)	(1953)

07180500 CEDAR CREEK NEAR CEDAR POINT, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1939 - 2005	
ANNUAL MEAN	78.8		123		58.2	
HIGHEST ANNUAL MEAN					159	1993
LOWEST ANNUAL MEAN					0.91	1954
HIGHEST DAILY MEAN	4,810	Jul 9	5,000	Aug 25	10,900	Jun 29, 1951
LOWEST DAILY MEAN	8.1	Oct 6	8.1	Oct 6	0.00	Jul 12, 1939
ANNUAL SEVEN-DAY MINIMUM	8.9	Sep 30	9.2	Oct 1	0.00	Jul 12, 1939
MAXIMUM PEAK FLOW			11,000	Jun 3	52,400	Jun 29, 1951
MAXIMUM PEAK STAGE			19.82	Jun 3	23.70	Jun 29, 1951
INSTANTANEOUS LOW FLOW			7.7	Oct 6	0.00	at times
ANNUAL RUNOFF (AC-FT)	57,180		89,340		42,180	
10 PERCENT EXCEEDS	88		97		76	
50 PERCENT EXCEEDS	27		35		16	
90 PERCENT EXCEEDS	10		12		2.0	



07182250 COTTONWOOD RIVER NEAR PLYMOUTH, KS

LOCATION.--Lat 38°23'51", long 96°21'21", in NE 1/4 NE 1/4 SE 1/4 sec.13, T.19 S., R.9 E., Chase County, Hydrologic Unit 11070203, on right bank at upstream side of county highway bridge, 0.8 mi downstream from Buckeye Creek, 1.5 mi southwest of Plymouth, and at mile 39.2.

DRAINAGE AREA.--1,740 mi^2.

PERIOD OF RECORD.--March 1963 to current year.

GAGE.--Water-stage recorder. Datum of gage is 1,109.04 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Flow partially regulated since 1968 by Marion Lake (station 07179794), 87.3 mi upstream. Satellite telemeter at station.

EXTREMES OUTSIDE PERIOD OF RECORD.--Maximum stage since at least 1903, 37.8 ft, July 11, 1951, from information by local residents, discharge not determined.

PEAK DISCHARGES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 4,900 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Mar 24	0300	5,850	19.31	Jun 13	2100	*27,400	*33.85
May 13	1600	16,600	32.84	Aug 27	1200	18,400	33.04
Jun 5	0700	13,900	32.32				

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	114	120	282	193	568	716	815	395	570	1,480	191	894
2	113	213	276	191	639	684	769	379	479	962	179	732
3	110	184	269	326	686	661	736	364	2,030	613	170	638
4	105	156	262	734	679	638	711	352	11,300	1,030	162	573
5	103	168	261	3,780	726	614	691	343	13,700	768	151	524
6	101	154	309	2,970	1,020	589	2,320	337	13,300	678	998	476
7	117	142	336	1,470	2,330	575	2,950	332	9,470	589	991	439
8	117	133	309	1,030	2,790	550	1,820	325	4,020	523	308	414
9	119	128	292	915	2,000	538	1,270	327	7,810	484	207	392
10	118	135	282	2,140	1,360	532	1,070	332	8,610	454	171	367
11	119	172	268	1,680	1,450	511	974	322	12,300	426	151	340
12	123	205	258	1,080	1,540	490	919	305	18,300	406	147	319
13	119	196	248	935	2,780	474	858	11,000	25,600	470	178	328
14	116	174	236	767	3,330	455	808	13,600	23,000	391	222	313
15	114	156	228	703	2,620	441	768	9,530	15,600	365	259	464
16	111	147	225	e600	1,620	431	709	3,960	7,590	346	253	723
17	109	144	222	e570	1,240	423	643	2,400	3,000	327	192	888
18	109	144	222	e600	1,080	414	611	2,080	2,290	312	166	559
19	108	145	219	634	1,010	401	589	1,900	2,140	411	157	416
20	108	144	216	910	1,030	390	570	1,760	1,940	371	265	356
21	108	142	214	1,400	997	399	549	1,570	1,710	317	312	322
22	108	137	210	1,750	928	1,230	507	1,220	1,570	289	431	294
23	107	136	e205	1,300	878	4,460	468	1,110	1,470	267	371	271
24	108	230	e203	794	888	5,170	444	1,110	1,380	247	1,510	256
25	105	512	215	728	865	2,200	438	1,170	1,320	228	7,000	247
26	116	404	201	613	821	1,370	454	809	1,570	218	15,700	236
27	138	383	195	541	779	1,160	454	605	1,610	226	17,900	226
28	153	323	195	509	751	1,050	437	541	1,560	229	13,700	220
29	151	291	195	501	---	976	421	500	1,530	229	4,690	212
30	138	285	197	502	---	921	410	470	1,480	216	1,600	206
31	123	---	196	521	---	867	---	521	---	204	1,150	---
MEAN	116	200	240	1,012	1,336	978	839	1,934	6,608	454	2,254	422
MAX	153	512	336	3,780	3,330	5,170	2,950	13,600	25,600	1,480	17,900	894
MIN	101	120	195	191	568	390	410	305	479	204	147	206
AC-FT	7,160	11,910	14,770	62,260	74,190	60,160	49,950	118,900	393,200	27,920	138,600	25,080

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1964 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	695	741	447	377	673	1,140	1,327	1,454	1,964	922	456	476
MAX	6,370	8,861	2,389	1,727	2,948	7,548	5,588	8,608	9,568	7,881	2,254	2,654
(WY)	(1986)	(1999)	(1993)	(1974)	(1973)	(1973)	(1999)	(1993)	(1965)	(1993)	(2005)	(1965)
MIN	12.3	29.5	31.9	38.0	31.9	43.0	48.2	51.2	127	42.0	21.4	20.6
(WY)	(1992)	(1981)	(1992)	(1981)	(1967)	(1981)	(1989)	(1967)	(1980)	(1980)	(1991)	(1980)

07182250 COTTONWOOD RIVER NEAR PLYMOUTH, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1964 - 2005	
ANNUAL MEAN	1,086		1,359		888	
HIGHEST ANNUAL MEAN					2,701	1993
LOWEST ANNUAL MEAN					121	1991
HIGHEST DAILY MEAN	18,100	Mar 5	25,600	Jun 13	73,500	Nov 2, 1998
LOWEST DAILY MEAN	101	Oct 6	101	Oct 6	8.7	Oct 21, 1964
ANNUAL SEVEN-DAY MINIMUM	107	Oct 19	107	Oct 19	11	Oct 18, 1964
MAXIMUM PEAK FLOW			27,400	Jun 13	92,900	Nov 2, 1998
MAXIMUM PEAK STAGE			33.85	Jun 13	36.78	Nov 2, 1998
INSTANTANEOUS LOW FLOW			99	Oct 6	8.7	Oct 21, 1964
ANNUAL RUNOFF (AC-FT)	788,200		984,200		643,600	
10 PERCENT EXCEEDS	2,240		2,240		1,900	
50 PERCENT EXCEEDS	297		455		262	
90 PERCENT EXCEEDS	125		142		47	

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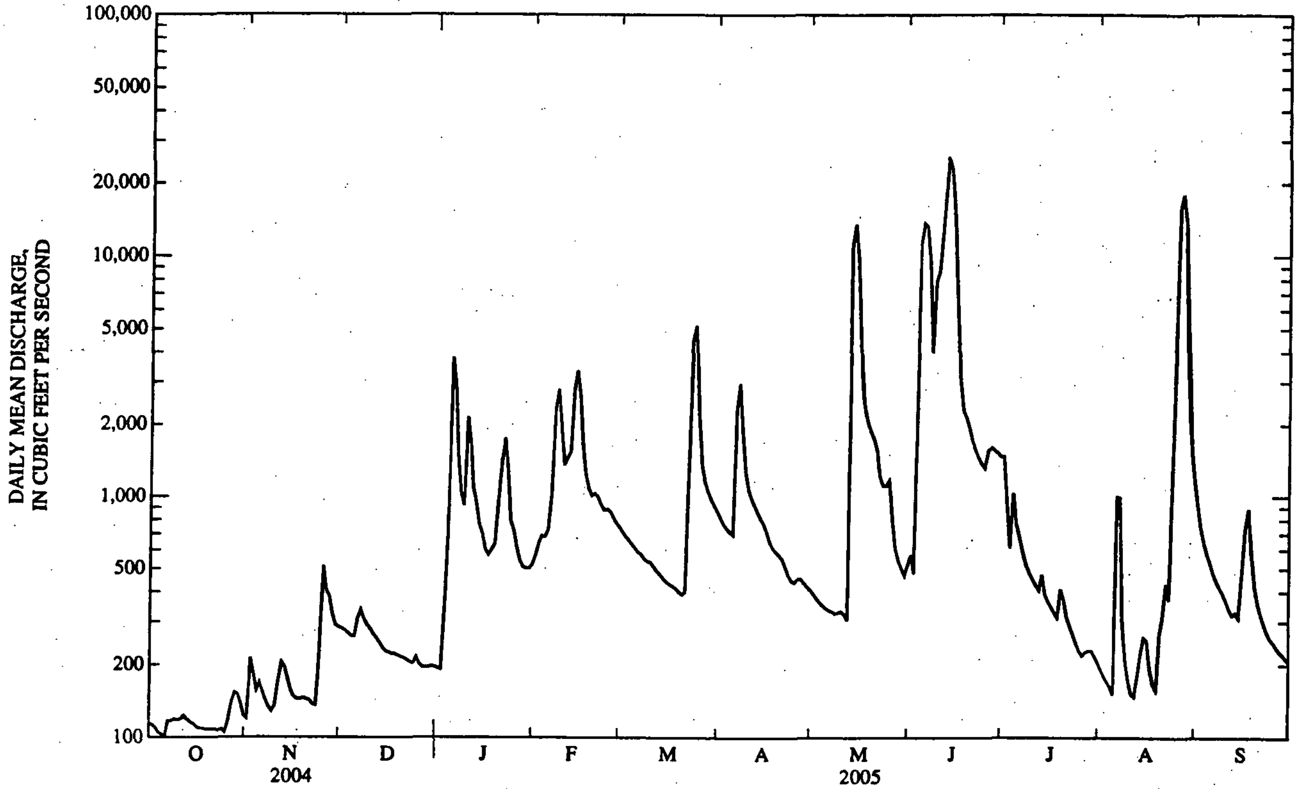


07182510 NEOSHO RIVER AT BURLINGTON, KS

LOCATION.--Lat 38°11'40", long 95°44'10", in SE 1/4 NW 1/4 sec.26, T.21 S., R.15 E., Coffey County, Hydrologic Unit 11070204, on right bank at upstream side of county highway bridge at Burlington, 0.3 mi upstream from Rock Creek, and at mile 338.4.

DRAINAGE AREA.--3,042 mi^2, includes that of Rock Creek.

PERIOD OF RECORD.--June 1961 to current year.

GAGE.--Water-stage recorder. Datum of gage is 983.56 ft above NGVD of 1929.

REMARKS.--Records good except those for estimated daily discharges, which are fair. Flow completely regulated since 1963 by John Redmond Reservoir (station 07182450), 5.3 mi upstream. Records include flow of Rock Creek. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	64	37	31	328	780	889	1,780	301	2,860	11,500	499	12,100
2	61	33	29	331	777	889	1,770	302	1,960	11,200	496	11,900
3	62	36	28	338	779	1,010	1,750	302	1,540	10,700	410	11,500
4	62	39	27	467	781	1,110	1,470	302	2,790	8,110	339	11,100
5	62	25	79	406	787	1,110	921	303	798	8,010	341	10,600
6	63	23	68	87	827	1,110	923	302	4,080	8,990	339	10,500
7	77	22	42	956	905	1,100	2,340	305	9,310	9,120	329	10,400
8	64	22	35	2,400	2,070	1,100	3,620	305	10,000	8,900	244	9,670
9	63	22	34	2,390	3,170	1,100	3,630	306	10,500	8,680	139	7,130
10	62	104	34	3,780	3,210	1,100	3,570	302	10,600	8,470	136	4,700
11	65	135	33	4,850	3,210	1,090	2,270	759	11,000	7,960	220	4,600
12	61	32	32	4,770	3,210	1,080	897	1,150	5,880	7,660	324	3,850
13	57	26	33	4,700	3,400	1,080	598	1,250	4,380	8,620	337	2,730
14	55	24	342	4,050	4,420	1,070	899	3,900	11,500	8,290	351	1,490
15	55	23	1,240	6,160	6,260	1,070	893	9,120	12,700	7,950	419	538
16	54	23	1,210	4,890	6,970	1,060	566	12,200	13,000	7,570	731	538
17	53	21	724	3,310	6,210	723	570	12,700	13,500	7,120	901	544
18	48	25	335	2,640	5,070	451	575	12,600	13,900	6,640	884	549
19	35	25	337	1,830	4,920	451	577	12,400	13,600	6,380	577	530
20	33	24	337	1,610	4,780	451	946	9,370	13,700	5,730	234	515
21	e33	24	336	1,610	4,610	274	1,220	8,940	13,400	4,240	231	512
22	33	24	338	1,610	4,450	50	1,220	8,590	12,400	3,700	351	517
23	30	26	322	1,640	2,610	44	1,200	8,220	12,200	3,590	682	377
24	29	187	338	1,870	867	168	1,200	4,980	12,300	3,480	977	240
25	29	148	333	2,770	865	1,350	1,190	3,150	12,300	3,330	1,730	239
26	37	37	332	3,060	869	2,040	1,190	4,680	12,100	3,240	325	239
27	38	31	331	2,970	875	2,040	1,170	4,750	11,900	2,620	1,440	240
28	46	28	331	1,710	886	2,940	840	4,610	11,800	2,070	6,380	242
29	33	34	331	767	---	3,600	465	4,470	11,600	1,150	10,100	137
30	31	34	328	768	---	3,500	303	4,320	11,400	505	12,400	31
31	31	---	329	773	---	2,800	---	3,460	---	504	12,500	---
MEAN	49.2	43.1	280	2,253	2,806	1,221	1,352	4,473	9,633	6,324	1,786	3,942
MAX	77	187	1,240	6,160	6,970	3,600	3,630	12,700	13,900	11,500	12,500	12,100
MIN	29	21	27	87	777	44	303	301	798	504	136	31
AC-FT	3,030	2,570	17,210	138,500	155,800	75,080	80,460	275,000	573,200	388,800	109,800	234,600

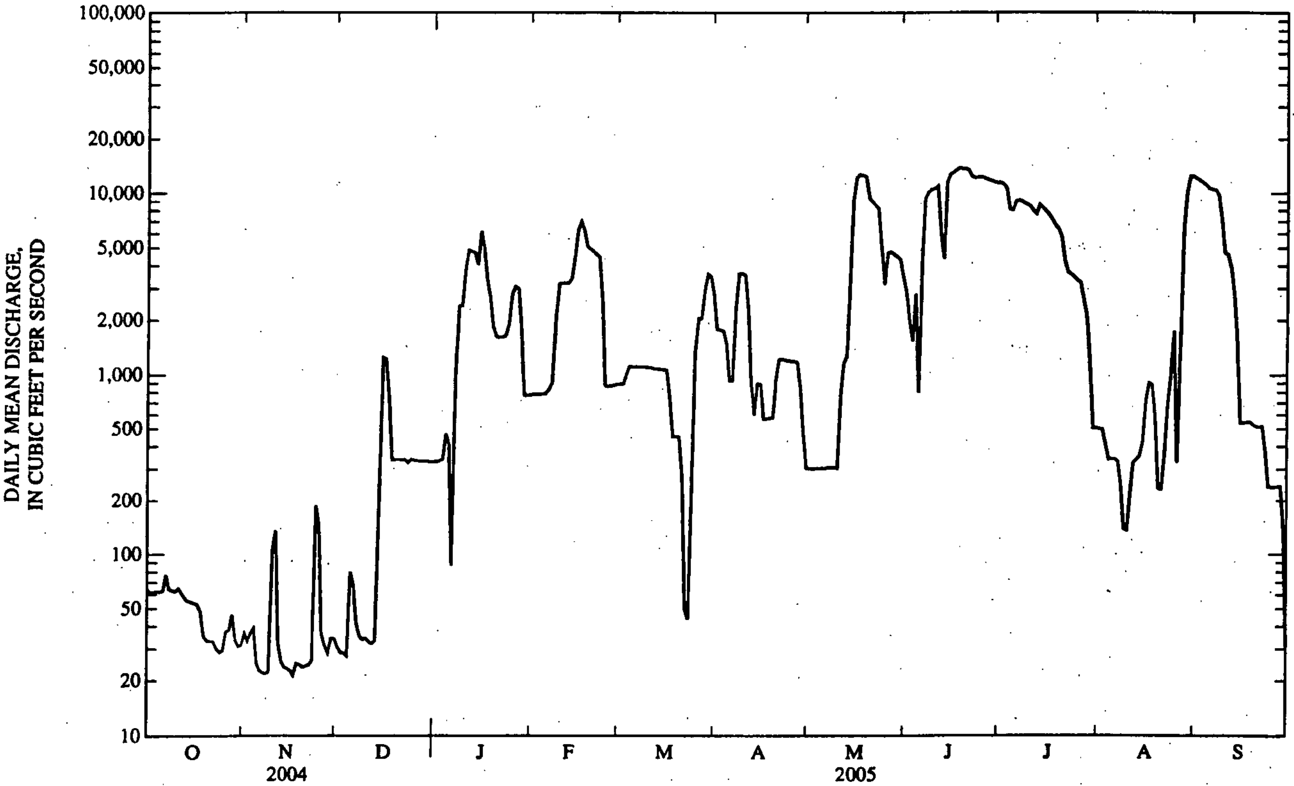
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1962 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	1,269	1,372	988	788	1,017	1,838	2,189	2,450	3,567	2,209	958	925
MAX	11,540	15,410	6,925	3,578	5,363	7,637	8,191	9,790	12,890	7,332	10,330	6,599
(WY)	(1974)	(1999)	(1993)	(1973)	(1973)	(1973)	(1984)	(1999)	(1995)	(1969)	(1993)	(1962)
MIN	22.4	12.0	12.4	17.7	17.1	13.8	21.5	44.5	162	66.0	44.3	30.8
(WY)	(1989)	(1991)	(1991)	(1989)	(1989)	(1981)	(1981)	(1989)	(1988)	(1966)	(2002)	(1963)

07182510 NEOSHO RIVER AT BURLINGTON, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1962 - 2005	
ANNUAL MEAN	2,032		2,837		1,631	
HIGHEST ANNUAL MEAN					4,982	1993
LOWEST ANNUAL MEAN					190	1991
HIGHEST DAILY MEAN	13,200	Mar 10	13,900	Jun 18	23,900	Sep 28, 1962
LOWEST DAILY MEAN	21	Nov 17	21	Nov 17	0.86	Nov 28, 1980
ANNUAL SEVEN-DAY MINIMUM	24	Nov 14	24	Nov 14	1.3	Sep 14, 1963
MAXIMUM PEAK FLOW			14,900	May 19	26,200	Sep 13, 1961
MAXIMUM PEAK STAGE			21.57	May 19	31.53	Sep 13, 1961
INSTANTANEOUS LOW FLOW			20	Nov 8	0.00	Nov 28, 1980
ANNUAL RUNOFF (AC-FT)	1,475,000		2,054,000		1,182,000	
10 PERCENT EXCEEDS	8,240		10,200		5,220	
50 PERCENT EXCEEDS	504		897		399	
90 PERCENT EXCEEDS	34		33		28	

e Estimated



07183000 NEOSHO RIVER NEAR IOLA, KS

LOCATION.--Lat 37°55'20", long 95°25'39", in NE 1/4 NE 1/4 NE 1/4 sec.33, T.24 S., R.18 E., Allen County, Hydrologic Unit 11070204, on right bank upstream side of State Highway 54 bridge, 1.0 mi west of State Street in Iola, and at mile 282.1.

DRAINAGE AREA.--3,723 mi^2.

PERIOD OF RECORD.--August 1895 to December 1903 (published as "at Iola"), October 1917 to current year. Monthly discharge only for some periods, published in WSP 1311. Figures of daily discharge for August 1895 to January 1898, published in previous reports, have been found to be unreliable and should not be used.

REVISED RECORDS.--WSP 1037: 1819-24, 1926-29, 1935(M). WSP 1117: Drainage area. WSP 1311: 1895-98. WSP 1391: 1896(M), 1899, 1901-02(M), 1903-04.

GAGE.--Water-stage recorder. Datum of gage is 928.92 ft above NGVD of 1929 (levels by U.S., Army Corps of Engineers). Prior to Oct. 1, 1917, nonrecording gage at tailgate of flume at mill dam, 4.8 mi upstream at datum 12.2 ft higher. Oct. 1, 1917 to May 9, 2005, at site 5.3 mi downstream at a datum 14.15 ft lower.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Considerable regulation since 1963 by John Redmond Reservoir (station 07182450), 54.0 mi upstream. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	65	465	995	379	939	1,030	2,560	322	3,150	12,700	562	12,500
2	64	928	603	379	1,040	1,000	1,920	305	2,960	12,700	552	12,200
3	63	878	429	399	979	982	1,880	300	1,670	10,500	543	11,800
4	61	2,450	342	1,080	914	1,120	1,830	297	15,800	14,400	453	11,300
5	59	1,310	781	12,500	881	1,180	1,390	296	25,500	12,900	364	10,800
6	60	487	4,520	5,900	913	1,170	940	296	6,990	9,150	360	10,400
7	95	278	2,790	1,560	2,240	1,160	921	295	8,740	9,130	361	10,500
8	120	188	1,350	2,000	2,630	1,140	2,960	304	10,200	8,930	351	10,200
9	100	145	706	3,100	3,260	1,140	3,570	e342	10,100	8,800	287	9,580
10	81	187	467	5,400	3,530	1,130	3,570	e342	10,500	8,670	167	5,810
11	104	5,040	356	6,210	3,500	1,120	3,510	e366	16,200	8,460	155	4,500
12	146	3,100	296	5,800	3,490	1,110	1,830	e889	28,500	7,500	211	4,170
13	108	904	254	6,960	5,170	1,090	879	e2,620	33,000	8,530	515	2,810
14	86	435	216	4,720	6,130	1,070	620	e5,000	30,200	8,630	1,370	2,210
15	85	296	378	5,410	5,730	1,060	926	e9,590	17,800	8,330	1,090	1,010
16	81	232	1,200	6,390	6,770	1,060	842	e12,500	14,700	7,860	642	544
17	77	195	1,210	4,630	6,770	1,050	567	13,000	13,900	7,430	858	492
18	77	193	755	3,580	5,600	715	552	13,600	13,900	6,970	940	502
19	75	236	427	2,650	5,000	485	551	20,900	13,900	6,690	911	493
20	71	254	406	2,000	4,890	471	559	19,200	13,500	7,050	594	477
21	62	219	403	1,950	4,760	474	953	9,950	13,700	5,340	271	476
22	58	194	391	1,950	4,530	486	1,180	9,100	12,700	4,250	242	475
23	59	244	347	1,830	4,280	1,050	1,180	8,730	11,700	3,710	412	467
24	52	8,130	364	1,820	2,330	699	1,170	8,170	11,400	3,560	956	351
25	50	5,700	421	2,260	1,370	460	1,170	3,200	11,600	3,430	9,960	220
26	68	1,970	381	3,170	1,180	1,770	1,170	4,200	11,500	3,300	23,800	209
27	212	3,600	364	3,220	1,100	2,290	1,150	4,780	11,300	3,190	8,970	206
28	569	1,670	370	3,130	1,060	2,290	1,130	4,680	11,100	2,250	4,540	205
29	863	1,230	373	1,470	---	3,470	782	4,460	10,800	1,980	8,850	203
30	325	1,680	382	873	---	3,650	481	4,300	10,500	939	11,300	159
31	164	---	380	885	---	3,570	---	4,120	---	582	12,600	---
MEAN	134	1,428	731	3,342	3,250	1,306	1,425	5,369	13,580	7,028	3,006	4,176
MAX	863	8,130	4,520	12,500	6,770	3,650	3,570	20,900	33,000	14,400	23,800	12,500
MIN	50	145	216	379	881	460	481	295	1,670	582	155	159
AC-FT	8,250	84,970	44,940	205,500	180,500	80,320	84,780	330,200	808,300	432,100	184,800	248,500

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1899 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	1,497	1,433	985	828	1,044	1,985	2,849	3,031	3,776	2,642	1,153	1,376
MAX	15,890	18,520	9,116	4,773	6,994	11,010	19,580	14,270	15,390	43,540	10,700	11,140
(WY)	(1942)	(1999)	(1993)	(1993)	(1949)	(1973)	(1944)	(1938)	(1995)	(1951)	(1993)	(1951)
MIN	0.21	0.52	1.39	1.33	3.24	11.4	19.8	82.3	126	10.8	1.10	0.64
(WY)	(1957)	(1957)	(1957)	(1957)	(1957)	(1956)	(1981)	(1967)	(1933)	(1954)	(1936)	(1956)

07183000 NEOSHO RIVER NEAR IOLA, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1899 - 2005	
ANNUAL MEAN	2,467		3,720		1,884	
HIGHEST ANNUAL MEAN					6,635	1951
LOWEST ANNUAL MEAN					141	1956
HIGHEST DAILY MEAN	27,500	Mar 5	33,000	Jun 13	344,000	Jul 13, 1951
LOWEST DAILY MEAN	50	Oct 25	50	Oct 25	0.00	Aug 19, 1936
ANNUAL SEVEN-DAY MINIMUM	60	Oct 20	60	Oct 20	0.00	Aug 19, 1936
MAXIMUM PEAK FLOW			34,400	Jun 13	436,000	Jul 13, 1951
MAXIMUM PEAK STAGE			18.56	Jun 13	43.00	Jul 13, 1951
INSTANTANEOUS LOW FLOW			47	Oct 25	0.00	at times
ANNUAL RUNOFF (AC-FT)	1,791,000		2,693,000		1,365,000	
10 PERCENT EXCEEDS	8,380		11,200		5,340	
50 PERCENT EXCEEDS	784		1,170		406	
90 PERCENT EXCEEDS	95		200		35	

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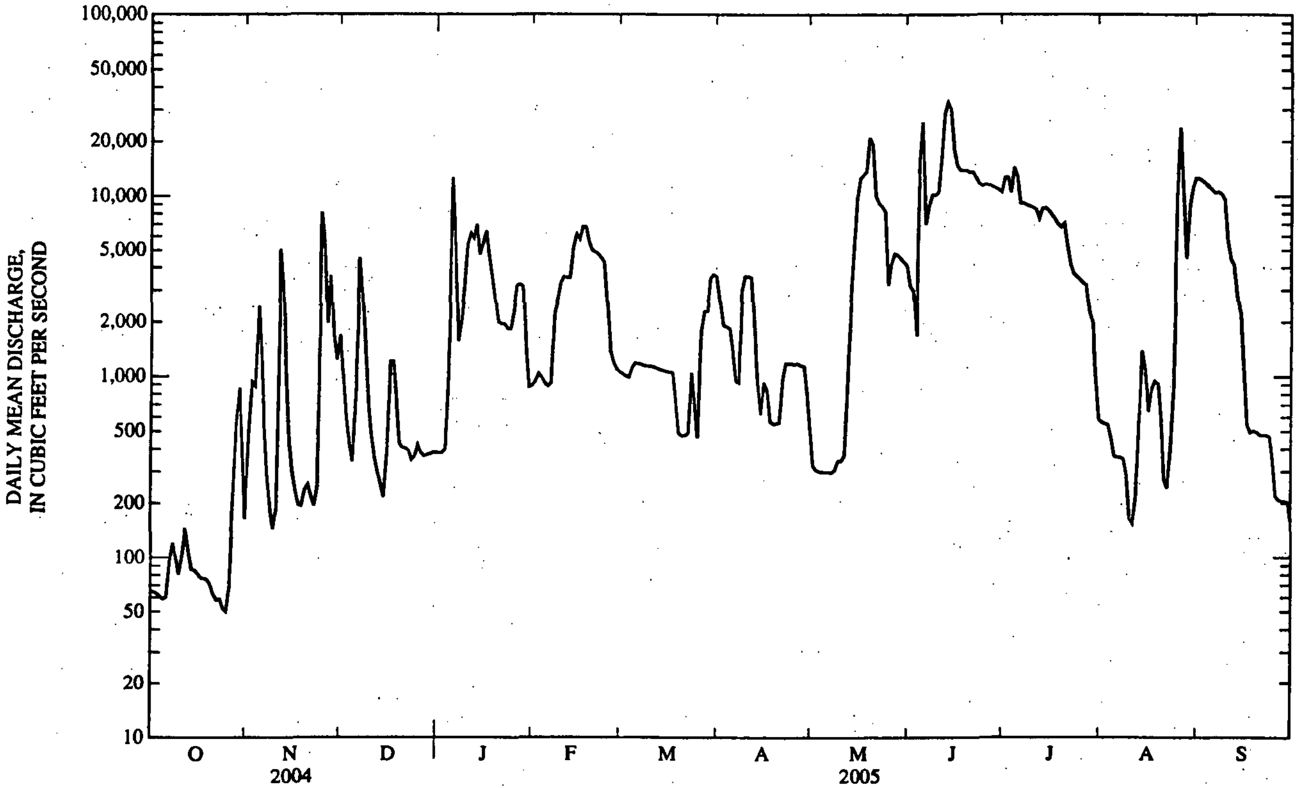


07183500 NEOSHO RIVER NEAR PARSONS, KS

LOCATION.--Lat 37°20'24", long 95°06'35", in NE 1/4 NW 1/4 NE 1/4 sec.21, T.31 S., R.21 E., Labette County, Hydrologic Unit 11070205, on right bank at downstream side of bridge on U.S. Highway 160, 0.4 mi upstream from Hickory Creek, 2.7 mi upstream from dam of Kansas Army Ammunition Plant, 8.0 mi east of Parsons, and at mile 204.1.

DRAINAGE AREA.--4,905 mi^2.

PERIOD OF RECORD.--October 1921 to current year. Monthly discharge only October 1921, published in WSP 1311.

REVISED RECORDS.--WSP 807: 1922-23. WSP 1391: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 810.25 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to Oct. 1, 1929, nonrecording gage at bridge 0.5 mi downstream at datum 0.04 ft lower. Oct. 1, 1929, to Feb. 7, 1935, nonrecording gage, and Feb. 8, 1935, to Dec. 7, 1966, water-stage recorder at present site and datum. Dec. 8, 1966, to June 8, 1987, water-stage recorder 2.7 mi downstream at present datum.

REMARKS.--Records good. Flow moderately regulated since 1963 by John Redmond Reservoir (station 07182450), 139.6 mi upstream. Small diversion by the Kansas Army Ammunition Plant. Records include flow of Hickory Creek. Satellite telemeter at station.

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

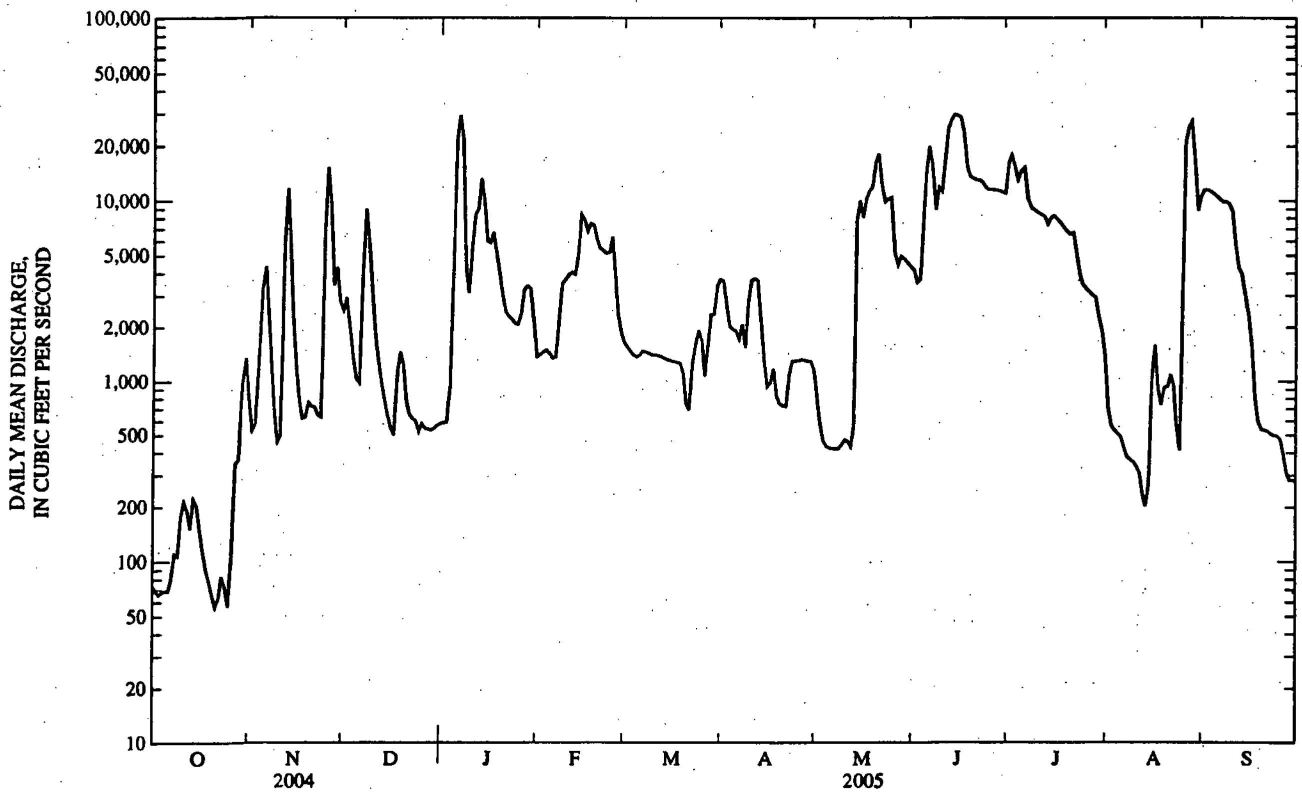
DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	73	530	2,930	587	1,410	1,550	3,630	800	4,180	16,000	713	11,500
2	69	573	1,950	589	1,450	1,470	2,700	574	3,560	17,800	562	11,500
3	65	1,620	1,370	944	1,500	1,410	2,020	461	3,690	15,500	530	11,200
4	68	3,310	1,030	2,980	1,440	1,370	1,940	434	7,380	13,000	510	10,900
5	69	4,320	977	21,400	1,350	1,400	1,910	425	14,400	14,500	490	10,600
6	68	2,250	4,070	29,200	1,370	1,480	1,720	422	19,900	15,200	427	10,200
7	81	1,120	8,970	22,000	2,320	1,460	2,060	420	15,400	10,200	380	9,830
8	110	657	5,740	4,260	3,500	1,430	1,550	420	8,980	9,130	366	9,880
9	107	457	2,970	3,120	3,700	1,410	2,760	442	11,900	8,840	355	9,570
10	177	492	1,760	5,520	3,910	1,410	3,650	472	11,300	8,570	336	8,740
11	213	5,930	1,270	8,390	4,050	1,390	3,740	463	16,200	8,380	309	5,650
12	192	11,600	965	9,010	3,940	1,370	3,660	431	24,700	8,170	236	4,290
13	152	5,190	791	13,200	5,010	1,350	2,270	553	27,700	7,410	202	3,960
14	220	1,970	647	10,000	8,400	1,320	1,350	7,760	29,600	8,000	268	3,040
15	203	1,150	548	5,970	7,860	1,300	931	10,000	29,300	8,240	1,060	2,350
16	148	787	500	5,870	6,800	1,290	978	8,090	28,600	7,890	1,590	1,550
17	113	619	1,140	6,680	7,470	1,280	1,180	10,200	23,700	7,550	895	813
18	92	628	1,450	5,100	7,340	1,270	836	11,300	15,500	7,170	740	594
19	78	759	1,240	3,960	6,130	1,100	749	11,900	13,500	6,790	924	539
20	65	723	787	3,070	5,480	759	729	16,000	13,300	6,550	934	533
21	56	716	653	2,450	5,340	693	726	18,100	13,000	6,660	1,090	524
22	62	648	620	2,310	5,130	1,250	1,100	12,400	13,000	5,080	935	508
23	83	631	597	2,230	5,190	1,620	1,300	9,860	12,500	3,980	550	499
24	73	7,000	519	2,100	6,310	1,920	1,300	10,200	11,700	3,470	413	496
25	57	15,200	579	2,070	3,890	1,680	1,310	10,400	11,500	3,310	4,370	473
26	105	9,330	544	2,370	2,350	1,070	1,330	5,180	11,500	3,160	21,000	390
27	345	3,430	537	3,250	1,870	1,640	1,310	4,430	11,500	3,030	25,400	312
28	363	4,310	533	3,400	1,650	2,340	1,300	4,950	11,300	2,920	27,300	282
29	982	2,770	546	3,270	---	2,360	1,290	4,800	11,100	2,280	16,800	283
30	1,350	2,480	566	2,050	---	3,410	1,150	4,570	11,000	1,910	8,870	275
31	788	---	578	1,380	---	3,700	---	4,360	---	1,360	10,600	---
MEAN	214	3,040	1,528	6,088	4,149	1,565	1,749	5,510	14,700	7,808	4,166	4,376
MAX	1,350	15,200	8,970	29,200	8,400	3,700	3,740	18,100	29,600	17,800	27,300	11,500
MIN	56	457	500	587	1,350	693	726	420	3,560	1,360	202	275
AC-FT	13,140	180,900	93,970	374,300	230,400	96,200	104,100	338,800	874,500	480,100	256,200	260,400

STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1922 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	2,232	2,238	1,457	1,312	1,705	2,998	4,246	4,429	5,315	3,667	1,391	1,939
MAX	25,520	20,340	12,760	7,762	9,492	18,100	25,520	22,110	20,610	52,780	11,140	15,030
(WY)	(1987)	(1999)	(1993)	(1973)	(1949)	(1973)	(1927)	(1961)	(1995)	(1951)	(1993)	(1951)
MIN	0.00	0.00	0.00	0.00	0.00	8.10	18.6	282	210	10.8	0.00	0.90
(WY)	(1957)	(1957)	(1957)	(1957)	(1957)	(1957)	(1981)	(1967)	(1980)	(1954)	(1936)	(1956)

07183500 NEOSHO RIVER NEAR PARSONS, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1922 - 2005	
ANNUAL MEAN	3,498		4,562		2,744	
HIGHEST ANNUAL MEAN					8,611	1993
LOWEST ANNUAL MEAN					173	1953
HIGHEST DAILY MEAN	29,400	Mar 7	29,600	Jun 14	366,000	Jul 14, 1951
LOWEST DAILY MEAN	56	Oct 21	56	Oct 21	0.00	Aug 26, 1934
ANNUAL SEVEN-DAY MINIMUM	68	Oct 19	68	Oct 19	0.00	Aug 26, 1934
MAXIMUM PEAK FLOW			30,200	Jan 6	410,000	Jul 14, 1951
MAXIMUM PEAK STAGE			25.55	Jan 6	40.20	Jul 14, 1951
INSTANTANEOUS LOW FLOW			53	Oct 21	0.00	at times
ANNUAL RUNOFF (AC-FT)	2,539,000		3,303,000		1,988,000	
10 PERCENT EXCEEDS	10,400		11,800		8,120	
50 PERCENT EXCEEDS	1,340		1,910		600	
90 PERCENT EXCEEDS	191		351		42	



07184000 LIGHTNING CREEK NEAR MCCUNE, KS

LOCATION.--Lat 37°16'52", long 95°01'57", in NE 1/4 NE 1/4 sec.7, T.32 S., R.22 E., Cherokee County, Hydrologic Unit 11070205, on right bank at downstream side of county highway bridge, 5.0 mi south of McCune, 13.0 mi southeast of Parsons, and at mile 12.6.

DRAINAGE AREA.--197 mi^2.

PERIOD OF RECORD.--October 1938 to September 1946, October 1959 to current year.

REVISED RECORDS.--WDR KS-86-1: 1993. WDR KS-87-1: 1993.

GAGE.--Water-stage recorder. Datum of gage is 818.10 ft above NGVD of 1929 (levels by U.S. Army Corps of Engineers). Prior to Mar. 10, 1945, nonrecording gage and Mar. 10, 1945, to Sept. 30, 1946, water-stage recorder at present site and datum. Oct. 1, 1959, to May 26, 1960, water-stage recorder 100 ft downstream at present datum. Satellite telemeter at station.

REMARKS.--Records good except those for estimated daily discharges, which are poor. Satellite telemeter at station.

PEAK DISCHARGES FOR CURRENT YEAR.--Peak discharges greater than base discharge of 1,800 ft^3/s and maximum (*):

Date	Time	Discharge (ft^3/s)	Gage height (ft)	Date	Time	Discharge (ft^3/s)	Gage height (ft)
Nov 12	0315	2,140	11.19	Jun 12	0600	1,870	10.31
Nov 25	0200	2,100	11.07	Jun 14	0200	2,620	12.66
Jan 6	0300	*7,280	*16.43	Jul 1	1800	1,890	10.37
Jan 14	0100	3,090	13.98	Jul 20	0100	2,110	11.08
May 14	2100	1,800	10.07				

DISCHARGE, CUBIC FEET PER SECOND
WATER YEAR OCTOBER 2004 TO SEPTEMBER 2005
DAILY MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	0.00	16	190	13	43	54	25	24	4.4	1,410	e2.8	0.30
2	0.00	15	105	14	40	44	28	26	12	804	e2.4	0.26
3	0.00	57	65	17	36	37	25	16	13	128	e2.0	0.23
4	0.00	237	46	467	31	32	20	12	387	386	e1.7	0.20
5	0.00	172	70	3,980	28	29	17	9.1	166	488	e1.5	0.17
6	0.00	48	831	5,960	37	26	28	7.5	327	130	e1.2	0.13
7	0.00	22	1,350	1,480	265	24	512	6.4	357	58	e0.89	0.10
8	0.00	13	635	247	265	22	313	5.7	69	33	e0.68	0.07
9	0.00	7.3	187	218	215	21	125	5.2	786	22	e0.58	0.06
10	0.00	8.8	105	361	177	18	75	4.6	617	15	e0.47	0.03
11	0.00	1,210	68	285	115	17	97	4.6	573	12	e0.53	0.02
12	0.00	1,660	50	581	90	15	62	4.1	1,550	8.7	e0.62	0.02
13	0.00	252	38	2,710	708	14	51	4.0	1,950	6.5	e0.63	0.01
14	0.00	77	30	1,880	712	13	36	888	1,900	4.8	e0.80	0.07
15	0.00	39	25	240	219	12	26	859	279	3.7	e5.6	0.22
16	0.00	26	22	127	127	12	21	134	136	3.0	e38	0.17
17	0.00	19	20	112	86	10	17	64	96	2.6	e18	0.15
18	0.00	21	18	84	62	9.5	14	36	64	2.8	4.6	0.52
19	0.00	34	17	68	51	8.8	12	23	41	830	2.9	0.64
20	0.00	28	16	66	46	8.4	12	19	29	1,360	2.0	0.51
21	0.00	31	14	67	49	9.2	11	13	21	e203	1.4	0.35
22	0.00	42	13	65	48	114	45	8.8	17	e108	1.2	0.27
23	0.00	68	10	51	79	387	72	7.3	13	e66	1.1	0.22
24	0.00	1,190	9.0	40	450	138	26	141	11	e42	0.89	0.14
25	0.00	1,510	7.7	34	220	238	14	228	8.4	e28	0.75	0.09
26	0.01	261	9.0	34	123	176	13	80	6.4	e19	0.63	0.04
27	0.02	151	8.9	32	86	99	13	30	5.2	e13	0.52	0.05
28	2.0	338	9.3	31	65	65	13	16	4.2	e8.4	0.47	0.05
29	220	278	10	31	—	48	13	11	3.3	e5.8	0.41	0.04
30	76	494	11	32	—	36	13	7.6	2.7	e4.3	0.31	0.03
31	25	—	11	39	—	28	—	5.2	—	e3.2	0.27	—
MEAN	10.4	278	129	625	160	56.9	58.3	87.1	315	200	3.09	0.17
MAX	220	1,660	1,350	5,960	712	387	512	888	1,950	1,410	38	0.64
MIN	0.00	7.3	7.7	13	28	8.4	11	4.0	2.7	2.6	0.27	0.01
AC-FT	641	16,510	7,940	38,410	8,870	3,500	3,470	5,360	18,740	12,320	190	10

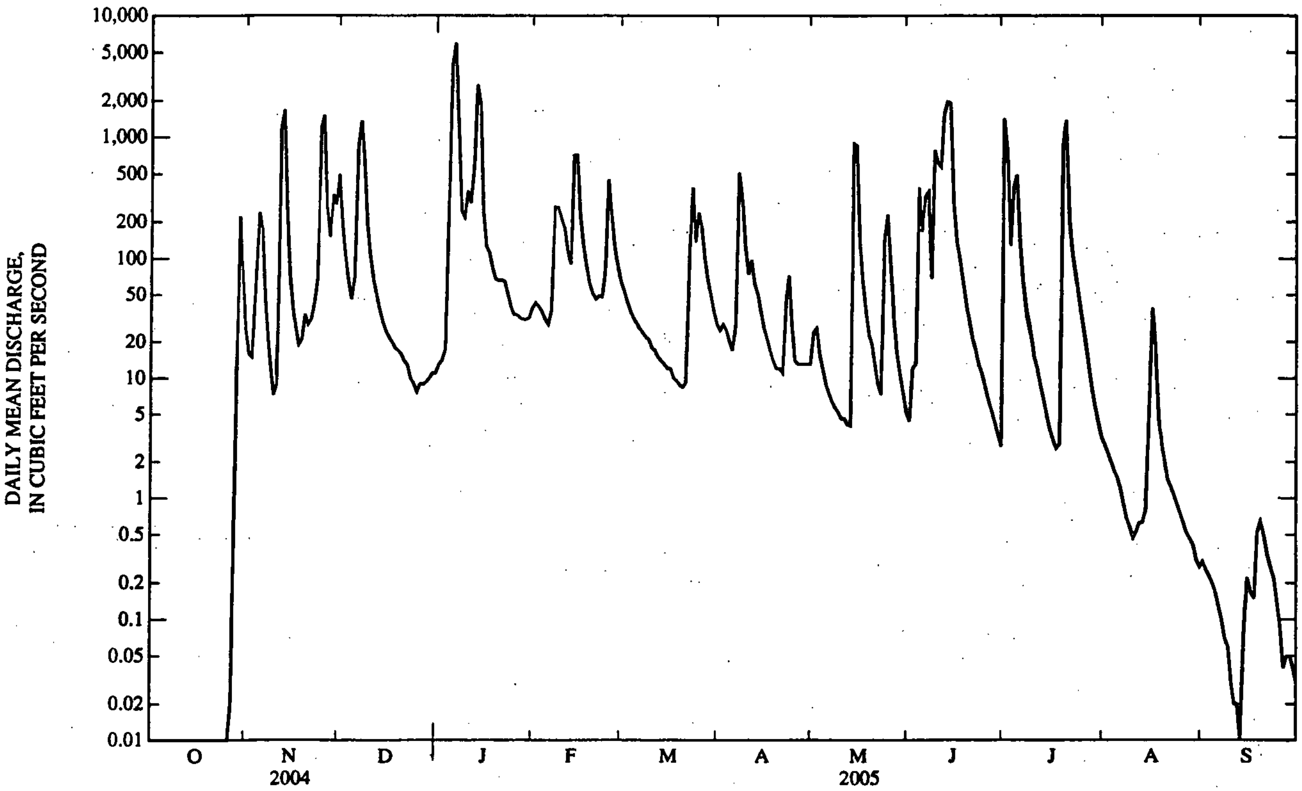
STATISTICS OF MONTHLY MEAN DATA FOR WATER YEARS 1939 - 2005, BY WATER YEAR (WY)

	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
MEAN	175	171	116	109	131	204	250	285	281	93.8	38.4	142
MAX	2,924	907	751	625	1,033	1,091	1,700	2,227	1,612	1,418	488	2,102
(WY)	(1987)	(1975)	(1993)	(2005)	(1985)	(1973)	(1994)	(1943)	(1995)	(1992)	(1985)	(1993)
MIN	0.00	0.00	0.00	0.00	0.00	0.00	0.18	7.58	0.55	0.00	0.00	0.00
(WY)	(1939)	(1939)	(1939)	(1939)	(1939)	(1964)	(1981)	(1988)	(1980)	(1991)	(1946)	(1946)

07184000 LIGHTNING CREEK NEAR MCCUNE, KS—Continued

SUMMARY STATISTICS	FOR 2004 CALENDAR YEAR		FOR 2005 WATER YEAR		WATER YEARS 1939 - 2005	
ANNUAL MEAN	189		160		166	
HIGHEST ANNUAL MEAN					498	1993
LOWEST ANNUAL MEAN					18.0	1940
HIGHEST DAILY MEAN	13,600	Mar 5	5,960	Jan 6	42,400	Sep 25, 1993
LOWEST DAILY MEAN	0.00	Sep 20	0.00	Oct 1	0.00	Oct 1, 1938
ANNUAL SEVEN-DAY MINIMUM	0.00	Sep 20	0.00	Oct 1	0.00	Oct 1, 1938
MAXIMUM PEAK FLOW			7,280	Jan 6	67,500	Sep 25, 1993
MAXIMUM PEAK STAGE			16.43	Jan 6	19.79	Sep 25, 1993
INSTANTANEOUS LOW FLOW			0.00	Oct 1	0.00	most years
ANNUAL RUNOFF (AC-FT)	137,500		116,000		120,400	
10 PERCENT EXCEEDS	240		359		258	
50 PERCENT EXCEEDS	24		20		12	
90 PERCENT EXCEEDS	0.01		0.06		0.00	

e Estimated



23. A statement is made in the 5th paragraph of Enclosure 2 to WM 06-0046 (November 17, 2006) that the state of Kansas has not required entrainment monitoring and will not require it for the 316(b) determination. Please provide documentation from KDHE regarding this issue.

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

• Current and historic flow records for the Neosho River.

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• If available, information on the location of the spawning areas for the various fish species in CCL.

• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

• Possible cold shock impacts to gizzard shad is mentioned in Section 2.2 of the ER (WCGS, 1990). If there have been any incidents of cold shock to gizzard shad or other fish, please provide supporting data.

• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

Bell Lorrie I

Subject: FW: 316(b) CWSH Entrainment Exempt Letter

-----Original Message-----
From: Logsdon Ralph L
Sent: Tuesday, February 27, 2007 10:59 AM
To: Hammond Robert A; Haines Daniel E
Subject: 316(b) CWSH Entrainment Exempt Letter

Talked to Eric today. Discussed the NY 2nd court ruling. Eric agrees with me that the ruling did not affect the exemption. Will consult with Don Carlson and gives us a reply to our request. Should be favorable. Ralph

Ralph L. Logsdon (CC-EM)
Senior Environmental Biologist
Wolf Creek Generating Station
PO Box 411
Burlington, KS 66839
Telephone: (620) 363-8831, ext. 4730
Fax: (620) 364-4154

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WOLF CREEK
NUCLEAR OPERATING CORPORATION

Kevin J. Moles
Manager Regulatory Affairs

JAN 24 2007

RA 07-0010

Kansas Department of Health and Environment
Bureau of Water – Industrial Programs
1000 SW Jackson St., Suite 420
Topeka, Kansas 66612-1367

Attention: Mr. Eric Staab

Reference: 69FR41576 "Final Regulations to Establish Requirements for Cooling Water Intake Structures at Phase II Existing Facilities; dated July 9, 2004

Subject: Entrainment Study Exemption Request.

Dear Mr. Staab:

Based on a conversation with Ralph Logsdon on January 23, 2007, Wolf Creek Nuclear Operating Corporation (WCNOC) requests a letter confirming Kansas Department of Health and Environment's (KDHE) position on exempting Wolf Creek Generating Station cooling water intake structure from an entrainment study.

Under the final rule, Environmental Protection Agency has established performance standards for the reduction of impingement mortality and, when appropriate, entrainment. The type of performance standard to a particular facility is based on several factors, including the facility's location (i.e., source waterbody). Exhibit V-1, Performance Standards Requirement, summarizes the performance standards based on waterbody type. For lakes and reservoirs Exhibit V-1 only requires an impingement mortality study to be performed.

WCNOC understands that Environmental Protection Agency final rule referenced above does not require an entrainment study on lake and reservoirs and, therefore exempt from that portion of 316(b) performance standards. WCNOC is requesting written confirmation of this position stated in the reference. If you have any questions regarding this request, please contact Mr. Ralph Logsdon at (620) 364-8831, extension 4730.

Sincerely,

Kevin J. Moles

Kevin J. Moles

KJM/rll

exploited, overfished or collapsed.[38] Another estimated that large predatory fish stocks are only a tenth of what they were 50 years ago.[39] Most studies of fish populations last only a few years, do not encompass the entire life span of the species examined, and do not account for cyclical environmental changes such as ENSO events, and other long term cycles of oceanographic productivity.[40]

Although a clear and detailed picture of the status of all our fishery resources does not exist,[41] it is undisputed that fishermen are struggling to sustain their livelihood despite strict fishery management restrictions which aim to rebuild fish populations. EPA shares the concerns expressed by expert fishery scientists that historical overfishing has increased the sensitivity of aquatic ecosystems to subsequent disturbance, making them more vulnerable to other stressors, including cooling water intake structures.

In conclusion, EPA's mission includes ensuring the sustainability of communities and ecosystems. Thus, EPA must comprehensively evaluate all potential threats to resources and work towards eliminating or reducing identified threats. As discussed in this section, EPA believes that impingement and entrainment losses attributable to cooling water intakes do pose a threat to aquatic organisms and through today's rule is seeking to minimize that threat.

V. Description of the Final Rule

Clean Water Act section 316(b) requires that any standard established pursuant to section 301 or section 306 of the CWA and applicable to a point source shall require that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impact. Today's final rule establishes national performance requirements for Phase II existing facilities that ensure such facilities fulfill the mandate of section 316(b).

This rule applies to Phase II existing facilities that use or propose to use a cooling water intake structure to withdraw water for cooling purposes from waters of the United States and that have or are required to have a National Pollutant Discharge Elimination System (NPDES) permit issued under section 402 of the CWA. Phase II existing facilities include only those facilities whose primary activity is to generate and transmit electric power and who have a design intake flow of 50 MGD or greater, and that use at least 25 percent of the water withdrawn exclusively for cooling purposes (see § 125.91). Applicability criteria for this rule are discussed in detail in section II of this preamble.

Under this final rule, EPA has established performance standards for the reduction of impingement mortality and, when appropriate, entrainment (see § 125.94). The performance standards consist of ranges of reductions in impingement mortality and/or entrainment (*e.g.*, reduce impingement mortality by 80 to 95 percent and/or entrainment by 60 to 90 percent). These performance standards reflect the best technology available for minimizing adverse environmental impacts determined on a national categorical basis. The type of performance standard applicable to a particular facility (*i.e.*, reductions in impingement only or impingement and entrainment) is based on several factors, including the facility's location (*i.e.*, source waterbody), rate of use (capacity utilization rate), and the proportion of the waterbody withdrawn. Exhibit V–1 summarizes the performance standards based on waterbody type.

In most cases, EPA believes that these performance standards can be met using design and construction technologies or operational measures. However, under the rule, the performance standards also can be met, in whole or in part, by using restoration measures, following consideration of design and construction technologies or operational measures and provided such measures meet restoration requirements (see § 125.94(c)).

As noted earlier in this section, today's rule generally requires that impingement mortality of all life stages of fish and shellfish must be reduced by 80 to 95 percent from the calculation baseline; and for some facilities, entrainment of all life stages of fish and shellfish must be reduced by 60 to 90 percent from the calculation baseline (see § 125.94(b)).

EXHIBIT V–1.—PERFORMANCE STANDARD REQUIREMENTS

Waterbody type	Capacity utilization rate	Design intake flow	Type of performance standard
Freshwater River or Stream	Less than 15%	N/A [1]	Impingement mortality only.
	Equal to or greater than 15%.	5% or less mean annual flow.	Impingement mortality only.
		Greater than 5% of mean annual flow.	Impingement mortality and entrainment.
Tidal river, Estuary or Ocean	Less than 15%	N/A [1]	Impingement mortality only.
	Equal to or greater than 15%.	N/A	Impingement mortality and entrainment.
Great Lakes	Less than 15%	N/A	Impingement mortality only.
	Equal to or greater than 15%.	N/A	Impingement mortality and entrainment.

[38] Broad, W.J. and A.C. Revkin. 2003. Has the Sea Given Up its Bounty? The New York Times. July 29, 2003.

[39] Myers, R.A. and B. Worm. 2003. Rapid worldwide depletion of predatory fish communities. Nature 423: 280–283.

[40] Jackson, J.B.C., M.X. Kirby, W.H. Berger, K.A. Bjorndal, L.W. Botsford, B.J. Bourque, R.H. Bradbury, R. Cooke, J. Erlandson, J.A. Estes, T.P. Hughes, S. Kidwell, C.B. Lange, H.S. Lenihan, J.M. Pandolfi, C.H. Peterson, R.S. Steneck, M.J. Tegner, and R.R. Warner. 2001. Historical overfishing and the recent collapse of coastal ecosystems. Science 293(5530):629–638.

[41] National Marine Fisheries Service (NMFS). 2002. Annual Report to Congress on the Status of U.S. Fisheries—2001. U.S. Dep. Commerce, NOAA, Natl. Mar. Fish. Serv., Silver Spring, MD, 142 pp.

EXHIBIT V–1.—PERFORMANCE STANDARD REQUIREMENTS—Continued

Waterbody type	Capacity utilization rate	Design intake flow	Type of performance standard
Lakes or Reservoirs	N/A	Increase in design intake flow must not disrupt thermal stratification except where it does not adversely affect the management of fisheries.	Impingement mortality only.[1]

[1] Determination of appropriate compliance reductions is not applicable.

This final rule identifies five alternatives a Phase II existing facility may use to achieve compliance with the requirements for best technology available for minimizing adverse environmental impacts associated with cooling water intake structures. Four of these are based on meeting the applicable performance standards and the fifth allows the facility to request a site-specific determination of best technology available for minimizing adverse environmental impacts under certain circumstances. EPA has established these compliance alternatives for meeting the performance standards to provide a significant degree of flexibility to Phase II existing facilities, to ensure that the rule requirements are economically practicable, and to provide the ability for Phase II existing facilities to address unique site-specific factors. Application requirements vary based on the compliance alternative selected and, for some facilities, include development of a Comprehensive Demonstration Study. Application requirements are discussed later in this section. The five compliance alternatives are described in the following paragraphs.

Under § 125.94(a)(1)(i) and (ii), a Phase II existing facility may demonstrate to the Director that it has already reduced its flow commensurate with a closed-cycle recirculating system, or that it has already reduced its design intake velocity to 0.5 ft/s or less. If a facility can demonstrate to the Director that it has reduced, or will reduce, flow commensurate with a closed-cycle recirculating system, the facility is deemed to have met the performance standards to reduce impingement mortality and entrainment (see § 125.94 (a)(1)(i)). Those facilities would not be required to submit a Comprehensive Demonstration Study with their NPDES application. If the facility can demonstrate to the Director that is has reduced, or will reduce maximum through-screen design intake velocity to 0.5 ft/s or less, the facility is deemed to have met the performance standards to reduce impingement mortality only. Facilities that meet the velocity requirements would only need to submit application studies related to determining entrainment reduction, if subject to the performance standards for entrainment.

Under § 125.94(a)(2) and (3), a Phase II existing facility may demonstrate to the Director, either that its current cooling water intake structure configuration meets the applicable performance standards, or that it has selected design and construction technologies, operational measures, and/or restoration measures that, in combination with any existing design and construction technologies, operational measures, and/or restoration measures, meet the specified performance standards in § 125.94(b) and/or the requirements in § 125.94(c).

Under § 125.94(a)(4), a Phase II existing facility may demonstrate to the Director that it has installed and is properly operating and maintaining a rule-specified and approved design and construction technology in accordance with § 125.99(a). Submerged cylindrical wedgewire screen technology is a rule-specified design and construction technology that may be used in instances in which a facility's cooling water intake structure is located in a freshwater river or stream and meets other criteria specified at § 125.99(a).

In addition, under this compliance alternative, a facility or other interested person may submit a request to the Director for approval of a different technology. If the Director approves the technology, it may be used by all facilities with similar site conditions under his or her jurisdiction if allowed under the State's administrative procedures. Requests for approval of a technology must be submitted to the Director and include a detailed description of the technology; a list of design criteria for the technology and site characteristics and conditions that each facility must possess in order to ensure that the technology can consistently meet the appropriate impingement mortality and entrainment performance standards in § 125.94(b); and information and data sufficient to demonstrate that all facilities under the jurisdiction of the Director can meet the relevant impingement mortality and entrainment performance standards in § 125.94(b) if the applicable design criteria and site characteristics and conditions are present at the facility. A Director may only approve an alternative technology following public notice and opportunity for comment on the approval of the technology (§ 125.99(b)).

Under § 125.94(a)(5) (i) or (ii), if the Director determines that a facility's costs of compliance would be significantly greater than the costs considered by the Administrator for a like facility to meet the applicable performance standards, or that the costs of compliance would be significantly greater than the benefits of meeting the applicable performance standards at the facility, the Director must make a site-specific determination of best technology available for minimizing adverse environmental impact. Under this alternative, a facility would either compare its projected costs of compliance using a particular technology or technologies to the costs the Agency considered for a like facility in establishing the applicable performance standards, or compare its projected costs of compliance with the projected benefits at its site of meeting the applicable performance standards of today's rule (see section IX.H). If in either case costs are significantly greater, the technology selected by the Director must achieve an efficacy level that comes as close as practicable to the applicable performance standards without resulting in significantly greater costs.

During the first permit term, a facility that chooses compliance alternatives in § 125.94(a)(2), (3), (4), or (5) may request that compliance with the requirements of this rule be determined based on the implementation of a Technology Installation and Operation Plan indicating how the facility will install and ensure the efficacy, to the extent practicable, of design and construction technologies and/or operational measures, and/or a Restoration Plan (§ 125.95(b)(5)). The Technology Installation and Operation Plan must be developed and submitted to the Director in accordance with § 125.95(b)(4)(ii). The Restoration Plan must be developed in accordance with § 125.95(b)(5). During subsequent permit terms, if the facility has been in compliance with the construction, operational, maintenance, monitoring, and adaptive management requirements in its TIOP and/or Restoration Plan during the preceding permit term, the facility may request that compliance during subsequent permit terms be based on its remaining in compliance with its TIOP and/or Restoration Plan, revised in accordance with applicable adaptive management requirements if the applicable performance standards are not being met.

Three sets of data are required to be submitted 180 days prior to expiration of a facility's existing permit by all facilities regardless of compliance alternative selected (see § 122.21(r)(2)(3) and (5)). These are:

• Source Water Physical Data: A narrative description and scaled drawings showing the physical configuration of all source waterbodies used by the facility, including areal dimensions, depths, salinity and temperature regimes, and other documentation that supports your determination of the waterbody type where each cooling water intake structure is located; identification and characterization of the source waterbody's hydrological and geomorphological features, as well as the methods used to conduct any physical studies to determine the intake's area of influence and the results of such studies; and locational maps.

• Cooling Water Intake Structure Data: A narrative description of the configuration of each of its facility's cooling water intake structures and where it is located in the waterbody and in the water column; latitude and longitude in degrees, minutes, and seconds for each of its cooling water intake structures; a narrative description of the operation of each of its cooling water intake structures, including design intake flows, daily hours of operation, number of days of the year in operation, and seasonal changes, if applicable; a flow distribution and water balance diagram that includes all sources of water to the facility, recirculating flows, and discharges; and engineering drawings of the cooling water intake structure.

• Cooling Water System Data: A narrative description of the operation of each cooling water system, its relationship to the cooling water intake structures, proportion of the design intake flow that is used in the system, the number of days of the year the system is in operation, and seasonal changes in the operation of the system, if applicable; and engineering calculations and supporting data to support the narrative description.

In addition to the specified data facilities are require to submit, some facilities are also required to conduct a Comprehensive Demonstration Study. Specific requirements for the Comprehensive Demonstration Study vary based on the compliance alternative selected. Exhibit II summarizes the Comprehensive Demonstration Study requirements for each compliance alternative. Specific details of each Comprehensive Demonstration Study component are provided in section IX of this preamble.

EXHIBIT V–2.—SUMMARY OF COMPREHENSIVE DEMONSTRATION STUDY REQUIREMENTS FOR COMPLIANCE ALTERNATIVES

Compliance alternative (§ 125.94(b))	Comprehensive demonstration study requirements (§ 125.95(b))
1—Demonstrate facility has reduced flow commensurate with closed-cycle recirculating system.	None.
1—Demonstrate facility has reduced design intake velocity to ≤ 0.5 ft/s	No requirements relative to impingement mortality reduction. If subject to entrainment performance standard, the facility must only address entrainment in the applicable components of its Comprehensive Demonstration Study, based on the compliance option selected for entrainment reduction.
2—Demonstrate that existing design and construction technologies, operational measures, and/or restoration measures meet the performance standards.	Proposal for Information Collection. Source Waterbody Flow Information. Impingement Mortality and/or Entrainment Characterization Study (as appropriate). Technology and Compliance Assessment Information —Design and Construction Technology Plan —Technology Installation and Operation Plan Restoration Plan (if appropriate). Verification Monitoring Plan.
3—Demonstrate that facility has selected design and construction technologies, operational measures, and/or restoration measures that will, in combination with any existing design and construction technologies, operational measures, and/or restoration measures, meet the performance standards.	Proposal for Information Collection. Source Waterbody Flow Information. Impingement Mortality and/or Entrainment Characterization Study (as appropriate). Technology and Compliance Assessment Information —Design and Construction Technology Plan —Technology Installation and Operation Plan Restoration Plan (if appropriate). Verification Monitoring Plan.
4—Demonstrate that facility has installed and properly operates and maintains an approved technology.	Technology Installation and Operation Plan. Verification Monitoring Plan.

24. Larval fish monitoring data as described in Paragraph 6 of Enclosure 2 to WM 06-0046 (November 17, 2006).

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

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• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed *Restoration and Protection Strategy.*

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

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• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery *monitoring reports and management plans. Please have available the most recent* publication of each of these reports.

Generalized Larval Fish Densities in the Cooling Water Intake Water

of

Wolf Creek Generating Station

Prepared by:

Chris Eichman and Dr. James Triplett

Pittsburgh State University

Pittsburgh, Kansas

February 7, 2007

for

Wolf Creek Nuclear Operating Corporation

Burlington, Kansas

Introduction

The sampling of larval fish at Wolf Creek Generating Station (WCGS) is used to assess possible entrainment issues associated with cooling water usage. The reported data will be used to show what possible impacts that plant operation might pose to larval fish in the Coffey County Lake (CCL). Larval fish data was considered valuable for fishery management of CCL.

Sampling Effort

The sampling took place on a monthly basis starting on December 19, 2004 and ending on February 26, 2006. The sample period for each collection trip was a 24 hour period with samples taking place at the start of each trip and then at eight hour intervals. Fish impingement and plankton, samples were taken along with larval fish samples.

Larval fish samples were done at the intake structure and at the outlet. A larval fish net with a 30 cm hoop was used at both locations. The intake samples were taken from a boat if the weather conditions permitted, but if the waves were to strong the samples were taken off of the intake building's catwalk. When sampling from the boat five vertical tows from the bottom were made at around 10m in front of the intake building. Catwalk tows were taken on the east side of the intake building and only three samples were taken from this location. Outlet samples were take in the same location and were done parallel to the flow for a 10 second interval. Two samples were collected at each eight hour period from the outlet. Flow rates of the outlet were also recorded to estimate volume sample for each period. After each sample period the larval fish samples were examined and any larval fish present were identified.

Sample 1 **12/19/2004** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		11.0	0.778			
		10.0	0.707			
		10.0	0.707			
		9.5	0.672			
		9.0	0.636	3.500		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4199	0.297			
	10 sec.		0.297	0.594		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
			0.000			
			0.000			
			0.000			
			0.000			
			0.000	0.000		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet		0.000			
	10 sec.		0.000	0.000		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		6.0	0.424			
		7.0	0.495			
			0.000			
			0.000			
			0.000	0.919		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4199	0.297			
	10 sec.		0.297	0.594		
		Total intake		4.419		
		Total outlet		1.188		
		Total Vol.	**5.606**			

Sample 2 **01/30/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		9.0	0.636			
		9.5	0.672			
		9.0	0.636			
		8.0	0.566	3.111		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4374	0.309			
	10 sec.		0.309	0.619		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		7.5	0.530			
		9.0	0.636			
		9.0	0.636			
		9.0	0.636			
		9.0	0.636	3.075		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4199	0.297			
	10 sec.		0.297	0.594		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
			0.000			
			0.000			
			0.000			
			0.000			
			0.000	0.000		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0	0.000			
	10 sec.		0.000	0.000		
		Total intake		6.186		
		Total outlet		1.212		
		Total Vol.	**8.017**			

Sample 3 **02/20/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		8.0	0.566			
		9.0	0.636			
		9.0	0.636			
		9.5	0.672	3.111		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3211	0.227			
	10 sec.		0.227	0.454		

Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		9.0	0.636			
		9.0	0.636			
		9.0	0.636			
		8.5	0.601	3.111		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3998	0.283			
	10 sec.		0.283	0.565		

Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		8.5	0.601			
		9.0	0.636			
		8.5	0.601			
		8.0	0.566	3.005		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3430	0.242			
	10 sec.		0.242	0.485		

Total intake		9.226
Total outlet		1.504
Total Vol.	**10.731**	

Sample 4 **03/14/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		8.5	0.601			
		9.0	0.636			
		9.5	0.672			
		9.5	0.672	3.182		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3815	0.270			
	10 sec.		0.270	0.539		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.0	0.566			
		9.0	0.636			
		8.5	0.601			
		8.5	0.601			
		8.5	0.601	3.005		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4042	0.286			
	10 sec.		0.286	0.572		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		9.0	0.636			
		8.5	0.601			
		9.0	0.636			
		8.5	0.601	3.075		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3578	0.253			
	10 sec.		0.253	0.506		
		Total intake		9.262		
		Total outlet		1.617		
		Total Vol.	**10.879**			

Sample 5	**04/17/2005**		Net area (0.0707)				
Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		7.5	0.530				
		8.5	0.601				
		8.0	0.566				
		9.0	0.636				
		8.5	0.601	2.934			
		Depth (m)			**Species Collected**	**Qty.**	
	Outlet	3.0	0.210				
		3.0	0.210	0.420			
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		7.5	0.530				
		8.0	0.566				
		8.0	0.566				
			0.000				
			0.000	1.661			
		Depth (m)			**Species Collected**	**Qty.**	
	Outlet	3.0	0.210				
		3.0	0.210	0.420			
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		6.0	0.424				
		7.5	0.530				
		7.5	0.530				
			0.000				
			0.000	1.485			
		Depth (m)			**Species Collected**	**Qty.**	
	Outlet	3.0	0.210		White Crappie		1 Dead
		3.0	0.210	0.420	Gizzard Shad		4 Dead
		Total intake		6.080			
		Total outlet		1.260			
		Total Vol.	**7.340**				

Sample 6 **05/12/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		7.0	0.495		Centrachid		1 Live
		8.0	0.566				
		9.0	0.636				
			0.000				
			0.000	1.697			
		Depth (m)			**Species Collected**	**Qty.**	
	Outlet	3.0	0.210				
		3.0	0.210	0.420			
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		7.0	0.495		Gizz. Shad		2 Live
		7.0	0.495		W. Crappie		1 Live
		7.5	0.530				
			0.000				
			0.000	1.520			
		Depth (m)			**Species Collected**	**Qty.**	
	Outlet	3.0	0.210				
		3.0	0.210	0.420			
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		6.0	0.424		F. Drum		2 Live
		6.0	0.424				
		6.0	0.424				
			0.000				
			0.000	1.273			
		Est. Velocity			**Species Collected**	**Qty.**	
	Outlet	0.4059	0.287				
	10 sec.		0.287	0.574			
		Total intake		4.489			
		Total outlet		1.414			
		Total Vol.	**5.903**				

Sample 7 **06/26/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		15.0	1.061				
		15.0	1.061				
		15.0	1.061				
		15.0	1.061				
		15.0	1.061	5.303			
		Est. Velocity			**Species Collected**	**Qty.**	
	Outlet	0.2301	0.163				
	10 sec.		0.163	0.325			
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		8.0	0.566		**Gizzard Shad**		1
		8.5	0.601				
		9.0	0.636				
		8.0	0.566				
		8.0	0.566	2.934			
		Est. Velocity			**Species Collected**	**Qty.**	
	Outlet	0.2695	0.191				
	10 sec.		0.191	0.381			
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**	
		9.0	0.636		**Gizzard Shad**		6 Live
		9.0	0.636				
		9.5	0.672				
			0.000				
			0.000	1.944			
		Est. Velocity			**Species Collected**	**Qty.**	
	Outlet	0.2782	0.197				
	10 sec.		0.197	0.393			
		Total intake		10.181			
		Total outlet		1.100			
		Total Vol.	**11.281**				

Sample 8 **07/24/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		9.5	0.672			
		9.0	0.636			
		11.0	0.778			
		10.0	0.707			
		10.0	0.707	3.500		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3876	0.274			
	10 sec.		0.274	0.548		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		9.5	0.672			
		9.5	0.672			
		9.5	0.672			
		9.5	0.672	3.288		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3613	0.255			
	10 sec.		0.255	0.511		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		9.0	0.636			
		9.5	0.672			
		9.5	0.672			
			0.000			
			0.000	1.980		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4409	0.312			
	10 sec.		0.312	0.623		
		Total intake		8.767		
		Total outlet		1.682		
		Total Vol.	**10.449**			

Sample 9 **08/20/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.0	0.566			
		9.0	0.636			
		9.0	0.636			
		8.0	0.566			
		9.5	0.672	3.075		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.2091	0.148			
	10 sec.		0.148	0.296		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.0	0.566			
		8.5	0.601			
		8.0	0.566			
		9.0	0.636			
		9.0	0.636	3.005		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3517	0.249			
	10 sec.		0.249	0.497		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		9.5	0.672			
		9.0	0.636			
		9.0	0.636			
		9.0	0.636			
		9.0	0.636	3.217		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4173	0.295			
	10 sec.		0.295	0.590		
		Total intake		9.297		
		Total outlet		1.383		
		Total Vol.	**10.976**			

Sample 1 **09/10/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		3.5	0.247			
		3.5	0.247			
		3.5	0.247			
			0.000			
			0.000	0.742		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3771	0.267			
	10 sec.		0.267	0.533		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		3.5	0.247			
		3.5	0.247			
		3.5	0.247			
			0.000			
			0.000	0.742		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4593	0.325			
	10 sec.		0.325	0.649		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		3.5	0.247			
		3.5	0.247			
		3.5	0.247			
			0.000			
			0.000	0.742		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3263	0.231			
	10 sec.		0.231	0.461		
		Total intake		2.227		
		Total outlet		1.644		
		Total Vol.	**3.871**			

Sample 11 **10/08/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		8.5	0.601			
		8.5	0.601			
		9.0	0.636			
		9.0	0.636			
		9.0	0.636	3.111		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.2415	0.171			
	10 sec.		0.171	0.341		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		9.0	0.636			
		9.0	0.636			
		9.5	0.672			
		9.5	0.672			
		9.0	0.636	3.252		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3771	0.267			
	10 sec.		0.267	0.533		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		9.0	0.636			
		9.0	0.636			
		9.0	0.636			
		6.0	0.424			
		9.0	0.636	2.969		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.1785	0.126			
	10 sec.		0.126	0.252		
		Total intake		9.332		
		Total outlet		1.127		
		Total Vol.	**10.459**			

Sample 12 **11/12/2005** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		4.0	0.283			
		4.0	0.283			
		4.0	0.283			
			0.000			
			0.000	0.848		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4374	0.309			
	10 sec.		0.309	0.619		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		5.0	0.354			
		4.0	0.283			
		4.0	0.283			
			0.000			
			0.000	0.919		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4427	0.313			
	10 sec.		0.313	0.626		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		4.0	0.283			
		4.0	0.283			
		4.0	0.283			
			0.000			
			0.000	0.848		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.1365	0.096			
	10 sec.		0.096	0.193		
		Total intake		2.616		
		Total outlet		1.438		
		Total Vol.	**4.053**			

Sample 13 12/19/2005 Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		7.0	0.495			
		6.0	0.424			
		6.5	0.460			
			0.000			
			0.000	1.379		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3596	0.254			
	10 sec.		0.254	0.508		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		7.0	0.495			
		7.0	0.495			
		7.0	0.495			
			0.000			
			0.000	1.485		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4339	0.307			
	10 sec.		0.307	0.614		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		7.0	0.495			
		7.0	0.495			
		7.0	0.495			
			0.000			
			0.000	1.485		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.2808	0.199			
	10 sec.		0.199	0.397		
		Total intake		4.348		
		Total outlet		1.519		
		Total Vol.	**5.867**			

Sample 14 **01/16/2006** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		10.0	0.707			
		10.0	0.707			
		10.0	0.707			
		10.0	0.707			
		10.0	0.707	3.535		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3053	0.216			
	10 sec.		0.216	0.432		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		10.0	0.707			
		10.0	0.707			
		10.0	0.707			
		10.0	0.707			
		11.0	0.778	3.606		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3657	0.259			
	10 sec.		0.259	0.517		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		10.0	0.707			
		10.0	0.707			
		10.0	0.707			
		10.0	0.707			
		10.0	0.707	3.535		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3911	0.276			
	10 sec.		0.276	0.553		
		Total intake		10.676		
		Total outlet		1.502		
		Total Vol.	**12.178**			

Sample 15 **03/04/2006** Net area (0.0707)

Period 1	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		5.0	0.354			
		5.0	0.354			
		5.0	0.354			
			0.000			
			0.000	1.061		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.2730	0.193			
	10 sec.		0.193	0.386		
Period 2	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		5.0	0.354			
		5.0	0.354			
		5.0	0.354			
			0.000			
			0.000	1.061		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.4427	0.313			
	10 sec.		0.313	0.626		
Period 3	**Intake**	**Depth (m)**	**Vol. (cubic m)**		**Species Collected**	**Qty.**
		5.0	0.354			
		5.0	0.354			
		5.0	0.354			
			0.000			
			0.000	1.061		
		Est. Velocity			**Species Collected**	**Qty.**
	Outlet	0.3237	0.229			
	10 sec.		0.229	0.458		
		Total intake		3.182		
		Total outlet		1.470		
		Total Vol.	**4.651**			

Sampled Volumes	Total (cubic m)
All samples	121.348
Intake samples	100.288
outlet samples	21.060

Larval Fish Sampled	Total	Status		Intake	Outlet
White Crappie	2	Live	1	1	
		Dead	1		1
Gizzard Shad	13	Live	9	9	
		Dead	4		4
F. Drum	2	Live	2	2	
		Dead	0		
Centrachid	1	Live	1	1	
		Dead	0		

Density Est.	#/cubic m
Total density	0.148
Intake density	0.13
Outlet density	0.237

25. If available, information on the location of the spawning areas for the various fish species in CCL.

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

• Current and historic flow records for the Neosho River.

• A statement is made in the 5th paragraph of Enclosure 2 to WM 06-0046 (November 17, 2006) that the state of Kansas has not required entrainment monitoring and will not require it for the 316(b) determination. Please provide documentation from KDHE regarding this issue.

• Larval fish monitoring data as described in Paragraph 6 of Enclosure 2 to WM 06-0046 (November 17, 2006).

15 • If available, information on the location of the spawning areas for the various fish species in CCL.

• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

• Possible cold shock impacts to gizzard shad is mentioned in Section 2.2 of the ER (WCGS, 1990). If there have been any incidents of cold shock to gizzard shad or other fish, please provide supporting data.

• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

Aquatic Ecology

Audit Needs request #52

> "Does the applicant have an indication of where the spawning areas are for the various fish species in CCL?"

Specific spawning area research has not been conducted within CCL. Spawning habitats are present in the lake, and species present likely use them accordingly. A summary of common species and their spawning habitat requirements are presented below:

Common fish species in Coffey County Lake, and their spawning requirements.

Species	**Spawning habitat requirements**
Gizzard shad	Pelagic, open water areas
Channel catfish	Cavities associated with structure, inundated trees, and riprap areas
Blue catfish	Cavities associated with structure, inundated trees, and riprap areas
Flathead catfish	Cavities associated with structure, inundated trees, and riprap areas
White bass	Shallow flowing waters
Bluegill	Shallow gravel or firm clay shoreline areas
Smallmouth bass	Shallow gravel or firm clay shoreline areas
Largemouth bass	Shallow gravel or firm clay shoreline areas
White crappie	Shallow gravel or firm clay shoreline areas
Walleye	Clean, wave-washed areas along rocky shorelines, and riprap
Freshwater drum	Pelagic, open water areas

There are indications of earlier than normal spawning activities in the thermally influenced portion of the lake. Such variances in spawning activity were expected. According to biologists' observations, reproductive state of several species in the thermal discharge indicates early spawning activities, primarily among the white bass, which also benefit from the flowing water. Bimodal, young-of year length frequency distributions also supports use of the heated circulating water discharge area of CCL as spawning habitat for gizzard shad (WCNOC 1992, 1998, Haines 2000).

Literature Cited

WCNOC. 1992. 1991 Operational Fishery Monitoring Report. WCNOC, Environmental Management. Internal Report.

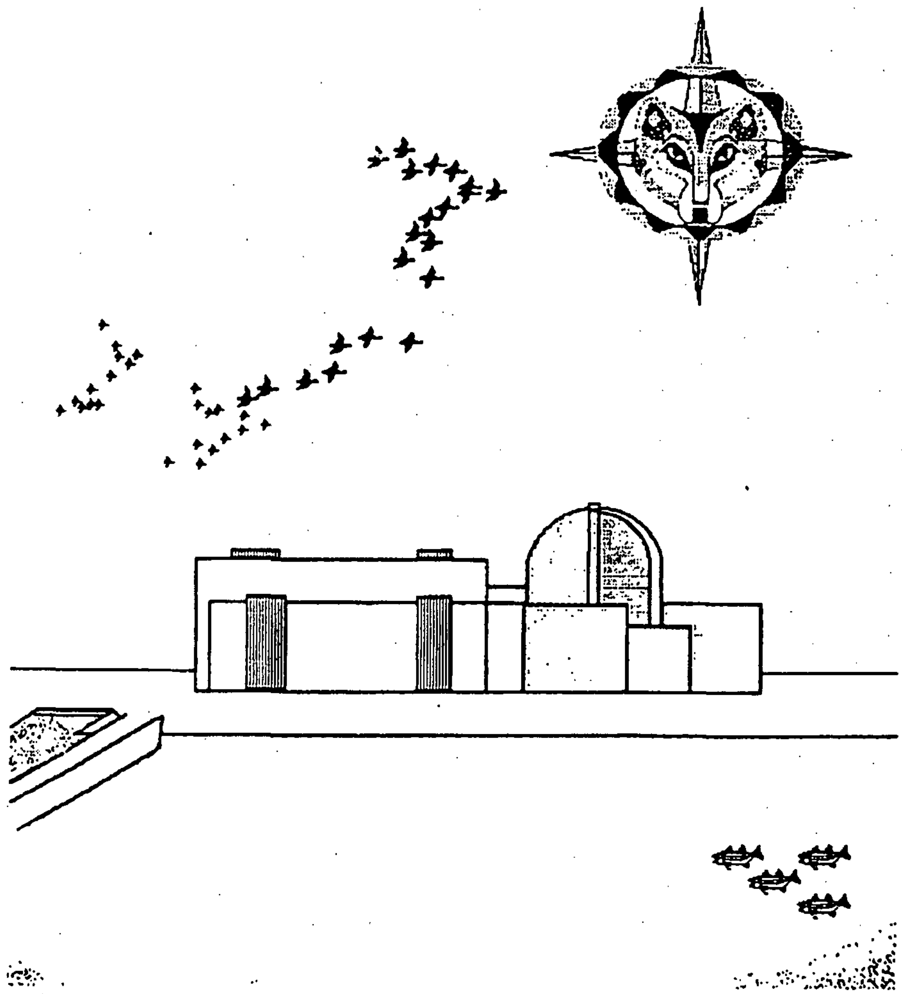
WCNOC. 1998. Fishery Monitoring Report for Wolf Creek Lake 1997. WCNOC, Internal Report.

Haines D. D. 2000. Biological control of gizzard shad impingement at t nuclear power plant. Environmental Science & Policy 3: 275-281. (See Audit Needs request # 12)

WOLF CREEK GENERATING STATION

1991 OPERATIONAL FISHERY MONITORING REPORT

WOLF CREEK NUCLEAR OPERATING CORPORATION



ENVIRONMENTAL MANAGEMENT
REGULATORY SERVICES
NOVEMBER 1992

WOLF CREEK GENERATING STATION

OPERATIONAL FISHERY

MONITORING REPORT

Dan Haines

Environmental Management Group

Wolf Creek Nuclear Operating Corporation

P.O. Box 411

Burlington, Kansas 66839

Published November 1992

Annual Report for 1991

by: 11/2/92
Dan E. Haines Date

Supervisor Environmental
Management Approval: 11/10/92
Brad S. Loveless Date

Manager Regulatory
Services Approval: 11/30/92
Kevin J. Moles Date

ABSTRACT

Fishery monitoring surveys were conducted on WCCL from April through November 1991. These resulted in the collection of 2,613 individual fish representing 11 families and 30 species. Collection methods used were fyke netting, seining, electrofishing and gill netting. Data collected were used to describe the fishery which was subsequently evaluated based on the goal of increased plant reliability through reduced gizzard shad impingement. The sportfish/roughfish ratio in Wolf Creek was very high when compared with other reservoirs in the midsection of the United States. Catch data calculated as percent relative abundance for all gears combined showed gizzard shad highest (28.2%) and white bass next (14.4%). The shad percentage represented an increase of 2.5% from 1990, and was the highest measured. Next were bluegill (11.2%), smallmouth bass (7.1%) and walleye (5.0%). When total biomass of all species in the standardized effort was considered, wiper were highest at 17.3% followed by white bass (14.6%), walleye (10.8%), bigmouth buffalo (10.7%), smallmouth bass (6.1%), smallmouth buffalo (6.0%), gizzard shad (5.9%), and common carp (5.9%). Largemouth bass biomass fell in 1991 from comprising in the past a high percentage of the biomass statistic to only 4.7 percent. The age of the older wiper year class was ten in 1991 and considering a life expectancy of five to seven years, it was surprising that natural mortality hadn't reduced their number further. Wipers from the 1988 and 1989 stocking supported the 1991 biomass statistic, but the older 1981 year class was still present in large numbers. Gizzard shad biomass from 1990 to 1991 rose from 3.9% to 5.9% which is the highest measured to date. Shad biomass has varied slightly since lake fill but has rarely exceeded 5%.

Growth and body condition data using Proportional and Relative Stock Density (PSD, RSD), relative weight (<u>Wr</u>) and condition factor (K_{TL}) continued to show large average sizes, slowing growth of early predator year classes and low to moderate condition for Wolf Creek predators. Wiper growth continued but at rates which were more modest and variable than in their earliest years. Growth of crappie, white bass, and walleye continued at moderate rates. Largemouth bass growth continued to fall, but was still within acceptable limits. For most WCCL predators, average sizes were large and the proportion of mature fish (quality size and larger) versus smaller, immature fish (stock size) was also large. This led to very high PSD's. At the same time, condition of these predators was generally lower than the averages from other Kansas impoundments. In contrast, both gizzard shad PSD and <u>Wr</u> values were close to the top of reservoirs surveyed in Kansas. While these qualities in shad have been shown to be optimal for production of a good prey base, few young-of-the year gizzard shad in WCCL have remained through their first winter. Little or no survival of the last four year classes of gizzard shad indicated that the combination of predation pressure and winterkill was adequate to control expansion of the WCCL shad population. Thus, no impingement problems were experienced in 1991. The unusually low number of gizzard shad and equally unusually high number of predators in WCCL meant predator condition was low but more importantly, so were impingement rates.

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INTRODUCTION

The purpose of this report is to present and interpret Wolf Creek Nuclear Operating Corporation (WCNOC) fisheries data from Wolf Creek Cooling Lake (WCCL) collected during 1991. Studies of fish populations around Wolf Creek Generating Station (WCGS) were initiated in 1973 to fulfill commitments made by Kansas Gas and Electric Company to the Nuclear Regulatory Commission as a condition to the construction permit. Efforts were directed toward the establishment of a cooling lake fishery which would enhance station operability and a monitoring program to provide adequate preoperational and operational baseline data with which operational events can be compared in order to assess impact.

BACKGROUND

During the operational licensing process, several conditions due to plant operations were identified as potentially impacting the WCCL fishery. These were addressed in the WCGS Environmental Report and Final Environmental Statement. They included thermal effects (temperature elevation and winter "cold shocks"), effects of chlorine used as a biocide, and entrainment and impingement effects.

Although impingement has been categorized as plant operations impacting the fishery, excessive clogging of circulating water intake equipment with impinged fish is the converse impact. This presents a serious problem in many cooling lakes, often resulting in costly equipment damage and power production delays (Bruce N.G.S. 1977). In the Midwest, excessively abundant gizzard shad (Dorosoma cepedianum) cause major impingement concerns (Olmstead and Clugston 1986). Its prolific nature and low tolerance to winter temperatures sometimes lead to severe fall and winter impingement events which affect power plant operation. Since it was impossible to exclude shad from the cooling lake, a management strategy using predation was developed to biologically control gizzard shad biomass and reduce impingement potential at WCGS.

Gizzard shad typically reach high densities in impoundments (Pflieger 1975) and have been controlled significantly in few instances. Jester (1972) credited walleye (Stizostedion vitreum) and white bass (Morone chrysops) while Stroud (1949) cited walleye, largemouth bass (Micropterus salmoides) and northern pike (Esox lucius) for reducing gizzard shad levels. In our review of Morone-controlled shad populations we found few examples and only one which took place in a reservoir greater than 2000 acres, that being Smith Mountain Reservoir, Virginia (Hart 1978). All other examples of shad control with striped bass (Morone saxatilis) or with white bass/striped bass hybrids (wipers) have been through predator "loading" in small water bodies. Hence, control in a large reservoir such as WCCL (5090 acres) appears to be uncommon.

Prior to lake filling, basin preparation was undertaken and this included comprehensive poisoning of ponds and areas of Wolf Creek (Kansas Gas and Electric Co. 1984). This effort was followed by the stocking in the ponds of fathead minnows (Pimephales promelas) and predator fish, including striped bass, wipers (M. saxatilis X M. chrysops), walleye, largemouth bass, smallmouth bass (Micropterus dolomieui), blue catfish (Ictalurus furcatus), channel catfish (I. punctatus), and black crappie (Pomoxis nigromaculatus). These ponds were subsequently flooded by WCCL. Predator species that were either pumped from the Neosho River during lake fill or survived poisoning efforts included the white bass and white crappie (P. annularis).

Given the unusually diverse nature of the predators which expanded into WCCL upon filling and the absence of angler harvest, it was considered possible that the predators could over-exploit the prey base. Gizzard shad indicators of over-exploitation could include poor recruitment, declining catch per unit of effort (CPUE) and low production (Anderson 1973). Corresponding predator characteristics would include slow growth, poor body condition and reduced recruitment due to cannibalism. Additionally, increased predation would be expected on other forage, such as young of the year (YOY) sunfishes and crappies, also leading to diminished recruitment.

Significant development of submersed macrophytes, primarily various pondweed species, (Potamogeton spp.) was observed in WCCL for the first time in 1984. It increased greatly in 1985 and continued at that level through 1988. Since 1989, pondweed species composition has shifted from predominantly P. foliosus to P. nodosus, which was less dense. Pondweed all but disappeared from the thermally influenced discharge cove. Factors enhancing pondweed development included very stable lake levels and clear water conditions (Canfield et al. 1985). Besides impairing fishery collection efforts, pondweed growth could noticeably alter predator-prey relationships in a lake (Savino and Stein 1982) and modify recruitment patterns for littoral, cover-loving centrarchids (sunfishes).

MATERIALS AND METHODS

Fishery monitoring on WCCL was conducted from April through November 1991. This monitoring program has generally followed the standardized efforts of the Kansas Department of Wildlife and Parks (KDWP), (Stafford 1979). This standardized sampling regime utilized a variety of equipment with each one targeting a particular species or group of species. The use of this regime was designed to permit a thorough characterization and subsequent evaluation of the WCCL fishery. The gear types, effort, and locations used appear in Appendix A, Table 1 and Appendix B, Figure 1. A glossary of fisheries management terms appears in Appendix C.

Beginning in 1985, sampling in the circulating water discharge area was initiated. Labeled Location 9, data from this area was considered supplemental so it was not included in preoperational-operational comparisons which used standardized efforts and locations. Knowledge of fish use of the discharge area became important because plant operational impacts would likely first appear there. The moving, heated water was predicted in the Environmental Report Operating License Stage (Kansas Gas and Electric Co. 1981) to attract many WCCL fishes during the cold winter months and to repel them in the warm summer months. The maximum rise in temperature for the circulating water as it passes through the plant was predicted to be 31.5°F, but during early stages of commercial operations this temperature exceeded predictions by ranging up to 42°F. Potential problems were possible if the plant would drop quickly in power during cold weather and the discharge water dropped to ambient levels in a short time. Fish concentrated in the once warm water could experience "cold shock" and die or be incapacitated and more susceptible to predation (Wolters and Coutant 1976). For these reasons, Location 9 was electrofished, seined, and trawled from spring through fall in 1985 and has been sampled with identical effort as at the standard locations beginning in 1986.

COLLECTING EQUIPMENT

Fyke netting consisted of four net nights at each location during April. The efforts were targeted to sample white and black crappie as they moved inshore prior to spawning activities as water temperatures reached 10°C (50°F). Another objective was to sample walleye as they moved inshore prior to or during spawning.

Electrofishing was completed monthly from May through October at each location. Standardized electrofishing efforts consisted of two 15 minute periods at each location. The same shoreline areas were shocked each time. The main components of the electrofishing unit were a 3500 watt generator, Plaster transformer unit, dead-man foot switch, and DC electrode array. A pulsed (120 cycles/second) DC current of 7-10 amperes was used for all WCCL shocking activities.

Shoreline seining was completed monthly on WCCL from May through September and in early November. The standard seining efforts consisted of two modified Swingle swings at each location using a 15.2 X 1.8 m bag seine with 0.6 cm mesh. Shoreline areas seined each time were consistent from month to month and from year to year, except during November when only five hauls were completed on the entire lake. In addition, supplemental efforts consisting of three Swingle swing seine hauls at locations 2, 6, and 8 and five hauls at location 9 were done during the same months to assess gizzard shad and centrarchid production.

Gill net collections were conducted on WCCL during October. Each net complement consisted of four uniform mesh flag monofilament panels, one each of 2.5, 3.8, 6.4, and 10.2 cm bar mesh 30.5 x 2.4 m nets (1, 1.5, 2.5 and 4 inch mesh, 100 x 8 ft.). Complements were set for two consecutive nights at each location. Nets were set in similar spots within each location as during previous years.

DATA TYPES

During WCCL fishery monitoring a number of physical parameters were measured and recorded on field data sheets. Cooling lake parameters recorded were depth, water temperature, substrate type, secchi depth, turbidity, and meteorological conditions. Conductivity was also recorded for electrofishing efforts.

Fish collected during field activities were identified, measured (total length in mm), and weighed (g) in the field or identified, measured and weighed in the laboratory, depending on sample size and time constraints. Fish identified in the laboratory, which were almost exclusively from seine hauls, were preserved in buffered formalin until they were processed.

STATISTICS EMPLOYED

Data from all 1991 WCGS fishery collections were entered in the WCNOC Sperry Modem 3M computer. Cooling lake fishery data were then processed through the use of the Maintaining, Preparing and Producing Executive Reports (MAPPER) system with programs developed by WCNOC Computer Services personnel.

In addition to commonly used interpretive calculations such as species composition, relative abundance, relative biomass, CPUE, length frequency, and coefficient of condition (K_{TL}), (Ricker 1975), several other analytical methods were utilized for data analysis. Proportional Stock Density (PSD) (Anderson 1976), traditional Relative Stock Density (RSD) (Wege and Anderson 1978, Anderson 1980), incremental RSD (Gablehouse 1983), and Relative Weight (Wr) (Wege and Anderson 1978) were computations also performed on 1991 fisheries data. Length-weight equations adopted by KDWP were utilized for relative weight calculations. For gizzard shad, white bass and walleye, a series of correction factors were applied to incremental gill net catch data prior to PSD and RSD calculations (Willis et al. 1983, Willis 1985).

RESULTS AND DISCUSSION

In 1991 a total of 30 fish species were captured from WCCL. Nine years have now passed since WCCL was first brought to full pool in 1982 and few species changes are expected in the future. The species sampled are well adapted to a lentic existence and are anticipated to remain.

ABUNDANCE

In contrast to occurrence statistics, relative abundance data fluctuates between years because most fish caught were YOY and reproductive and recruitment success for most species varies widely from year to year. In 1991 the top three in abundance were gizzard shad, white bass, and bluegill (Lepomis macrochirus) at 28.2%, 14.4% and 11.2%, respectively (Appendix A, Table 2). While the percentage for white bass rose, that for shad and bluegill remained very similar to 1990 with shad rising and bluegill falling slightly. The 1991 shad abundance results were the highest monitored to date.

BIOMASS

The 1991 percent biomass rankings in WCCL changed from previous years (Appendix A, Table 3). The top ranked species in biomass was wiper (17.3%) followed by white bass (14.6%), walleye (10.8%), and bigmouth buffalo (Ictiobus cyprinellus, 10.7%). Wiper biomass rose from the 1990 level, and continued to comprise a relatively large percentage of WCCL's total biomass. Many of the wipers caught were from the 1981 year class, but support to the biomass percentage from the 1988 and 1989 year class stockings also was present. The 1981 year class of these nonreproducing hybrids has reached and exceeded the end of its 4-7 year expected life span (Wolf Creek Nuclear Operating Corporation 1987a). Slower growing fish tend to have longer life spans than faster growing individuals of the same species (Bennett 1970). This may explain the cause for the unusual wiper longevity in WCCL since toward the end of their expected life span they have not grown to be as large as in other midwestern impoundments (S. Price, Kansas Wildlife and Parks, personal communication). The slow growth was presumed to be due to the consistently small biomass of gizzard shad present and the wiper's dependence on this species (Gilliland and Clady 1981).

Percent biomass of WCCL species in 1991 was again strongly weighted toward predators (Table 3). Of the eleven species which individually accounted for over 4% of the total biomass and collectively made up 93.1%, seven were predators (64.6%). Jenkins and Morais (1971) documented that as reservoirs age, roughfish biomass increases and sportfish biomass was replaced with expanding clupeid (shad) populations. This condition of roughfish dominance was illustrated in data from five other midwestern reservoirs (Appendix A, Table 4). Considering common roughfish species in those five reservoirs, roughfish biomass ranged from 69% to 92.1% of the total. In 1991, roughfish in WCCL accounted for only 30.1%. Still, the WCCL roughfish percentage was higher than past years. A large increase in total numbers caught was not evident (Table 2), just the weight of the individual fish. Nevertheless, as years pass, WCCL's consistently high predator/sportfish biomass appears more and more unusual compared with other reservoirs. Possibly due to the continued high sportfish biomass in WCCL and its predation on shad and other roughfish, typical reservoir species composition changes have not occurred in WCCL.

GROWTH AND STRUCTURAL INDICES

Growth and structural indices reflect an interaction of rates of reproduction, growth, and mortality of the age groups present. Over time they can help in understanding the dynamics of populations and in identifying problems such as year class failure or low recruitment, slow growth, or excessive annual mortality. For this report the growth and structural indices focus on species important to the WCCL fishery and the effect they have on the objective of maintaining low impingement rates.

Gizzard Shad

Discussion of the WCCL gizzard shad population has so far shown that both their abundance and percentage of the total biomass were unusually low (Tables 2 and 3, respectively). A pattern of soft fluctuations for gizzard shad biomass roughly between two and six percent of the fishery's total was evident. Electrofishing CPUE in 1991 for shad was normal for WCCL (Appendix A, Table 5). Seine catch data throughout summer 1991 appeared similar to those in other years (Appendix A, Table 6) with monthly fluctuations but consistently low levels by October. When seine data from just August were compared with average catches from 21 other Kansas reservoirs, 1991 values again came out very low at 21st (Appendix A, Table 7).

Structural indices for WCCL shad were atypical. Fall seine, gill net, and electrofishing data have usually shown a bimodal length frequency distribution. Three modes were evident in 1991 (Appendix B, Figure 2). The smallest of the three modes was close to the principal mode observed in past years and which consisted entirely of YOY gizzard shad. In the fall of 1991, another mid-sized peak was evident in the 170-190 mm range. When compared with regional sizes reported by Carlander (1969), this WCCL mid-sized mode could represent faster growing YOY shad, probably from an earlier spawn. This size of fish was present in past years, but there were few relative to the other size classes. To give further support to the idea that these were fast-growing YOY, their growth would be below Carlander (1969) indications for shad after their second growing season. Gizzard shad in WCCL have not been considered slow growing. Scale aging data to determine with certainty which year class the second mode represented were not collected. The third upper mode was composed of fish which past scale analyses have shown to be primarily composed of 5+ and older fish (WCNOC 1991).

Assuming that the second mode was faster growing YOY shad, the lack of intermediate year classes in WCCL was somewhat unusual compared to other reservoirs. Willis et. al. (1983) showed that the one-inch gill net was very effective at catching gizzard shad in the 180-220 mm range and a 1.5 inch gill net was effective catching shad in the 270 mm range. Since these sizes were part of the net complement used at WCCL (Table 1), gear bias was not suspected as the answer. One explanation could be that during the winters when these shad were small (≤7 in.) and still vulnerable to predators (Anderson 1983), predation in the heated discharge cove reduced their numbers drastically. Ordinarily, YOY shad year classes experience high winter mortality due to their inability to survive water temperatures below 5°C (EA, Engineering, Science, and Technology, Inc. 1985). In a typical reservoir the small percentage of YOY which survive the cold and the low winter predation rates caused by it go on to comprise a given year class and reproduce in later years. In WCCL, however, gizzard shad in recent years have had to contend with both severe cold and no decrease in predation. EA, Engineering, Science and Technology, Inc. (1985) documented that the YOY shad kill in Sutherland Reservoir, Nebraska was essentially complete by January 7 in 1985. At Wolf Creek, refueling outages during the operational winters of 1986/87 and 1987/88 meant no heated water was produced from October 17 to December 20, 1986 and from September 28, 1987 to January 4, 1988. Therefore, during the first part of winter when cold stress mortality was usually high, WCCL shad did not have the benefit of warm water from station operation. Further limiting recruitment, warm water discharges during the late winter periods concentrated the remaining shad along with predators (Wolf Creek Nuclear Operating Corporation 1987b) at temperatures of 15-25°C which would have elevated predation rates far above those normal for winter (Bennett 1970). In support of this, no shad were observed during supplemental winter collections that were less than 240 mm (Wolf Creek Generating Station, unpublished data). When age, length frequency and winter mortality data were combined, they have strongly suggested that little or no recruitment of gizzard shad has taken place in WCCL.

Not surprisingly, shad PSD and RSD indices lead to the same conclusions that length frequency data did (Appendix B, Figure 3). The proportion of shad larger than 180 mm but smaller than 280 mm, as indicated by the RSD S-Q graph, has declined through 1990, rebounding only slightly in 1991. This indicates poor recruitment of successive year classes of shad which would ordinarily keep PSD's in the 40-60 range. Compared with PSD values for 19 other Kansas reservoirs, this was not exceedingly high (4th highest, Willis 1986) but was certainly above average Kansas values. Willis' Kansas data showed that higher PSD's led to higher YOY production, but adequate recruitment of this production must occur to sustain the adult population, even if only at low levels. In WCCL, this may be the case.

Largemouth Bass

Largemouth bass, as a principal littoral predator species in WCCL, received special attention during 1991 monitoring activities. By all indications, largemouth numbers and average size declined in 1991. Standardized biomass data collected since 1985 have fluctuated mildly with no apparent trend developing until in 1990 and 1991 when consecutive declines were evident (Table 3). Catch frequencies also declined in 1991 (Table 2 and Table 5).

The size distribution trend for the WCCL largemouth bass population brings into question its continued role as a dominant shad predator. The 1991 largemouth length frequency distribution was similar to 1990 (Appendix B, Figure 4) with the upper mode composed of 3+ aged fish in the 380 mm to 400 mm range and 4+ through 6+ in the 410 mm and larger sizes. Few fish from pre-1986 year classes were represented in the 1991 spring shocking. This and the reduced catch indicate that the initial, dominant largemouth year classes have waned. In addition, the PSD indices showed that a 1989 or 1990 year class to replace them was not sampled in the spring of 1991 (Appendix B, Figure 5). Based on information from Carlander (1977), 1989 and 1990 year classes in WCCL may be expected to be in the RSD,S-Q range within which spring electroshocking on WCCL collected none. It was expected that the proportion of WCCL largemouth bass in the "preferred-memorable" size class would diminish as some of the older fish from early year classes died and smaller fish were recruited into the "quality-preferred" category (WCNOC 1990). Data from 1989 suggested that this may have happened as the "preferred-memorable" size class leveled while some stock sized largemouth grew into the "quality-preferred" size. Data from 1990 and 1991 contradicted this assumption as RSD,Q-P fell, and RSD,P-M rose.

Overall PSD may not decline unless angling and substantial harvest are allowed in WCCL. The older of the larger group of bass which has few natural predators would then be removed by anglers. This would decrease the population's PSD toward the more usual, "objective range" used by Willis (1984). Still, some natural loss through aging was apparent in 1991. Both harvest and natural mortality would tend to decrease the predation pressure on shad and allow greater survival to an uncertain degree. However, it would probably be beneficial, given the objective of minimizing gizzard shad impingement, if the WCCL largemouth PSD "objective range" remained slightly higher than that proposed by Willis (1984) for other Kansas reservoirs. This would keep maximum predation pressure on the shad.

Wiper

When the wiper biomass in WCCL fell from 20.8% in 1985 to 13.6% in 1986, there was concern that the original 1981 year class was reaching the end of its life span and fading as a major shad predator. Information on Kansas wipers indicated that large losses may occur after 5-6 years (S. Price, Kansas Wildlife and Parks, personal communication). This coincided with the 5-7 year spans experienced in Texas (P. Durocher, Texas Game and Parks, personal communication). In WCCL, a sudden loss due to old age of wipers did not materialize as indicated by the biomass remaining steady and rising through 1989 (Table 3). Nevertheless, loss of this year class was considered imminent and unavoidable. Consequently, 66,000 fingerling wipers which averaged 34 mm were stocked in June 1988. An additional 60,000 wipers which averaged 50 mm were stocked in June 1989. Length frequency data showed these two younger year classes emerging and catching up to the older aged fish in 1991 (Appendix B, Figure 6). Scale aging revealed that the 1988 and 1989 year classes generally ranged from 450 mm to 500 mm. The 1981 year class was mostly above 500 mm total length. PSD-RSD indices also reflected the growth of these fish (Appendix B, Figure 7). Apparently, all of the 1988 and 1989 wiper year classes were in the upper end of the RSD,P-M class. Many of the older, 1981 year class remained in the lower end of the RSD,M-T size range.

Walleye

The walleye length frequency data for WCCL during 1991 were encouraging (Appendix B, Figure 8). A trend toward an expanding, well balanced population appears to have developed. Scale aging showed that recruitment of 1989 and 1990 year class walleye was obvious in the 340 mm to 390 mm and 420 mm to 450 mm ranges, respectively. More YOY fish were also evident in 1991 sampling. The PSD-RSD indices also reflect the changes (Appendix B, Figure 9). The high production of 1991 YOY and the recruitment of 1990 year class fish has caused the PSD to drop from 97 to 77, which was closer to the objective range of 40 to 70 proposed by Willis (1984). Monitoring in 1991 revealed increased representation of the larger 1990 year class individuals and those from the 1989 year class have caused the RSD-P to rise. The higher percentage of the larger (RSD,P-M) walleye reflected growth of the older year classes.

Black Crappie

Continued maturation of early WCCL year classes of black crappie was evidenced in the 1991 spring Fyke net samples. Older fish from the strong 1982 through 1985 year classes were represented in the 300 to 350 mm range (Appendix B, Figure 10). The rise in seine CPUE in 1991 indicated increased production (Table 5), but little recruitment from previous years appears to have occurred. As the older fish approach their maximum expected life span of eight years (Carlander 1977) and if at the same time younger fish compose a higher percentage of the population, the PSD should decline from the high level prevalent since 1984 (Appendix B, Figure 11). The PSD-RSD indices showed the progression over the years of the dominant year class into almost entirely the RSD,M-T size range. As these dominant year classes diminish, the black crappie percent biomass will decline. Considering 1991 data, the WCCL population should continue, however, its importance will likely be limited.

White Crappie

Similar to black crappie, spring sampling showed that WCCL's white crappie were on the average large. One difference from the black crappie population is that the white crappie consistently have had wider size distributions over the years with broader representation of 2+ and 3+ aged fish in the 200-300 mm size range. As evidenced by the presence of RSD,Q-P sized fish (Appendix B, Figure 13), recruitment and growth of younger classes have occurred, but the high RSD-P indicates that this recruitment has been low. The older dominant year classes were reflected in the RSD,M-T and the RSD-T indices, which were relatively high. Willis (1984) surveyed results from 21 Kansas reservoirs and found the highest value for RSD,M-T and RSD-T classes combined to be 25 in Lovewell Reservoir. With a RSD,M-T value of 90 and a RSD-T of 3, WCCL was over three times higher. The lack of significant angler mortality and low intraspecific competition caused by low recruitment was believed to be why WCCL had high numbers of large crappie.

Smallmouth Bass

The smallmouth bass in WCCL has become an important and stable contribution to the predator population. Their numbers grew slowly through 1986 but in 1987 it expanded greatly in abundance and in its share of the fishery's biomass (WCNOC 1990). Data from 1991 showed continued increases in abundance (Table 2) and in biomass (Table 3).

The smallmouth length frequency distribution (Appendix B, Figure 14) shows the presence of many size classes with no single size dominating. This suggests good recruitment. The PSD-RSD indices lend further evidence for successful reproduction and recruitment (Appendix B, Figure 15). The smallmouth PSD has consistently been in the mid-range and good representation in the RSD Q-P and RSD P-M sizes indicates high recruitment. The percentage of trophy sized fish also increased in 1991. With another year of broad size distribution and strong recent year classes, the 1991 catch infers that the WCCL smallmouth bass population is still expanding and is one of the lake's more stable predator populations.

Bluegill

Bluegill in WCCL provide predators with a food supply during periods of low shad availability, thus tend to buffer the predators against losses due to starvation. Size frequency distributions of cooling lake bluegill have experienced some change since 1986. A trend since 1986 from dominance of larger fish (centered at 180 mm) to a situation in 1988 where smaller bluegills (centered at 80 mm) dominated (WCNOC 1989) was evident. In 1989, the larger percentage of bluegill sampled decreased again to around the 60 mm range. Since then the distribution has remained similar (Appendix B, Figure 16) indicating that this decrease in size trend has bottomed.

Bluegill tend to have high productivity and recruitment rates which lead to overcrowding and poor growth. This condition had a greater chance of occurring in WCCL when significant growth of pondweed (Potamogeton spp) began in 1984 and expanded through 1988. Although pondweed has generally been a factor causing decreased predation on YOY centrarchids (Glass 1971), it may also increase competition for food and reduce growth rates (Savino and Stein 1982). Food competition in WCCL was not specifically determined, but the declining PSD values (Appendix B, Figure 17) have shown that smaller bluegill have become a more prominent component of the WCCL population. The concurrent decrease in the largemouth bass dominance, which would be expected to reduce the number of smaller bluegill, may have played a role.

White Bass

The white bass in WCCL has developed a stable population. A large percentage of YOY fish from 175 mm to 230 mm was sampled in the fall of 1991 as was in 1990 (Appendix B, Figure 18). Recruitment of 1990 YOY into the 280 to 320 size range was also evident. The PSD/RSD indices reflect this high 1990 production (Appendix B, Figure 19). The lower PSD in 1990 was similar to 1986, another year when white bass produced high numbers. Monitoring in 1991 revealed that the 1990 production moved into the RSD,Q-P and RSD,P-M size classes. These size structure statistics have shown that WCCL white bass were on the average large and periodically produce large numbers of offspring.

CONDITION

Average condition of a fish species is an important variable for consideration by fishery managers because it indicates the average health or "plumpness" of a species. Condition can be averaged over a long period of time, for an entire population, or used for only a single fish. Since condition of a species may change over the course of a year due to variations in reproductive status or food availability, specific time periods are often targeted for between-impoundment or between-year comparisons. Coefficient of condition (K_{TL}) and relative weight Wr are two condition indices commonly used. The latter index is newer and easier to use since its calculation relies on comparisons with regional averages for weight at various lengths (Wege and Anderson 1978). Values of 100 would rank at the 75th percentile and higher or lower values would fall in the plumper 25% or thinner 74%, respectively. Since Wr is relatively new, regional standard values have not been formulated for all species, so use of K_{TL} may be necessary for some. Condition factors are most useful if compared with others from similar size categories. Of WCCL species considered, Wr was calculated for gizzard shad, largemouth bass, smallmouth bass, black crappie, white crappie and bluegill. For wipers and walleye, K_{TL} was used.

Gizzard Shad

Condition of WCCL gizzard shad fluctuated between months in 1991, but, by fall a mean Wr for all size classes combined measured 94 (Appendix A, Table 8). In a comparison between years, this ranks high indicating good health (Appendix B, Figure 20). Next to gizzard shad populations from 19 other Kansas reservoirs (Willis 1986), WCCL's Wr in 1991 was 4th from the top.

Shad populations with high PSD and a high mean Wr typically can produce abundant young over a relatively short spawning season (Willis 1986), but WCCL's population has not been consistent with this characterization. Shad spawns in WCCL have not appeared to be necessarily compressed into a short period. Using data from the July 1991 seining effort, two YOY length frequency modes were obvious with one centered around 40 mm and the other around 70 mm. Thermal discharge from the power plant was thought responsible for this as the larger YOY shad were almost exclusively caught in the heated areas. The small YOY fish were most prevalent in the areas where thermal effluents have little or no impacts. Given these factors, it was likely that in 1991 WCCL's shad population was performing at its utmost potential, with the possible exception of sufficient recruitment. By Kansas standards, the WCCL shad population's PSD and average Wr were high. The literature indicates that a population of mostly mature shad in excellent health such as WCCL's should produce high numbers of young, usually in one major spawn. The effect of the heated water has been to spread the spawning season of the WCCL population as a whole over a longer time period. This meant that the highest number of young fish were produced with wide variations in size. This allowed more of the annual shad production to be available longer to a wider size range of WCCL's predators which allowed the predator population to more efficiently control YOY shad density. This reduced catastrophic shad impingement potential on the power plant's cooling water intake screens.

Largemouth Bass

Condition of largemouth bass in WCCL was assessed using May and June data in 1991 because these were the spring months with highest catches (Appendix A, Table 9). Data from these two months were also used during past years. The 1991 largemouth catch was lower with only 23 fish greater than stock size sampled. These months combined gave average Wr values of 93 and 77 for quality and preferred size classes, respectively (Appendix B, Figure 21). Since only one "quality" size largemouth was caught, few comparisons to past years could be made. However, the mean of the preferred sized fish, with an overall Wr average of 77, fell below the 95-105 desirable range (Willis 1984). Considering the "predator-loaded" nature of WCCL (Table 4) and the resultant low gizzard shad biomass, such condition was neither surprising nor entirely undesirable. Since a primary objective of the WCCL fishery's establishment was to control excess shad production, lower than normal largemouth "plumpness" indicates a food-limited population which should be able to absorb annual fluctuations in shad production. Nevertheless, the continued slow decline in the average Wr is cause for concern and this index should be watched carefully in the future.

Smallmouth Bass

Condition of WCCL smallmouth bass has been assessed since 1987 using September and October data (Appendix B, Figure 22). Sample sizes prior to 1987 were too small to allow meaningful year to year comparisons. The average 1991 Wr for all size classes was 91, which was down from 1990 but similar to 1988 and 1989 levels. Monthly conditions in 1991 within each size class ranged low in the summer, but by fall Wr ranges appeared to narrow (Appendix A, Table 10). Although the Wr was down in 1991, the cooling lake's smallmouth population was still generally healthy and did not appear to be limited by low shad densities.

Wipers

Regional Wr equations have not yet been developed for wipers so K_{TL}'s have been calculated for months that they were collected in 1991 (Appendix A, Table 11). In October 1991 when highest catches were made, wiper average K_{TL} was 1.17. Condition data for a similar length range of wipers from Sebelius Reservoir, Kansas was 1.40 (S. Price, Kansas Wildlife and Parks, personal communication). That Sebelius wipers were plumper is not unexpected because gizzard shad were very abundant in that reservoir.

Contrary to the norm, the condition of WCCL wipers decreased as total length increased. Typically, K_{TL}'s increase with increasing lengths (Anderson and Gutreuter 1983). Because of this, comparisons between size groups of a specific population usually should not be made. However, the atypical inverse relationship among WCCL wipers added insight to this important, shad-controlling predator. As stated earlier, the 1988 and 1989 year class' total lengths overlapped with those of the much older 1981 year class'. Discrete principal modes related to a specific age in the length-frequency (Figure 6) distribution were difficult to determine, but scale age analysis revealed that generally the smaller end of the main mode was made up of the younger fish. The inverse K_{TL}/total length relationship for WCCL wipers indicate that the older, longer fish may be weakening and declining in health. As these fish age further and competition from the younger classes increase, they should fade from the WCCL population in the next few years.

Walleye

The walleye in WCCL have been sampled during October 1991 gill netting in a way which is comparable with the KDWP collections. This fall sample was used to calculate K_{TL}. October condition of walleye averaged 0.90 which was identical to 1990 (Appendix A, Table 11). Most WCCL walleye fell in the "quality-preferred" (375-499 mm) or the "preferred-memorable" (500-674 mm) size ranges (Figure 9), so WCCL average K_{TL}'s were compared with values from those size classes of walleye in other Kansas reservoirs. Twenty-three Kansas impoundments had mean K_{TL}'s for "quality-preferred" walleye ranging from 0.90 to 1.13 with a grand mean of 1.00 (Willis 1984). Twenty-one reservoirs had mean K_{TL}'s for "preferred-memorable" walleye from 0.95 to 1.19 with an overall mean of 1.07. The WCCL walleye K_{TL}'s in 1991 for the same size classes were 0.87 and 0.88, respectively. Clearly, these differences with WCCL were notable, but walleye condition in WCCL was not bad. The lower conditions did not appear to cause poor reproduction and recruitment of WCCL walleye. If the declining largemouth bass trend identified earlier continues, walleye condition may improve due to greater shad availability.

White Crappie

Condition of white crappie in WCCL has varied since 1985, particularly with respect to the different size classes (Appendix B, Figure 23). The trend of increasing condition with size class was obvious from cooling lake data and was also shown in statewide data from 22 other Kansas reservoirs (Willis 1984). The white crappie data from these 22 reservoirs were collected during the fall with some data from spring sampling being presented. Because of more consistent and higher catches during spring sampling efforts, year-to-year comparisons of WCCL crappie have used spring data. Hansen (1951) showed that white crappie condition reached a low in spring and summer and peaked in fall and winter. To try to reduce sampling season bias when comparing between reservoirs, fall WCCL data were analyzed. These place the condition (Wr) of cooling lake white crappie among the 22 Kansas reservoirs at 3rd, 5th, and 13th for Q-P, P-M, and M-T sized fish respectively. Available spring data from eight Kansas reservoirs (Willis 1984) revealed that in 1991 WCCL spring crappie Wr ranked last, 6th, and 4th in Q-P, P-M, and M-T categories respectively. In 1991 cooling lake white crappie were in similar condition during the fall but lower in the spring than Kansas reservoirs suggesting that forage for crappie became limited over the winter in the predator-laden WCCL.

Black Crappie

Black crappie Wr's resembled the condition found in the WCCL white crappie population, but not to such extremes (Appendix B, Figure 24). Black crappie showed the same trend of increasing condition with size, but when compared with the Kansas data for whites (Willis 1984), the black crappie were consistently at about the 25th percentile. Overall, in WCCL they were at or just below the targeted range for smaller sized fish and in the bottom half of the range for the larger sizes.

Bluegill

Bluegill in the cooling lake have usually shown highly variable condition among size classes (Appendix B, Figure 25). The Wr for bluegill in WCCL rose during 1991 and may have been a result of normal data fluctuation. In the past, mean Wr for bluegill had increased steadily through 1987. The Wr decline from 1988 through 1990 may be indicative of increased intraspecific competition due to either higher production rates or lower predation rates. This was also inferred by the declining PSD values discussed in the Growth and Structural Indices section. The 1991 Wr increase implied possible reduced production or sufficient predation. Future monitoring of this index should be watched as a declining trend will bring into question predator dominance in WCCL, especially that of the largemouth bass.

SUMMARY

During 1991 relative abundance of WCCL fishes varied from past years due largely as a reflection of YOY reproduction. Abundance of bluegill fell by 0.7% and that of gizzard shad rose by 0.7%. White bass abundance continued to rise in 1991. All together, the prey species in WCCL totaled 48.0% of all fish caught in 1991 but comprised less than 8% of the total biomass sampled. Wiper led all WCCL fishes in biomass with 17.3% due to growth of the 1988 and 1989 year classes. Walleye and white bass maintained a high percentage of the total biomass. Common carp biomass fell for the fourth consecutive year to 5.9%. Although the sportfish/predators didn't comprise as much of the biomass as earlier years, they still dominated the fishery at 64.6% of the 1990 total biomass with 35.4% remaining for forage, roughfish and others. These proportions were highly unusual when compared with other reservoirs in the country's midsection.

The relationship between WCCL's predators and roughfish has been somewhat stable thus far as a shift has been avoided towards the normal roughfish-dominated condition found as reservoirs age (Bennett 1970). Ordinarily, by WCCL's age, gizzard shad or some other clupeid has expanded greatly while predators have similarly declined (Jenkins and Morais 1971). In the cooling lake, predation pressure exerted by the abundant and diverse predator population was largely responsible for shad not yet expanding. Shad reproduction, based on adult PSD's and Wr's, should have been good in WCCL given certain assumptions (Willis 1984). Anderson (1983) cited low adult shad biomass as generally leading to greater YOY production, with exceptions occurring when adult biomass has been reduced to levels physically incapable of producing sufficient young. In WCCL, fall length frequency distributions of gizzard shad showed some YOY present although in very low densities by Kansas standards (Willis 1986). By midwinter, observations of discharge cove gizzard shad in WCCL over four winters have shown that few YOY remain and age data verified little or no representation by intermediate year classes. Reduced shad YOY recruitment was hypothesized to be the result of two impacts aided indirectly by the operation of the power plant. The first was based on the fact that annual die-offs of YOY shad have been shown to occur by the beginning of January in this part of the country (EA, Engineering, Science, and Technology, Inc. 1985). Also, WCGS had been down for refueling outages from early fall through the latter part of December or later during 1986 through 1988. Thus, at the time of year when the plant's warm water discharge might have helped WCCL shad avoid winter kill, it was not present. Collections in 1990 and 1991, however, did not show that constant operation of WCGS through the 1989-1990 and 1990-1991 winters reduced normal shad winter kill. This was where the second impact came into play. When the plant was operating and producing warm water during the cold winter months, both shad and predators moved into the discharge area in very high numbers. Older shad have little to fear due to their large size, but YOY shad, which were generally less than 180 mm were vulnerable to nearly all predators present. From this set of circumstances and the survival data available, it was apparent that gizzard shad recruitment through 1991 in WCCL has varied between little and none.

Wipers dominated WCCL biomass in 1985 and their decline in 1986 caused a prediction of an imminent die-off of the solitary 1981 year class (Wolf Creek Nuclear Operating Corporation 1987a). In defiance of this, 1987 wiper biomass remained steady and increased to the top position in 1988 and again in 1989. Nevertheless, this year class was still expected to fade and disappear. To establish younger year classes, spring 1988 and 1989 stockings of wiper fingerlings took place and recruitment of these has occurred. Growth of the younger classes occurred and has approached the size range of the slow growing 1981 year class. . Body condition declines in the older fish signalled that they were weakening and may be fading from the wiper population in WCCL.

Stock indices in general and PSD's in particular were very high for WCCL predators. This was a function of both very strong year classes when the reservoir was first filled and of recruitment levels which would not likely support the continuance of such numerically successful year classes. Such an adjustment was inevitable in a young impoundment, but the diverse and abundant predator array in the cooling lake should soften the impact of this transition with temporally staggered losses of dominant year classes with continued high predation pressure on gizzard shad.

When considering the health of WCCL fish species as a group, a split was seen between those which were dominant piscivores and the rest. Bluegills and gizzard shad had relatively high Wr's while largemouth bass, wiper, and walleye conditions were below Kansas averages. While it would be nice if all the piscivores relying on gizzard shad were plump, the cost for this increased condition may be more than WCGS would want to bear. If gizzard shad YOY became so abundant that there was a constant surplus available for predators, plant impingement rates would undoubtedly increase. Extremes of this have shut down numerous plants across the midwestern United States and Canada (B. Barrels, Nebraska Public Power District, personal communication; R. Lewis, Public Service of Indiana, personal communication; Bruce N.G.S. 1977). Given that the primary purpose of fish management at Wolf Creek was to enhance operability of the plant by controlling gizzard shad impingement, sub-par condition of its predators has been a discomfort which appears tolerable to achieve this end.

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APPENDIX A
TO 1991 WCGS OPERATIONAL
FISHERY MONITORING REPORT

Appendix A

List of Tables

TABLE 1. SUMMARY OF GEAR UTILIZED FOR STANDARDIZED FISH SURVEYS IN WOLF CREEK COOLING LAKE, 1991

Gear Type	Description(A)	Unit of Effort	Locations
Fyke Net	Large frame, 1.2 x 1.5 m (4 x 5 ft.) large, 2.5 cm (1 inch) and small, 1.3 cm (0.5 inch) bar mesh trap nets	Four net nights per location	Location 2 -WCCL causeway Location 6 -Saddle dam 4 -Main dam Location 8 -Baffle dike A -Dew Point
D.C. Electro-fishing	Boat mounted pulsed D.C. boom shocker with Plaster transformer unit and 3500 watt generator	Two 15 minute sub-samples per location	Location 2 -West causeway -East causeway Location 6 -Saddle dam 4 -Allen's cove Location 8 -Baffle dike A north end -Robinson's cove
Seining	15.2 x 1.8 m (50 x 6 ft.) bag seine with 0.6 cm (0.25 inch) mesh	Two-modified Swingle swings per location	Location 2 -West causeway -East causeway Location 6 -Saddle dam 4 -Main dam, east end Location 8 -Baffle dike A north end -Robinson's road
Gill Net	Uniform mesh flag nets 30.5 x 2.4 m (100 x 8 ft.) with monofilament panels of 2.5, 3.8, 6.4, 10.2 cm (1.0, 1.5, 2.5, 4.0 inch) bar mesh	Two complement net nights per location	Location 2 -WCCL causeway Location 6 -Saddle dam 4 -Main dam -Baffle dike A south end Location 8 -Baffle dike A, north end -UHS dam -Robinson's cove

(A) From A Manual of Survey Techniques for Reservoir Management, Kansas Fish and Game Commission.

TABLE 2. COMPARISON OF CATCH STATISTICS FROM WOLF CREEK COOLING LAKE AT WOLF CREEK GENERATING STATION USING A STANDARDIZED SAMPLING REGIME

	% RELATIVE ABUNDANCE						
Species	Preoperational 1983 to 1985 Average [A]	1986	1987	1988	1989	1990	1991
Gizzard shad	13.9	20.4	21.4	11.2	22.1	27.5	28.2
Common carp	1.1	2.6	2.5	3.0	2.0	1.7	1.1
Golden shiner	0.5	0.4	0.9	0.7	1.2	0.4	0.1
Ghost shiner	<0.1	-	-	-	-	-	<0.1
Red shiner	4.6	2.7	1.7	2.4	2.2	3.8	4.7
Notropis spp.	-[B]	0.6	-	-	-	-	-
Fathead minnow	<0.1	-	-	-	-	-	0.5
Bigmouth buffalo	<0.1	-	-	0.3	0.2	0.2	1.2
Smallmouth buffalo	<0.1	<0.1	0.4	1.0	0.1	0.4	0.8
Black bullhead	16.0	2.4	0.2	<0.1	-	-	-
Yellow bullhead	0.1	0.5	1.9	1.7	0.8	0.2	0.2
Channel catfish	1.1	2.6	1.9	2.9	2.1	4.3	2.7
Blue catfish	-	<0.1	-	-	-	<0.1	0.1
Flathead catfish	-	-	-	-	-	0.4	0.6
Blackstripe topminnow	-	<0.1	<0.1	0.1	0.1	0.2	0.2
Mosquitofish	-	<0.1	-	<0.1	0.1	0.1	0.3
White bass	3.5	5.1	3.7	5.2	8.1	10.2	14.4
Striped bass	0.1	<0.1	<0.1	-	<0.1	<0.1	-
Wiper	1.8	3.0	2.5	4.2	5.5	3.9	4.5
Morone spp.	<0.4	0.5	0.1	0.5	0.6	<0.1	-
Brook silverside	0.9	0.6	1.9	3.6	1.0	5.0	1.1
Green sunfish	2.6	2.1	10.6	4.0	2.0	1.2	0.9
Longear sunfish	<0.1	0.2	<0.1	0.1	<0.1	0.1	0.1
Orangespotted sunfish	<0.2	0.3	0.1	-	0.2	0.1	0.1
Bluegill	18.5	30.4	23.5	27.4	21.7	11.9	11.2
Lepomis spp.	12.9	<0.1	-	-	0.2	0.1	0.1
Smallmouth bass	0.5	1.0	3.2	3.8	5.1	5.3	7.1
Largemouth bass	7.4	10.5	7.2	8.2	9.5	6.1	4.5
White crappie	1.5	3.1	6.1	6.9	3.9	4.6	4.6
Black crappie	8.2	4.3	4.9	3.4	3.0	1.9	3.6
Walleye	2.4	4.7	3.6	6.7	5.8	7.6	5.0
Logperch	0.3	0.4	0.2	0.5	0.6	0.4	0.4
Freshwater drum	0.7	1.3	1.2	1.7	1.5	2.5	1.5
Total No.	6,734	4,500	4,037	3,313	2,957	2,706	2,613

(A) Includes otter trawling.

(B) None collected in standardized efforts.

TABLE 3. PERCENT BIOMASS OF WCCL SPECIES COLLECTED WITH STANDARDIZED SAMPLING REGIME

Species	Preoperational 1983-1985 Average %	1986 %	1987 %	1988 %	1989 %	1990 %	1991 %
Gizzard shad	3.9	5.3	3.6	2.3	4.4	3.9	5.9
Common carp	14.1	15.9	17.3	13.7	11.8	9.1	5.9
Bigmouth Buffalo	<0.2	0.0	0.2	3.0	2.3	2.0	10.7
Smallmouth buffalo	1.4	0.9	5.2	7.2	0.6	2.9	6.0
Black bullhead	9.7	1.6	0.1	0.1	0.0	0.0	0.0
Yellow Bullhead	<0.1	0.3	0.9	0.6	0.3	0.1	0.1
Channel catfish	8.8	11.7	7.1	9.0	7.7	15.5	5.6
White bass	7.4	6.9	6.4	6.1	11.6	7.6	14.6
Striped bass	2.0	0.6	1.6	0.0	0.1	0.2	0.0
Wiper	15.5	13.6	13.8	16.5	21.2	13.9	17.3
Bluegill	2.7	1.7	1.4	0.9	1.2	0.5	0.6
Smallmouth bass	1.1	1.8	3.3	2.2	3.8	5.7	6.1
Largemouth bass	14.7	18.8	11.9	10.8	13.6	8.6	4.7
White crappie	1.7	4.2	8.9	9.3	4.2	7.2	5.5
Black crappie	5.5	3.2	5.7	3.0	2.5	2.7	2.5
Walleye	8.4	10.9	9.4	13.1	12.4	16.7	10.8
Freshwater drum	0.5	1.6	1.9	1.1	1.5	2.5	1.5
Other taxa	2.6	1.3	1.5	1.1	0.8	0.9	2.2
Total Biomass (kg)	1035	1222	1193	1386	1113	980	1083

TABLE 4. COMPARISON OF RELATIVE PERCENT FISH BIOMASS FOR SELECTED MIDWESTERN RESERVOIRS

	RESERVOIRS					
SPECIES	Clinton (Ill.) (1981 ha)(A)	Shelbyville (Ill.) (4452 ha)(B)	Spence (Tex.) (6000 ha)(C)	Marion (Ks.) (2510 ha)(D)	Perry (Ks.) (4950 ha)(D)	Wolf Creek (Ks.) (2060 ha)(E)
Bowfin	--	3.7	--	--	--	--
Gizzard shad	11	38.2	32.8	31.3	31.1	5.9
Northern pike	--	--	--	2.4	--	--
Tiger musky	7	--	--	--	--	--
Common carp	42	25.7	22.1	51.2	31.7	5.9
Golden shiner	--	--	--	0.3	--	<0.1
Red shiner	--	--	--	0.2	--	0.1
River carpsucker	--	1.4	8.9	5.8	7.2	--
Quillback	5	--	--	--	--	--
Smallmouth buffalo	--	--	--	--	0.4	6.0
Bigmouth buffalo	7	2.0	--	--	0.6	10.7
Golden redhorse	2	--	--	--	--	--
Shorthead redhorse	2	--	--	--	--	--
Black bullhead	--	--	--	0.5	--	0.0
Yellow bullhead	--	0.4	--	--	--	0.1
Channel catfish	1	--	5.1	<0.1	6.3	5.9
Flathead catfish	1	--	--	--	5.4	1.2
Blackstripe topminnow	--	--	--	<0.1	--	<0.1
Brook silverside	--	--	--	<0.1	--	<0.1
White bass	--	3.3	--	0.5	--	14.6
Striped bass	--	--	--	--	0.4	--
Striped X white bass hybrid	--	--	--	--	--	17.3
Green sunfish	1	0.4	--	0.4	0.7	0.1
Orangespotted sunfish	--	--	--	0.2	--	<0.1
Bluegill	2	3.1	4.8	0.2	3.5	0.6
Hybrid sunfish	--	--	--	--	--	<0.1
Longear sunfish	--	0.9	--	<0.1	--	<0.1
Smallmouth bass	0.1	--	--	--	--	6.1
Largemouth bass	9	6.1	2.1	2.2	0.8	4.7
White crappie	5	1.1	2.0	0.3	5.6	5.5
Black crappie	--	--	--	<0.1	--	2.5
Logperch	--	--	--	<0.1	--	<0.1
Walleye	4	6.3	--	0.2	--	10.8
Freshwater drum	--	2.0	17.4	3.3	6.2	1.5
Other taxa	--	--	4.8	0.1	<0.1	<0.6
% of Total Biomass	99	94.5	100.0	>99.1	>99.9	>99.9
% of Roughfish	69	73.4	81.2	92.1	77.2	30.1
Total # of Species	33	14	>9	22	14	29

(A) Data from Illinois Power Company (1987) (1978-1986 electrofishing collections, filled 1978).
(B) Data from Electric Power Research Institute (1979).
(C) Data from Crandall (1978) (August, 1978 cove rotenone sample).
(D) Data from D.W. Willis, 1986b, personal communication (Marion; August, 1975 cove rotenone sample and Perry; 1982 cove rotenone sample).
(E) Data from 1991 study representing total annual biomass from standardized samples.

TABLE 5. AVERAGE ANNUAL CATCH PER UNIT EFFORT (CPUE) BY GEAR TYPE FOR FISH COLLECTED FROM WOLF CREEK COOLING LAKE, 1982-1991

Species	Year	Gear (A) FK	EF	SN	OT	GN
Gizzard shad	1982	0.0	7.2	5.8	10.9	0.2
	1983	0.8	9.4	7.5	16.4	0.2
	1984	0.2	13.9	4.9	30.5	0.4
	1985	<0.1	9.4	1.7	3.1	<0.1
	1986	<0.1	27.3	5.1	--	0.4
	1987	<0.1	26.3	7.0	--	0.1
	1988	<0.1	16.0	11.2	--	0.2
	1989	<0.1	35.5	4.3	--	0.3
	1990	<0.1	34.3	8.3	--	0.1
	1991	0.0	25.8	15.3	--	0.2
Channel catfish	1982	0.0	0.0	0.3	0.0	0.2
	1983	<0.1	0.3	0.1	<0.1	0.2
	1984	<0.1	0.5	0.0	<0.1	0.2
	1985	<0.1	0.3	0.0	<0.1	0.2
	1986	<0.1	2.3	0.0	--	0.2
	1987	<0.1	1.5	<0.1	0.0	0.1
	1988	<0.1	1.8	0.0	--	0.1
	1989	<0.1	1.9	0.1	--	0.1
	1990	<0.1	2.8	<0.1	--	0.2
	1991	<0.1	1.7	0.4	--	0.1
White bass	1982	0.0	0.0	2.9	0.0	0.1
	1983	<0.1	0.5	1.0	<0.1	0.4
	1984	0.3	3.6	0.9	7.4	0.3
	1985	0.2	2.3	0.0	0.0	<0.1
	1986	0.3	1.7	0.4	--	0.3
	1987	<0.1	1.0	<0.1	--	0.3
	1988	<0.1	0.8	<0.1	--	0.3
	1989	0.1	2.4	<0.1	--	0.4
	1990	0.2	2.0	0.4	--	0.5
	1991	0.4	3.2	0.1	--	0.6
Wiper	1982	0.0	0.0	0.2	0.0	0.6
	1983	<0.1	0.0	0.1	0.0	0.4
	1984	0.0	0.7	0.0	0.0	0.2
	1985	0.1	0.4	0.0	0.0	0.4
	1986	0.1	0.5	0.0	--	0.2
	1987	<0.1	0.3	0.0	--	0.3
	1988	<0.1	0.8	<0.1	--	0.4
	1989	<0.1	0.1	0.0	--	0.3
	1990	0.1	0.6	0.0	--	0.1
	1991	0.1	1.7	0.0	--	0.2

TABLE 5. (CONT.)

Species	Year	Gear (A) FK	EF	SN	OT	GN
Bluegill	1982	<0.1	1.8	5.7	* (B)	*
	1983	0.8	7.4	7.9	2.5	<0.1
	1984	0.5	8.7	6.9	29.4	0.1
	1985	0.1	9.6	19.1	39.8	<0.1
	1986	<0.1	9.3	32.0	--	<0.1
	1987	<0.1	40.5	13.8	--	<0.1
	1988	0.1	16.4	13.0	--	<0.1
	1989	<0.1	12.2	12.4	--	<0.1
	1990	<0.1	7.5	5.9	--	<0.1
	1991	<0.1	6.3	5.1	--	<0.1
Smallmouth bass	1982	0.0	0.3	0.1	0.0	*
	1983	<0.1	1.8	0.1	<0.1	0.0
	1984	<0.1	2.0	0.1	<0.1	<0.1
	1985	0.0	2.3	<0.1	0.1	0.0
	1986	<0.1	1.6	0.1	--	0.0
	1987	<0.1	4.8	0.2	--	<0.1
	1988	<0.1	4.2	0.3	--	<0.1
	1989	<0.1	5.4	0.8	--	<0.1
	1990	<0.1	5.3	0.3	--	<0.1
	1991	<0.1	7.5	1.5	--	<0.1
Largemouth bass	1982	<0.1	2.3	3.1	0.6	<0.1
	1983	0.1	12.5	2.0	0.5	0.1
	1984	0.2	12.9	1.0	0.5	<0.1
	1985	0.2	12.7	3.3	1.6	<0.1
	1986	<0.1	15.3	3.2	--	<0.1
	1987	<0.1	9.7	3.6	--	<0.1
	1988	<0.1	9.7	2.8	--	<0.1
	1989	<0.1	9.8	3.7	--	<0.1
	1990	<0.1	5.2	1.0	--	<0.1
	1991	<0.1	3.7	1.4	--	<0.1
White crappie	1982	0.1	0.0	0.1	*	<0.1
	1983	0.1	0.1	0.9	0.1	<0.1
	1984	0.3	0.2	0.1	0.3	0.1
	1985	0.3	1.2	0.5	0.3	<0.1
	1986	0.2	1.4	0.4	--	<0.1
	1987	0.6	1.8	<0.1	--	<0.1
	1988	0.5	0.4	0.3	--	0.1
	1989	0.2	1.3	0.2	--	0.1
	1990	0.3	1.0	0.0	--	<0.1
	1991	0.2	0.7	0.5	--	0.1

TABLE 5. (CONT)

Species	Year	Gear (A) FK	EF	SN	OT	GN
Black crappie	1982	0.1	0.3	0.1	*	<0.1
	1983	1.0	1.0	2.6	0.5	0.1
	1984	1.2	1.7	3.8	4.1	0.2
	1985	1.9	2.3	0.8	0.8	<0.1
	1986	0.2	3.0	1.0	--	<0.1
	1987	0.5	1.4	0.2	--	<0.1
	1988	0.2	1.5	0.3	--	<0.1
	1989	0.2	1.0	0.5	--	<0.1
	1990	0.1	0.7	<0.1	--	<0.1
	1991	0.2	0.6	1.6	--	<0.1
Walleye	1982	<0.1	0.0	0.3	*	<0.1
	1983	0.0	0.5	0.0	0.0	0.1
	1984	0.1	0.5	0.0	0.1	0.4
	1985	0.5	0.4	<0.1	<0.1	0.4
	1986	0.5	0.5	0.0	--	0.2
	1987	0.1	0.4	0.0	--	0.2
	1988	0.3	0.8	<0.1	--	0.3
	1989	0.1	0.7	<0.1	--	0.3
	1990	0.3	0.8	<0.1	--	0.2
	1991	0.2	0.9	0.0	--	0.3
Total fish	1982	12.4	14.7	56.4	21.1	1.9
	1983	10.1	50.5	36.0	63.7	2.5
	1984	7.5	56.6	31.2	105.7	7.2
	1985	3.2	67.8	41.2	79.3	1.4
	1986	1.9	74.6	55.2	--	1.7
	1987	1.7	115.1	32.6	--	1.4
	1988	1.5	65.1	35.8	--	1.8
	1989	0.7	80.8	27.7	--	1.9
	1990	1.1	66.8	21.8	--	1.4
	1991	1.1	58.0	37.2	--	1.8

(A) FK = Fyke Net, EF = Electrofishing, SN = Seine, OT = Trawl, and GN = Gill Net.
(B) Not calculated.

NOTE: Units of effort for FK = # per hour; EF = # per 30 minutes; SN = # per haul; OT = # per 5 minutes; and GN = # per hour.

TABLE 6. JUVENILE GIZZARD SHAD CATCHES IN WOLF CREEK COOLING LAKE USING 20 SWINGLE SWING EFFORTS, 1984-1991

	Catch (Avg. #/haul)					
	May	June	July	Aug	Sept	Oct
1984				10.5		
1985		31.6	11.5	1.8		
1986	0.1	24.4	13.8	2.7	9.6	1.2
1987	0.0	1.4	0.0	0.6	40.0	0.2
1988	0.0	48.8	1.4	3.3	13.5	<0.1
1989	4.6	4.6	12.5	3.1	1.1	0.0
1990	0.0	24.3	21.3	3.2	0.7	0.1
1991	0.3	51.3	24.1	2.1	3.0	0.0*

* October seine hauls were not completed. Six hauls were completed during November with none captured.

TABLE 7. JUVENILE GIZZARD SHAD SHORELINE SEINING DATA FROM KANSAS RESERVOIRS IN MID-AUGUST 1984(1) AND FROM WOLF CREEK COOLING LAKE THROUGH 1991

IMPOUNDMENT	Mean # of Shad per Seine Haul							
	1984	1985	1986	1987	1988	1989	1990	1991
Lovewell	345.2							
Webster	246.6							
Cedar Bluff	101.6							
Cheney	99.3							
Glen Elder	88.2							
Perry	83.0							
Melvern	72.8							
Wilson	67.4							
Tuttle Creek	64.3							
Clinton	56.7							
Milford	54.9							
Hillsdale	47.4							
Winfield City Lake	47.0							
Fall River	36.1							
Pomona	26.8							
Elk City	21.4							
LaCygne	20.7							
Kanopolis	19.4							
El Dorado	15.9							
John Redmond	13.3							
Wolf Creek	10.5	1.8	2.7	0.6	3.3	3.1	3.2	2.1
Marion	2.0							
Statewide Average	70.0	70.0	(2)	(2)	(2)	(2)	(2)	(2)

(1) Twenty Single Swings from each reservoir using a 50 foot bag seine with 1/4 inch mesh. Effort facilitated by Kansas Fish and Game and directed by D. Willis. Data used with permission of D. Willis.

(2) No statewide average calculated since 1986.

TABLE 8. RELATIVE WEIGHT (Wr) VALUES OF WOLF CREEK COOLING LAKE GIZZARD SHAD FOR SELECTED MONTHS IN 1991

CATEGORY	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
STOCK (180-279 mm)							
$\bar{X}$	-	117	-	97	103	-	91
Range	-	110-129	-	-	-	-	80-104
N	0	3	0	1	1	0	34
QUALITY (>280 mm)							
$\bar{X}$	-	102	89	89	95	83	94
Range	-	92-109	83-95	81-95	82-108	56-107	67-214
N	0	4	6	7	11	10	86
MONTHLY $\bar{X}$	-	109	89	90	95	83	94
MONTHLY RANGE	-	92-129	83-95	81-97	82-108	56-107	67-214
TOTAL N	0	7	6	8	12	10	120

TABLE 9. RELATIVE WEIGHT (Wr) VALUES OF WOLF CREEK COOLING LAKE LARGEMOUTH BASS FOR SELECTED MONTHS IN 1991

CATEGORY	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
STOCK (200-299 mm)							
$\bar{X}$	0	-	-	88	120	109	105
Range	-	-	-	-	120-120	92-118	92-146
N	-	0	0	1	2	10	23
QUALITY (300-379 mm)							
$\bar{X}$	0	0	93	94	101	77	98
Range	-	-	-	87-101	-	-	-
N	-	0	1	2	1	1	1
PREFERRED (380-509 mm)							
$\bar{X}$	83	75	82	76	77	77	90
Range	73-95	50-92	72-100	58-89	69-86	52-96	76-107
N	3	15	7	5	2	6	19
MEMORABLE (510-629 mm)							
$\bar{X}$	-	-	-	-	-	-	-
Range	-	-	-	-	-	-	-
N	0	0	0	0	0	0	0
MONTHLY $\bar{X}$	83	75	84	82	99	96	98
MONTHLY RANGE	73-95	50-92	72-100	58-101	69-120	52-118	76-146
TOTAL N	3	15	8	8	5	17	43

TABLE 10. RELATIVE WEIGHT (Wr) VALUES OF WOLF CREEK COOLING LAKE SMALLMOUTH BASS FOR SELECTED MONTHS IN 1991

CATEGORY	APRIL	MAY	JUNE	JULY	AUGUST	SEPTEMBER	OCTOBER
STOCK (180-279 mm)							
$\bar{X}$	-	98	92	-	125	93	92
Range	-	81-152	85-97	-	91-244	64-117	84-102
N	0	9	5	0	6	23	10
QUALITY (280-349 mm)							
$\bar{X}$	-	96	91	67	122	92	89
Range	-	90-102	85-101	39-95	89-246	69-107	75-103
N	0	6	4	2	7	10	11
PREFERRED (350-429 mm)							
$\bar{X}$	-	84	86	68	78	86	91
Range	-	73-96	77-95	44-88	56-93	58-109	79-115
N	0	15	4	4	4	10	19
MEMORABLE (430-509 mm)							
$\bar{X}$	-	86	-	-	-	65	81
Range	-	79-90	-	-	-	56-73	81-81
N	0	3	0	0	0	3	2
TROPHY (510 + mm)							
$\bar{X}$	-	-	-	-	-	128	-
Range	-	-	-	-	-	-	-
N	0	0	0	0	0	1	0
MONTHLY $\bar{X}$	-	86	90	68	113	90	91
MONTHLY RANGE	-	73-152	77-101	39-95	56-246	56-128	75-115
TOTAL N	0	33	13	6	17	47	42

TABLE 11. AVERAGE MONTHLY COEFFICIENT OF CONDITION (K_{TL}) FOR WIPER HYBRIDS AND WALLEYE IN WOLF CREEK COOLING LAKE IN 1991

WIPERS

MONTHS COLLECTED	N	MEAN COND(K)	MEAN LENGTH(mm)	LENGTH RANGE(mm)	MEAN WEIGHT(g)	WEIGHT RANGE(g)
April	13	1.24	510	426-568	1660	1060-2000
September	6	1.04	505	463-538	1342	1050-1700
October	176	1.17	515	406-676	1575	670-2550

WALLEYE

MONTHS COLLECTED	N	MEAN COND(K)	MEAN LENGTH(mm)	LENGTH RANGE(mm)	MEAN WEIGHT(g)	WEIGHT RANGE(g)
April	50	0.93	456	380-540	893	515-1500
June	1	0.79	519	-		-
July	1	0.74	435	-	610	-
August	3	0.79	492	471-509	940	790-1090
September	5	0.76	506	480-528	989	890-1075
October	160	0.90	444	255-625	842	160-3460

APPENDIX B
TO 1991 WCGS OPERATIONAL
FISHERY MONITORING REPORT

Appendix B

List of Figures

List of Figures, (cont.)

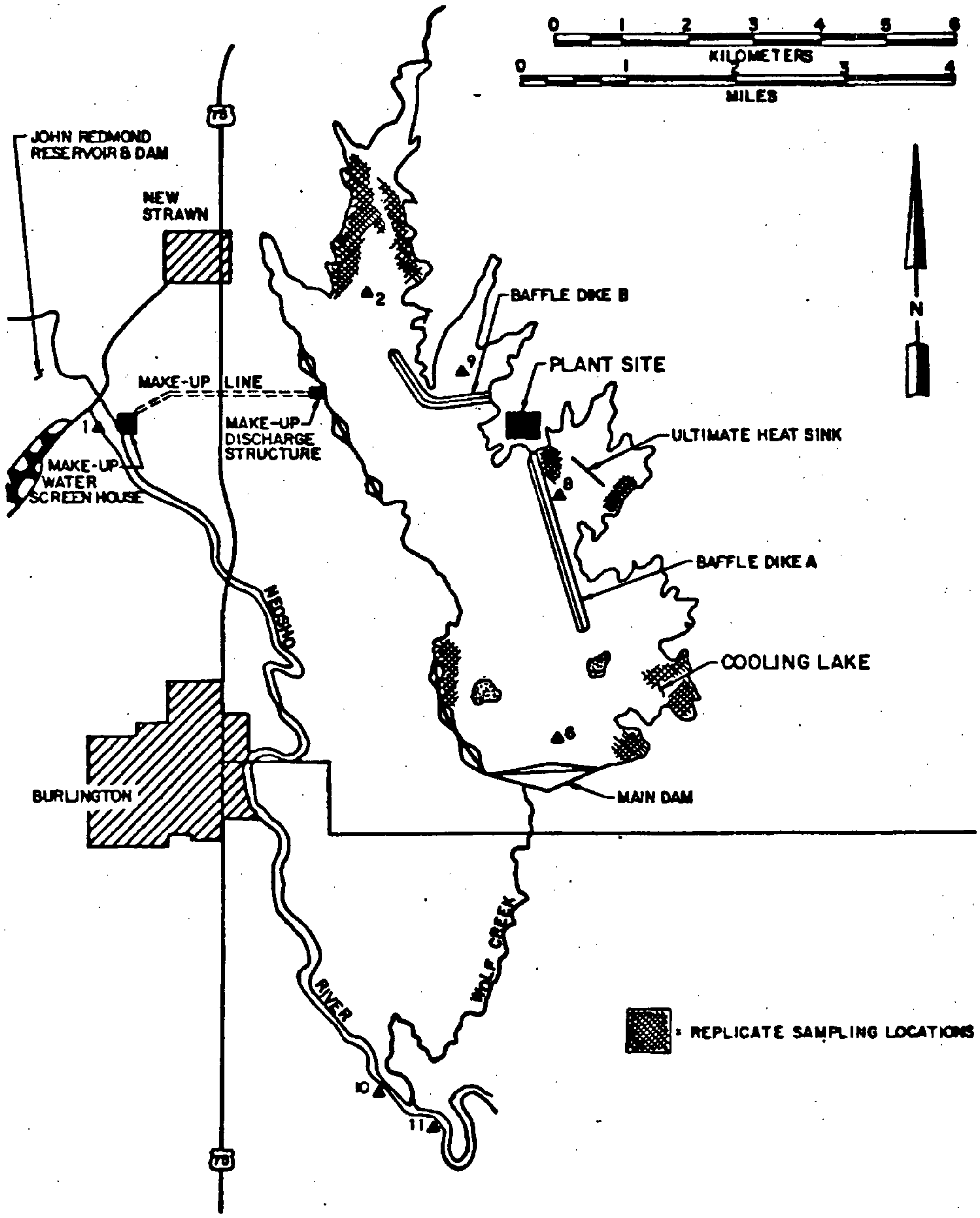


FIGURE 1. FISHERY SAMPLING LOCATIONS IN THE VICINITY OF WOLF CREEK GENERATING STATION

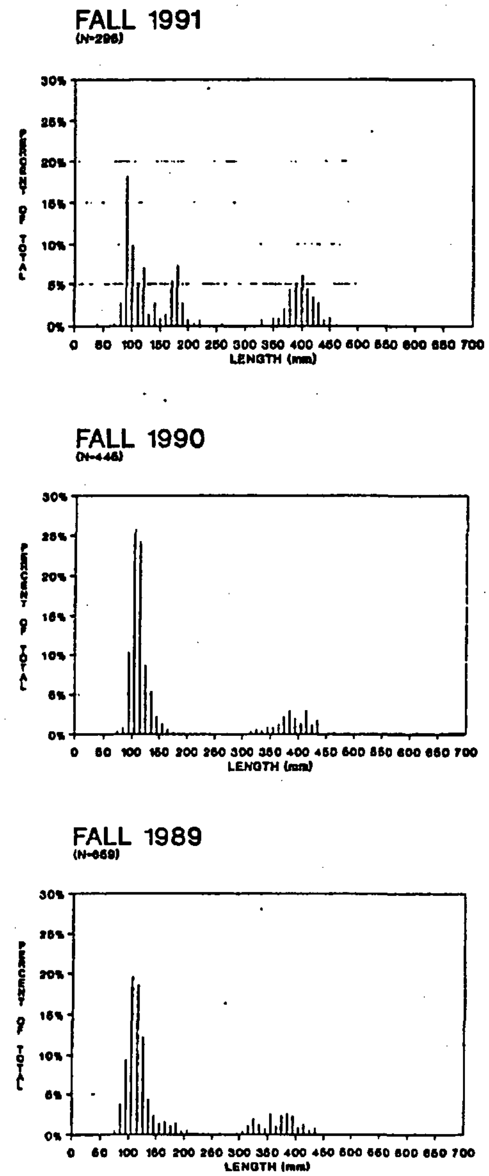
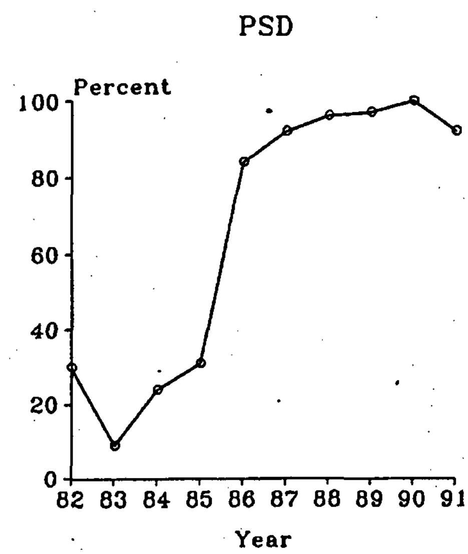


FIGURE 2. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF GIZZARD SHAD COLLECTED FROM WOLF CREEK COOLING LAKE



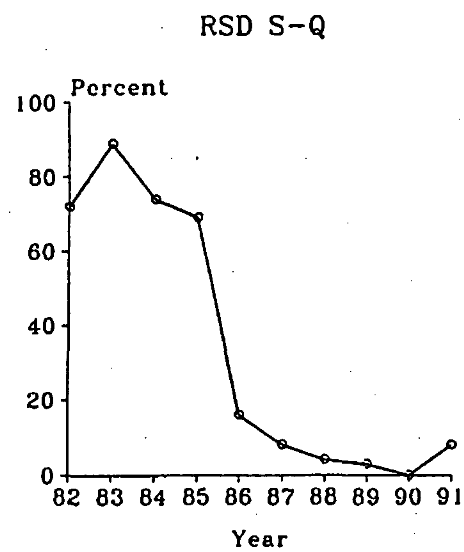


FIGURE 3. FALL GIZZARD SHAD PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FROM CORRECTED (WILLIS et al. 1983) WOLF CREEK COOLING LAKE GILL NET CATCHES S-Q=180-279 mm. Q-P=280-349 mm

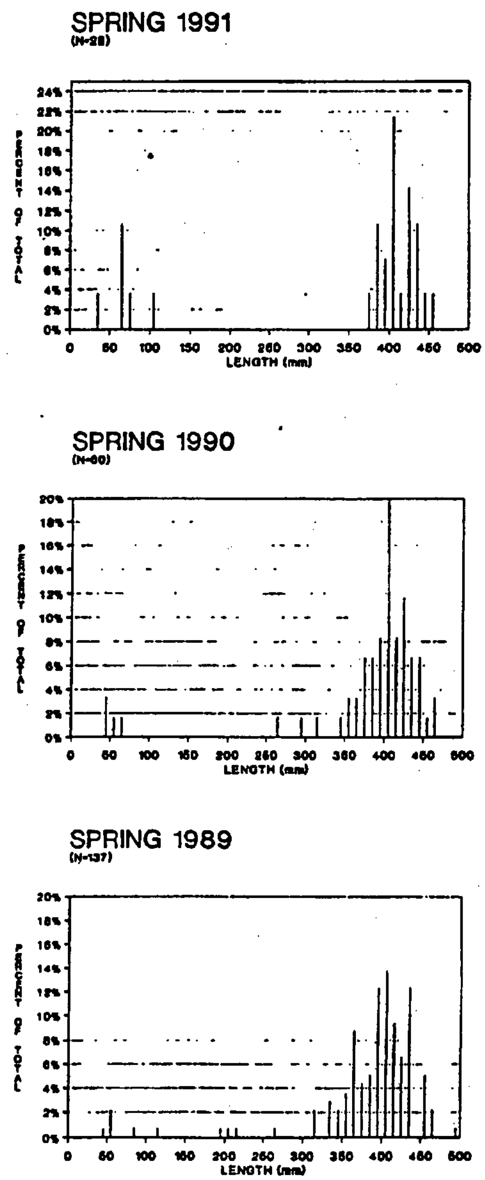


FIGURE 4. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF SPRING SAMPLED LARGEMOUTH BASS COLLECTED FROM WOLF CREEK COOLING LAKE

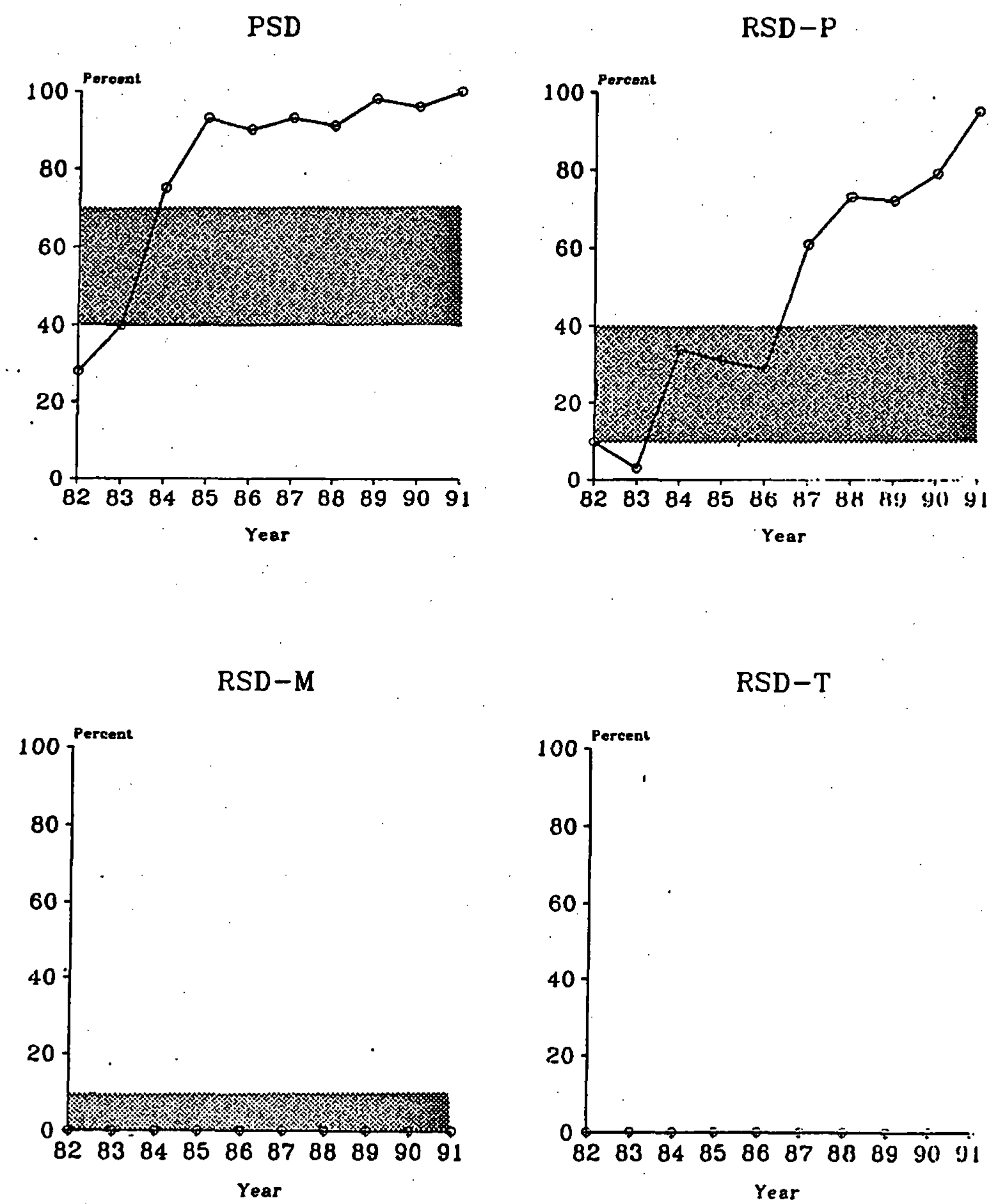


FIGURE 5. SPRING LARGEMOUTH BASS PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FROM WOLF CREEK COOLING LAKE ELECTROFISHING. S-Q=200-299 mm. Q-P=300-379 mm. P-M=380-509 mm. M-T=510-629 mm. T≥630 mm. SHADED AREA REPRESENTS PROPOSED OBJECTIVE RANGE (WILLIS, 1984)

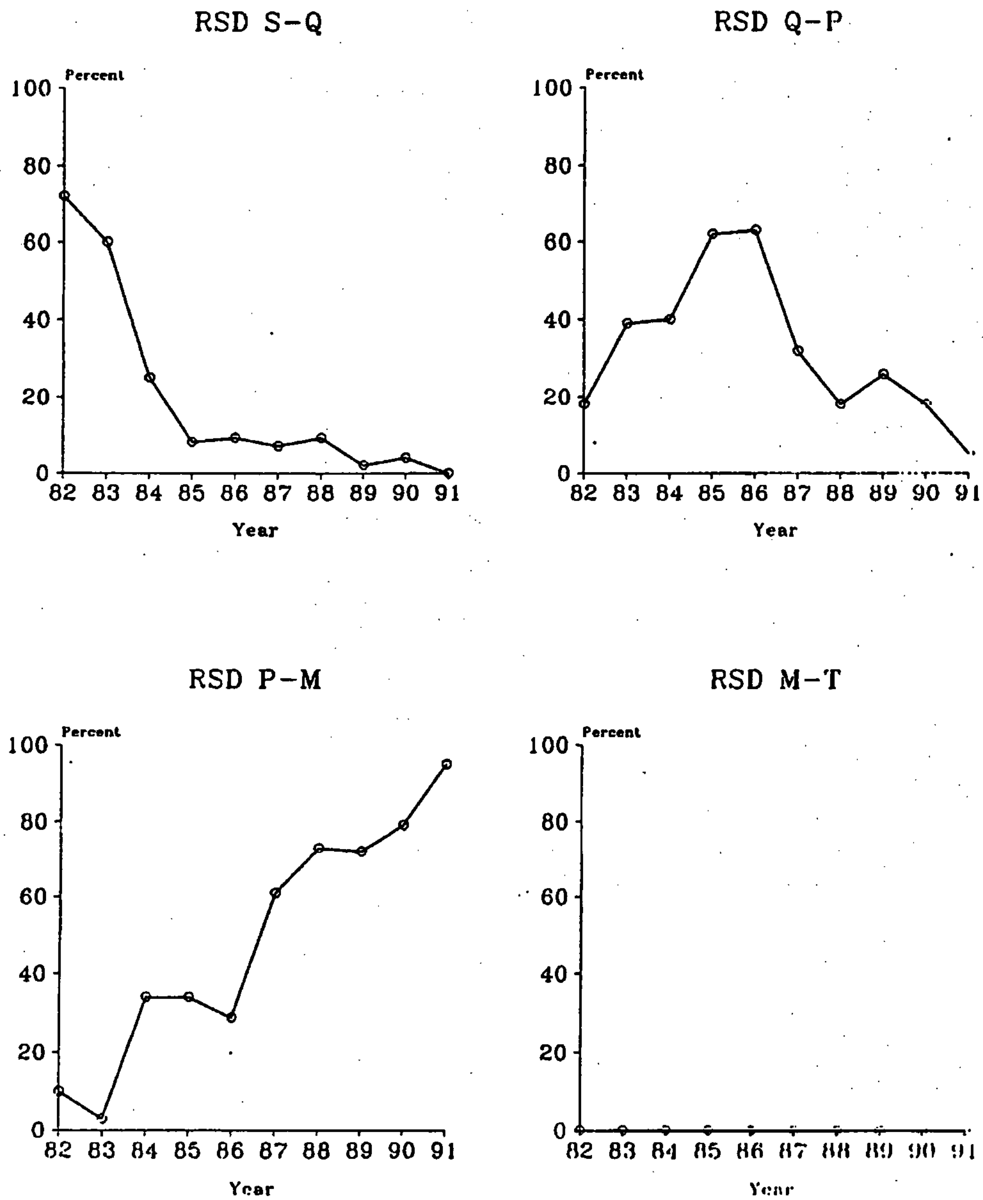
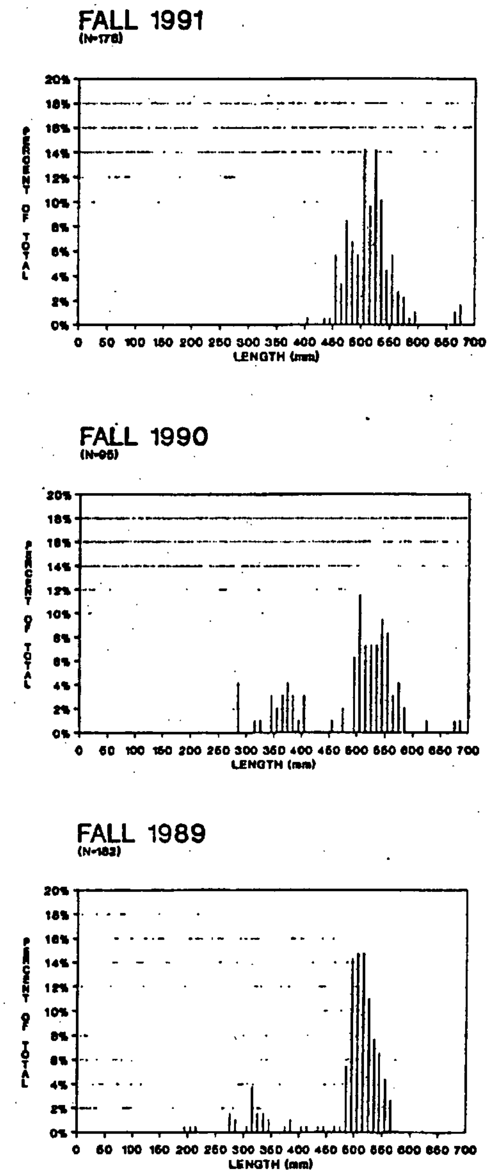


FIGURE 5. CONT. SPRING LARGEMOUTH BASS PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FROM WOLF CREEK COOLING LAKE ELECTRO-FISHING. S-Q=200-299 mm. Q-P=300-379 mm. P-M=380-509 mm. M-T=510-629 mm. T$\geq$630 mm. SHADED AREA REPRESENTS PROPOSED OBJECTIVE RANGE (WILLIS, 1984)



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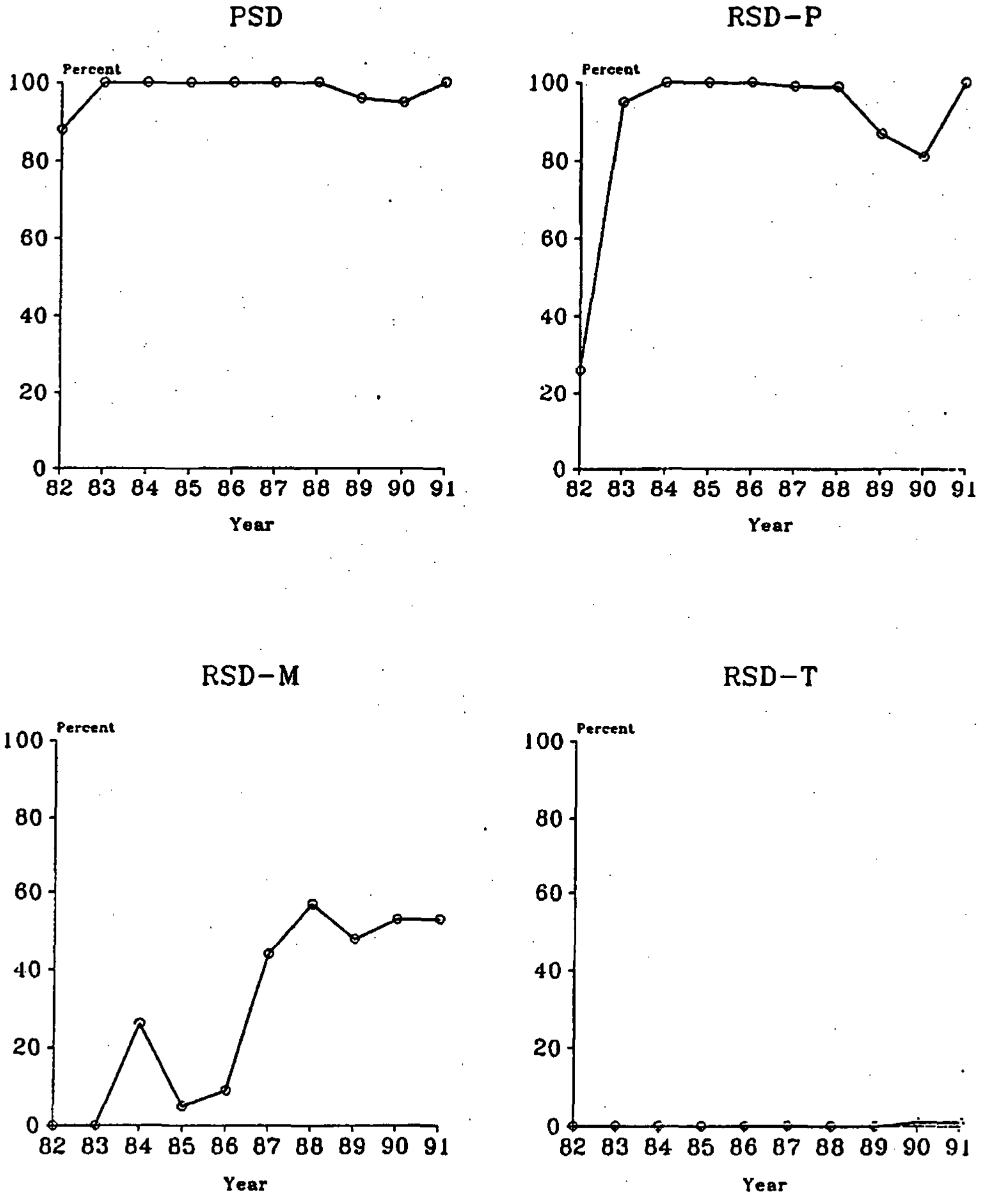

FIGURE 7. FALL WIPER PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FOR WOLF CREEK COOLING LAKE GILL NETTING. S-Q=200-299 mm. Q-P=300-374 mm. P-M=375-499 mm. M-T=500-625 mm. T≥625 mm

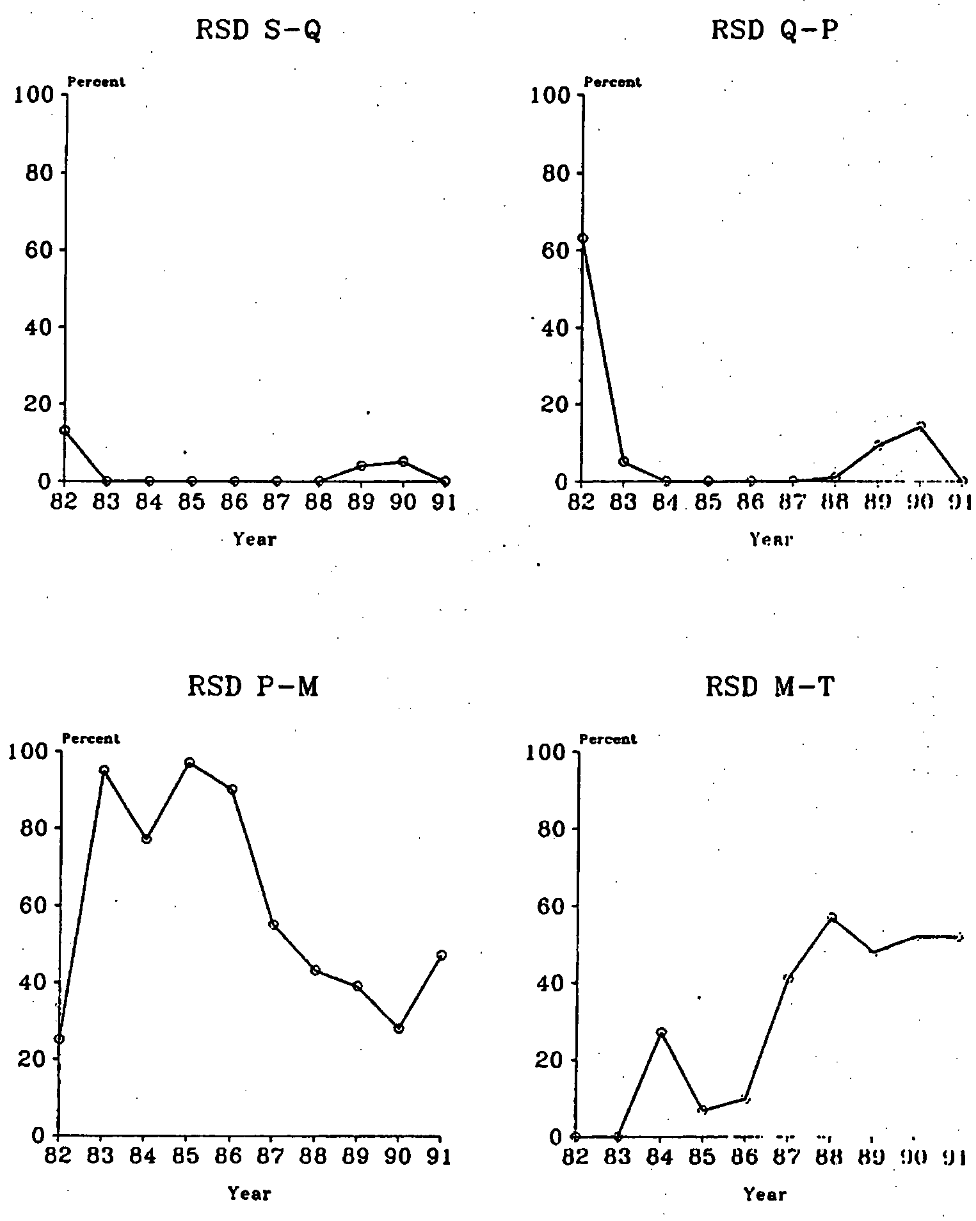

FIGURE 7. FALL WIPER PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD)
CONT. RELATIONSHIPS FOR WOLF CREEK COOLING LAKE GILL NETTING.
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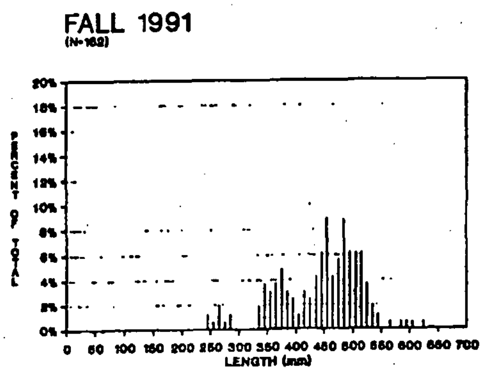
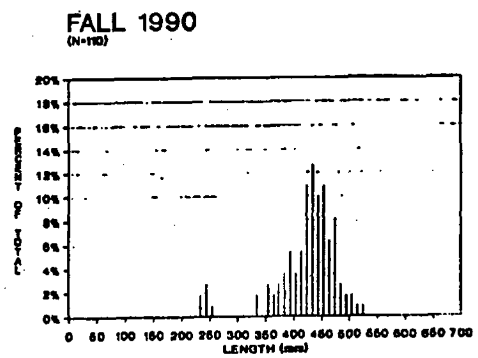




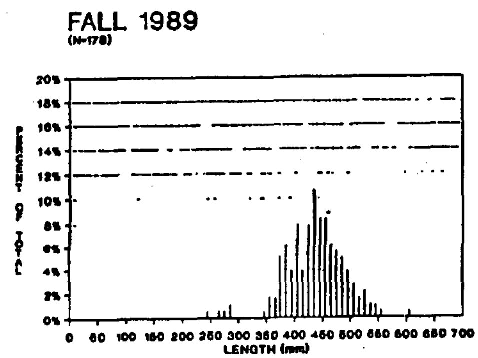


FIGURE 8. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF FALL SAMPLED WALLEYE COLLECTED FROM WOLF CREEK COOLING LAKE

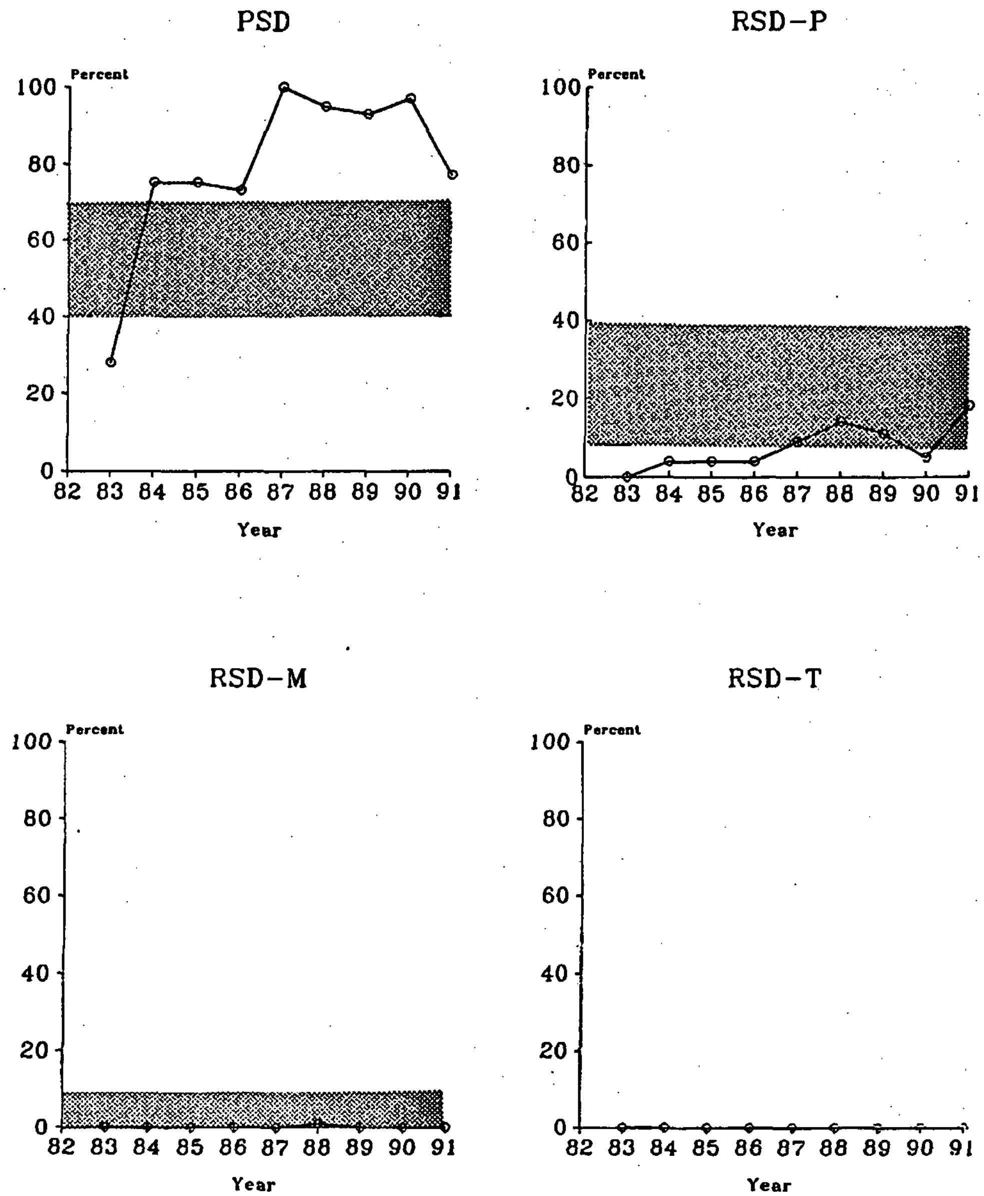
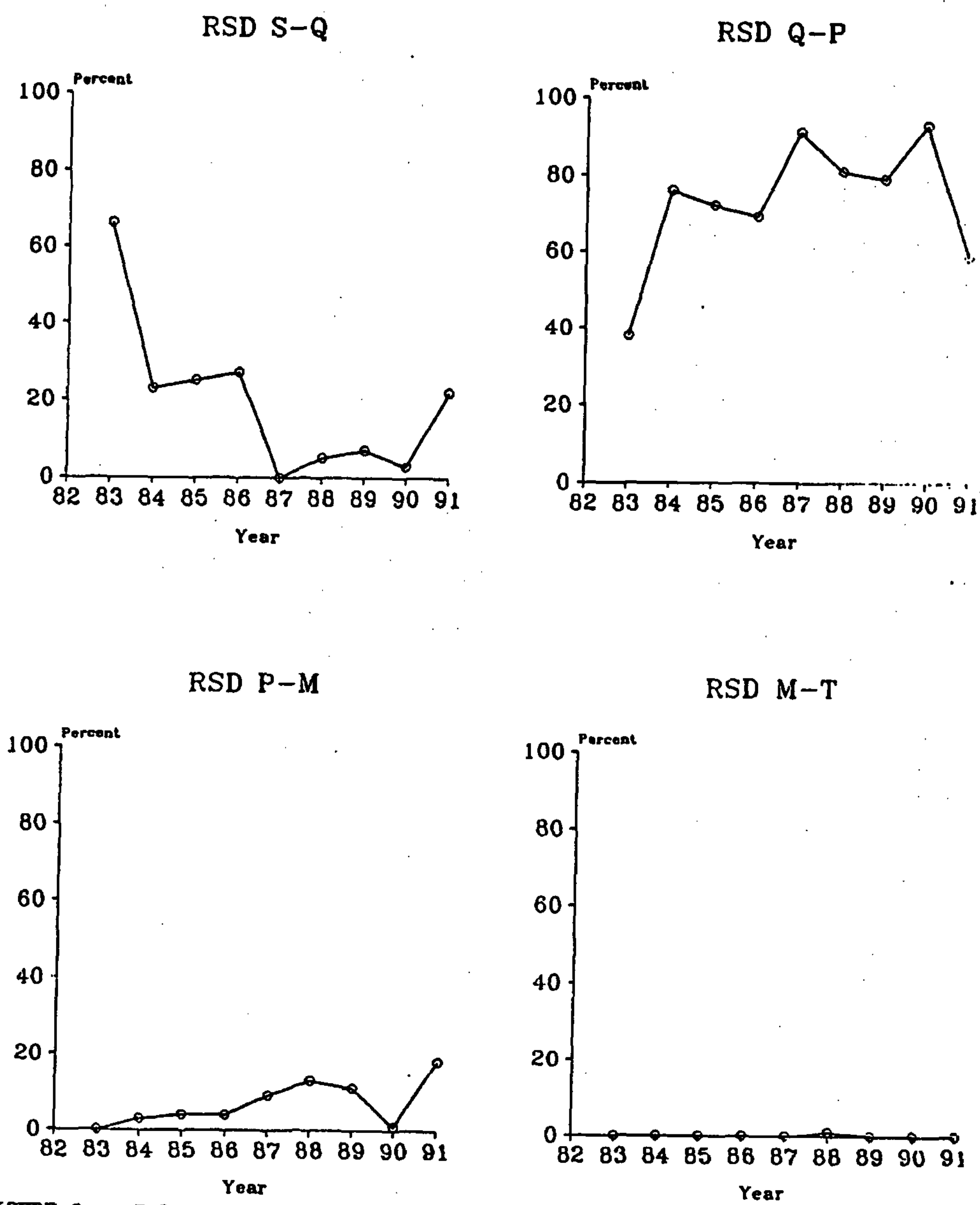


FIGURE 9. FALL WALLEYE PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FOR WOLF CREEK COOLING LAKE CORRECTED GILL NET CATCHES. (WILLIS et al. 1983) S-Q=250-379 mm. Q-P=380-509 mm. P-M=510-629 mm. M-T=630-759 mm. T≥760 mm. SHADED AREAS ARE PROPOSED OBJECTIVE RANGES (WILLIS 1984)



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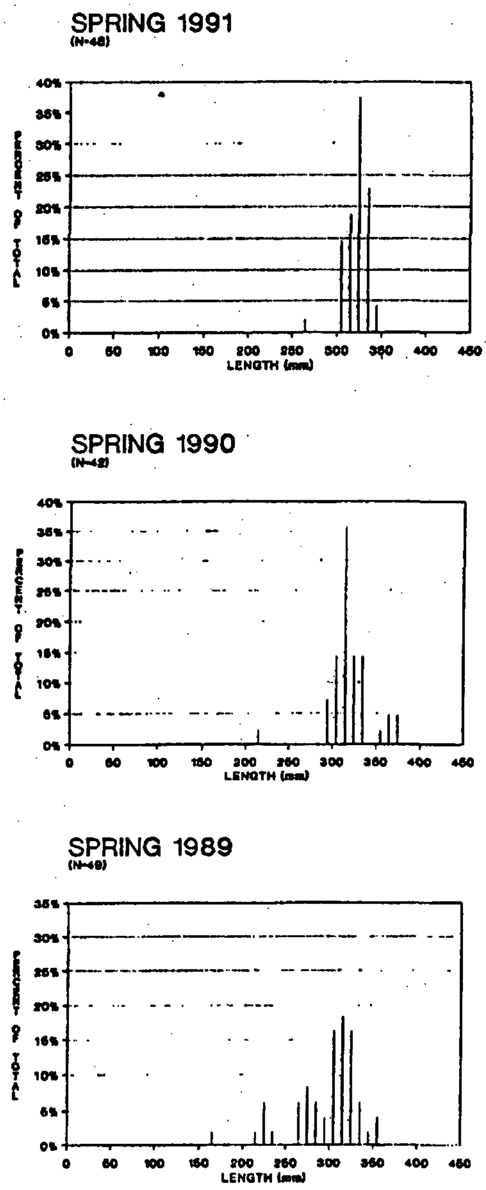


FIGURE 10. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF SPRING SAMPLED BLACK CRAPPIE COLLECTED FROM WOLF CREEK COOLING LAKE

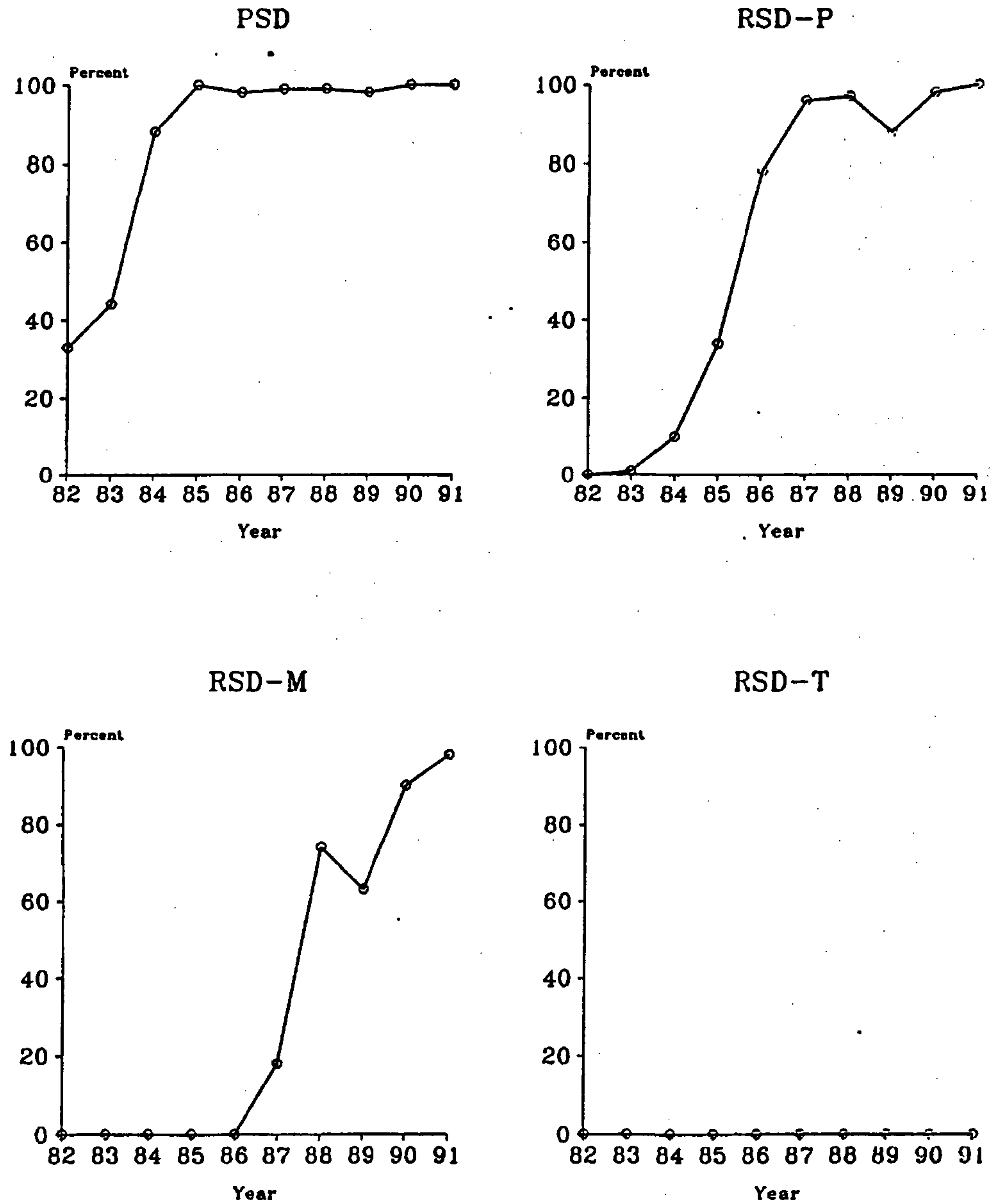
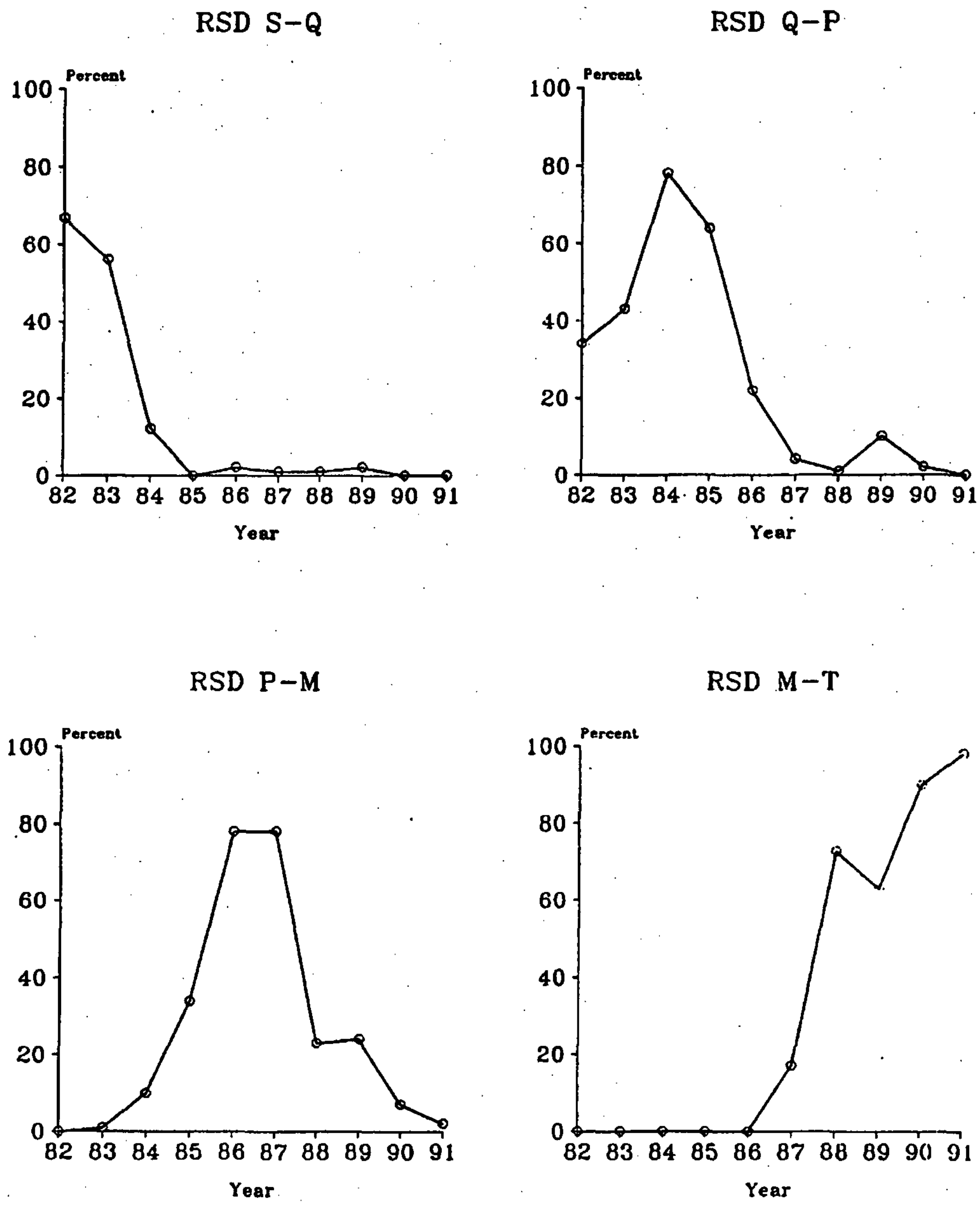


FIGURE 11. SPRING BLACK CRAPPIE PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FOR WOLF CREEK COOLING LAKE FYKE NETTING. S-Q=130-199 mm. Q-P=200-249 mm. P-M=250-299 mm. M-T=300-379 mm. T≥380 mm



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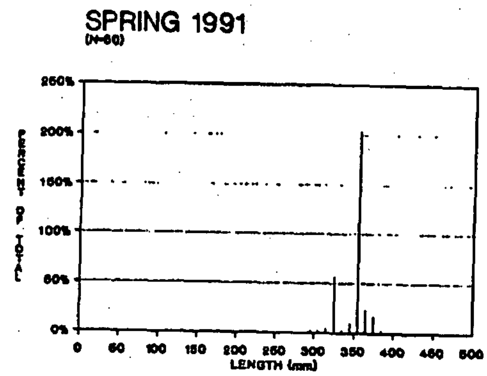
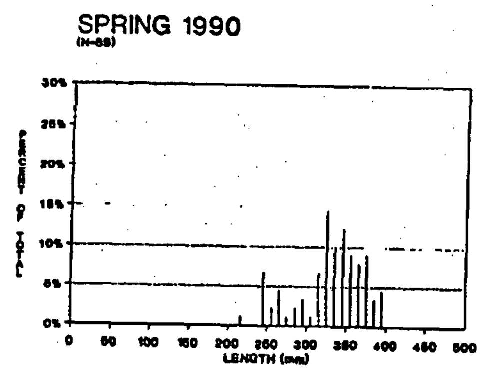




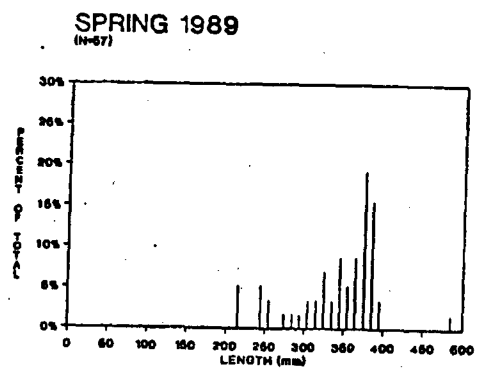


FIGURE 12. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF SPRING SAMPLED WHITE CRAPPIE COLLECTED FROM WOLF CREEK COOLING LAKE

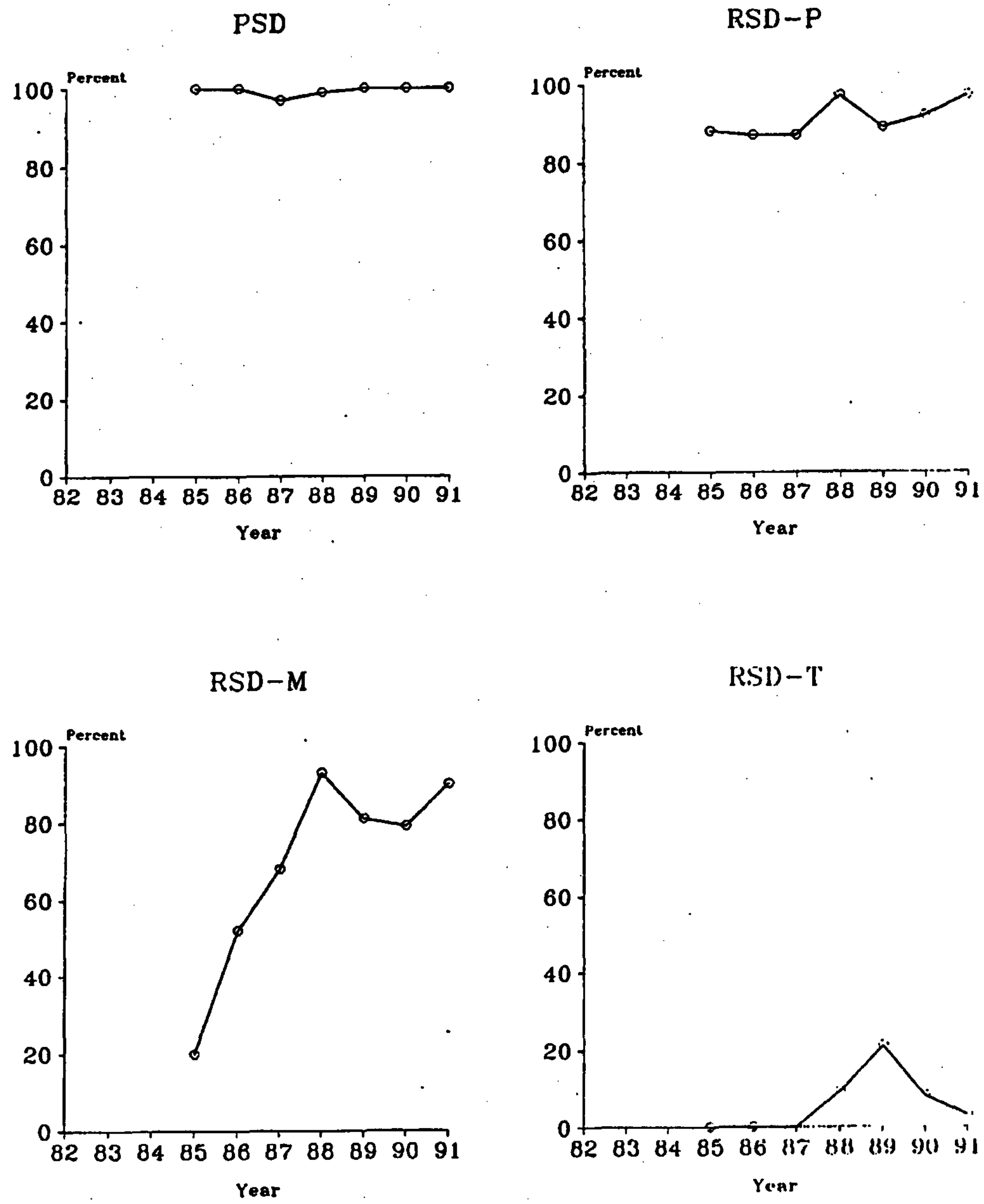


FIGURE 13. SPRING WHITE CRAPPIE PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FOR WOLF CREEK COOLING LAKE FYKE NETTING. S-Q=130-199 mm. Q-P=200-249 mm. P-M=250-299 mm. M-T=300-379 mm. T≥380 mm

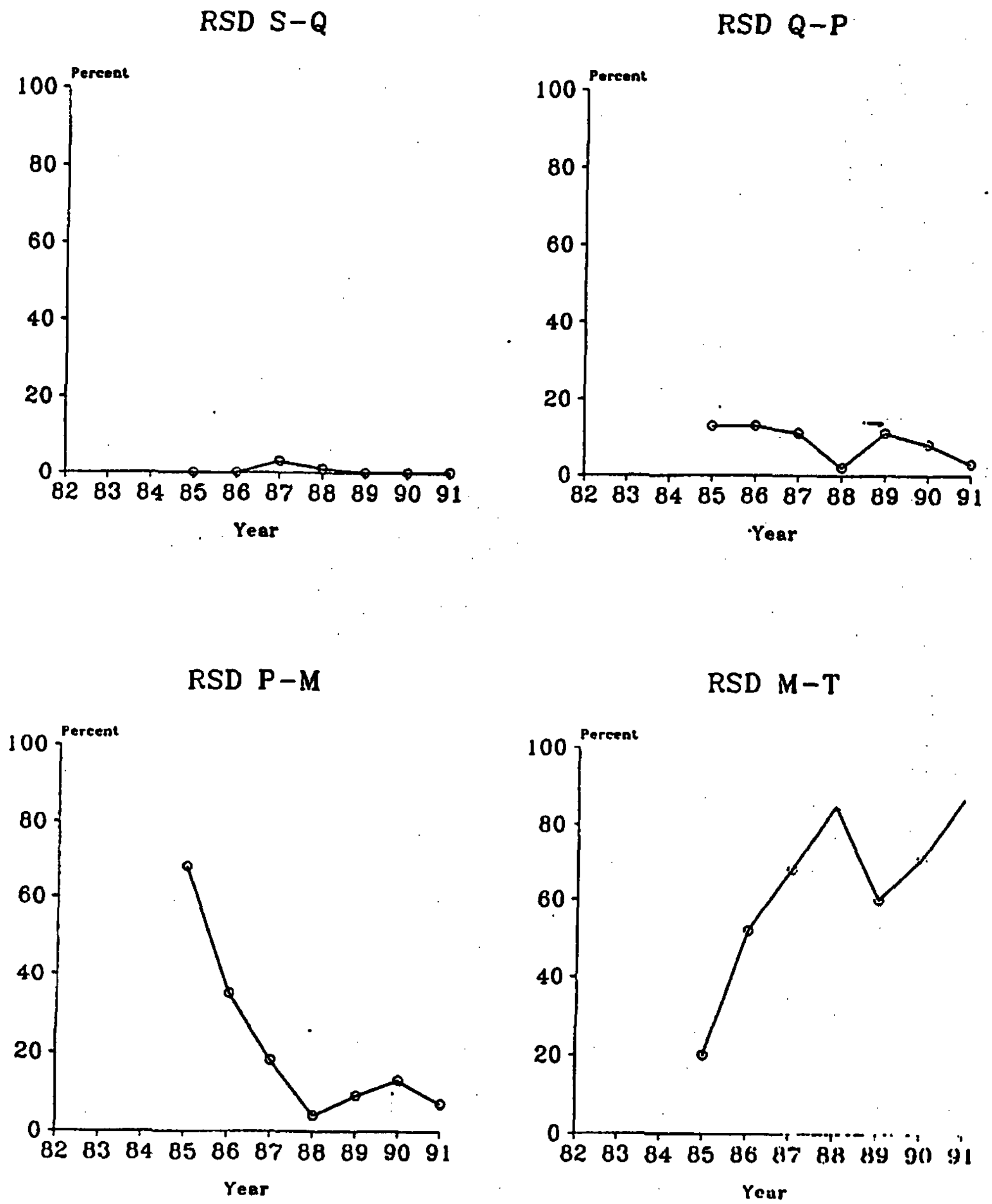


FIGURE 13. CONT. SPRING WHITE CRAPPIE PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FOR WOLF CREEK COOLING LAKE FYKE NETTING. S-Q=130-199 mm. Q-P=200-249 mm. P-M=250-299 mm. M-T=300-379 mm. T≥380 mm

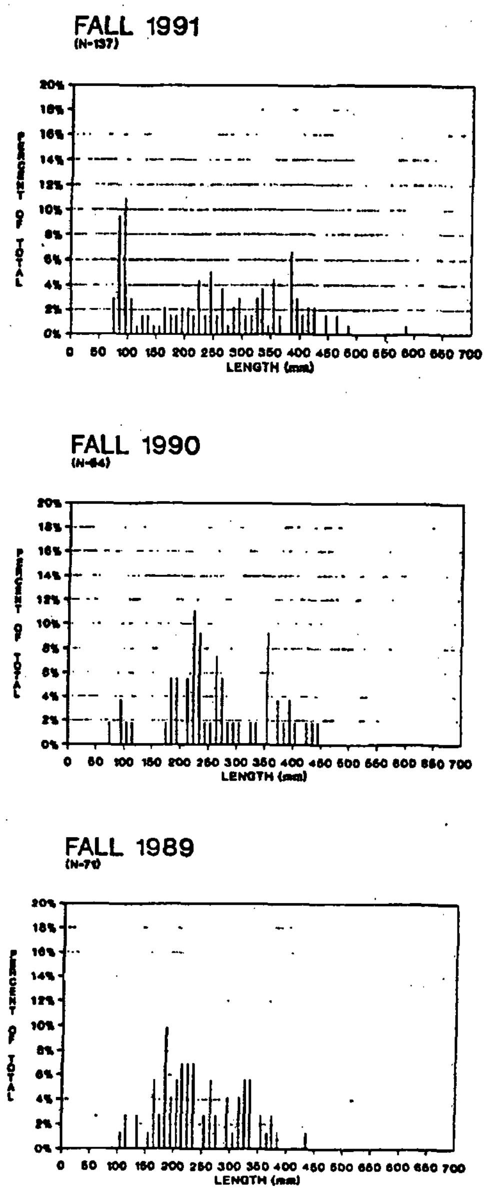


FIGURE 14. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF FALL SAMPLED SMALLMOUTH BASS COLLECTED FROM WOLF CREEK COOLING LAKE

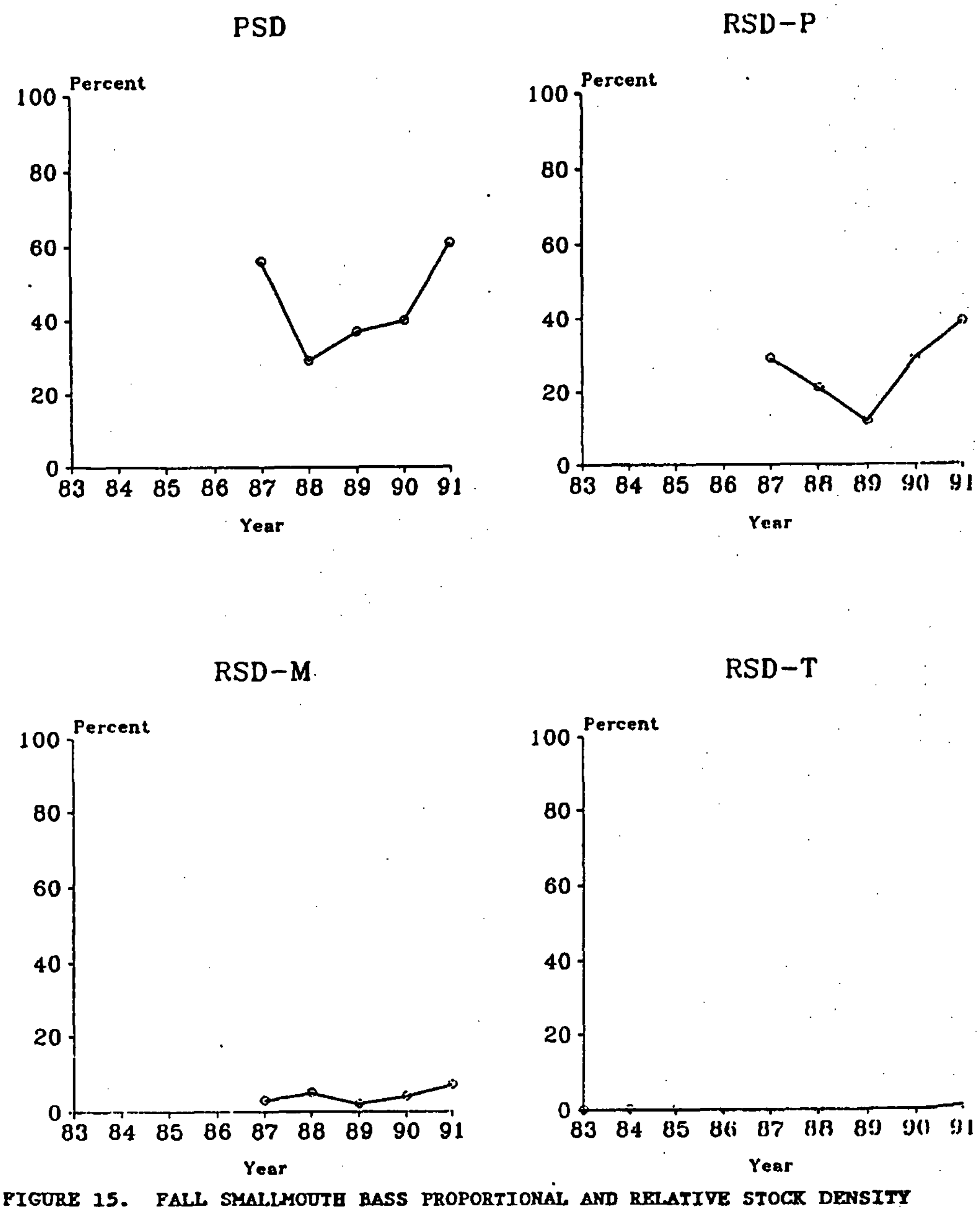


FIGURE 15. FALL SMALLMOUTH BASS PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FOR WOLF CREEK COOLING LAKE ELECTROFISHING. S-Q=180-279 mm. Q-P=280-349 mm. P-M=350-429 mm. M-T=430-509 mm. T≥510 mm

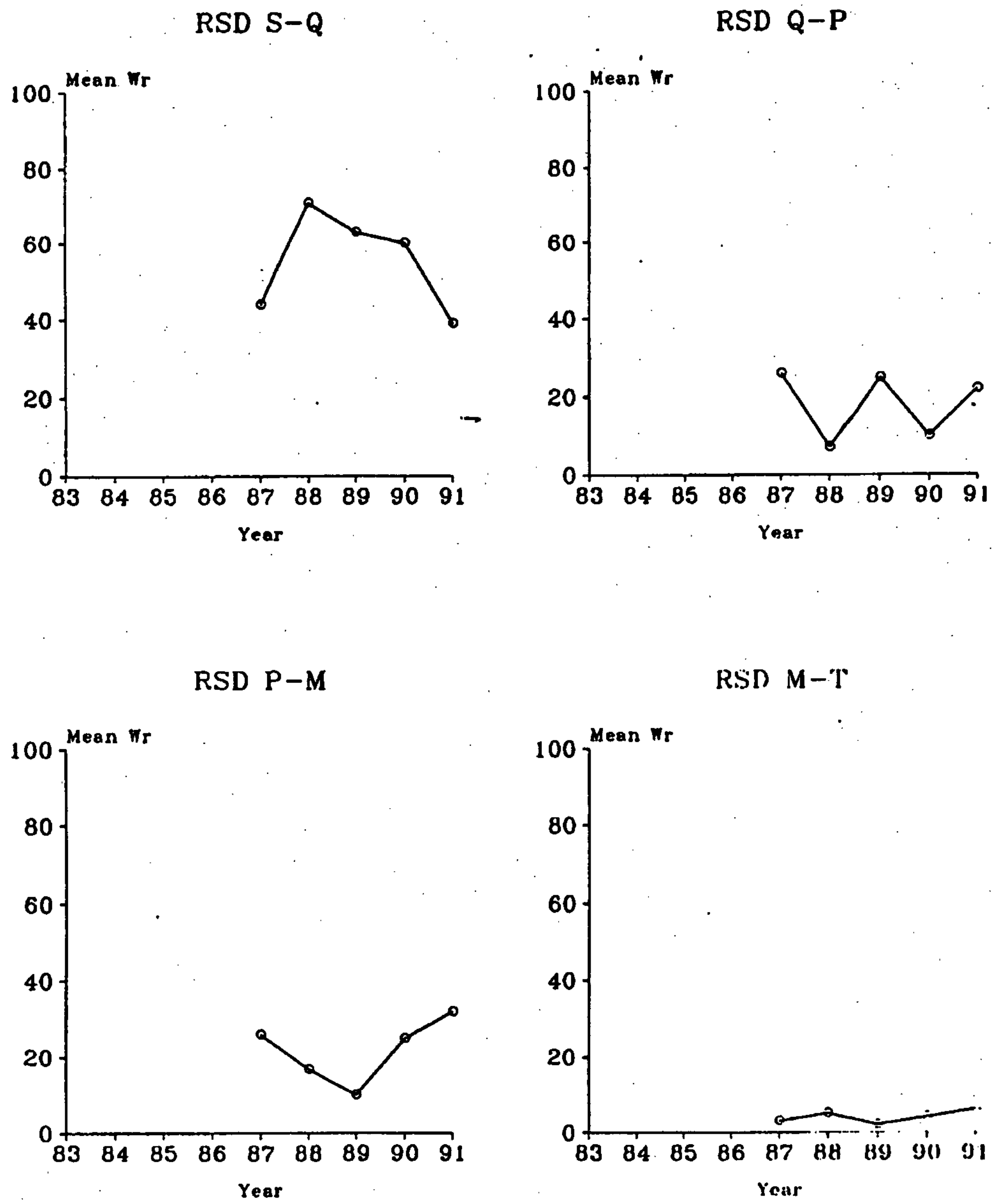


FIGURE 15. CONT. FALL SMALLMOUTH BASS PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FOR WOLF CREEK COOLING LAKE ELECTROFISHING. S-Q=180-279 mm. Q-P=280-349 mm. P-M=350-429 mm. M-T=430-509 mm. T≥510 mm

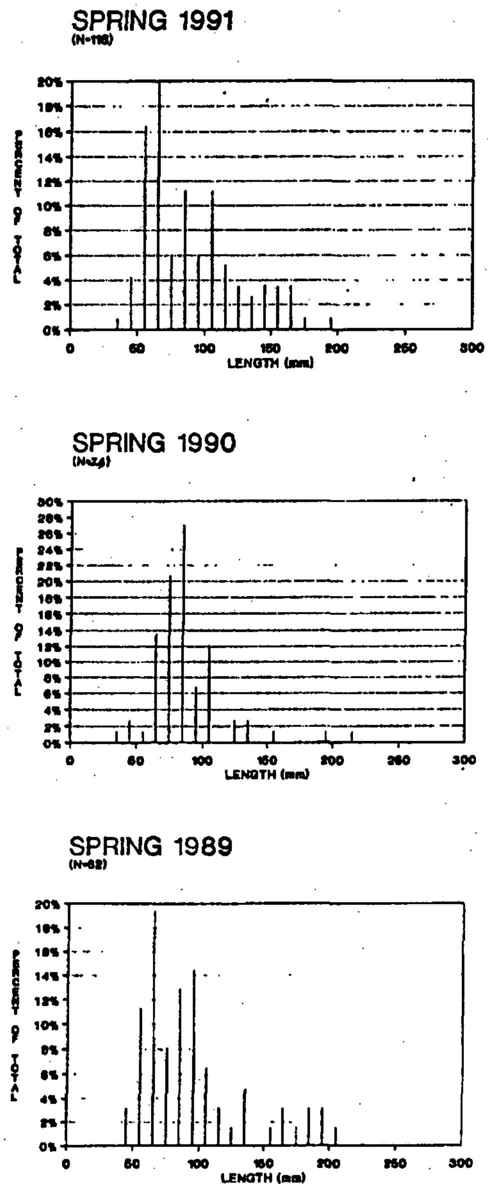


FIGURE 16. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF SPRING SAMPLED BLUEGILL COLLECTED FROM WOLF CREEK COOLING LAKE

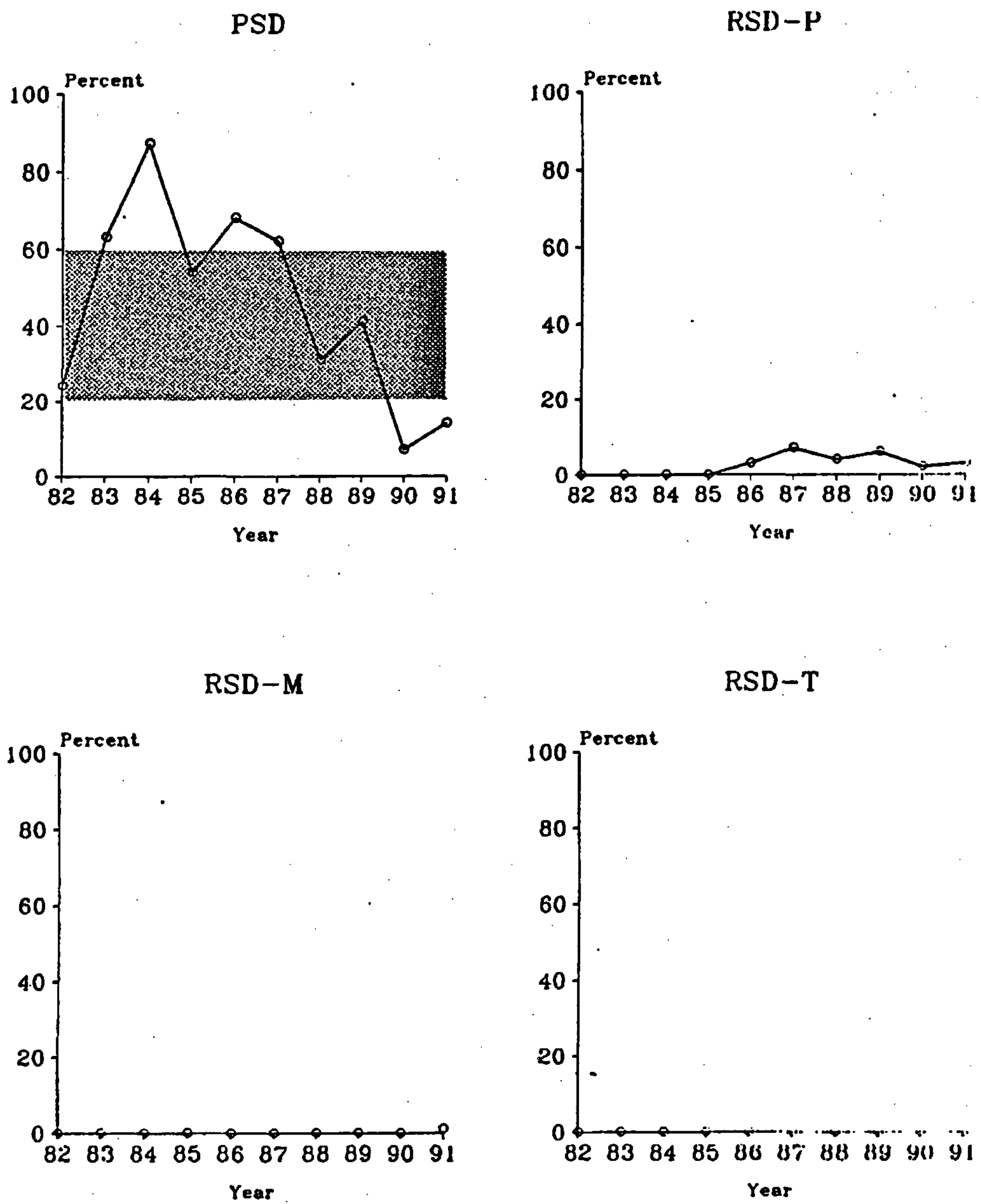


FIGURE 17. SPRING BLUEGILL PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FROM WOLF CREEK COOLING LAKE SEINING AND ELECTROFISHING. S-Q=80-159 mm. Q-P=160-199 mm. P-M=200-249 mm. M-T=250-299 mm. T$\geq$300 mm. THE SHADED AREA REPRESENTS THE DESIRABLE RANGE (ANDERSON 1984).

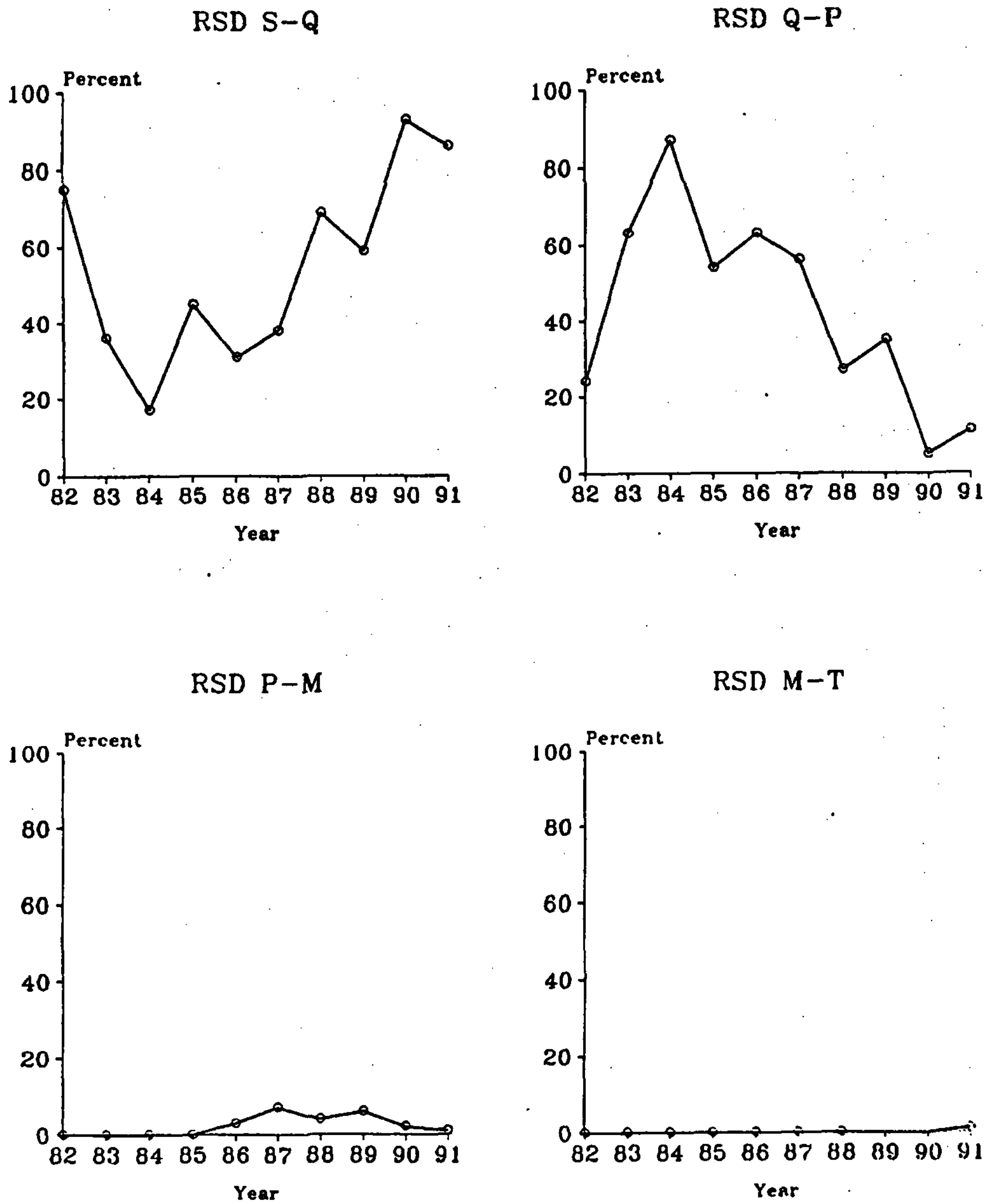
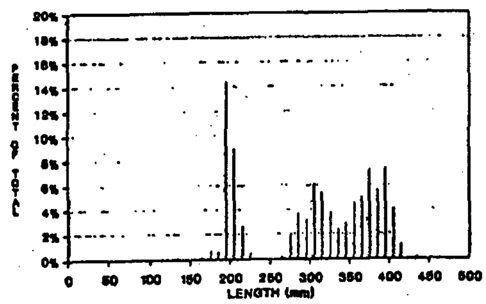


FIGURE 17. CONT. SPRING BLUEGILL PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FROM WOLF CREEK COOLING LAKE SEINING AND ELECTROFISHING. S-Q=80-159 mm. Q-P=160-199 mm. P-M=200-249 mm, M-T=250-299 mm. T≥300 mm.
THE SHADED AREA REPRESENTS THE DESIRABLE RANGE (ANDERSON 1984).

FALL 1991
(N=411)



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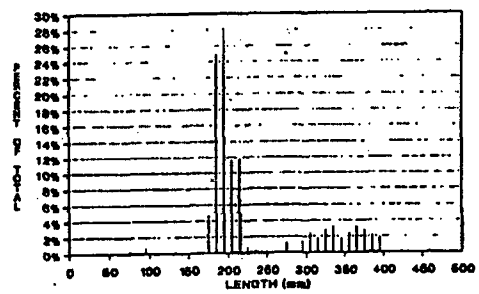

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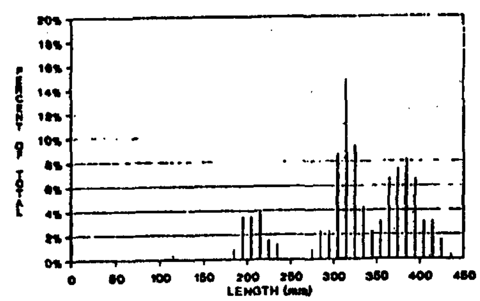


FIGURE 18. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF FALL SAMPLED WHITE BASS COLLECTED FROM WOLF CREEK COOLING LAKE

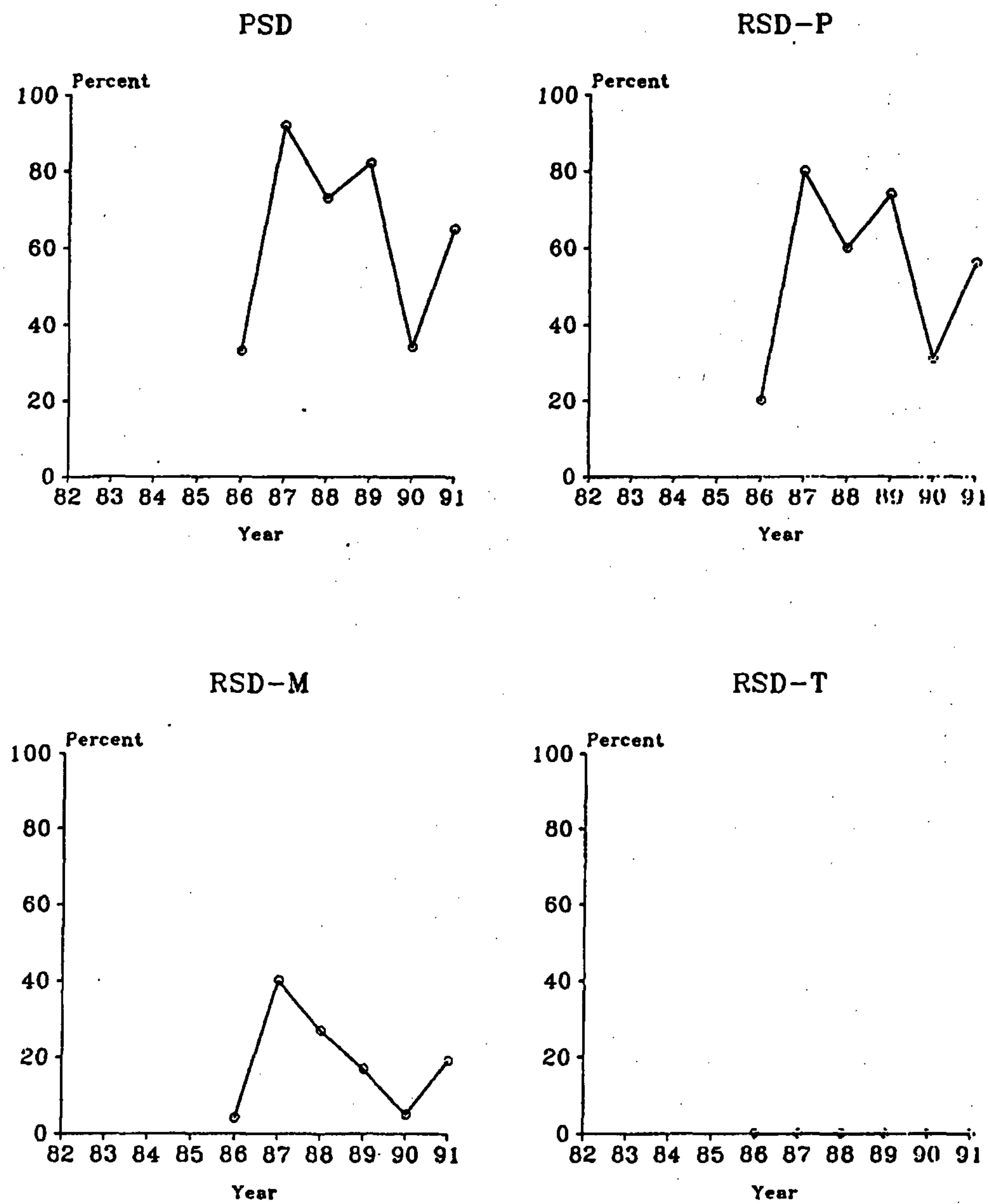


FIGURE 19. FALL WHITE BASS PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FROM WOLF CREEK COOLING LAKE ELECTROFISHING AND CORRECTED (WILLIS et al. 1983) GILL NET CATCHES.
S-Q=150-229 mm. Q-P=230-299 mm. P-M=300-379 mm. M-T=380-459 mm. T≥460 mm

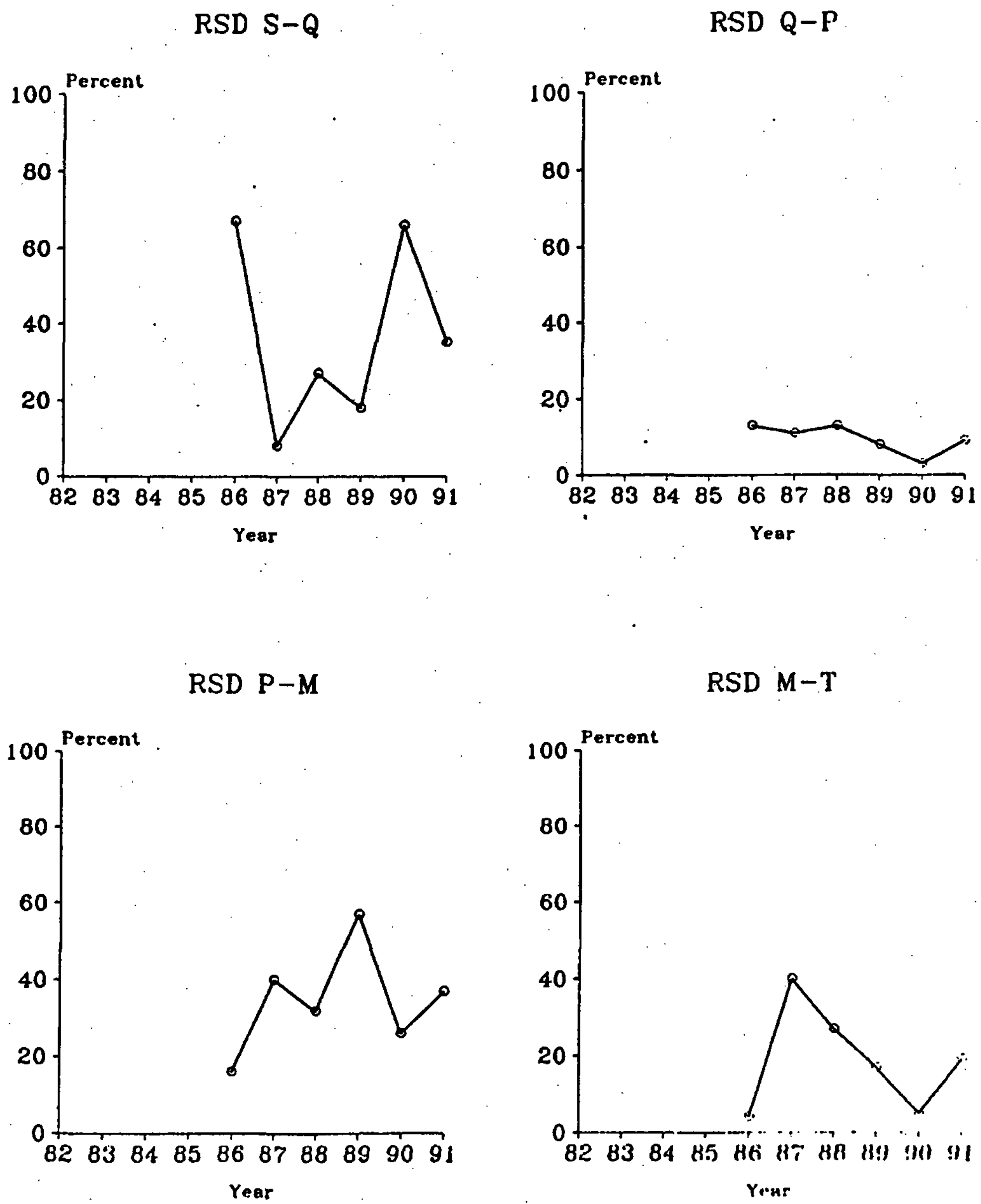


FIGURE 19. CONT. FALL WHITE BASS PROPORTIONAL AND RELATIVE STOCK DENSITY (PSD, RSD) RELATIONSHIPS FROM WOLF CREEK COOLING LAKE ELECTROFISHING AND CORRECTED (WILLIS et al. 1983) GILL NET CATCHES.
S-Q=150-229 mm. Q-P=230-299 mm. P-M=300-379 mm. M-T=380-459 mm. T≥460 mm

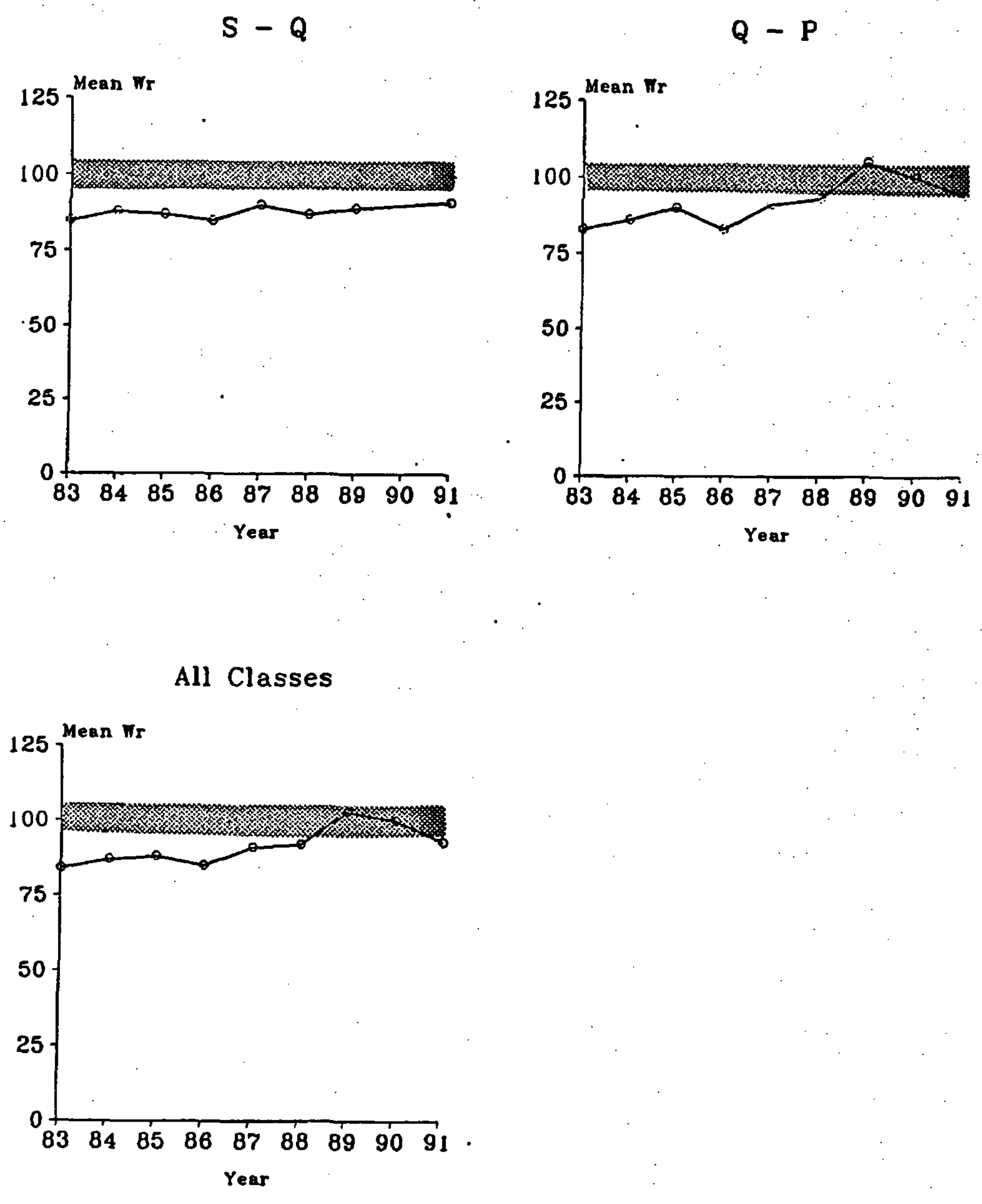


FIGURE 20. FALL GIZZARD SHAD RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=180-279 mm. Q=280 mm+

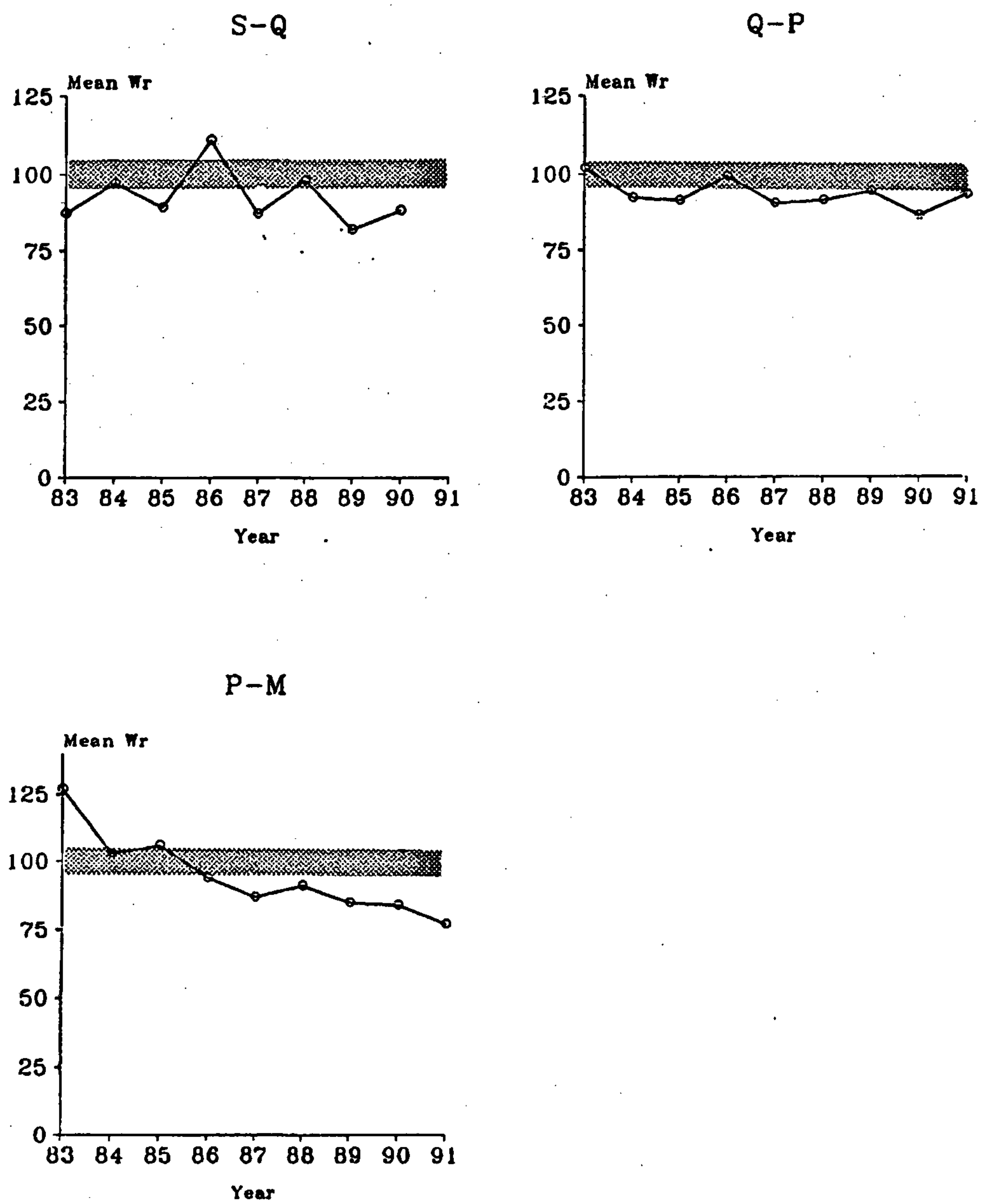
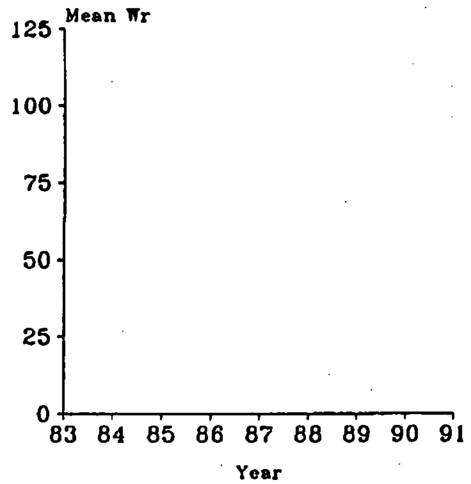
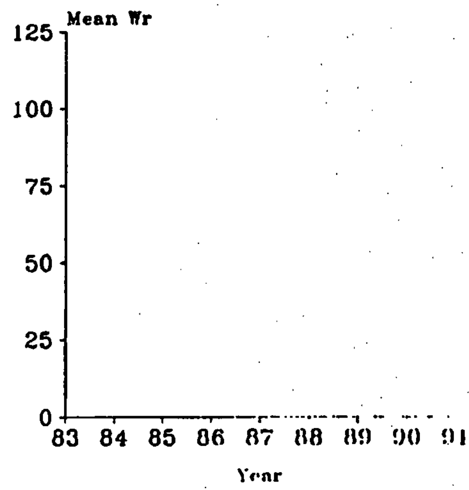


FIGURE 21. SPRING LARGEMOUTH BASS RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=200-299 mm. Q-P=300-379 mm. P-M=380-509 mm. M-T=510-629 mm. T≥630 mm

M-T



Trophy



All Classes

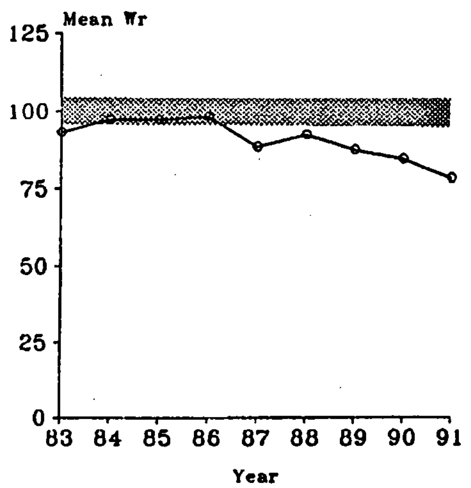


FIGURE 21. CONT. SPRING LARGEMOUTH BASS RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=200-299 mm. Q-P=300-379 mm. P-M=380-509 mm. M-T=510-629 mm. T≥630 mm

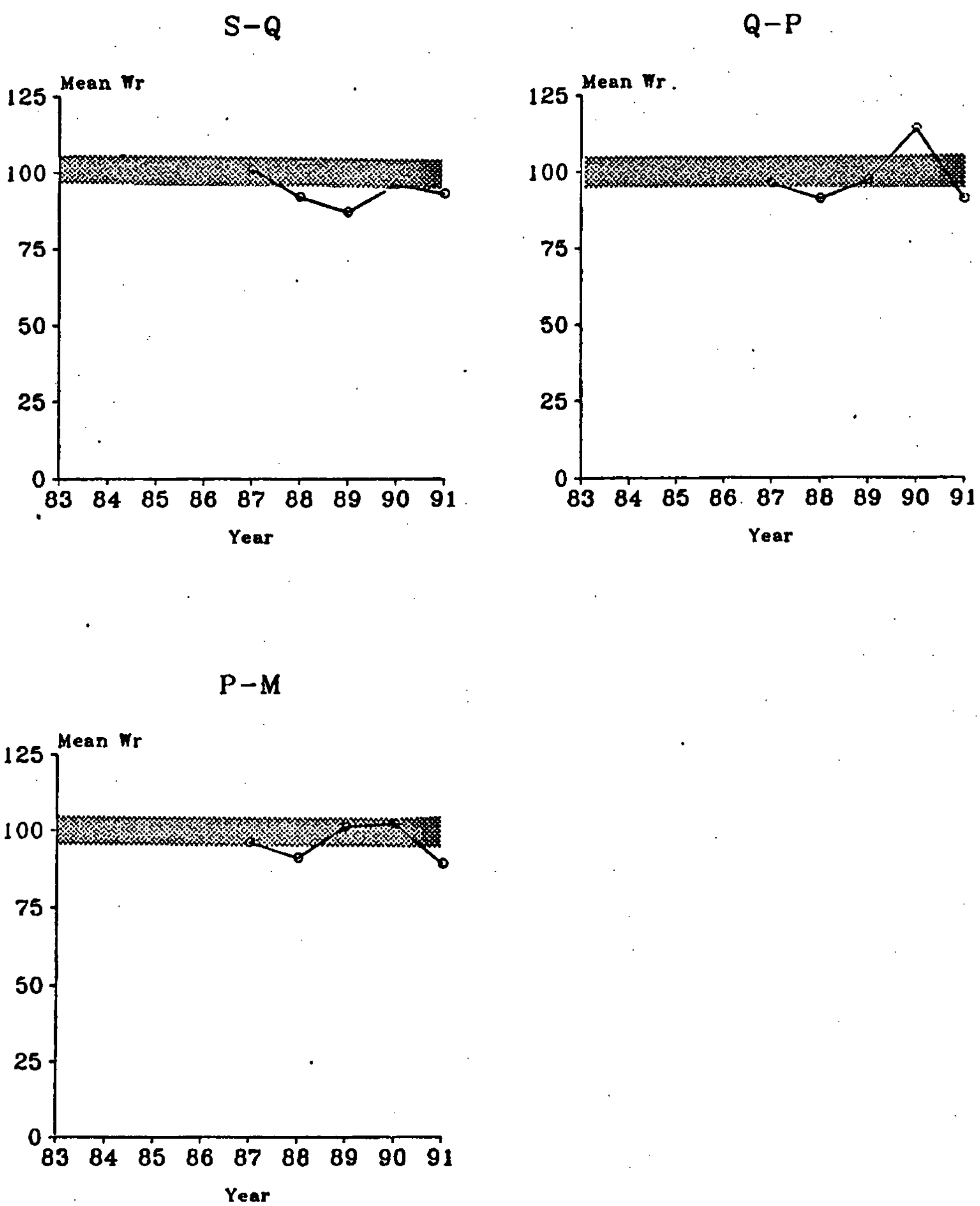


FIGURE 22. FALL SMALLMOUTH BASS RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=180-279 mm. Q-P=280-349 mm. P-M=350-429 mm. M-T=430-509 mm. T≥375 mm

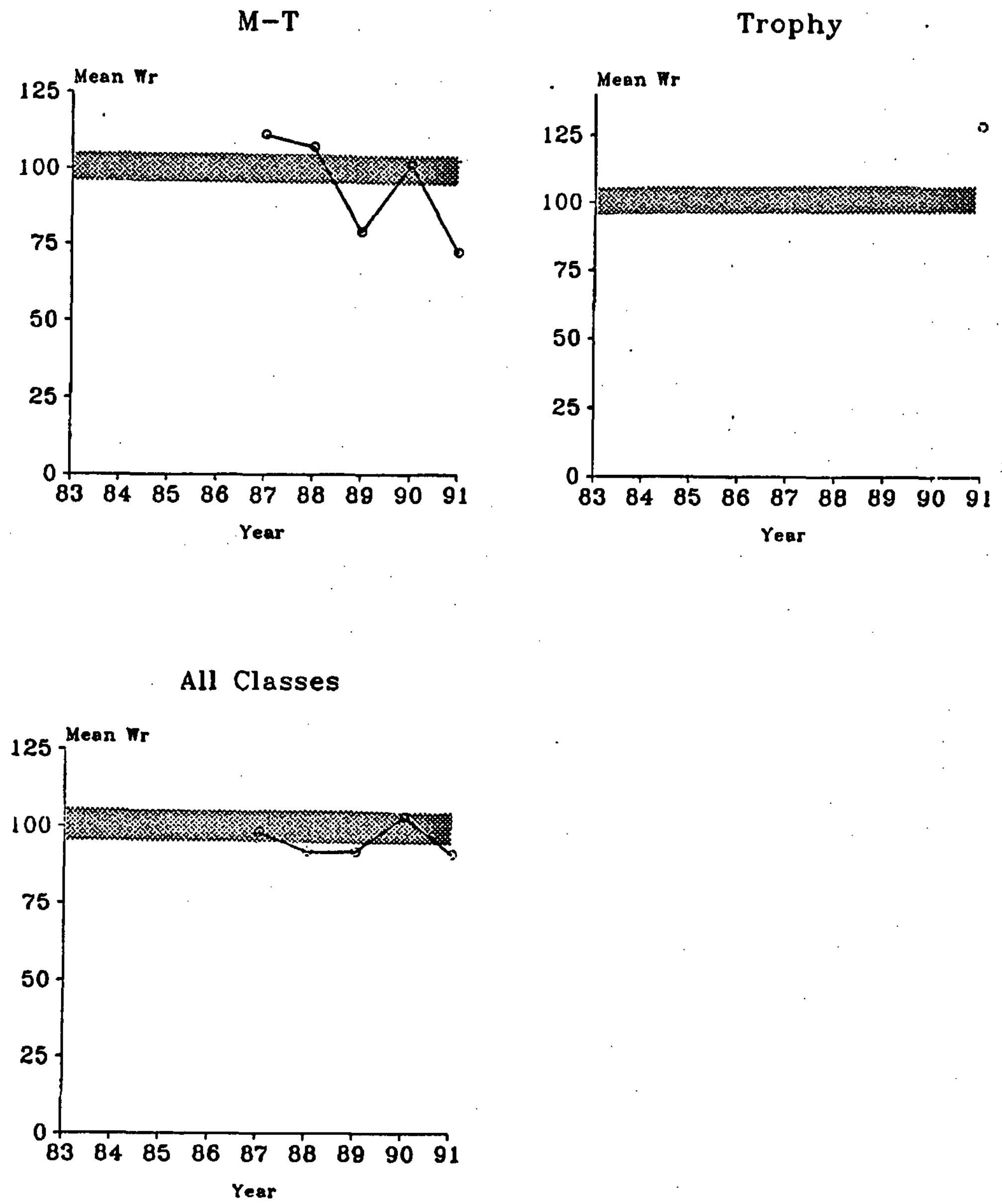


FIGURE 22. CONT. FALL SMALLMOUTH BASS RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=180-279 mm. Q-P=280-349 mm. P-M=350-429 mm. M-T=430-509 mm. T≥375 mm

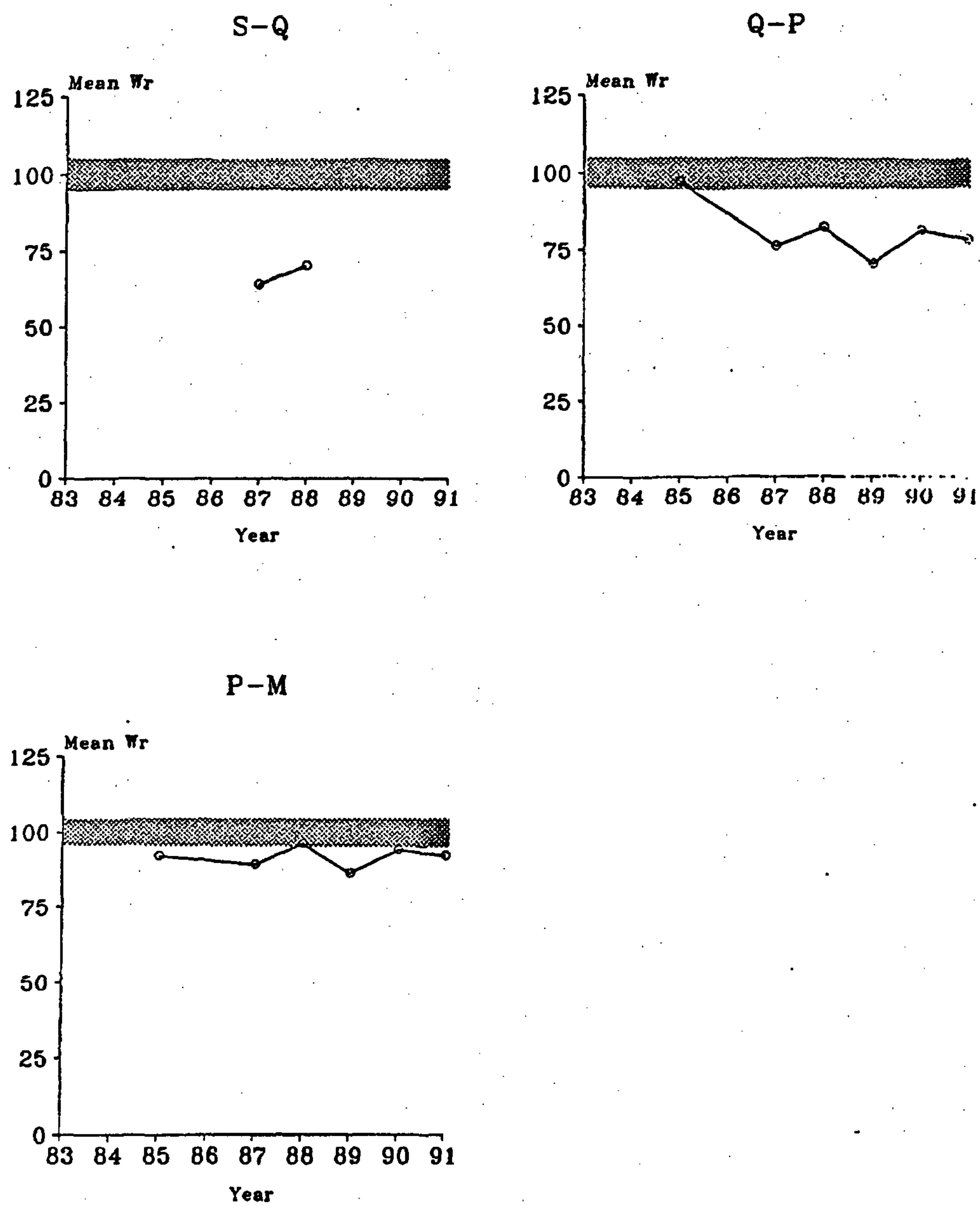


FIGURE 23. SPRING WHITE CRAPPIE RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=125-199 mm. Q-P=200-249 mm. P-M=250-299 mm. M-T=300-374 mm. T≥375 mm

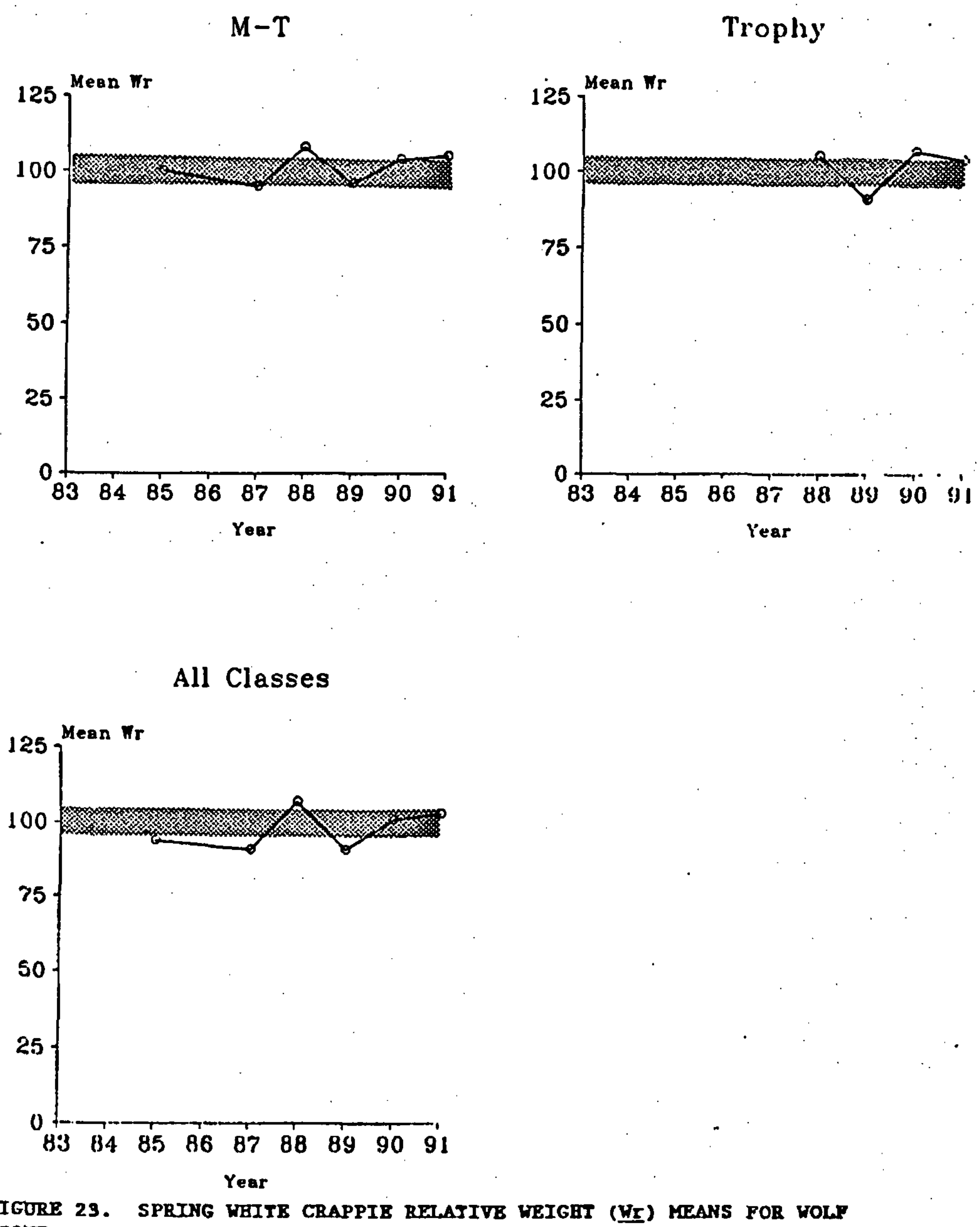


FIGURE 23. CONT. SPRING WHITE CRAPPIE RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=125-199 mm. Q-P=200-249 mm. P-M=250-299 mm. M-T=300-374 mm. T≥375 mm

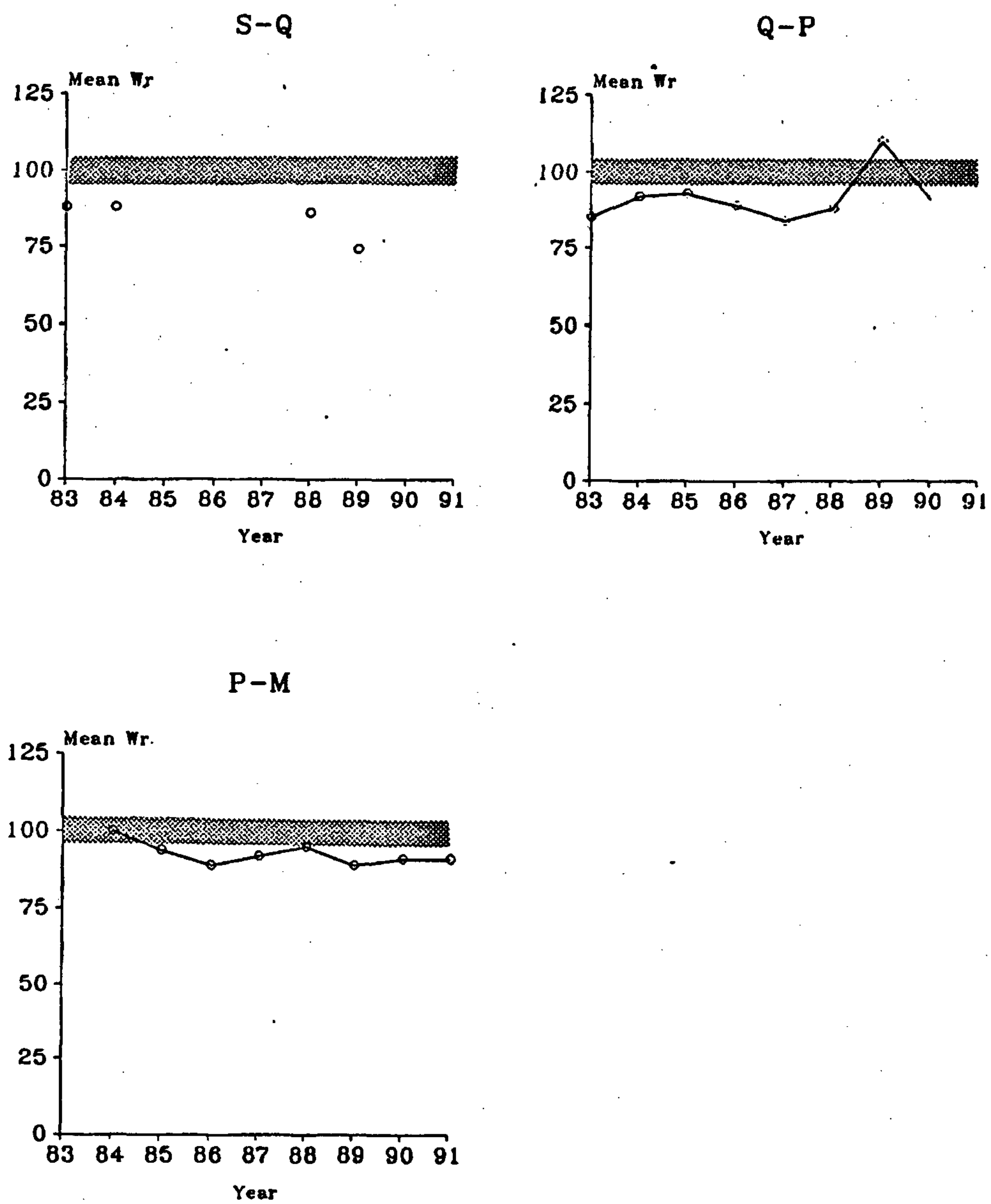


FIGURE 24. SPRING BLACK CRAPPIE RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=125-199 mm. Q-P=200-249 mm. P-M=250-299 mm. M-T=300-374 mm. T≥375 mm

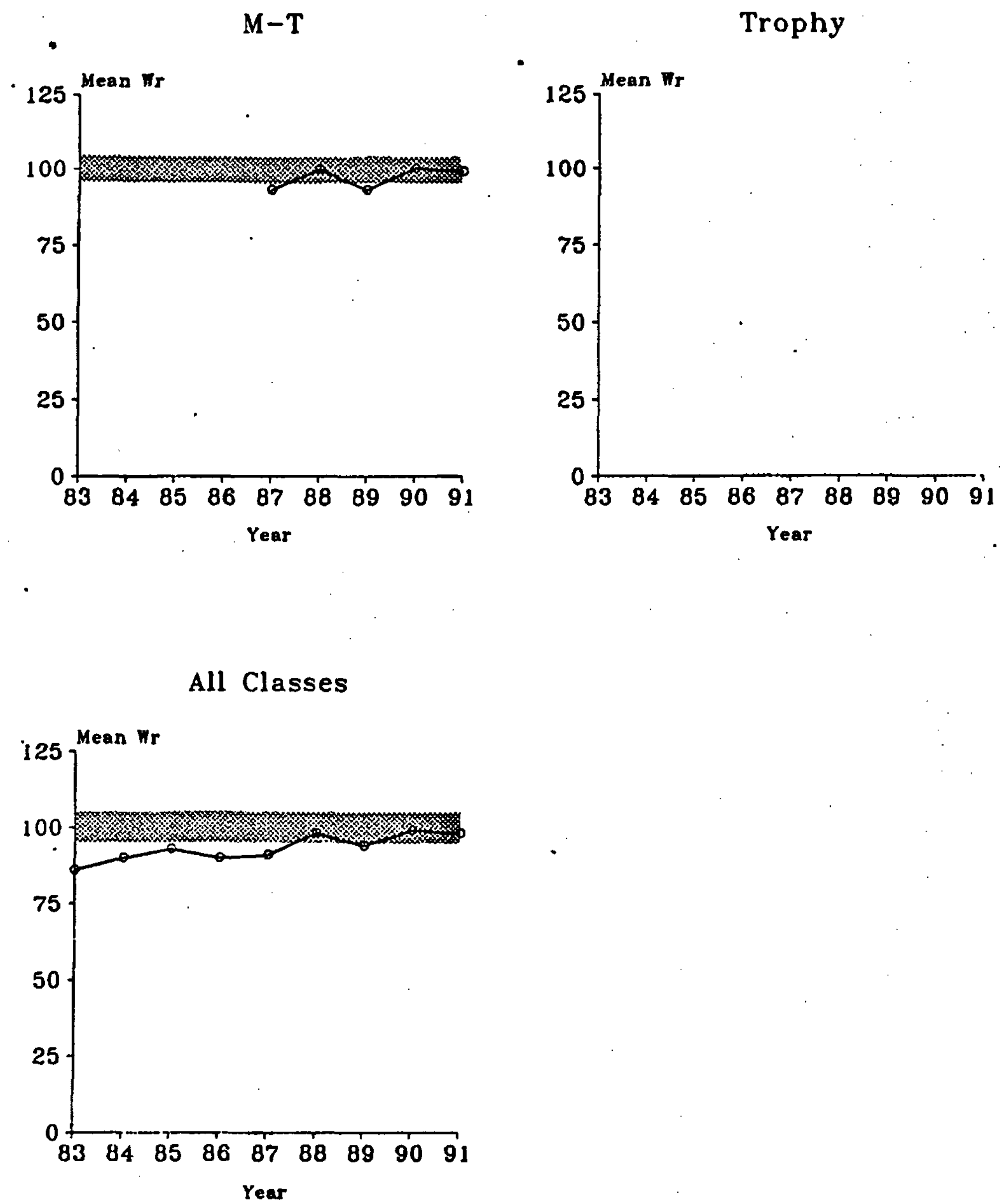


FIGURE 24. CONT. SPRING BLACK CRAPPIE RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Ws) EQUATIONS. S-Q=125-199 mm. Q-P=200-249 mm. P-M=250-299 mm. M-T=300-374 mm. T≥375 mm

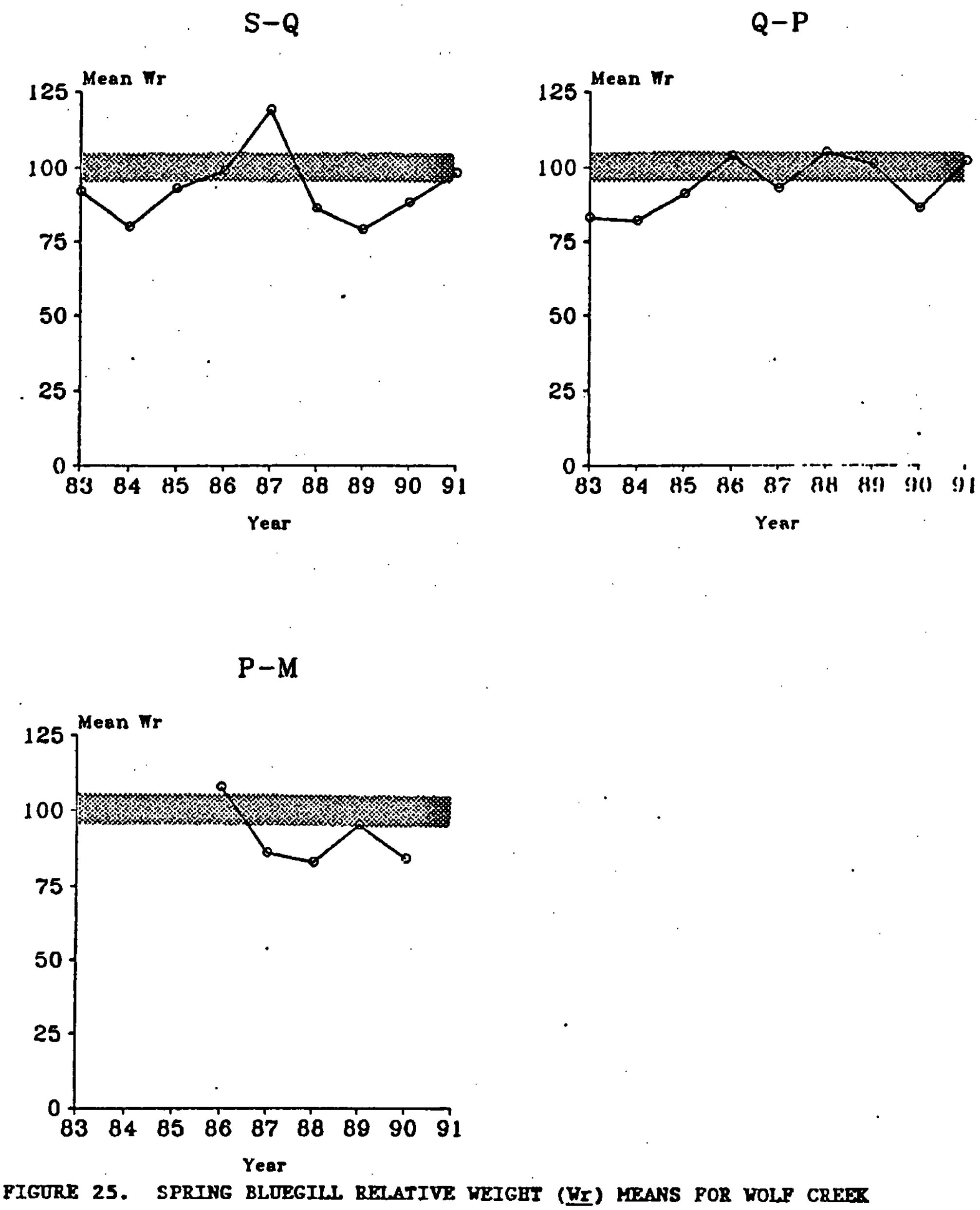
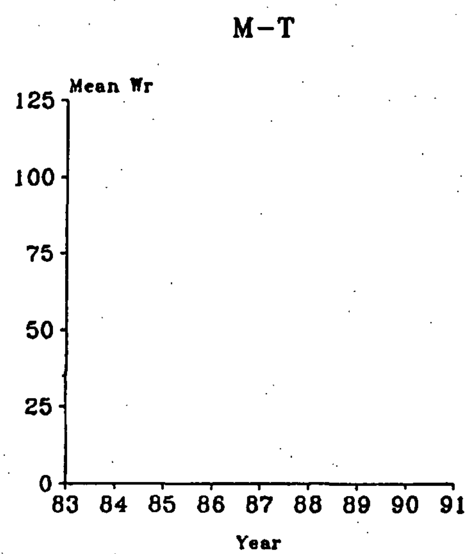
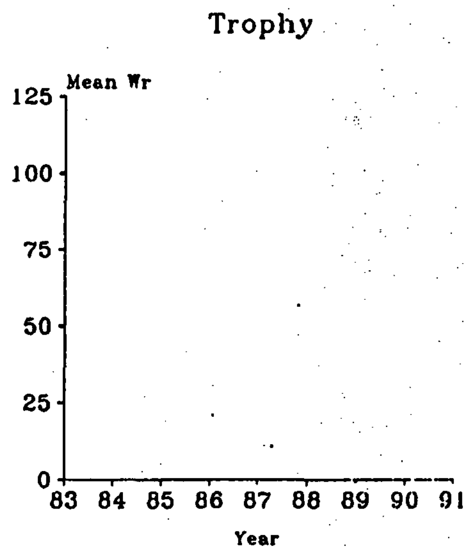


FIGURE 25. SPRING BLUEGILL RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Wr) EQUATIONS S-Q=80-149 mm. Q-P=150-199 mm. P-M=200-249 mm. M-T=250-299 mm. T≥300 mm.





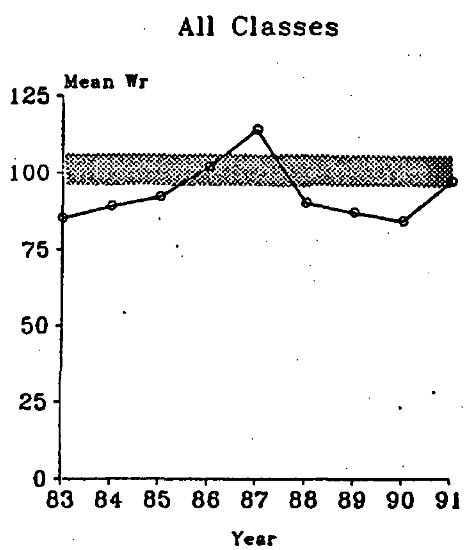


FIGURE 25. CONT. SPRING BLUEGILL RELATIVE WEIGHT (Wr) MEANS FOR WOLF CREEK COOLING LAKE. THE SHADED AREA REPRESENTS THE OBJECTIVE RANGE OF 95-105 FOR SPECIES WITH ESTABLISHED STANDARDIZED WEIGHT (Wr) EQUATIONS S-Q=80-149 mm. Q-P=150-199 mm. P-M=200-249 mm. M-T=250-299 mm. T≥300 mm.

**APPENDIX C
TO 1991 WCGS OPERATIONAL
FISHERY MONITORING REPORT**

GLOSSARY

Common Fishery Management Terms As They Relate To The 1991 WCGS Operational Monitoring Report

<u>Centrarchid</u> - This refers to a member of the fish family Centrarchidae, commonly known as the sunfish family. Members of this family in WCCL include, but are not limited to, bluegill, largemouth bass, and white crappie.

<u>Clupeid</u> - This refers to a member of the fish family Clupeidae, commonly known as the herring family. In WCCL, gizzard shad is the only member of this family.

<u>Cold shock</u> - This refers to the incapacitation or death of a fish due to a sudden drop in body temperature. At WCGS, sudden temperature declines occur at the cooling water discharge immediately following plant trips.

<u>Complement net night</u> - This refers to a group of gill nets set for one night. A complement used by the Kansas Department of Wildlife and Parks and by WCNOC consists of four nets. One each of 1", 1.5", 2.5", and 4" mesh 100' x 8' gill nets comprise this complement of four. These sizes are used to sample a wide size variation of fish. Standardized use increases comparability and reduces net biases when comparing catches between reservoirs or from year to year within a single reservoir.

<u>Electrofishing</u> - This is a fish collecting method particularly efficient at sampling centrarchids in shallow water (<6'). A portable 220 volt generator provides power directed through a transformer to a boat-mounted electrode array. On WCCL, the same shoreline areas are electrofished during each effort for the same amount of time.

<u>Entrainment</u> - At WCGS this refers to the aquatic organisms including juvenile fish which are small enough to pass through the traveling circulating water intake screens and through the power plant. In the licensing documents, the NRC expected 100% mortality of these due to thermal stress and physical damage.

<u>Forage species</u> - This refers to fish species which are eaten as prey. In WCCL, these include gizzard shad, bluegill, and various shiners or minnows.

<u>Fyke net</u> - This is a modified hoop style trap net consisting of a series of funnels suspended within one meter diameter metal hoops. When set properly, it diverts fish moving along the shoreline through the funnels back through which the fish are unable to find their way out.

<u>Gear bias</u> - Gear refers to the type of equipment used to collect a particular fish sample such as gill nets or electrofishing. Gear bias refers to the selectivity of a particular gear towards catching a specific fish species. For example, gill netting is efficient at sampling open water species such as wipers which travel relatively long distances. Species not prone to large spatial movements are not as likely to encounter a set gill net, thus are not efficiently sampled by such a gear type.

<u>Gill net</u> - This gear, as used at WCGS, is a 8' x 100' panel with mesh openings of 1", 1.5", 2.5", or 4" made of monofilament line. When set, fish swim into these nets and become entangled around the gills.

<u>Impingement</u> - At WCGS, this refers to the trapping of fish by circulating water intake flows on the travelling screens.

<u>Incremental Relative Stock Density</u> - This is a variation of the traditional RSD index. It is the percentage of fish individuals between the minimum and maximum size of the designated size ranges. This index is less repetitious and more definitive than the traditional approach. It is particularly useful in assessing year class strength. The following size categories are used in this system:

RSD,S-Q - Percentage of fish within the stock size range of a particular species.

RSD,Q-P - Percentage of fish within the quality size range of a particular species.

RSD,P-M - Percentage of fish within the preferred size range of a particular species.

RSD,M-T - Percentage of fish within the memorable size range of a particular species.

RSD,T - Percentage of fish greater than the minimum trophy size within a particular species.

$\underline{K_{TL}}$ - This is the unit of measure for the coefficient of conditions when in the calculation, the total length of a fish expressed in the metric system is used. It is a common measure of well-being or plumpness of a fish.

<u>Length frequency</u> - This is a typical method of describing the relative size distribution of fish in a population. Generally, the percentage of fish within each 10 mm size increment is used to describe length frequency.

<u>Lentic</u> - Refers to still water habitats such as in ponds and lakes.

<u>Littoral</u> - Generally, this refers to the shoreline areas of WCCL shallow enough for sunlight to penetrate to the bottom. This zone varies widely in width and depth. It is considered the most biologically productive area within a lake.

<u>Macrophytes</u> - This term simply means "large plant" referring to all multi-celled plants.

<u>Morone</u> - This is the genus of the sea basses. In WCCL, striped bass, white bass and their hybrids (wipers) are of the genus <u>Morone</u>.

<u>Net night</u> - This is a common way to express the amount of sampling effort expended during netting activities. One net night is simply one net set for one night.

<u>NTU</u> - This stands for Nephelometric Turbidity Unit and is a measure of the turbidity in water. It was used to measure water clarity of WCCL.

Production - This refers to the amount of reproduction by a population of a particular fish species.

Proportional Stock Density (PSD) - This is an index describing the proportion of fish within a population that is longer than a predetermined standard quality length. For example, if 50 largemouth bass are ≥30 cm long (quality size) in a sample of 100 fish ≥20 cm long (stock size), the PSD is 50. It is used for WCCL species to indicate whether most fish are larger, thus older, or are younger, smaller fish.

Recruitment - This refers to that part of fish production which survived to reach reproductive maturity.

Relative Abundance - As used for WCCL monitoring, this simply is the number of a fish species sampled expressed as a percentage of the total fish caught of all species.

Relative Biomass - As used for WCCL monitoring, this simply is the total weight of a fish species sampled expressed as a percentage of the total weight of all fish species sampled.

Relative Stock Density (RSD) - This is an index of the proportion of fish longer than any designated size group in a population. PSD is part of the RSD index. Each species has specific designated size groups based on assigned angler preference or recreational value. Even though angling has not been a facet of WCCL fishery management, these indices are useful in determining size structure, year class recruitment, and to give insight into predator/prey relationships. How these classes are broken down are provided below:

Stock - This is the size of a species equivalent to a minimum length of 20-26 percent of the world-record length for that species. It is the size at which most fish reach maturity and are recruited.

Quality - This is the size of a species equivalent to a minimum length of 36-41 percent of the world-record length for that species. A quality sized fish is the minimum size that most anglers like to catch. The PSD index is the percentage of these fish and larger in a population.

Preferred - This is the size of fish most anglers would prefer to catch. The RSD indices are used to describe proportions of fish in this and larger categories. The RSD-Preferred (RSD-P) index is the percentage of fish in a population greater than the designated length for preferred sized fish. The percentage includes the next two size categories.

Memorable - This is defined as a size most anglers remember catching. The RSD-Memorable (RSD-M) index describing this size is the percentage of fish in a population greater than the designated length for memorable sized fish. This includes the next size class.

Trophy - This is defined as a size considered worthy of acknowledgment. The RSD-Trophy (RSD-T) index is the percentage of fish in a population greater than the designated length for trophy sized fish. This is the largest size class.

Relative Weight (Wr) - This is an index of fish condition that compares the actual weight with a standard weight for fish of the same length. It is a measure of plumpness and gives valuable insight to the health of a fish population.

Roughfish - This is a general classification which include fish species that are of limited recreational or commercial value. In WCCL, it includes such fish as carp, buffalo, and drum.

Scale age - In this report, ages of fish determined with scale analyses represent the determined age of the fish plus the current growing season. For example, a 2+ fish was spawned two years ago and is currently within its third growing season.

Secchi - This is a simple bicolored disk used to take field measurements of water turbidity. It is lowered into the water and the average depth at which it disappears and then reappears is the secchi reading. It is used to give rough estimates of the amount of material suspended in the water.

Swingle swing - This is a standardized method of using a seine. It was devised to make a seine haul consistent between locations, times, and investigators. Basically, one end of a seine is held stationary on the shore with the net stretched into the water at a 90^{o} angle from the shore. The offshore end is then pulled in a 90^{o} arc to the shore.

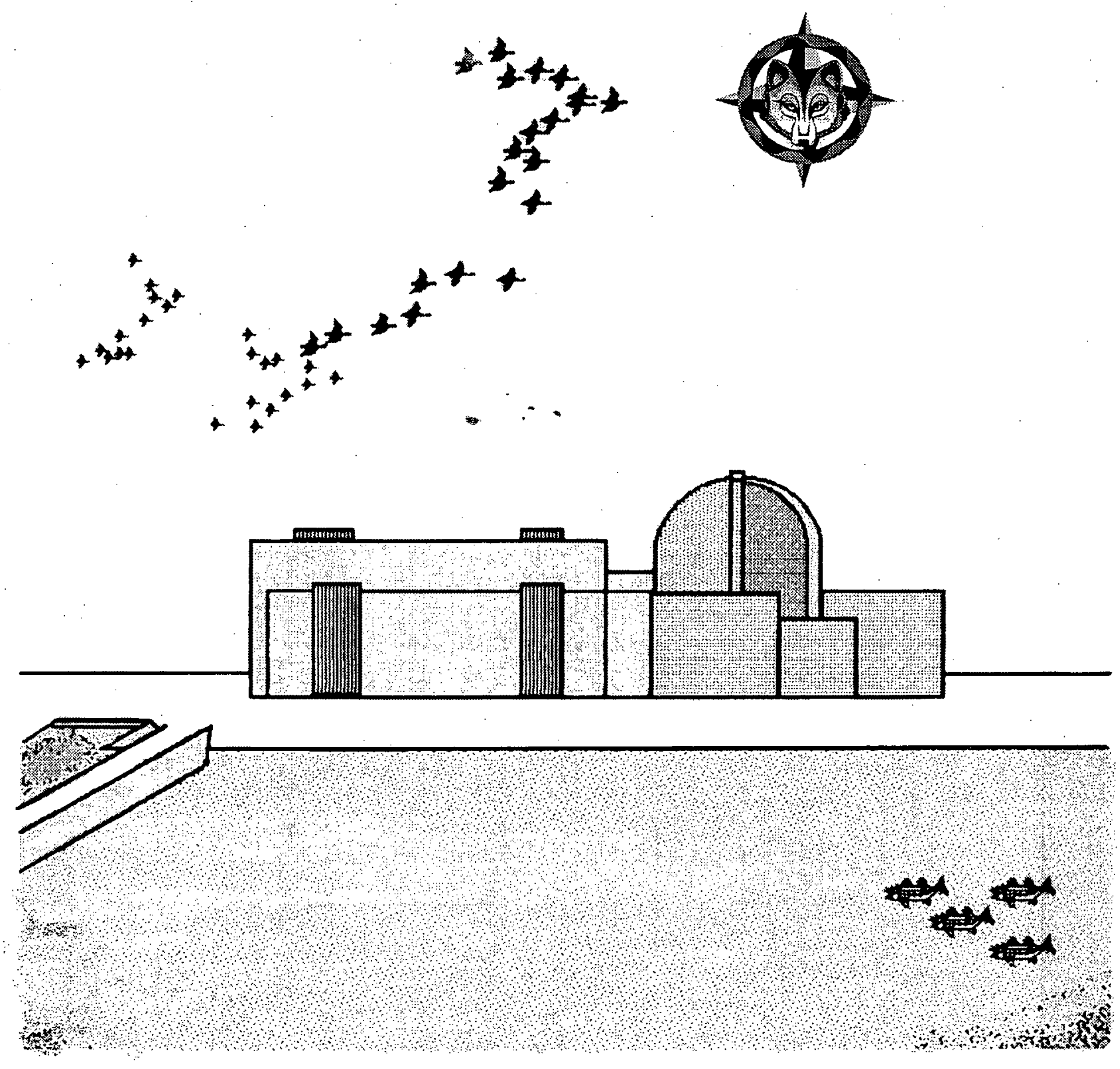
Total length - This is the greatest possible length of a fish with the mouth closed and the tail squeezed together. It is a standardized measurement to inform report readers of the type of length measurement used. Other similar types of length measurement are standard length and fork length.

Wiper - This is the common name given to the hybrid between the white bass and striped bass (striper).

Year class - This refers to a particular age group of a fish species recruited in a reservoir's fishery. Manipulation of year class presence, absence, or strength of a target species is an objective of many fishery management strategies. In WCCL, large year classes of shad have been successfully avoided.

Young of the year (YOY) - This refers to the fish in their first growing season (0+).

Fishery Monitoring Report for Wolf Creek Lake 1997



Wolf Creek Nuclear Operating Corporation
Burlington, Kansas

WOLF CREEK GENERATING STATION
WOLF CREEK LAKE

1997 FISHERIES MONITORING REPORT
FEBRUARY, 1998

Dan Haines

Supervisor Environmental Management Approval: Daniel Williamson — 4-24-98

Daniel L. Williamson — **Date**

Manager Resource Protection Approval: John W Johnson — 4-22-98

John Johnson — **Date**

EXECUTIVE SUMMARY

This report summarizes the results obtained from fishery monitoring of Wolf Creek Lake during 1997. The fishery was monitored to assess gizzard shad densities and the status of the predator species that have kept shad numbers low. Operational problems that are routinely experienced at some power plants due to excessive shad impingement and clogging of cooling water intake screens have been avoided at Wolf Creek. The dynamics of the fishery in the lake has kept shad numbers low enough to prevent this. Monitoring revealed that small shad numbers were low, but recruitment of 1994 and 1995 shad to reproductive sizes may increase production in the next few years. Data showed that predator fish responsible for keeping shad numbers down generally had good densities, were large on average, but had lower body conditions.

Fishery surveys in 1997 revealed that more shad from 1994 and 1995 survived than usual. This indicates that there is a greater potential for more shad reproduction in the next few years. The majority of 1996's and 1997's production of young appeared to have been consumed. Shad density was low enough so that no impingement problems occurred.

Most predator species had lower body conditions in 1997, likely due to the normally low, young-of-the-year shad numbers. Sampling revealed that a 1995 and 1996 year class of wipers has been established, but not as numerically abundant as the previous 1989 and 1990 year classes. Fish from the 1997 wiper stocking were represented in the gill net catches. Another stocking to establish a 1998 wiper year class is planned, because of the lower wiper numbers sampled, and because of the higher potential for shad production in the next few years.

Shad control should not be sacrificed in lieu of angler harvest, but with the catch-and-release philosophy being stressed at Wolf Creek, limited harvest has been compatible with continued shad control. Angler use and/or harvest during 1997 had no observable impact to the fishery. Catch rates and health statistics of the game fish remained similar to past years.

In summary, a potential exists for increased gizzard shad production for the next few years. Predator populations continued to maintain control of shad numbers. Wiper stocking was completed in 1997 and planned for 1998 to help maintain the predator numbers. Public fishing access during 1997 did not adversely impact the fishery.

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1997 FISHERIES MONITORING REPORT

1.0 INTRODUCTION

This report presents and interprets the results of fisheries monitoring activities on Wolf Creek Lake (WCL). The monitoring results presented in this report demonstrate that the fishery has functioned as desired through 1997. Its intent is to document and track long term fishery trends to identify change and forecast potential impacts to the efficient and safe operation of Wolf Creek Generating Station (WCGS). This report, as appropriate, will also provide insights into the fishery management options that may be available if the fishery begins to fail.

Initially, monitoring the fishery in WCL was undertaken to satisfy environmental monitoring commitments made to the Nuclear Regulatory Commission prior to plant operation (KG&E 1981, NRC 1982). The expected operational impacts were from thermal effects (temperature elevation and winter "cold shocks"), from chlorine use as a biocide, and from entrainment and impingement effects. Monitoring during plant operation coupled with various operational events have revealed that the thermal impacts have been well below initial licensing predictions. Impacts from the other concerns mentioned have been minimal. All fishery monitoring commitments were satisfied after the completion of 1987 activities.

Generally, operational impacts were considered as plant effects to the fishery, but the opposite can also occur in which the fishery could impact plant operations. For this reason, fishery monitoring continued on WCL beyond licensing commitments. Excessive fish impingement on intake screens can cause costly equipment damage and power production delays. This has been common at many power plants (Bruce NGS 1977) in the midwest, and excessively abundant gizzard shad have caused the most problems (Olmstead and Clugston 1986, White et al ~1989).

Early during WCL construction, it was determined that shad could not be excluded from, and would flourish, in the lake. Consequently, an aggressive stocking program was completed (KG&E 1984) which has effectively established a virtually self-sustaining shad control system using natural fish predators. Shad impingement problems at Wolf Creek Generating Station's (WCGS) cooling water intake have been nonexistent.

Public angling was allowed for the first time starting on October 1, 1996. The Kansas Department of Wildlife and Parks (KDWP) and Wolf Creek Nuclear Operating Corporation jointly determined appropriate creel and length limits to protect current predator populations. A primarily catch-and-release fishery was promoted. This strategy appears to have succeeded with no changes through 1997 attributable to angler harvest being detected.

2.0 METHODS

The methods employed during 1997 were consistent with past years to analyze long term trends. Trap (Fyke) netting, seining, electrofishing, and gill netting were used at long-term sites on WCL (Figure 1). Species important to the WCL fishery were targeted when they were expected to be most efficiently sampled. These standardized sampling methods also improved fishery comparisons with other regional reservoirs in many cases.

A total of eight Fyke nets were set for two nights for a total of 16 net nights. They were set in April, 1997, to target primarily white crappie, black crappie, and walleye. The Fyke net effort also yielded important information about the winter survival and recruitment of the previous year's gizzard shad production.

Three shoreline seining efforts were completed to assess the current year's reproductive success of gizzard shad. Each seine haul consisted of a standard Swingle swing with a 6 x 50 foot bag seine with 0.25 inch mesh. Five hauls were completed within Location 9 (Figure 1) during late

May to determine early shad production in the warmer plant discharge before summer water temperatures rose high enough that fish avoided the area.. Fifteen seine hauls were completed in the remainder of WCL during June, and again during July, 1997. Five seine hauls were completed in each location (Locations 2, 6, and 8) during each month.

Four electrofishing efforts were completed in 1997, two in the spring (May), and two in the fall (September and October). This gear type targeted largemouth bass and bluegill in the spring/summer. It provided indications on the production and fate of the shad production during late summer and fall months as well. Smallmouth bass samples were targeted during the fall. A Smith-Root boat mounted shocker with circular electrode arrays was used. Two 15 minute (energized time) subsamples at each location (Figure 1) were shocked at approximately 10 amps and 220 volts.

Gill netting was an extensive, two day effort in October, 1997. This effort was used to catch the wiper hybrid, which has been one of the most important shad-controlling predators in WCL. The gill nets were also used to sample white bass, walleye, gizzard shad, and catfishes. One gill net complement was set at each location during each night (Figure 1) for a total of eight complement net nights. A net complement included four nets, one each with 1, 1.5, 2.5, and 4 inch mesh sizes. Each was an 8 x 100 feet uniform mesh monofilament net.

Additional small-mesh gill nets were set during the same week as the standard gill net complements. These were to better assess young-of-the-year (YOY) gizzard shad production. Two 1/2 inch and two 3/4 inch monofilament mesh nets (8 x 100 foot) were set for two consecutive nights. A pair, one of each mesh size, comprised a small mesh complement. One complement, each, was set for one night at Location 2 and 6. Two small mesh complements were set the following night at Location 8, which is the location encompassing the WCGS cooling water intake structure (Figure 1). These nets were set to determine catch frequency and size distribution of young-of-year (YOY) shad too small to be caught in the standard one-inch nets. A total of four small mesh complement net-nights were fished. Gizzard shad only were measured and counted from these nets.

Size ranges of gizzard shad impinged on the plant's intake screens were determined by measuring a representative sample of fish removed from the screens. The shad were impinged within one day prior to measurement. This supplemental data was used to verify that the sizes impinged were sampled in the small mesh gill net catch results.

3.0 RESULTS AND DISCUSSION

During 1997, a total of 26 different species were collected. All were sampled in the past. The relative abundance (Table 1) and percent biomass (Table 2) of each species collected in 1997 were similar to past years, but with slightly higher roughfish numbers. Prey species such as gizzard shad and bluegill comprised a high relative percentage of the numbers collected, but a low percentage of the total weight (biomass). This was because most were small YOY fish.

Conversely, relative numbers of predator species were lower and biomass percentages were higher. This indicates good numbers of larger individuals. In addition, the biomass of roughfish such as common carp, buffalo and gizzard shad in WCL was atypical. The 1997 gamefish to roughfish ratio was 1.5 to 1, which was weighted much more toward gamefish than in other reservoirs. When using similar gears, other reservoirs were usually opposite from WCL's ratio (Crandall 1978, Electric Power Research Institute 1979, Pallo 1992). This ratio is valuable only when used to generalize relatively between reservoir fisheries.

3.1 PREDATOR/PREY INTERACTIONS

The fishery's ability to eliminate shad impingement events, which can be detrimental to plant operation, depends to a large degree on the interactions between the array of predator and prey species. Typical prey species tend to produce a large number of young each year. Characteristics of an annually cropped prey population, such as in WCL, would be a high percentage of larger, older individuals, fast growth of YOY, and good health of individuals. The number of fish making it to reproductive age (recruitment) would also be low. A concern with excessive cropping would be if the number of reproducing adults became too low to produce enough young to support the predators controlling them and a subsequent loss of the predators would result.

Characteristics of predator populations in a low-prey fishery would include low recruitment due to cannibalism or predation, slow or no growth of adults, large percentages of older individuals, and poor health of adults. Difficulty in producing trophy size individuals would also be evident.

3.1.1 Gizzard shad

Gizzard shad population dynamics were very important, because YOY shad impingement can directly impact plant operations. Shad proportional stock density (PSD) from gill net data showed signs of recruitment during 1994 and 1995 of shad into the 180 to 280 mm (7 to 11 inches) range (Figure 2). The proportional stock density (PSD) indices from 1996 and 1997 indicate little recruitment of 1996 shad production, probably as a result of heavy predation pressure.

The PSD index is valuable in determining shad recruitment to stock and larger sizes, but it doesn't identify YOY production. The shad length frequency histogram for 1997 (Figure 3) shows a mode around 180 mm total length (TL), which is the minimum stock size for shad. Scale aging revealed that most of these are from 1996 production, with a few being from 1997. The shad that grew >180 mm TL their first summer (1987) were likely from early spawning activity in the heated area of WCL. The dominant mode around 310 mm TL are fish from 1994 and 1995 production. These two year classes are entering their full reproductive potential, which is typically around 3 years (Pflieger 1975). The higher numbers of shad recruited to this reproductive age, when compared to past years, may increase YOY shad production in the next few years.

To measure YOY shad production in 1997, catch-per-unit of effort (CPUE) from summer shoreline seine were calculated (Figure 4). Seine CPUE in 1997 was lower. All seine efforts and locations were combined. Individual seine haul catches, that caused the higher CPUE in 1994 and 1995, were highly variable making it difficult to put any confidence in them, but the obvious recruitment of these age classes supports the higher seine catch results in 1994 and 1996.

Shoreline seining in 1997, as in past years was completed to measure YOY gizzard shad production in an attempt to forecast potential impingement increases during the upcoming winter. Monitoring results were useful when shad numbers remained low, but seining was not accurate enough to confidently detect subtle increases in YOY shad numbers. The lack of precision of the seine data make effective sample sizes impractical (Boxrucker et al~1991). This was likely due to net avoidance and movement offshore of YOY shad, making capture by the seine less likely. Small mesh gill nets would sample YOY shad more effectively in deeper water and would be more likely than seining to encounter schooling shad because they would be set overnight. Consequently, the gill nets would tend to provide less variable data than summer shoreline seining. Discontinuing the seining efforts, in favor of small mesh gill nets is recommended for WCL. Discussion of the small mesh gill net results are presented later in the report.

The 1997 YOY shad densities at WCL were much lower than around some power plants with shad impingement problems. Based on shoreline seine results converted to number per square yard, WCL densities were 0.01 in 1987 to 0.44 per square yard in 1995 (Figure 4). Other studies, primarily in Lake Erie, have estimated YOY gizzard shad densities from approximately 1 to 15 YOY per square yard (White et al ~ 1989, and literature cited within). The cited concentrations are rough, as well as Wolf Creek numbers. However, this indicates that the highest measured WCL shad density in 1995 was approximately 2.3 to 34.1 times less than in areas where plants have shad impingement problems. Further distancing WCL shad numbers from the other studies cited was that the WCL numbers were mid-summer as opposed to fall numbers at the other locations. YOY shad numbers typically peak in mid-summer. Predation pressure appears to decrease WCL shad numbers into fall.

Wolf Creek gizzard shad YOY lengths were highly variable in 1997 most likely due to early spawning in the plant's heated discharge water. Shad ranging from 90 to 230 mm (4 to 9 inches) their first year were common during past years. Back-calculated lengths from scale samples of 12 large adult shad showed first year growth from 126 to 228 mm with an average of 174 mm (Colvin 1995). Health of the Wolf Creek shad was also good with an average $\underline{Wr}$ value of 89 (Figure 5).

Small Mesh Gill Net Results

Previous annual data for the small mesh gill nets on WCL was insufficient to compare catch rates. As annual data is collected, this will be possible. Nevertheless, inferences can be made with respect to potential plant impingement impact.

The 1/2 inch mesh size appears to efficiently sample the shad less than 120 mm TL. Gizzard shad less than ~120 mm TL typically are most vulnerable to winter die-off and intake screen impingement (White et al ~1989). To verify this at WCGS, lengths were recorded for a portion of the shad impinged on the intake screens on December 11, 1997. As obvious in Figure 6, the impinged size range was nearly identical to the 1/2 inch gill net catches.

Gizzard shad catches in the 3/4 inch nets targeted the 120 to 180 mm TL range, but few numbers were sampled. This mesh size has been shown effective at this size range (Boxrucker et.al. ~ 1991). Consequently, the 3/4 inch catch results for WCL indicate that few shad existed in the 120 to 180 mm (TL) range in 1997. The advantage the 3/4 inch size provides to the small mesh complement is to ensure that a wider range of shad are sampled, thus reducing the chances of missing a dominant size range of YOY shad.

The catch rates of the small mesh complements were highly variable, in 1997. Difficulty in consistent catches, in WCL's case, implies that shad numbers were low. Upper lake versus lower lake sampling locations may also have contributed in the catch variance. The primary reason for the small mesh effort was to efficiently assess YOY shad changes, year to year. This will allow predictions to be made on possible plant impingement problems. Consequently, sampling effort should be refined to include at least six complement net nights in the main dam and cooling water intake areas of the lake. These are areas least influenced by the attraction in winters to the heated effluent discharge, and are areas where shad will be susceptible to impingement.

3.1.2 Predators

Wolf Creek Lake predators, by consuming a large portion of YOY gizzard shad production, have contributed to the absence of impingement problems at the station's intake screens. Gizzard shad attraction to the heated plant discharges, which is remote from the intake area, also likely contributed. Good to excellent recruitment of young to reproduction ages occured for all game fish except largemouth bass, which have been declining since 1992. Predator densities were generally from fair to excellent, again except for largemouth bass. Body conditions generally declined for game species, but fair conditions were still prevalent, with white bass and white crappie still considered excellent. Wiper hybrids from the stockings in 1995, 1996 and 1997 were evident in gill net catches, but numbers were lower than previous year classes. This, and the possibility of higher shad production discussed earlier, justifies that a 1998 wiper stocking be completed.

There were no definite indications that angler harvest adversely impacted predator fish populations. Equal or declining body conditions, similar monitoring catch rates, and similar or declining shad catch rates are indicative of no angling impact.

White Bass:

White bass sampled in WCL were larger than in 1996 with nearly half of the fish being of preferred size (Figures 7 and 8). This indicates good recruitment. White bass density was also up as evidenced by the gill net catches (Figure 9). Average body condition of white bass was also good to excellent (Figure 10).

Wiper:

The wiper has been well suited for shad control in WCL, but appear to be limited in how large they can grow. This was likely due to the low shad densities over the years. The 1989 and 1990 supplemental stockings grew well up to the 510 to 560 mm TL range (20-22 inches), but rarely into the trophy size class (Figures 11 and 12). The 1995 wiper stocking, now about 400 mm TL, was well represented in the 1997 gill net catches. Fish from the 1996 stocking were evident in the 290-330 mm TL range. Wiper densities rose slightly in 1997, but were still lower than most previous years (Figure 13). Wiper health declined from the high measured in 1996, to levels common in the past (Figure 14). Wiper body condition, as a population, was good, but the larger, older fish were commonly of poor condition. Memorable sized fish (510-629 mm TL) caught in the gill nets, had an average relative weight ($W_{\underline{r}}$) of 72, which is considered poor to fair. These larger wipers are not expected to last much longer, due to the combination of old age, and insufficient shad prey to support larger body sizes. It is advantageous for shad control to have wipers approaching, and within the size range of these older fish. Considering the lower catch rate in the gill nets, the potential for higher YOY shad production in the next few years, and decline of the older wipers, it is recommended that 8-10 wipers per acre (40,000-50,000) be stocked, with a two inch minimum size in mid-June, 1998.

Smallmouth bass:

The WCL smallmouth bass population was well represented by various size classes (Figure 15). Electrofishing catch rates were lower in 1997 (Figure 16), and the catch was well distributed (Figure 17). Average health was fair with a $W_{\underline{r}}$ value of 81 (Figure 18).

Largemouth bass:

Densities of largemouth bass in WCL have declined greatly since the 1989 high (Figure 19). The 1997 spring electrofishing catch of largemouth bass was again, very low (n=4). Little confidence should be placed in the population statistics, other than low catch rates, because of the small sample size. Largemouth discussion here is included because of the species' past importance in controlling shad, and high angler popularity. Recruitment to replace the initial dominant year classes appeared to be taking place from 1992 through 1994, but there was no evidence of it in the spring electrofishing efforts since 1994 (Figure 20). Body conditions have generally declined since 1988, but rebounded in 1997 (Figure 21). In summary, largemouth was no longer a dominant predator in WCL as when the lake was younger.

White crappie:

White crappie were large on the average with most being in the memorable size class (Figures 22 and 23). Some bias toward larger crappie may have resulted from using spring Fyke net catches for determining length frequencies. Fyke net densities were relatively consistent from 1989 through 1997, with a high in 1996 (Figure 24). White crappie body conditions were excellent with W_r values over 100 in 1995 and 1996, but declined slightly in 1997 (Figure 25).

Walleye:

The walleye population was well represented by individuals from several year classes in the fall gill nets (Figure 26). Most walleye were in the quality size class in 1997 and good recruitment has occurred since 1991 as evidenced by mid-range PSD's (Figure 27). Growth of YOY walleye has been good with total length reaching 250 mm (10 inches) by fall. Average body condition of walleye in the gill nets was excellent in 1996 with a W_r of 105 (Figure 28). Condition in 1997 declined, but was still considered good. The 1996 high was likely caused by the higher 1994 and 1995 shad production. Walleye catch density in 1997 was the highest recorded for WCL (Figure 29).

3.2 ANGLER HARVEST IMPACTS

The lake opened for limited public fishing October 1, 1996. Near 100% creel data was gathered as anglers exited the park. The creel and size limits were restrictive (Table 3) and were set to protect the predators so that beneficial shad control could continue. High length limits restricted harvest to only the largest and oldest individuals. The creel limits promoted catch-and-release fishing which has been compatible with the plant's efforts to control shad density. Overall angler harvest was low during 1997 (Table 4).

White bass:

A daily creel limit of two white bass >14 inches were allowed. The primary reason a length limit was placed on white bass was to protect the wiper hybrids. Many anglers have difficulty telling white bass and wipers apart. Identification is easier after the fish reach 14 inches. If smaller white bass were allowed to be harvested, incorrect identification would subject the wipers to harvest before they reach their optimum size for controlling shad.

No angler impacts to white bass were present. Creel survey data indicate that a very small percentage of white bass caught were harvested (Table 4). Length frequency indicates a high proportion of larger white bass (Figure 8), and gill net catch rates were up for 1997 (Figure 9). Most Kansas reservoirs where there were no creel limits have similar gill net CPUE as WCL (Willis 1984), and have harvest rates per acre of approximately 1.7 fish (mean of 10 Kansas reservoirs from 1989 through 1993, KDWP unpublished data). These indicate that the white bass population in WCL could withstand more harvest impacting their value as shad predators. A higher creel limit would be compatible with station operation. It is not recommended to change the length limit for white bass because of the benefits in reducing confusion with wipers.

Wiper:

In Wolf Creek Lake, wipers have been very important for controlling shad and the optimum size based on historic length frequency distributions (Figure 11) has been between 500 and 600 mm (approximately 20-24 inches). Wiper populations are not self-sustaining, consequently WCGS has invested and plans to continue investing in replacement wiper stockings. The 24 inch length limit for angler harvest was set to protect the investment and to help ensure that the wipers will reach the preferred size range for controlling shad. Wipers larger than 24 inches have generally been older individuals that were not expected to survive much longer, and thus their removal would not impact shad control benefits. The optimum size could change if higher numbers of shad increase wiper growth, thus exposing higher numbers of wipers to harvest. Future monitoring will determine if this occurs and angler limits may be altered accordingly.

The harvest of wipers from WCL was very low in 1997 (Table 4). If angler harvest was excessive, it would be expected that body conditions would increase due to less competition for food, primarily the gizzard shad. This would be especially true in a prey-limited lake like WCL. Body conditions of the larger wipers declined in 1997. However, because of the higher reproductive potential of shad due to the recruitment of 1994 and 1995 year classes, it is not recommended at this time to alter the wiper length limits.

Smallmouth bass:

Smallmouth bass were the dominant shoreline predator and were abundant along the riprap. A large number were caught and released, but few were harvested (Table 4). Hook scars were present on 71 percent of the smallmouth bass electrofished in areas of WCL open to public fishing during the spring of 1997. Fall electrofishing did not sample any smallmouth bass above the 18 inch length limit (Figure 17). Size range was well distributed, but body conditions were lower in 1997 (Figure 18) indicating that recruitment, and thus competition among themselves, was high. Consequently, there appears to be room to allow for more harvest without altering the population's benefits for controlling shad. Instituting a slot limit similar to allowing harvest of one fish per day over 18 inches, and five fish <10 inches, may be advantageous.

Largemouth bass:

Largemouth bass numbers have declined in the lake over the past few years. Setting the length limit at 21 inches was to allow essentially no harvest. Creel data indicate that only three largemouth bass were harvested in 1997 (Table 4). No changes to the current length and creel limits are recommended.

White or Black Crappie:

Very few lakes have a crappie length limit set so high. Setting the limit at sizes common to the rest of the state (9 or 10 inches) would expose a very high percentage of crappie to harvest in Wolf Creek, according to length frequency distribution for white crappie (Figure 22).

The creel limit of two fish per day could probably be raised. The 1997 harvest (Table 4) had no apparent impact on net catch frequencies (Figure 24), or on crappie size distribution (Figure 22). No changes to the length limit is recommended at this time.

Walleye:

This length limit was set to maintain the walleye in the lake essentially as is, indefinitely. Length frequency indices indicate good recruitment of walleye since 1991 (Figure 27). The lower body conditions in 1997 (Figure 28) indicates high competition for food. Walleye may not be as efficient shad predators as wipers or white bass, but they do add variety to the predator base allowing it to compensate for variable shad reproduction success. This was evidenced by the higher body conditions in 1996, which were likely a response to the higher gizzard shad numbers produced in 1994 and 1995. Indices indicate that the population in WCL could withstand more harvest, but it is not recommended at this time because of the potential increase in shad production in the next few years, and the lower numbers of larger wipers present.

Channel, Blue, and/or Flathead Catfish:

Catfish generally were not considered primary shad predators in the lake. Consequently no size restrictions were thought necessary. The low creel limit should spread the catfish harvest over more anglers without impacting the population. No changes to the current limits are recommended at this time.

4.0 CONCLUSIONS AND MANAGEMENT IMPLICATIONS

Fishery monitoring revealed that gizzard shad numbers continue to be kept low, primarily by game fish species. This, coupled with winter shad attraction to the warmer discharge waters, which are distant from the intake screens, has kept shad impingement problems from occurring at the plant's cooling water intake screens. Wolf Creek's shad population did show moderate recruitment of 1994 and 1995 shad year classes, which will be reproductively maturing in 1998, thus potentially increasing YOY production. The 1997 shad data indicate lower YOY catch rates. To the benefit of WCGS, the predators still managed to consume a large portion of the shad production in 1997. Impingement potential at the intake screens has remained low.

Predator body conditions generally declined in 1997 indicating low shad availability. These body condition variations have been common in the past. Average distributions of most predator species were good with high percentages of larger fish. This was true especially for white bass, white crappie, and walleye. The 1995 and 1996 wiper stockings appeared successful, but in smaller numbers than past year classes. Fewer numbers of the 1989 and 1990 wiper year classes were sampled, also. Another stocking is planned for 1998, because of the lower gill net catches, fewer older fish, and in anticipation of greater shad production in the next few years.

No adverse impacts to the fishery from angler harvest were identified. Due to the restrictive creel and angler limits, few fish were harvested. Most game fish indices indicate good recruitment, but declining body conditions. The body conditions of the predator species appeared to be tied more to YOY shad density changes than to the introduction of angler harvest. This is indicative of a prey-limited fishery. This benefits plant operation by keeping shad numbers low. Some increases in harvest were recommended for white bass, smallmouth bass and white crappie. Harm to the fishery from slightly increasing harvest for these species is not expected.

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Table 1. Relative Abundance (Percent) of Selected Fish Species Using a Standardized Sampling Regime in Wolf Creek Lake.

Species	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Gizzard shad	21.4	11.2	22.1	27.5	28.2	13.7	34.0	26.7	27.4	38.5	19.0
Channel catfish	1.9	2.9	2.1	4.3	2.7	3.9	5.3	4.6	5.8	2.2	3.7
White bass	3.7	5.2	8.1	10.2	14.4	16.9	14.6	20.1	16.9	7.8	22.8
Wiper	2.5	4.2	5.5	3.9	4.5	1.8	1.1	2.4	4.4	2.2	4.3
Bluegill	23.5	27.4	21.7	11.9	11.2	11.4	9.9	8.7	4.1	4.9	2.9
Smallmouth bass	3.2	3.8	5.1	5.3	7.1	6.5	7.6	7.8	5.9	5.6	7.5
Largemouth bass	7.2	8.2	9.5	6.1	4.5	4.6	2.8	3.1	1.4	1.3	1.0
White crappie	6.1	6.9	3.9	4.6	4.6	6.3	6.6	5.6	7.7	7.7	5.9
Black crappie	4.9	3.4	3.0	1.9	3.6	2.1	0.8	0.7	1.2	0.3	0.2
Walleye	3.6	6.7	5.8	7.6	5.0	9.0	5.0	8.5	10.6	14.1	14.4
Rough fish (2)						5.9	5.0	4.0	6.8	9.6	10.2

(1) 1987 through 1992 includes 120 seine hauls and six electrofishing efforts. 1993 includes 80 seine hauls and four electrofishing efforts. 1994 and 1995 include 40 seine hauls and four electrofishing efforts. 1996 and 1997 includes 35 seine hauls and four electrofishing efforts. All years include identical Fyke and gill netting efforts.

(2) Includes bigmouth buffalo, smallmouth buffalo, common carp, and freshwater drum and river carpsucker.

Table 2 Percent Biomass of Wolf Creek Lake Species Collected with Standardized Sampling Regime

Species	83-85 Average %	86-92 Average %	1993 %	1994 %	1995 %	1996 %	1997 %
Gizzard shad	3.9	4.1	8.1	4.7	8.5	8.1	7.8
Common carp	14.1	12.1	21.2	7.5	11.2	14.1	10.3
Bigmouth Buffalo	<0.2	2.9	0.0	4.3	2.1	8.0	<0.1
Smallmouth buffalo	1.4	4.0	5.4	4.9	1.7	3.4	16.2
Channel catfish	8.8	9.3	13.3	10.3	10.4	6.1	5.6
White bass	7.4	10.4	11.6	25.8	17.2	4.7	12.3
Wiper	15.5	14.8	6.0	10.9	13.2	4.6	7.9
Bluegill	2.7	1.0	0.7	0.6	0.3	0.5	0.2
Smallmouth bass	1.1	4.0	4.6	3.8	5.1	6.8	6.1
Largemouth bass	14.7	10.6	3.5	2.8	1.4	1.5	0.4
White crappie	1.7	6.5	7.0	5.0	7.1	9.3	5.8
Black crappie	5.5	3.1	0.5	0.7	1.1	0.4	0.2
Walleye	8.4	12.9	12.4	15.4	15.6	25.3	18.1
Freshwater drum	0.5	1.7	1.4	1.1	1.9	3.5	4.1
Other species	2.6	1.5	4.3	3.1	3.2	3.7	<5.1
Total biomass (kg)	1035	1137	866	765	824	692	867
Roughfish %	20.1	24.9	36.2	22.6	25.3	37.2	39.3
Gamefish %	77.6	73.7	62.8	76.7	74.3	62.1	60.4
Game/Rough Ratio	3.9/1	2.9/1	1.7/1	3.4/1	2.9/1	1.7/1	1.5/1

(1) Roughfish include gizzard shad, common carp, smallmouth buffalo, bigmouth buffalo, freshwater drum, and river carpsucker.

Table 3. Length and Creel Limits for Public Fishing at Wolf Creek Lake, 1997.

Species	Minimum length inches	Maximum Creel	% Vulnerable to Harvest (1)
White bass	14	2	4
Wiper hybrid	24	1	0
Smallmouth bass	18	1	0
Largemouth bass	21	1	0
Crappie (Black and/or White)	14	2	27
Walleye	21	1	2
Catfish (any species)	any size	2	all

(1) Based on 1997 length frequency distributions

Table 4. Creel Survey Summary for Selected Species in Wolf Creek Lake, 1997.

Species	#Caught	#Caught Per Angler (1)	#Released	>Length Limit Released	# Harvested	#Harvested Per Acre (2)
Blue catfish	140	0.01	109	NA	31	0.01
Channel catfish	12,989	0.79	10,516	NA	2473	0.49
White bass	10,202	0.62	10,145	100	57	0.01
Wiper hybrid	3,246	0.20	3227	3	19	<0.01
Smallmouth bass	20,943	1.27	20,838	15	105	0.02
Largemouth bass	4675	0.28	4672	8	3	<0.01
White crappie	8113	0.49	7193	32	920	0.18
Walleye	27,536	1.67	26,956	50	580	0.11
Total (3)	87,844	5.3	83,656		3,888	0.76

(1) Total number anglers surveyed was 16,538.

(2) Based on 5090acres for WCL.

(3) This total row includes only the species above. A small percentage of other species were harvested, but not included.

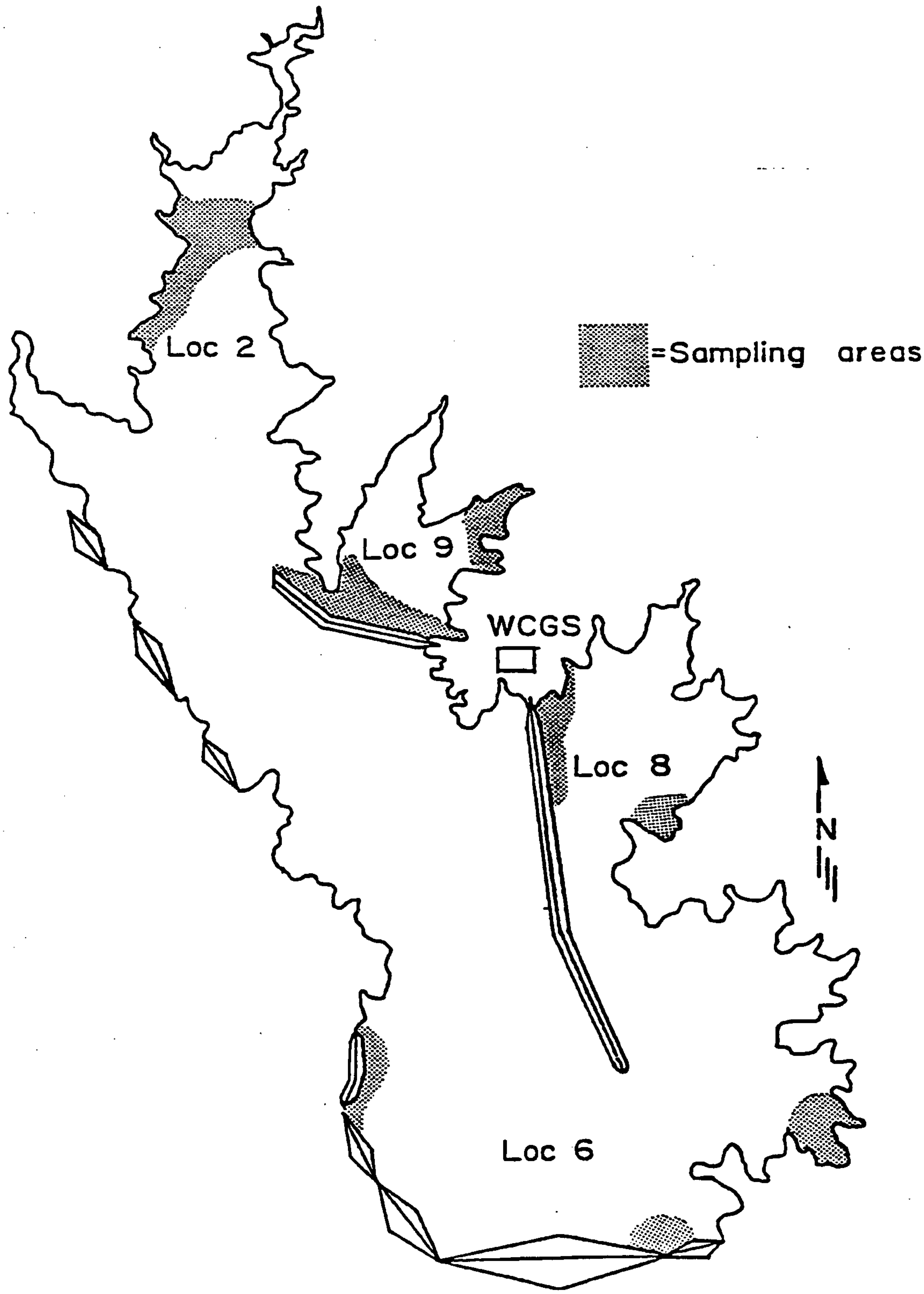


Figure 1. Fishery sampling locations on Wolf Creek Lake.

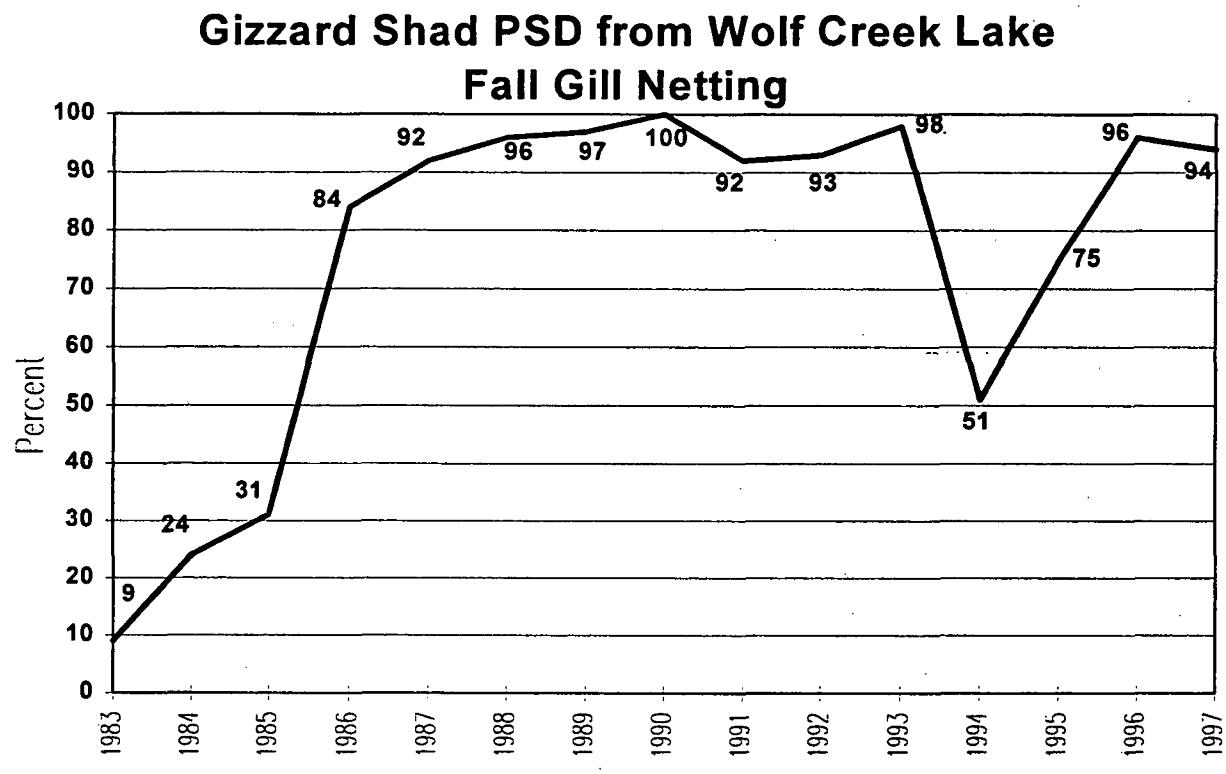


Figure 2. Fall gill net proportional stock density (PSD) relationships for gizzard shad in Wolf Creek Lake. Data corrected for net efficiencies (Willis et. al 1983). Stock size = 180-279 mm, Quality size ≥280 mm.

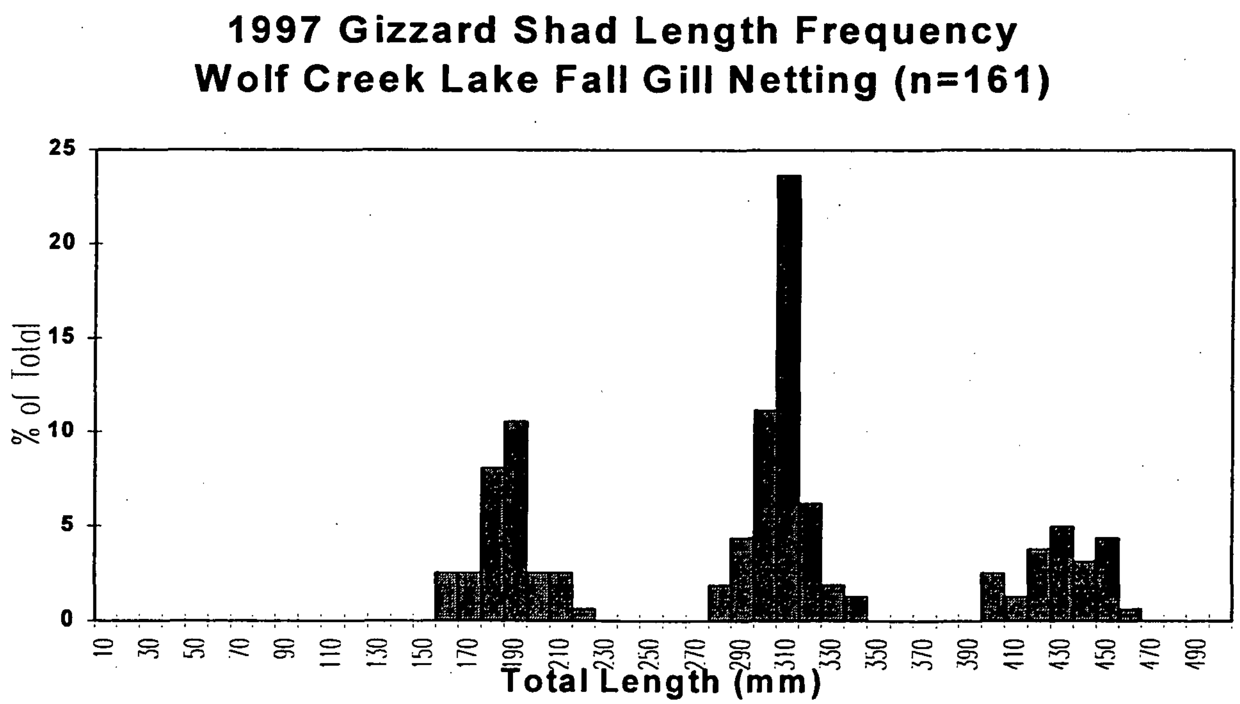


Figure 3. 1997 gizzard shad length frequency distribution in Wolf Creek Lake

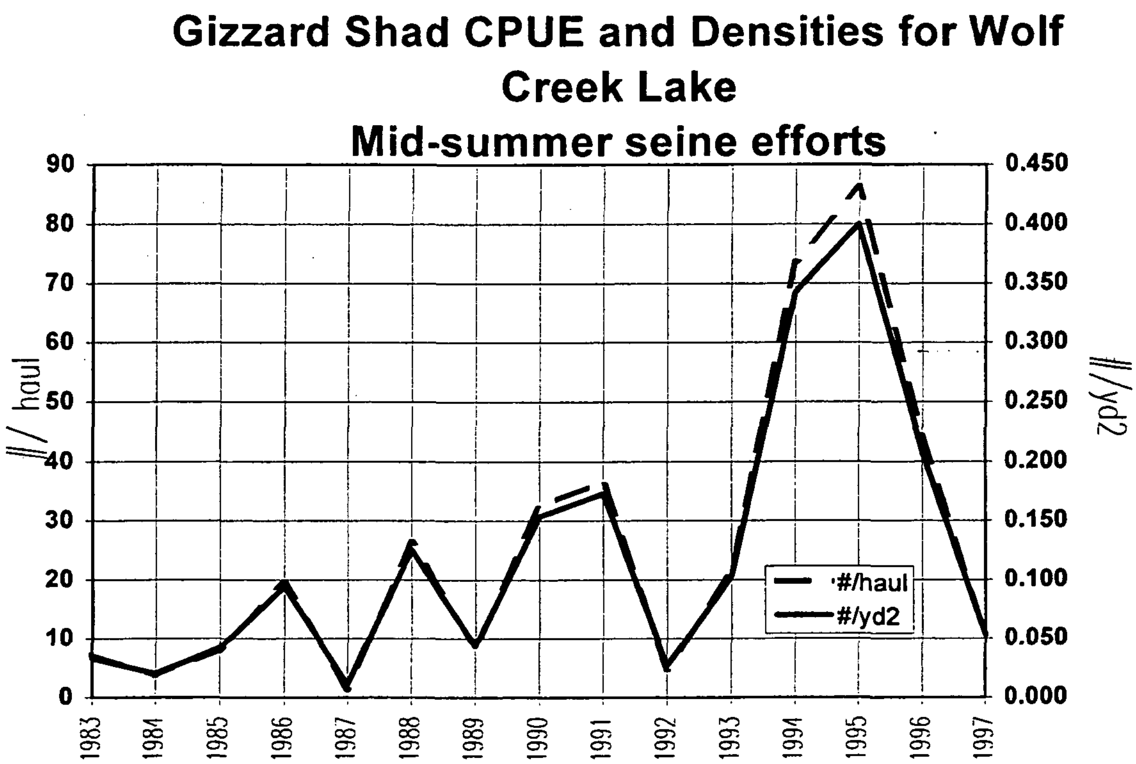


Figure 4. Gizzard shad catch-per-unit-of-effort (CPUE) and densities from summer shoreline seining in Wolf Creek Lake.

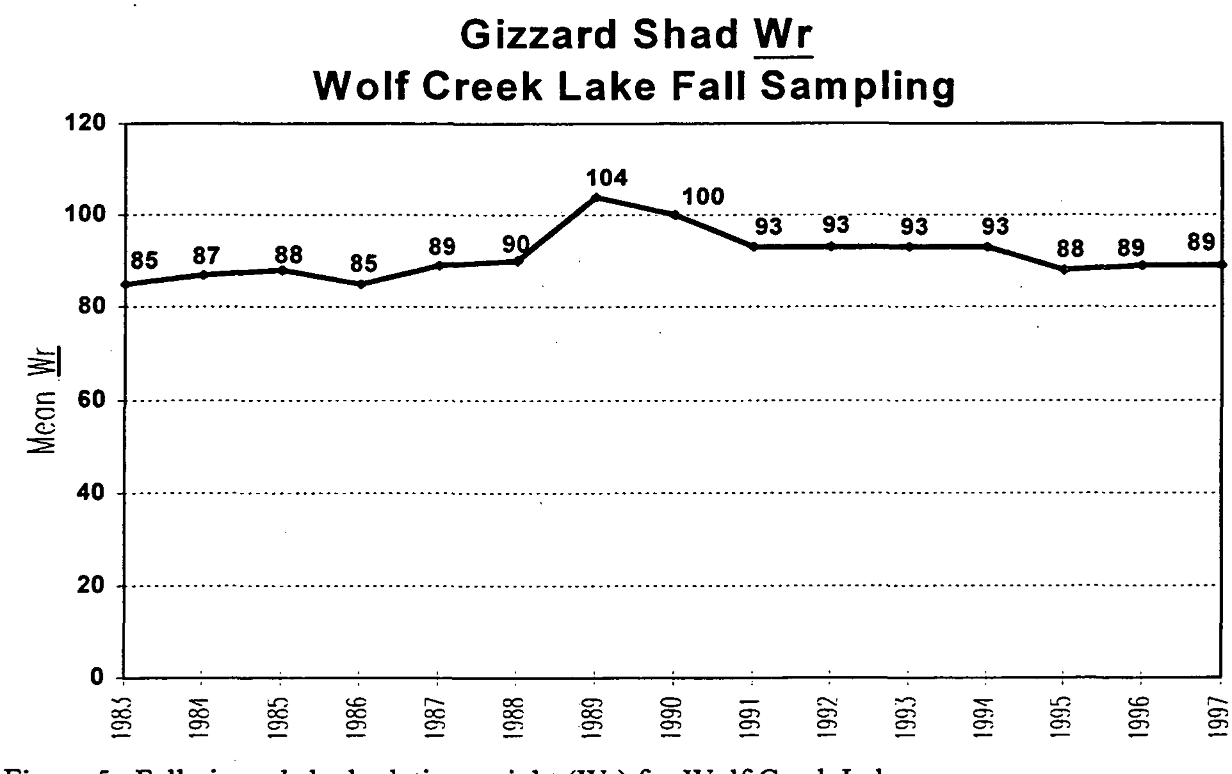


Figure 5. Fall gizzard shad relative weight (Wr) for Wolf Creek Lake.

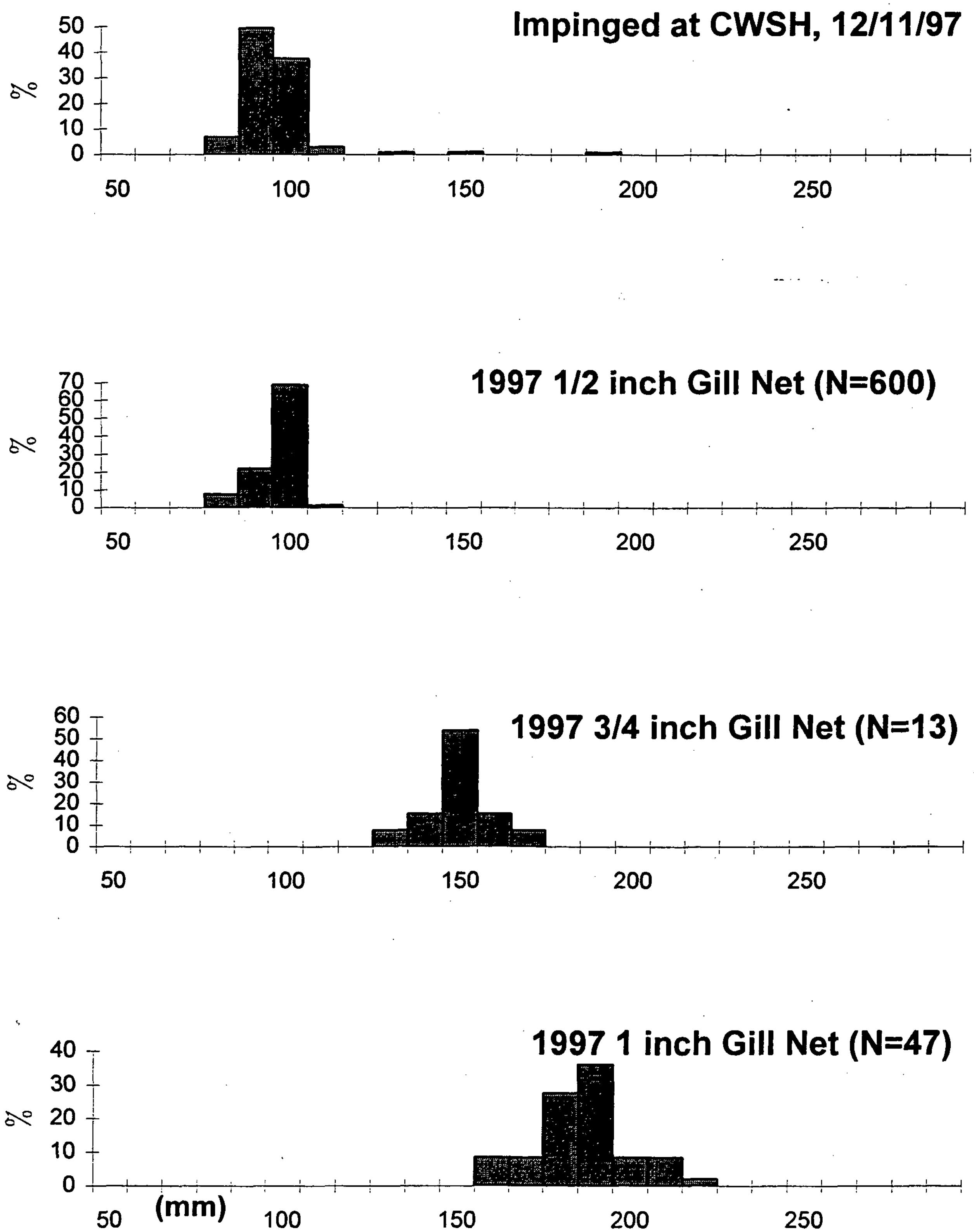


Figure 6. Length frequencies from WCGS intake impingement and small mesh gill nets for gizzard shad at Wolf Creek Lake, 1997.

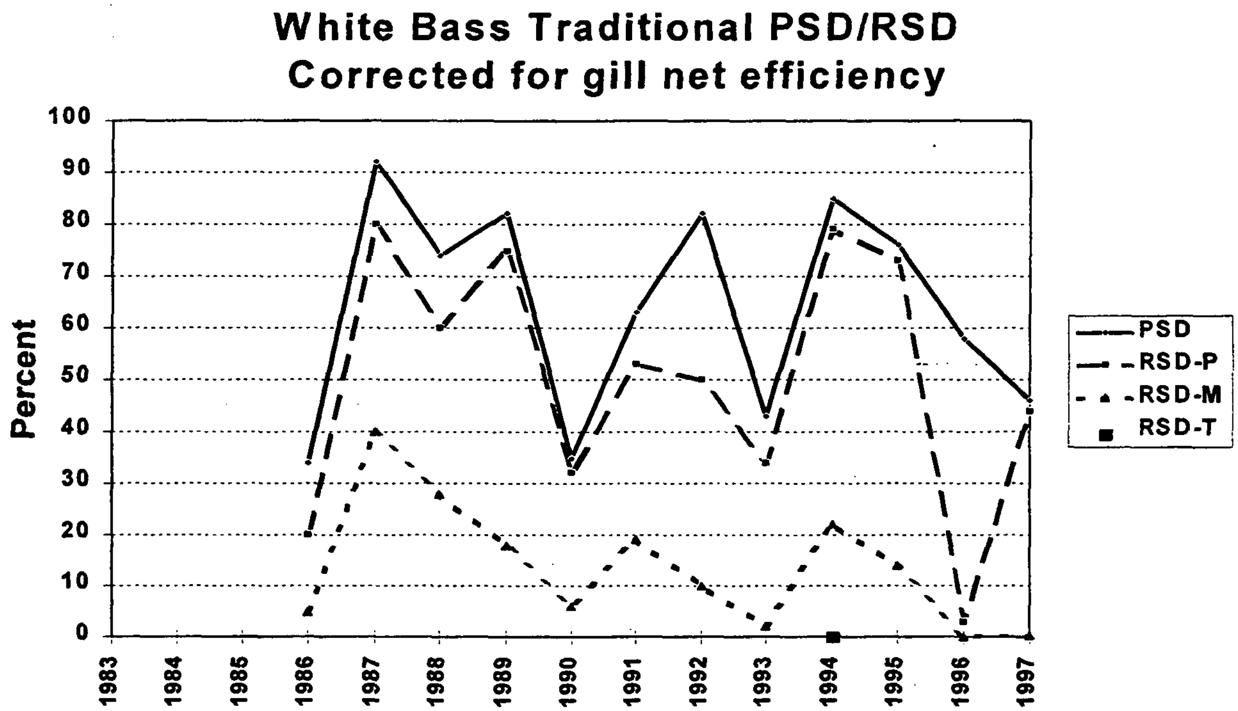


Figure 7. Fall white bass traditional proportional and relative stock density (PSD, RSD) relationships for Wolf Creek Lake. Percentages were corrected for gill net efficiency (Willis et al 1983). S-Q= 150-229 mm, Q-P = 230-299 mm, P-M=300-379 mm, M-T=380-459 mm, T≥460mm.

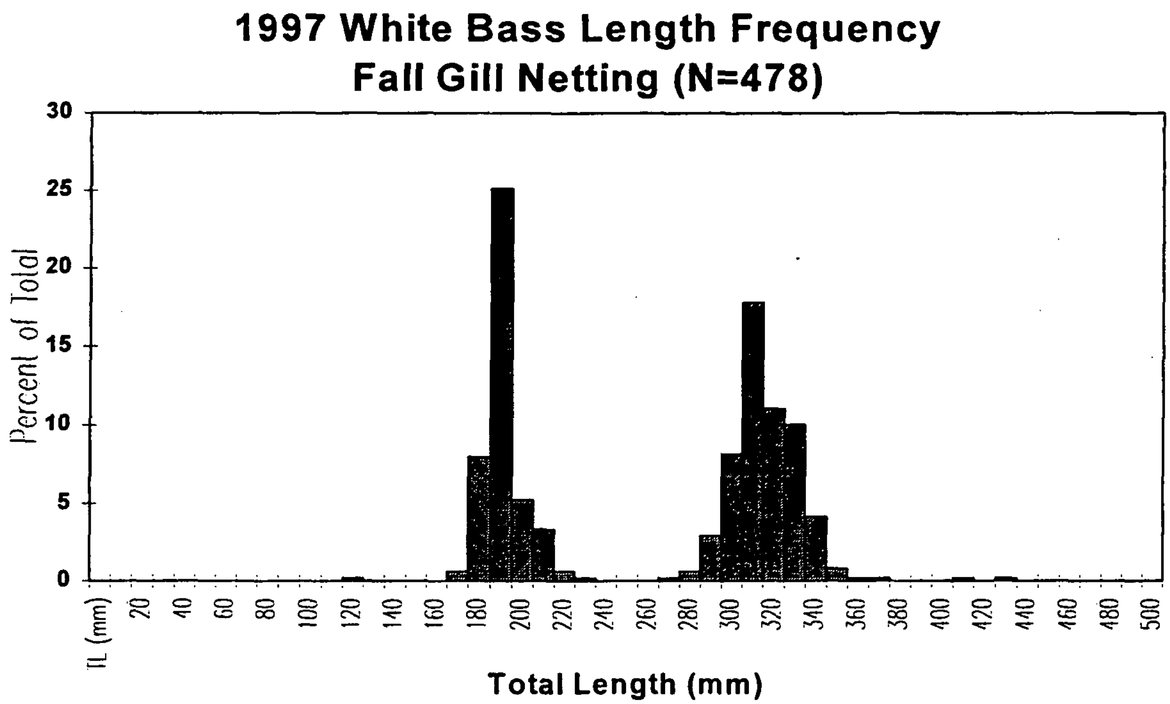


Figure 8. 1997 fall white bass length frequency distribution for Wolf Creek Lake.

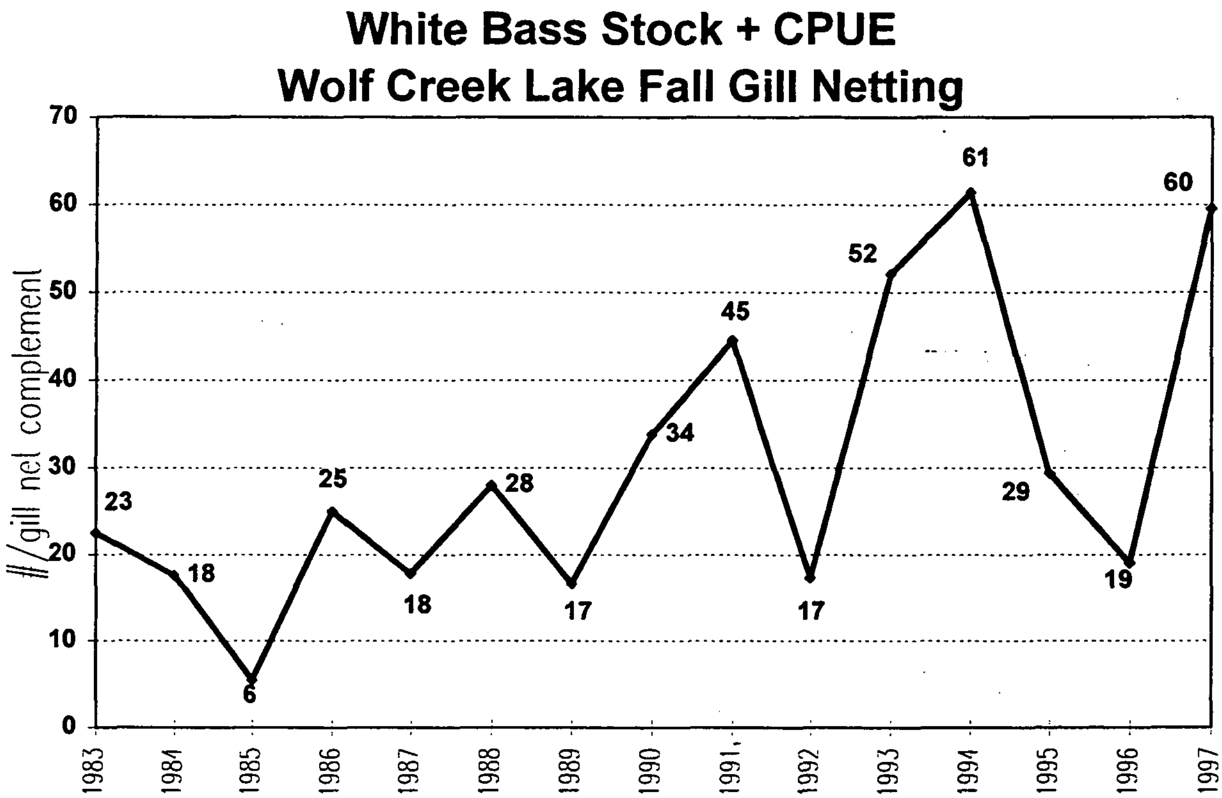


Figure 9. Fall gill net CPUE for white bass in Wolf Creek Lake. Effort is shown as number of fish > stock size per gill net complement night. One complement equals one net each of 1.0", 1.5", 2.5", and 4.0" mesh sizes.

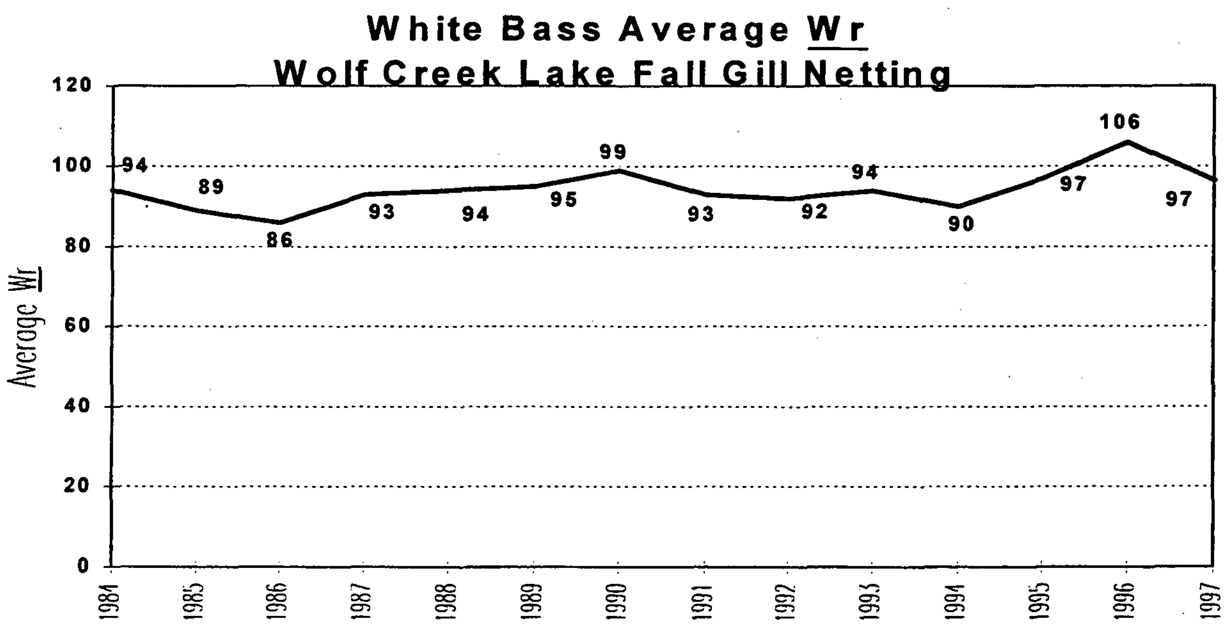


Figure 10. Fall white bass relative weight (Wr) for Wolf Creek Lake. Numbers shown are averages for all stock + fish (150 mm total length or greater).

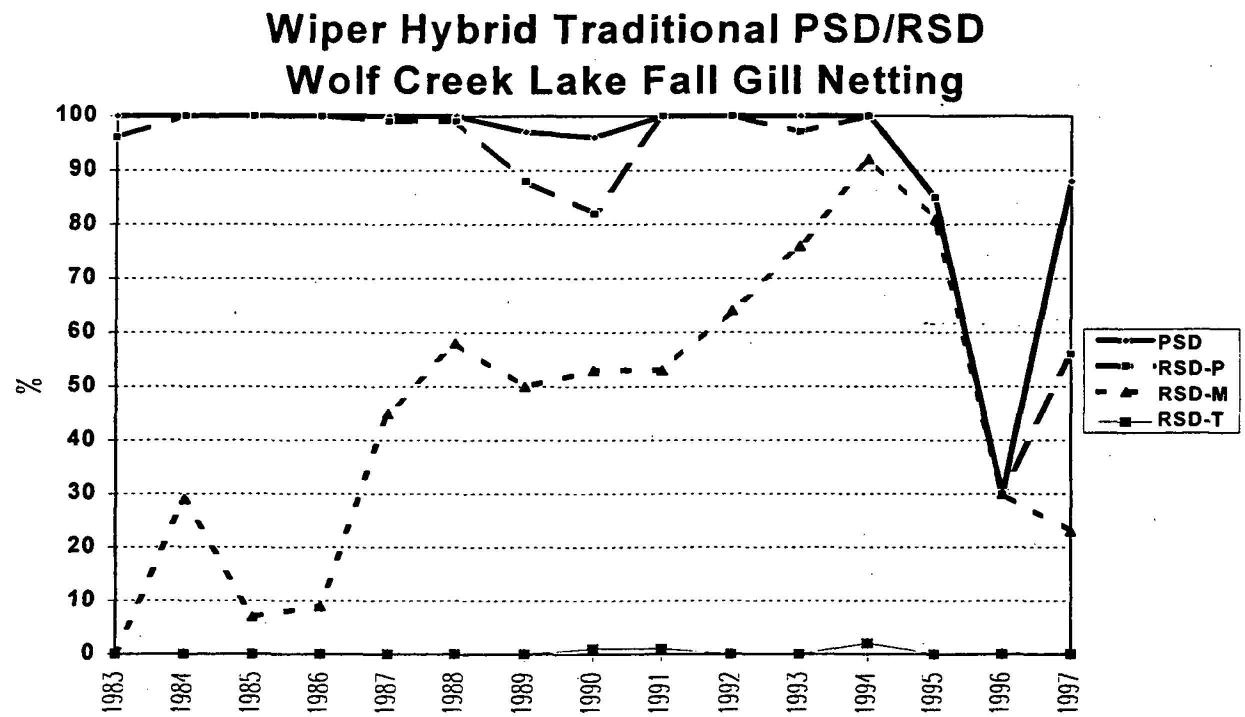


Figure 11. Fall gill net traditional proportional and relative stock density (PSD, RSD) relationships for wipers in Wolf Creek Lake. S-Q=200-299 mm, Q-P= 300-379 mm, P-M=380-509 mm, M-T = 510 to 629 mm, T≥629 mm.

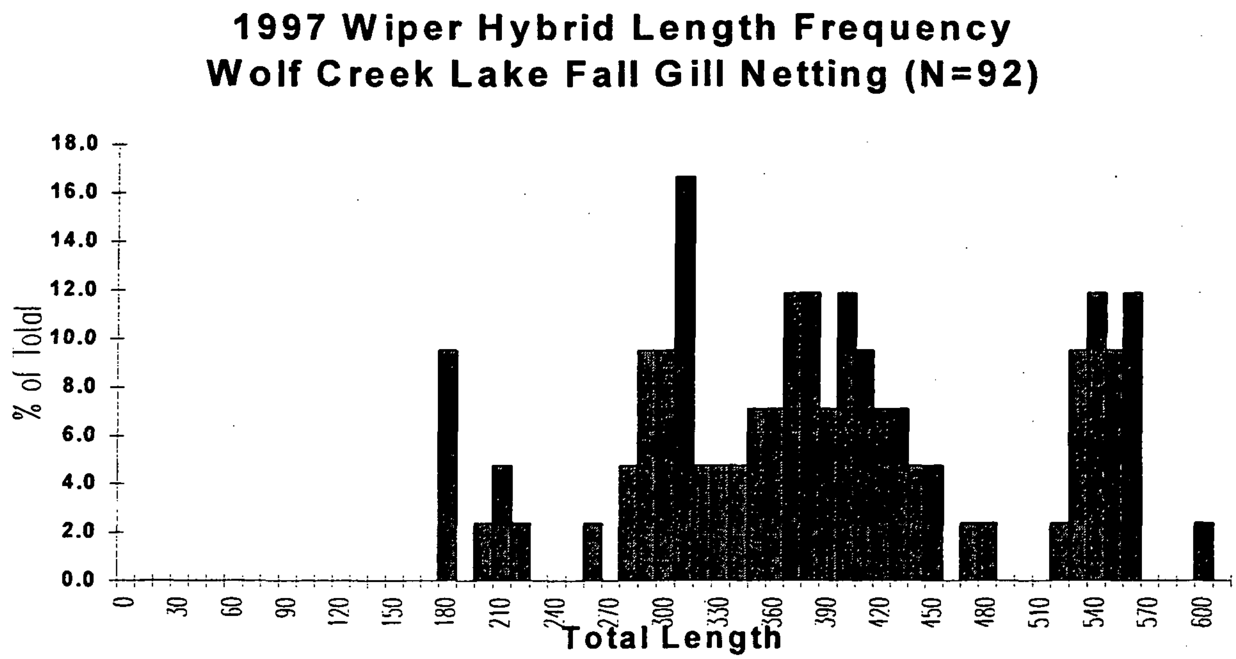


Figure 12. 1997 fall wiper length frequency distribution in Wolf Creek Lake.

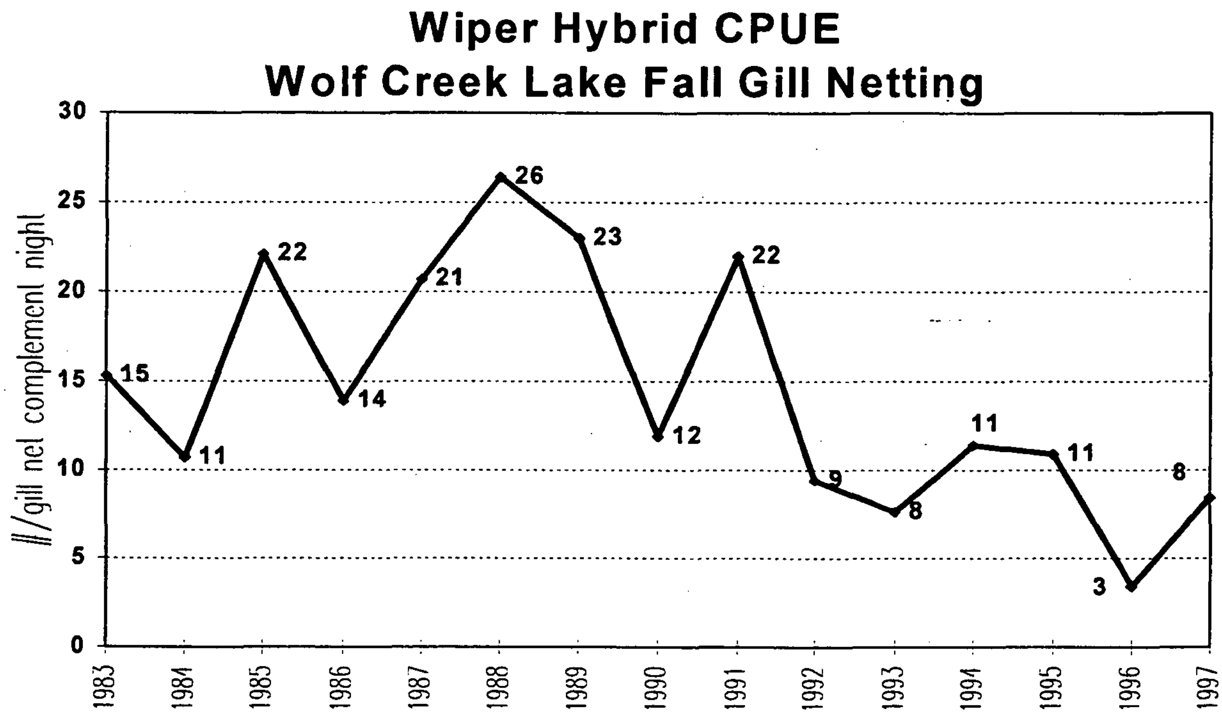


Figure 13. Fall gill net CPUE for wipers in Wolf Creek Lake. CPUE is the number per gill net complement night. One complement is one net each of 1", 1.5", 2.5" and 4.0" mesh.

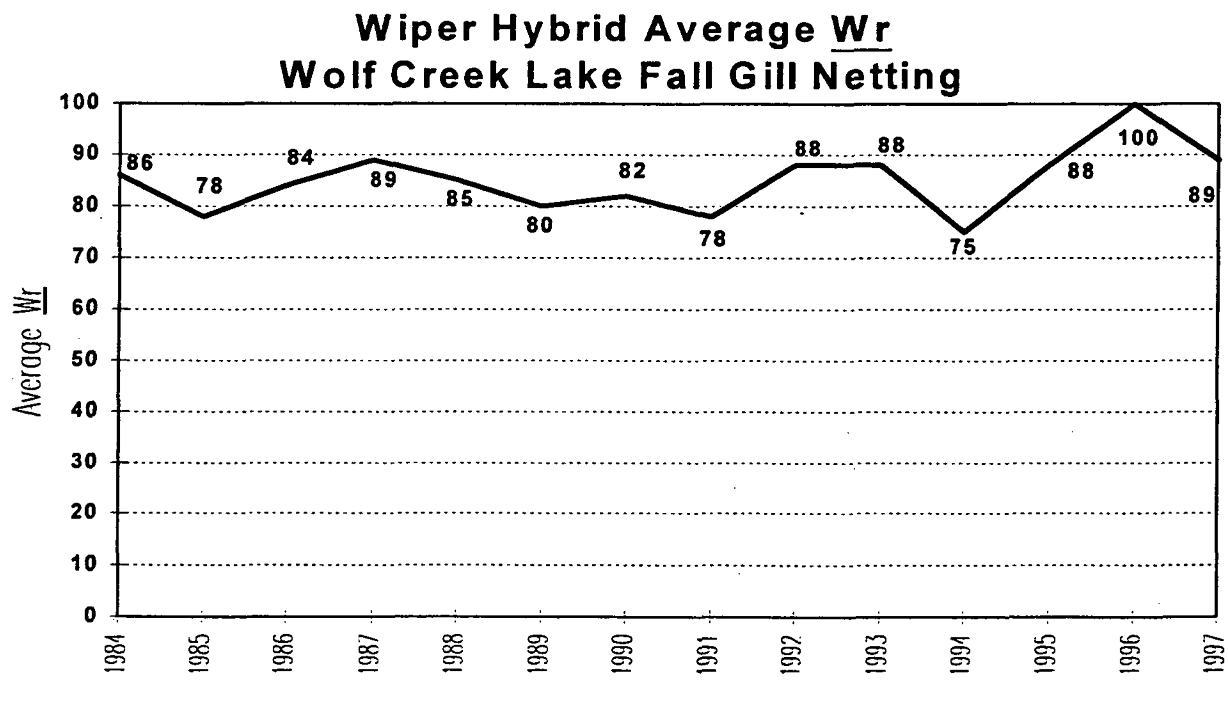


Figure 14. Fall wiper relative weights (W_r) for Wolf Creek Lake. Numbers shown are averages of all stock + fish (200 mm total length or greater).

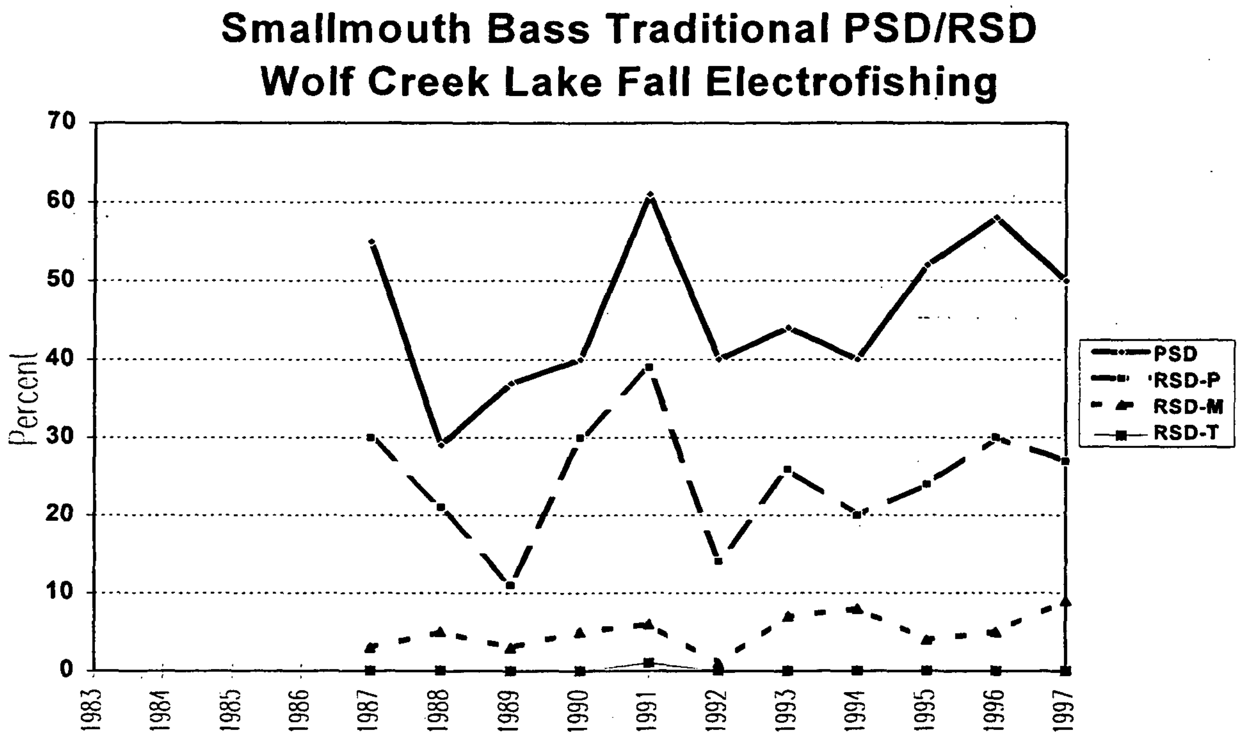


Figure 15. Fall electrofishing traditional proportional and relative stock density (PSD, RSD) relationships for smallmouth bass in Wolf Creek Lake. S-Q = 180-279 mm, Q-P = 280-349 mm, P-M = 350-429 mm, M-T = 430-509 mm, T $\geq$ 510 mm.

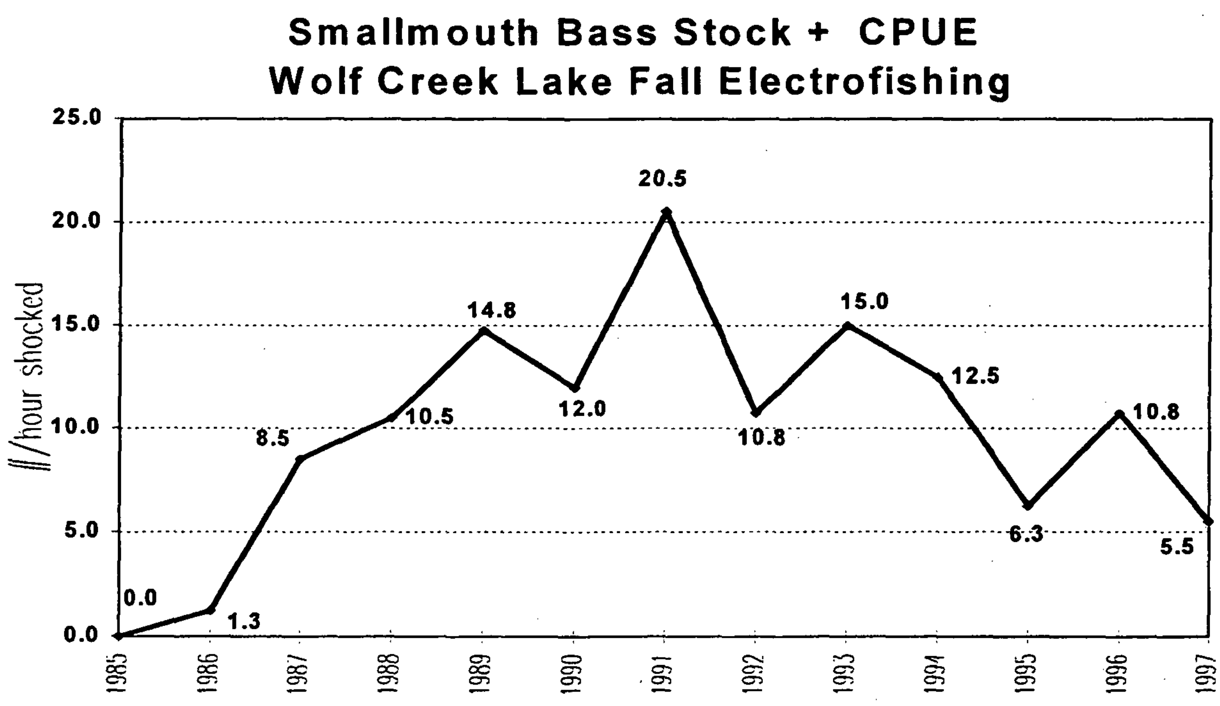


Figure 16. Fall electrofishing CPUE for smallmouth bass in Wolf Creek Lake.

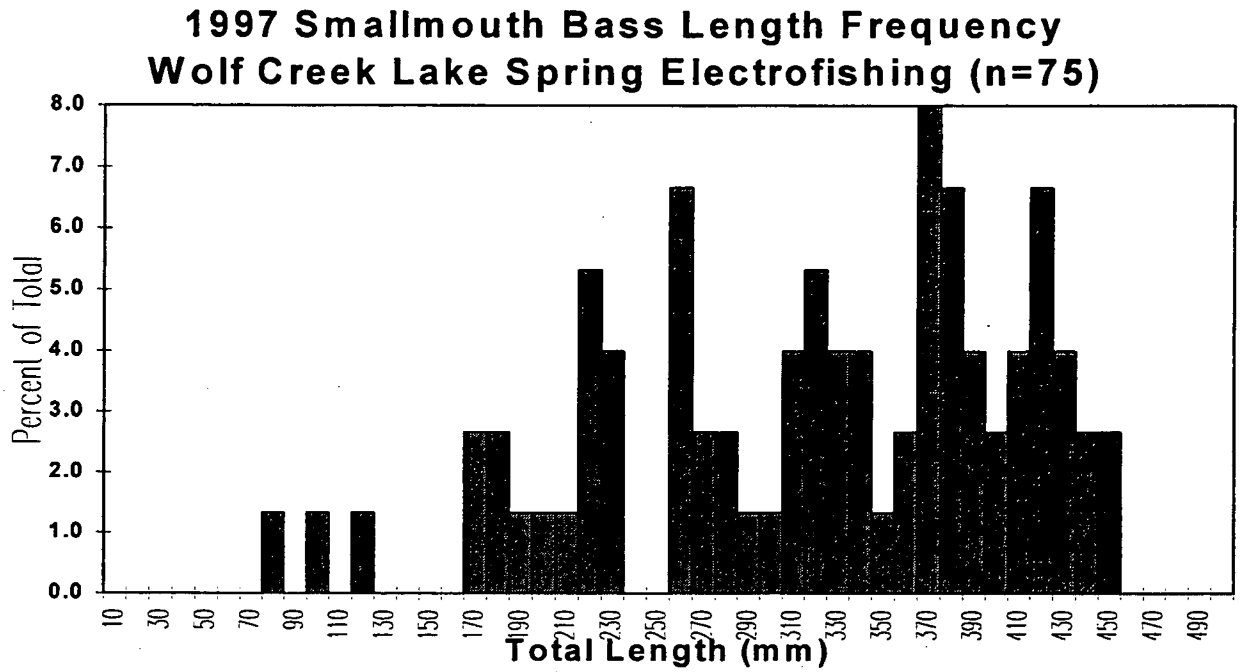


Figure 17. 1997 fall electrofishing length frequency distribution for smallmouth bass in Wolf Creek Lake.

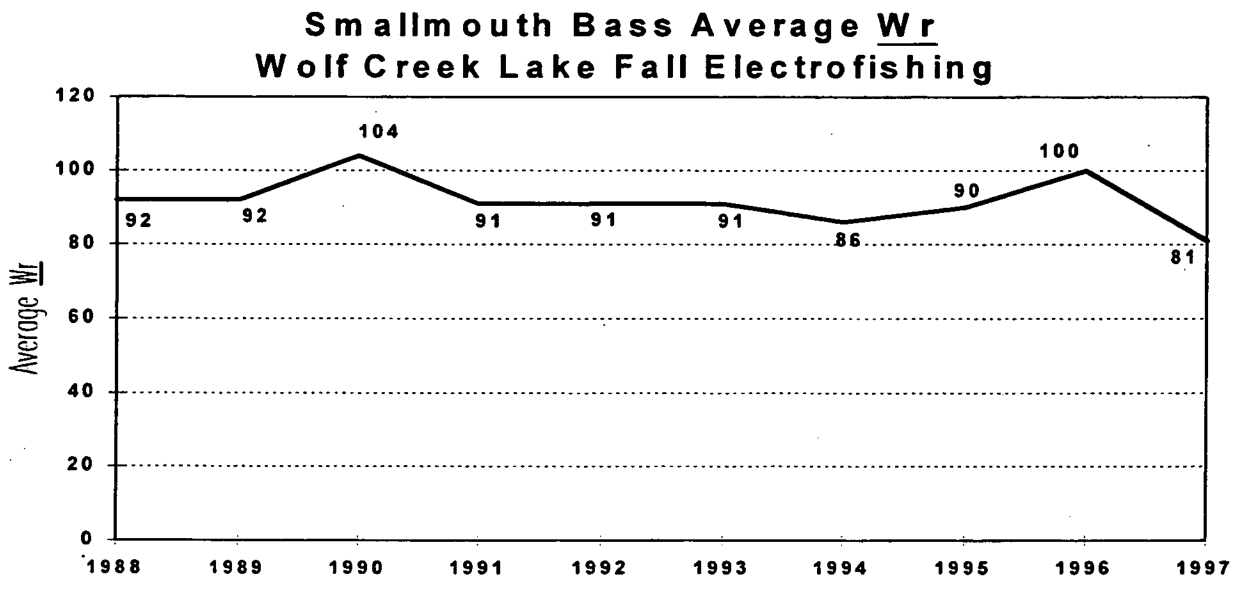


Figure 18. Fall electrofishing smallmouth bass relative weight (Wr) in Wolf Creek Lake. Numbers shown are averages for all stock + fish (180 mm total length or greater).

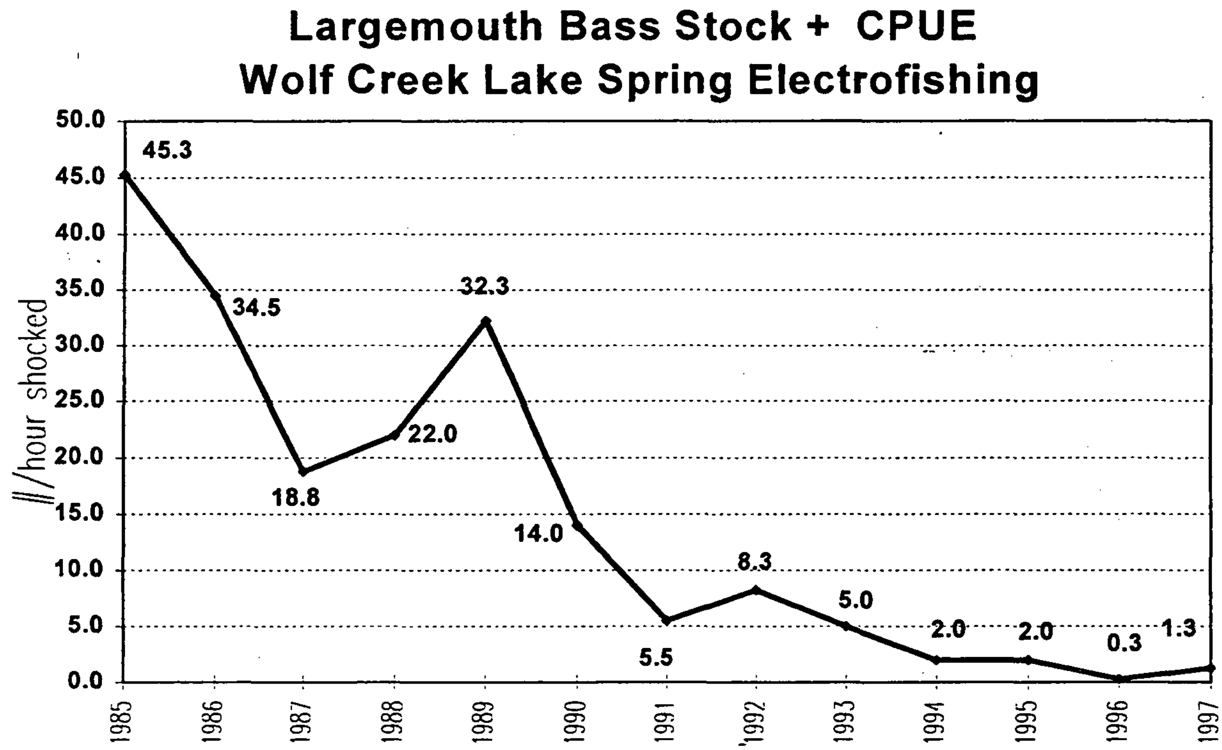


Figure 19. Spring electrofishing CPUE for largemouth bass in Wolf Creek Lake.

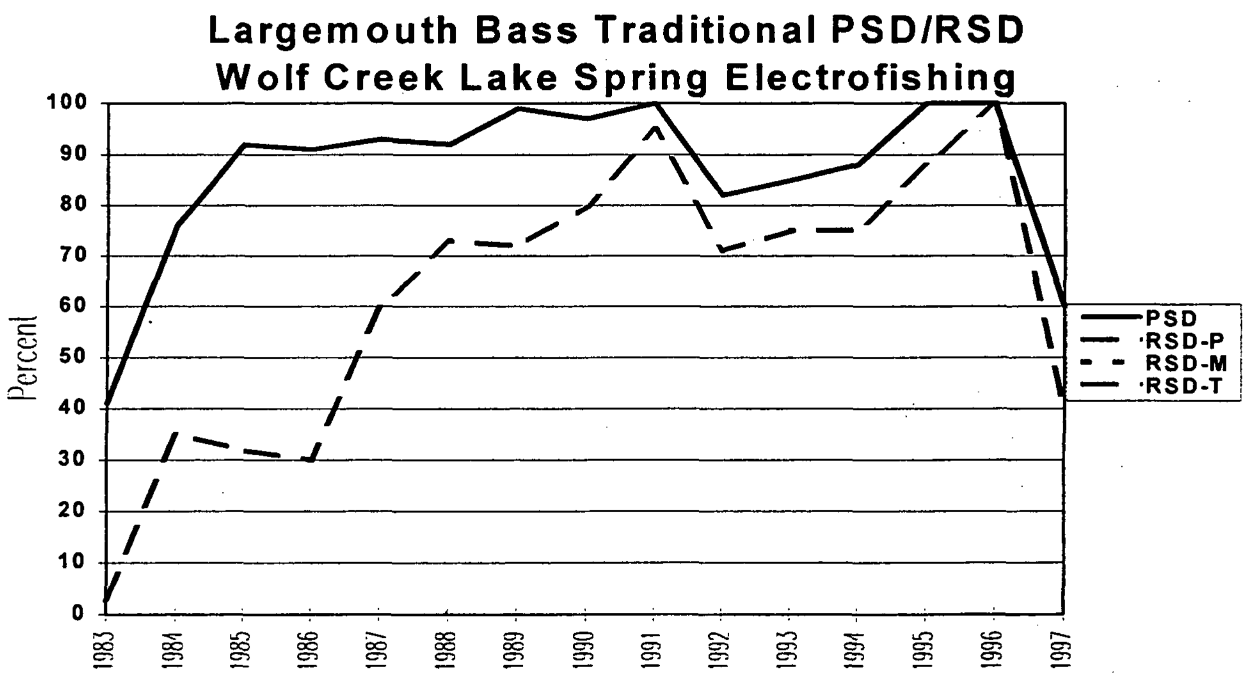


Figure 20. Spring electrofishing traditional proportional and relative stock density (PSD, RSD) relationships for largemouth bass in Wolf Creek Lake. S-Q = 200-299 mm, Q-P = 300-379 mm, P-M = 380-509 mm, M-T = 510-629 mm, T $\geq$ 630 mm.

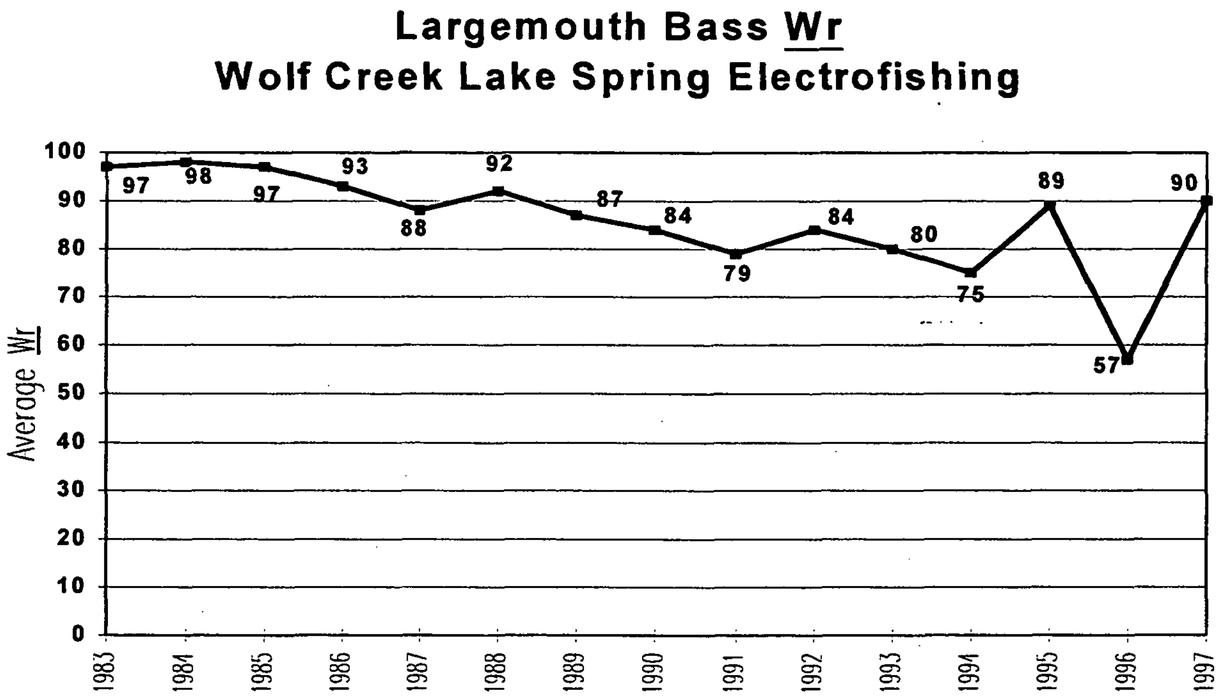


Figure 21. Spring electrofishing relative weight (Wr) for largemouth bass in Wolf Creek Lake. Numbers shown are averages of stock + fish (200 mm total length or greater).

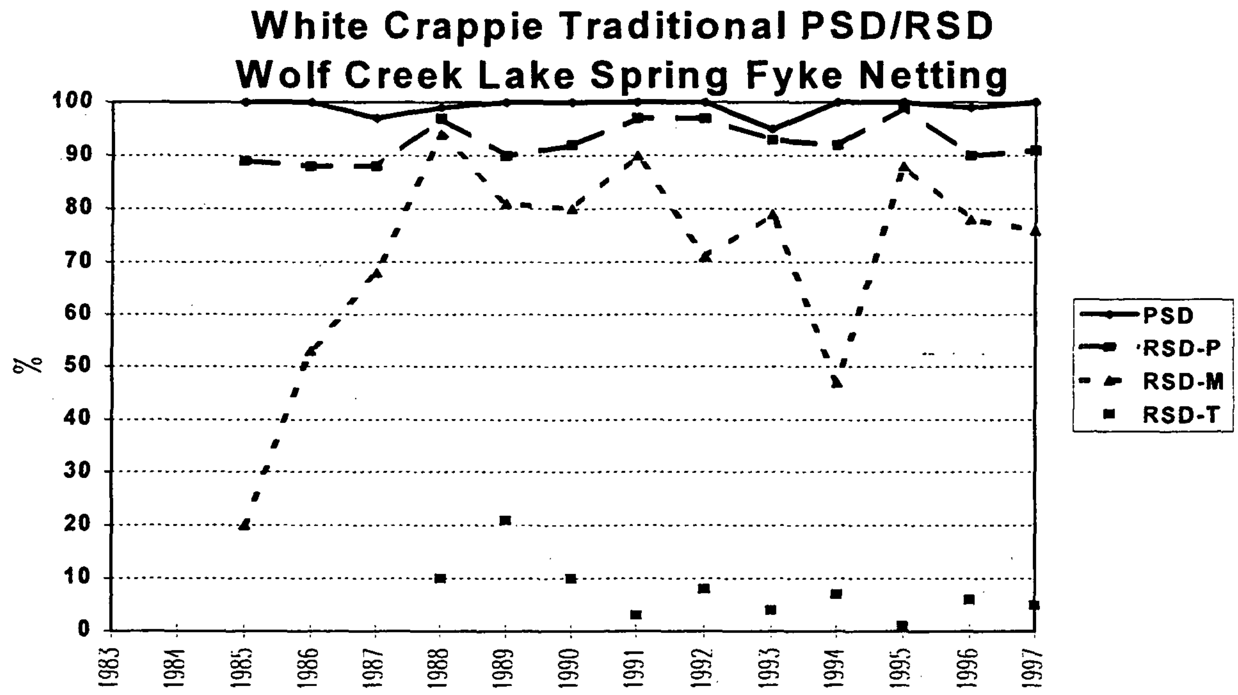


Figure 22. Spring fyke netting traditional proportional and relative stock density (PSD, RSD) relationships for white crappie in Wolf Creek Lake. S-Q = 130-199, Q-P = 200-249, P-M = 250-299 mm, M-T = 300-379 mm, T $\geq$ 380 mm.

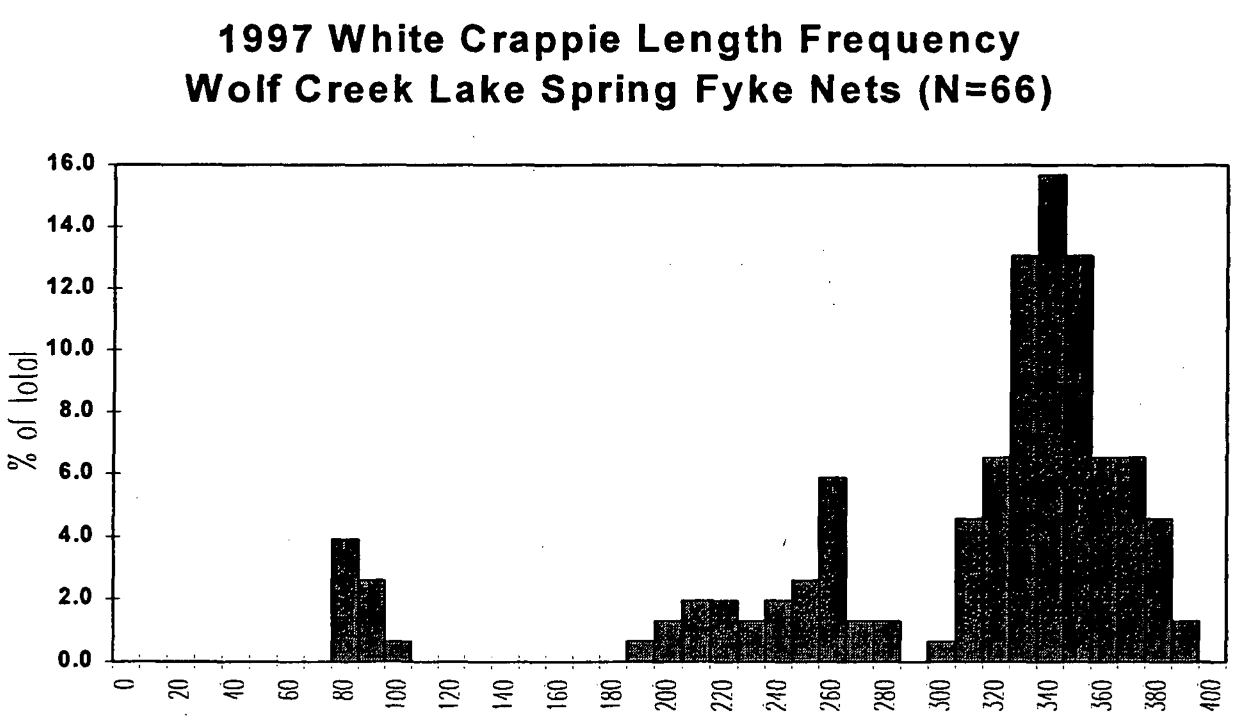


Figure 23. 1997 spring fyke net length frequency distribution of white crappie in Wolf Creek Lake.

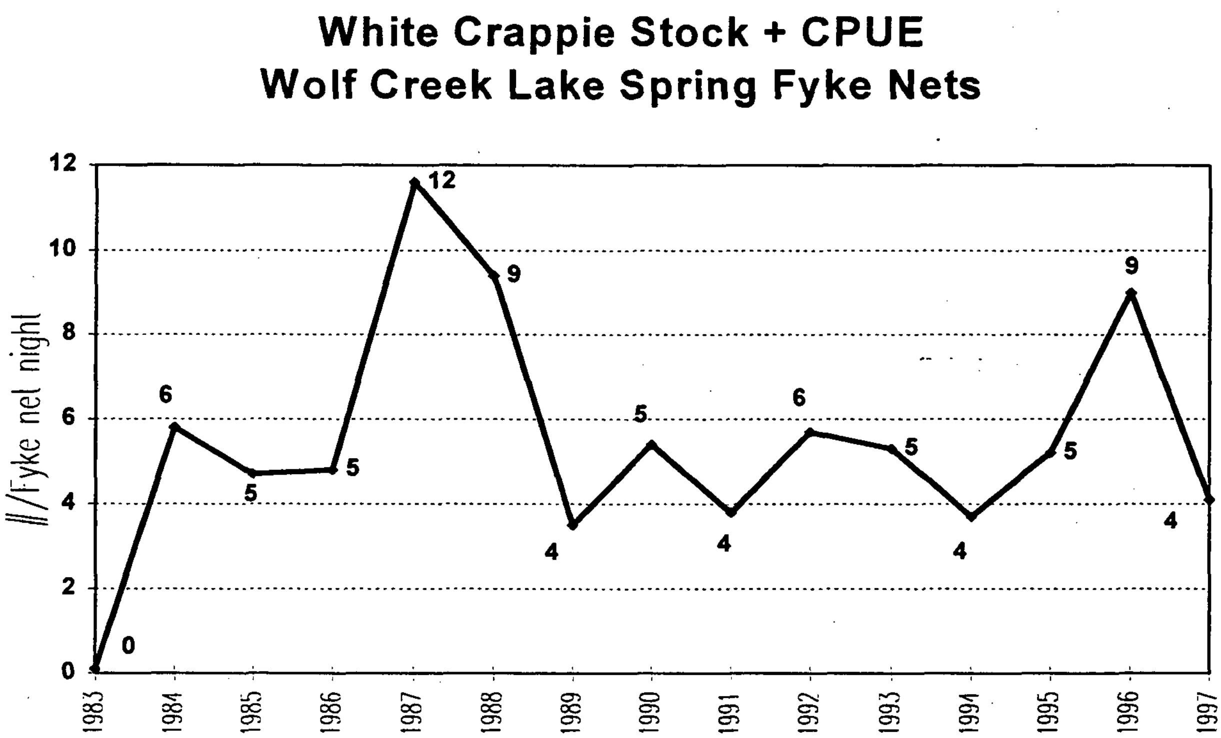


Figure 24. Spring fyke net CPUE for white crappie in Wolf Creek Lake.

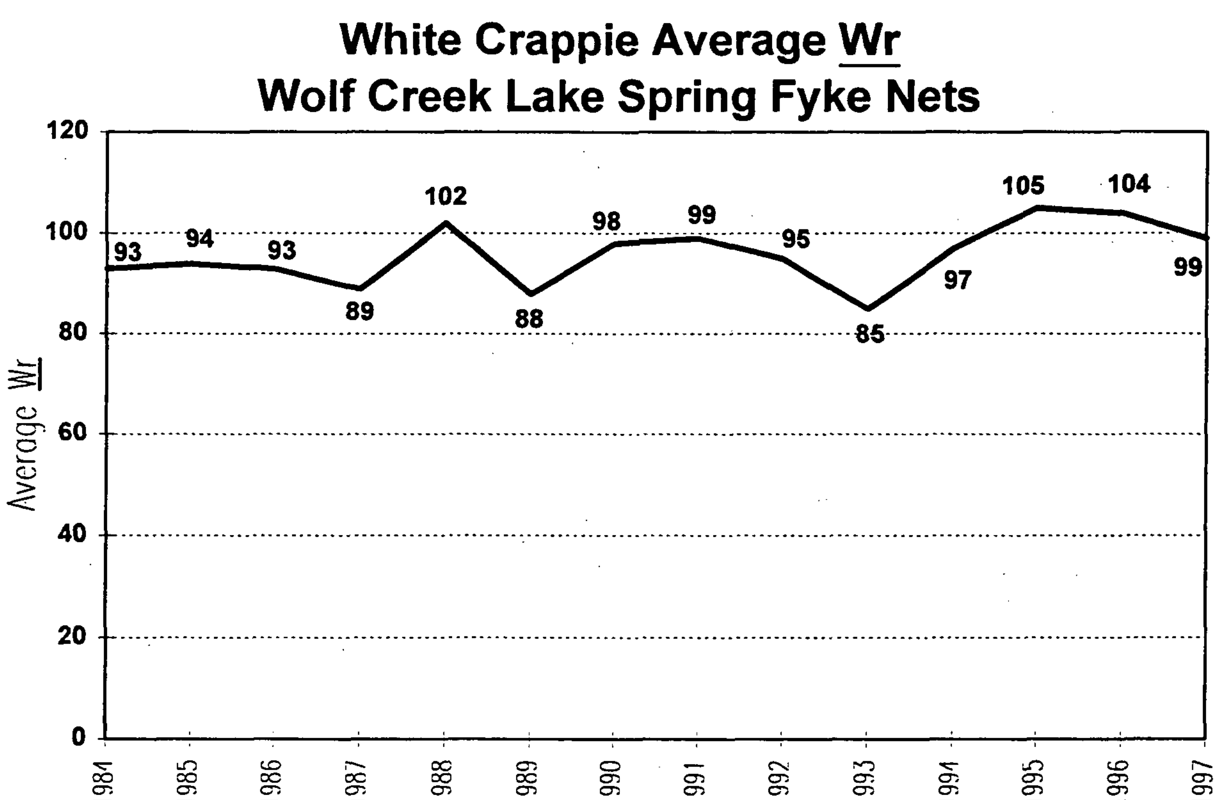


Figure 25. Spring fyke net relative weight (Wr) for white crappie in Wolf Creek Lake. Numbers shown are averages for stock + fish (130 mm total length or greater).

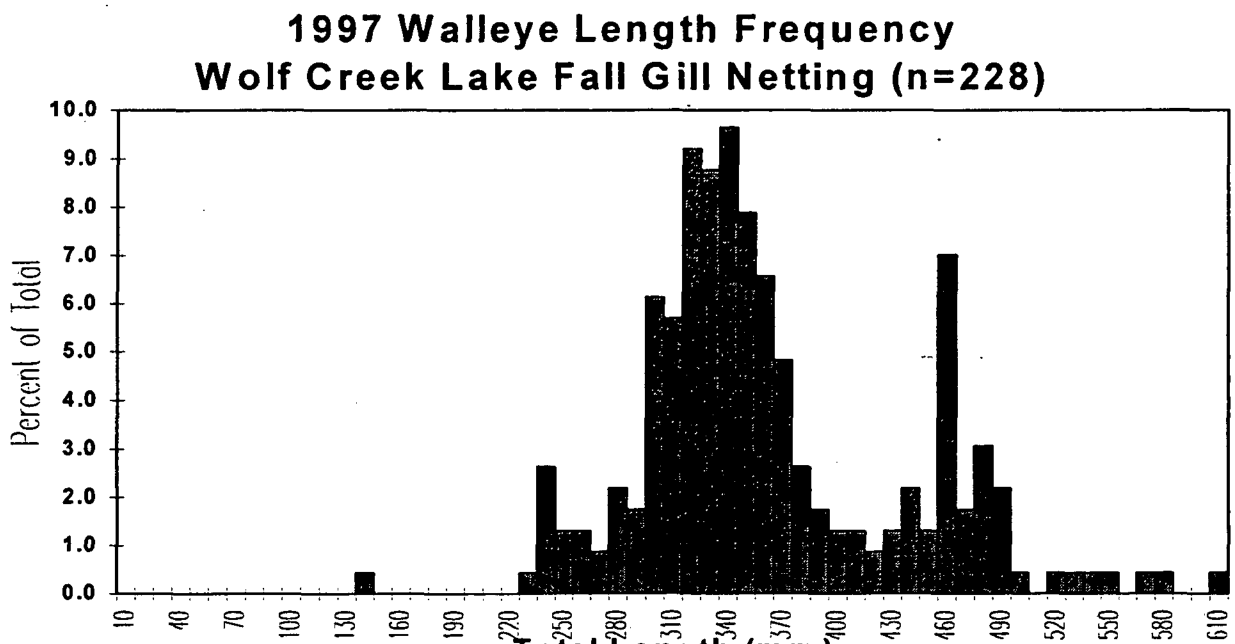


Figure 26. 1997 fall gill net length frequency distribution for walleye in Wolf Creek Lake.

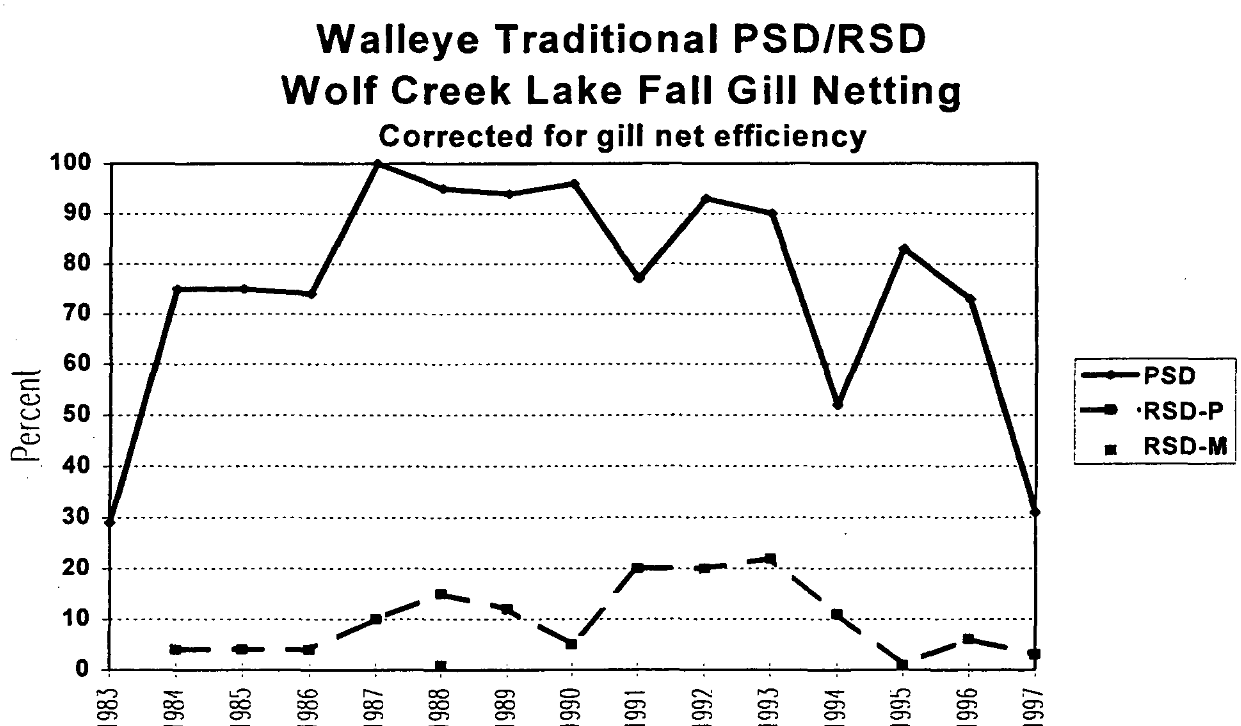


Figure 27. Fall walleye traditional proportional, and relative stock density (PSD, RSD) relationships for Wolf Creek Lake. Percentages were corrected for gill net efficiency (Willis et. al.1983). S-Q = 250-379 mm, Q-P = 380-509 mm, P-M = 510-629 mm, M-T = 630-759 mm, T $\geq$ 760mm.

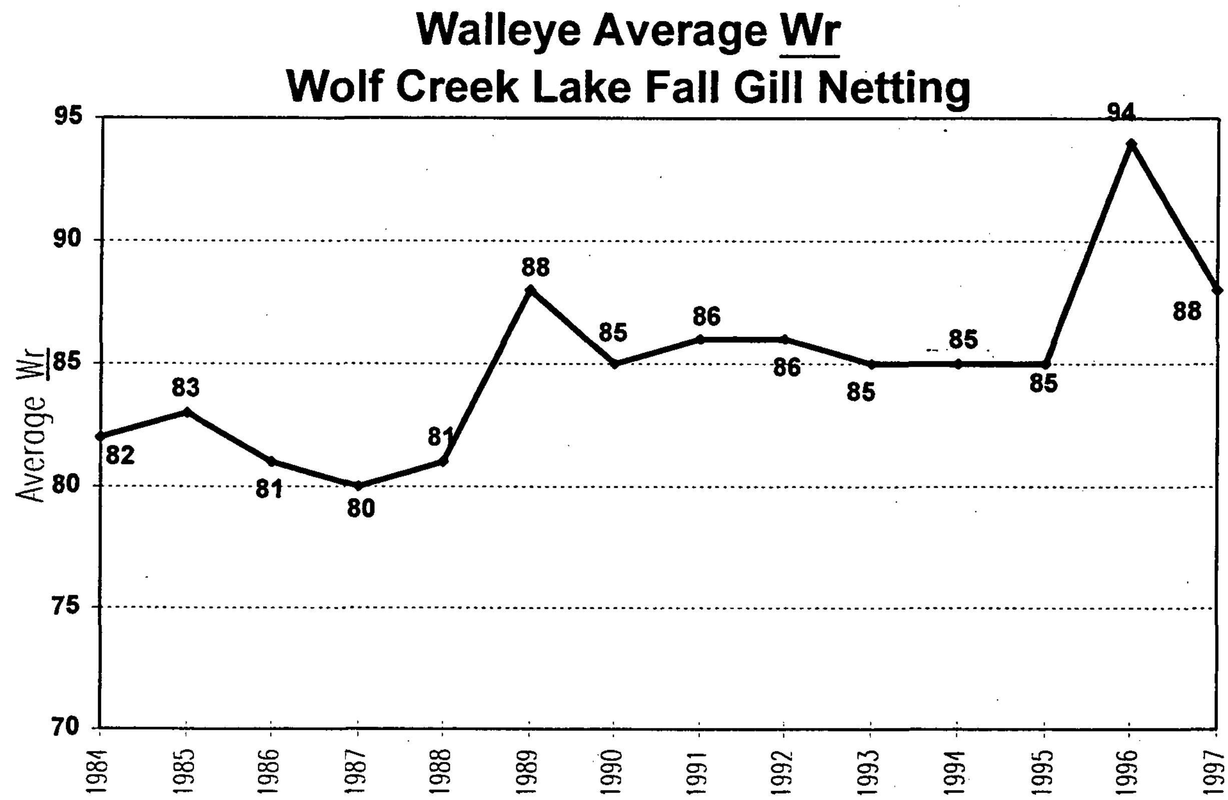


Figure 28. Fall gill net relative weight (Wr) for walleye in Wolf Creek Lake. Numbers shown are averages for stock + fish (250 mm total length or greater).

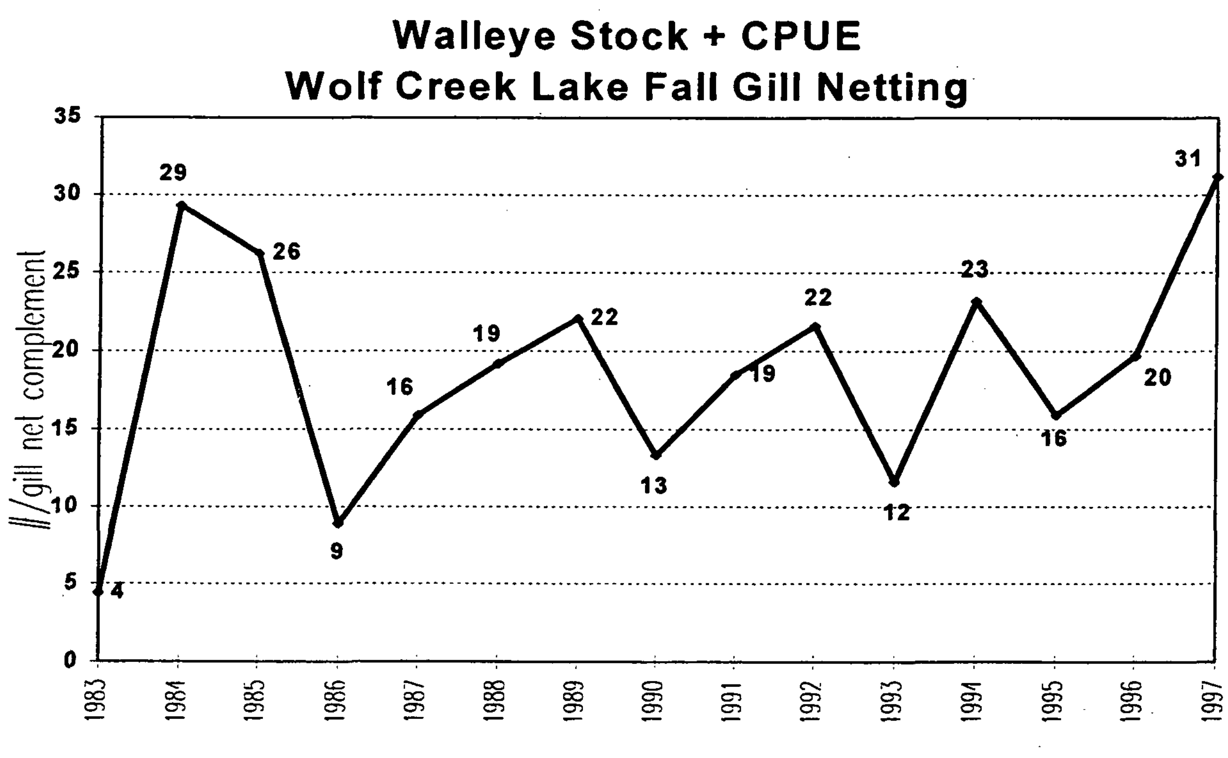
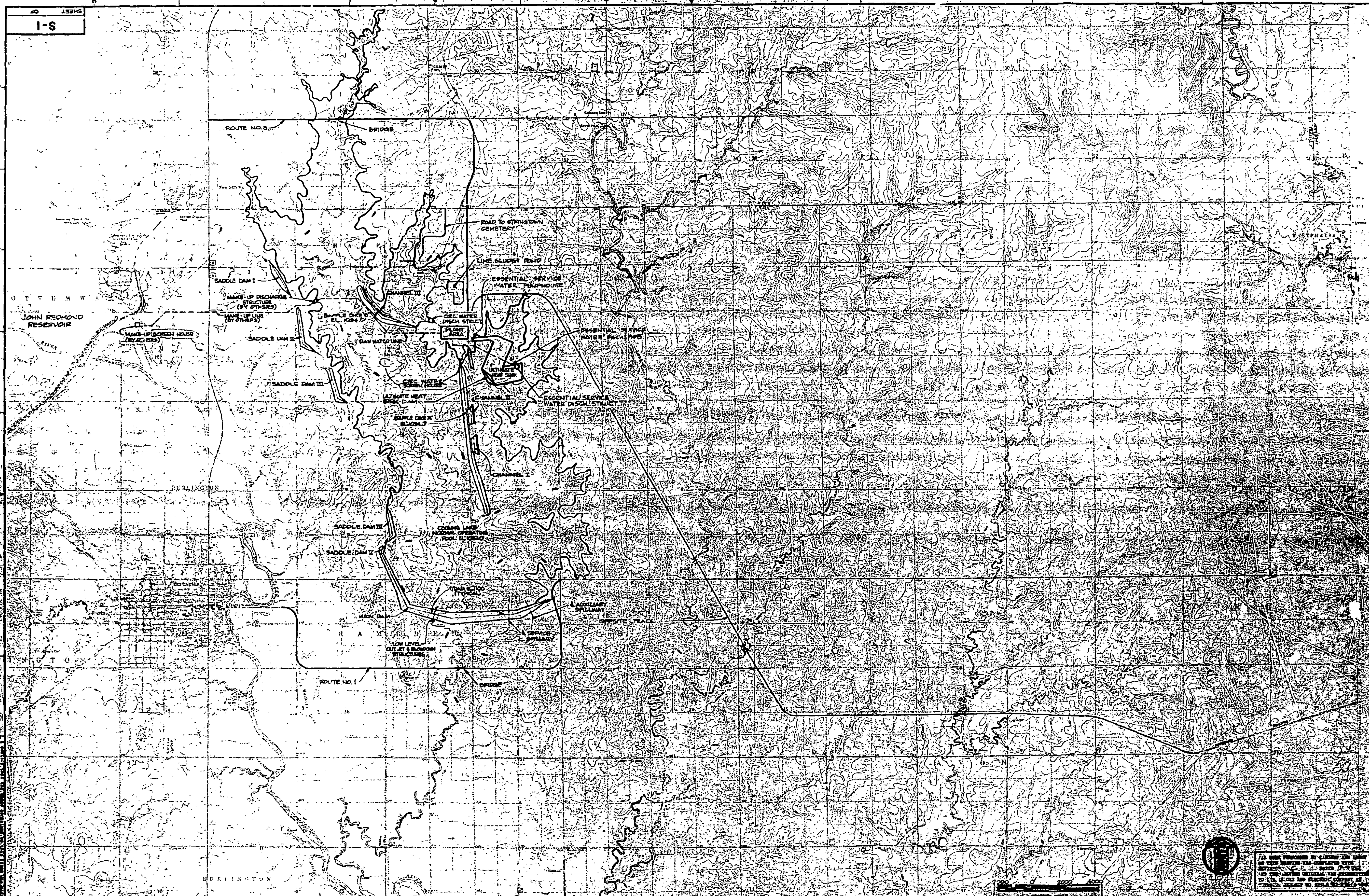


Figure 29. Fall gill net CPUE for walleye in Wolf Creek Lake.

26. Bathymetric map of CCL.

~~NO TAB~~
~~NO DATA~~
DH 4/20/07



DRAWING RELEASE RECORD							
REV.	SPEC. NO.	DATE	DRAWN	CHECKED	ENGR. APPROVAL	DESCRIPTION	FILM
—		7-26-76	[illegible]			FOR BIDS SPEC. A-3854	X
A		10-1-76	[illegible]	——	——	FOR CLIENTS COMMENTS SPEC. A-3859	X
B		12-17-76	[illegible]			ADDENDUM 5 SPEC. A-3854	X
C		10-21-77	[illegible]	[illegible]	[illegible]	FOR CONSTRUCTION SPEC. A-3854	X
C		7-9-82	F. LARSEN	——	——	SENT TO CLIENT	X

LEO TRINIDAD	1"=2000'	PROJECT NUMBER
DRAWN	SCALE	4.00
E. E. TALLARDEO	11-4-74	
CHECKED	DATE	
[illegible]	[illegible]	
ENGINEER	DATE	
[illegible]	10-18-77	
APPROVED	DATE	

GENERAL ARRANGEMENT
WOLF CREEK GENERATING STATION
UNIT 1
KANSAS GAS AND ELECTRIC COMPANY
KANSAS CITY POWER AND LIGHT COMPANY

SARGENT & LUNDY
ENGINEERS
CHICAGO

DRAWING NO. S-1 REV. C

27. Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

• Current and historic flow records for the Neosho River.

• A statement is made in the 5th paragraph of Enclosure 2 to WM 06-0046 (November 17, 2006) that the state of Kansas has not required entrainment monitoring and will not require it for the 316(b) determination. Please provide documentation from KDHE regarding this issue.

• Larval fish monitoring data as described in Paragraph 6 of Enclosure 2 to WM 06-0046 (November 17, 2006).

• If available, information on the location of the spawning areas for the various fish species in CCL.

• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

• Possible cold shock impacts to gizzard shad is mentioned in Section 2.2 of the ER (WCGS, 1990). If there have been any incidents of cold shock to gizzard shad or other fish, please provide supporting data.

• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

Aquatic Ecology

Audit Needs request #54

> "Please provide any information available regarding the initial stocking of CCL and subsequent stocking efforts."

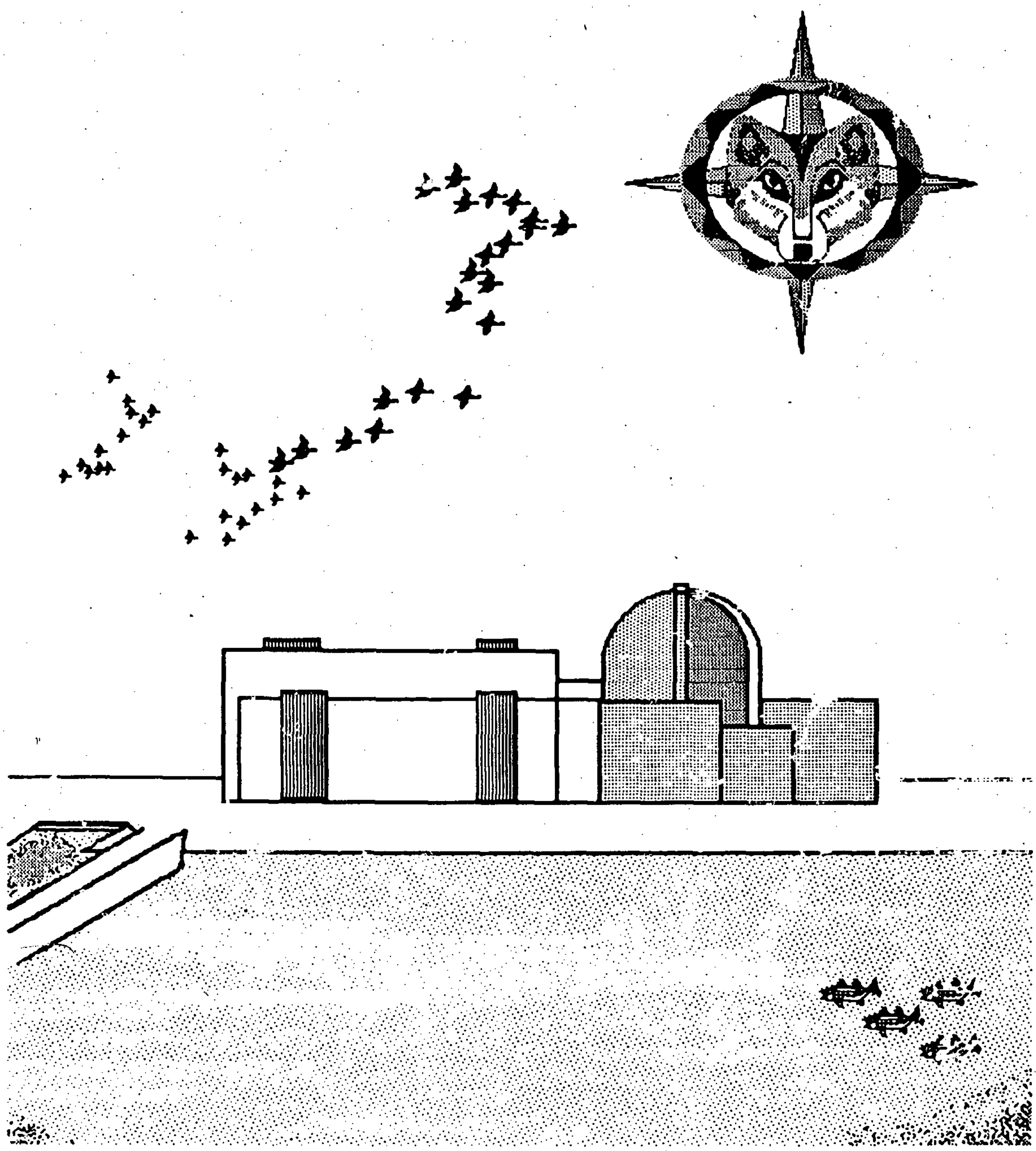
A copy of the 1983 Preoperational Fishery Monitoring Report is attached, which contains a detailed description of initial stocking efforts through 1983 (see pages 10 through 18). Stocking activities since 1983 were as follows:

Year	Species	Size	Number
1984	Wiper hybrid	4-6"	10,000
1985	Wiper hybrid	4-6"	15,000
1988	Wiper hybrid	2-4"	50,000
1989	Wiper hybrid	2-4"	50,000
1995	Wiper hybrid	2"	40,000
1996	Wiper hybrid	2"	50,000
1997	Wiper Hybrid	2"	69,444
1998	Wiper hybrid	2-4"	40,000
2001	Wiper hybrid	2-4"	40,000

WOLF CREEK GENERATING STATION

1983 PREOPERATIONAL FISHERY MONITORING REPORT

KANSAS GAS AND ELECTRIC COMPANY



NUCLEAR SERVICES
ENVIRONMENTAL MANAGEMENT GROUP
SEPTEMBER 1984

REPORT DOCUMENTATION PAGE

Report No.	Report Date
KG&E #2-84	September 1984

Title and Subtitle
Wolf Creek Generating Station Preoperational Fishery Monitoring Report

Author(s)
Greg R. Wedd and Daniel E. Haines

Performing Organization Name and Address

Kansas Gas and Electric Company
P.O. Box 208
Wichita, Kansas 67201

Abstract
Fishery monitoring surveys were conducted on the Neosho River and Wolf Creek Cooling Lake (WCCL) near Wolf Creek Generating Station, Coffey County, Kansas from March 1983 through November 1983. Fisheries data resulting from these efforts were compared to previous studies. Fishery surveys in 1983 resulted in the collection of a total of 7771 fish representing 10 families and 32 species. Of this total, 2421 fish, representing 8 families and 16 species, were captured in the Neosho River. Neosho River surveys verified the continued presence of the Neosho madtom (Noturus placidus) and blue sucker (Cycleptus elongatus) and provided a qualitative assessment of the fishery below John Redmond Reservoir. Wolf Creek Cooling Lake surveys resulted in the collection of a total of 5350 fish, representing nine families and 32 taxa. Cooling lake data were related to Kansas Gas and Electric Company fishery management efforts and compared to a number of regional reservoir fisheries. Cooling lake fishery management efforts were determined to have produced a fishery which compared favorably to cited reservoirs. Management techniques, such as basin renovation and decreased stocking rates, were identified as important steps in the management process. Taxa most frequently captured consisted of black bullhead (Ictalurus melas) (22.2%), Lepomis spp. (15.5%), bluegill (Lepomis macrochirus) (11.0%), black crappie (Pomoxis nigromaculatus) (6.9%), red shiner (Notropis lutrensis) (4.4%) and largemouth bass (Micropterus salmoides) (4.1%). The six species which comprised nearly 78% of the total collected biomass were common carp (Cyprinus carpio) (19.6%), wiper (Morone saxatilis X M. chrysops) (16.4%), largemouth bass (13.8%), channel catfish (Ictalurus punctatus) (11.4%), white bass (Morone chrysops) (8.5%), and black bullhead (8.0%). Growth rates of WCCL species were found to have slowed in 1983 but remained similar to or above published averages. The condition of WCCL species, evaluated through the use of Relative Weight (Wr), was found to generally be within the 85-100 range. Evaluation of the WCCL fishery through the use of structural indices revealed bluegill and largemouth bass Proportional Stock Density (PSD) and Relative Stock Density (RSD) values comparable to published desirable ranges. Overall, fishery monitoring activities revealed no detrimental effects resulting from plant construction activities and indicated that fishery management practices resulted in a desirable gamefish composition, as well as a low to intermediate gizzard shad biomass level.

Originator's Key Words
Wolf Creek, cooling lake fishery, station effects, fishery management, Relative Weight (Wr), structural indices, unfished impoundment, Neosho River, Striped X White Bass Hybrid, Bluegill, Largemouth Bass, Neosho Madtom, Blue Sucker

KG&E #2-84

WOLF CREEK GENERATING STATION

PREOPERATIONAL FISHERY

MONITORING REPORT

MARCH 1983 - NOVEMBER 1983

Greg R. Wedd and Daniel E. Haines

Kansas Gas and Electric Company

P.O. Box 208

Wichita, Kansas 67201

Published September 1984

Annual Report for 1983

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Corporate Approval Gene Rathbun
Gene P. Rathbun

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INTRODUCTION

Objectives

This report presents results of fishery monitoring studies conducted in the vicinity of Wolf Creek Generating Station (WCGS) from March 1983 through October 1983. Studies of fish populations around WCGS were initiated in 1973 to fulfill commitments made by Kansas Gas and Electric Company (KG&E) to the Nuclear Regulatory Commission as a condition to the construction permit.

The primary objective of the monitoring program was to document and assess aquatic environmental effects caused by construction of WCGS by KG&E. Other specific objectives included:

1) identification and evaluation of impacts to the Neosho River fishery in the vicinity of the make-up water screen house (MUSH).

2) documentation of the continued occurrence of the Neosho madtom (Noturus placidus) below the confluence with Wolf Creek in the Neosho River.

3) evaluation of the success of the KG&E Electric Company fishery management program initiated in 1978 on Wolf Creek Cooling Lake (WCCL).

4) identification and evaluation of impacts to the WCCL fishery resulting from WCGS construction and startup activities.

Description of Study Area

Station Description

Wolf Creek Generating Station is located in Coffey County approximately 5.6 kilometers (3.5 miles) northeast of Burlington, Kansas. The 1150 megawatt (net) pressurized water reactor of the Standardized Nuclear Unit Power Plant System (SNUPPS) design is scheduled for commercial operation in April 1985. The area within the WCGS site boundary encompasses 3973 hectares (ha) (9818 acres), composed primarily of range, cropland, and woodland habitats typical of southeastern Kansas. The power block area, including a switch yard and a lime sludge pond, covers nearly 100 ha (250 acres) while the cooling lake inundates 2060 ha (5090 acres) at normal pool. A once-through cooling system, utilizing water from WCCL, will be used by the station.

Neosho River Description

The Neosho River is a relatively slow meandering stream that rarely exceeds a gradient of 1 m/km (Prophet 1966). The river was significantly altered in 1964 with the completion of John Redmond Dam. River flow in the study area is dependent upon discharge from John Redmond Reservoir (JRR) which is regulated by the U.S. Army Corps of Engineers. Substrates in the tailwaters of the John Redmond Reservoir are layered limestone, shale, and sandstone bedrock. Flow immediately below the dam is variable and entirely dependent upon reservoir releases. Pools, gravel bars, and riffles characterize the lower river near the confluence with Wolf Creek. Substrates in the riffle habitats are rock, rubble, and gravel, whereas the pools are characterized by bedrock overlaid by silt.

Three locations in the Neosho River were sampled (Figure 1). Location 1 was in the tailwaters of John Redmond Dam. The bottom substrate was bedrock, with rock riprap along the banks. Pools and riffles characterized Location 10 which was 0.7 km (0.4 miles) upstream of the confluence with Wolf Creek. The riffles had substrates of rock, rubble, and gravel, whereas the pools were characterized by bedrock overlaid with silt. Location 11, 1.3 km (0.8 miles) downstream of the confluence with Wolf Creek, was comprised of deep pools and a shallow gravel bar. The substrate of the pools was silt and sand, whereas the gravel bar consisted of sand and gravel.

Wolf Creek Cooling Lake Description

The cooling lake for WCGS was formed by one main earth-rolled dam approximately 3.7 km (2.3 miles) long (Figure 1), with a crest of 331.3 m (1100 feet) MSL. The dam, along with five perimeter saddle dams, serves to impound Wolf Creek approximately 8.8 km (5.3 miles) above its confluence with the Neosho River. The upstream slopes of the main dam and saddle dams were riprapped for protection against wind-generated wave erosion while downstream slopes were seeded with an adapted native grass seed mix.

Wolf Creek cooling lake has three outlet structures which are capable of discharging to the Neosho River via Wolf Creek. The auxiliary or emergency spillway, with a crest at 332.4 m (1090.5 feet) MSL, was designed to discharge outflows anticipated from a Project Maximum Flood which had been preceded by a standard project flood. The second outlet, the service spillway, handles outflow from "normal" rainstorm events via a crest at 331.6 m (1088 feet) MSL. The Low Level Outlet, the third WCCL outlet, was designed for hypolimnetic lake releases from an elevation of 313.9 m (1030 feet) MSL.

An elevation of 331.3 m (1087 feet) MSL has been designated as the cooling lake operating pool. The cooling lake covers 2060 ha (5090 acres) at this elevation and has a mean depth of 6.6 m (21.5 feet).

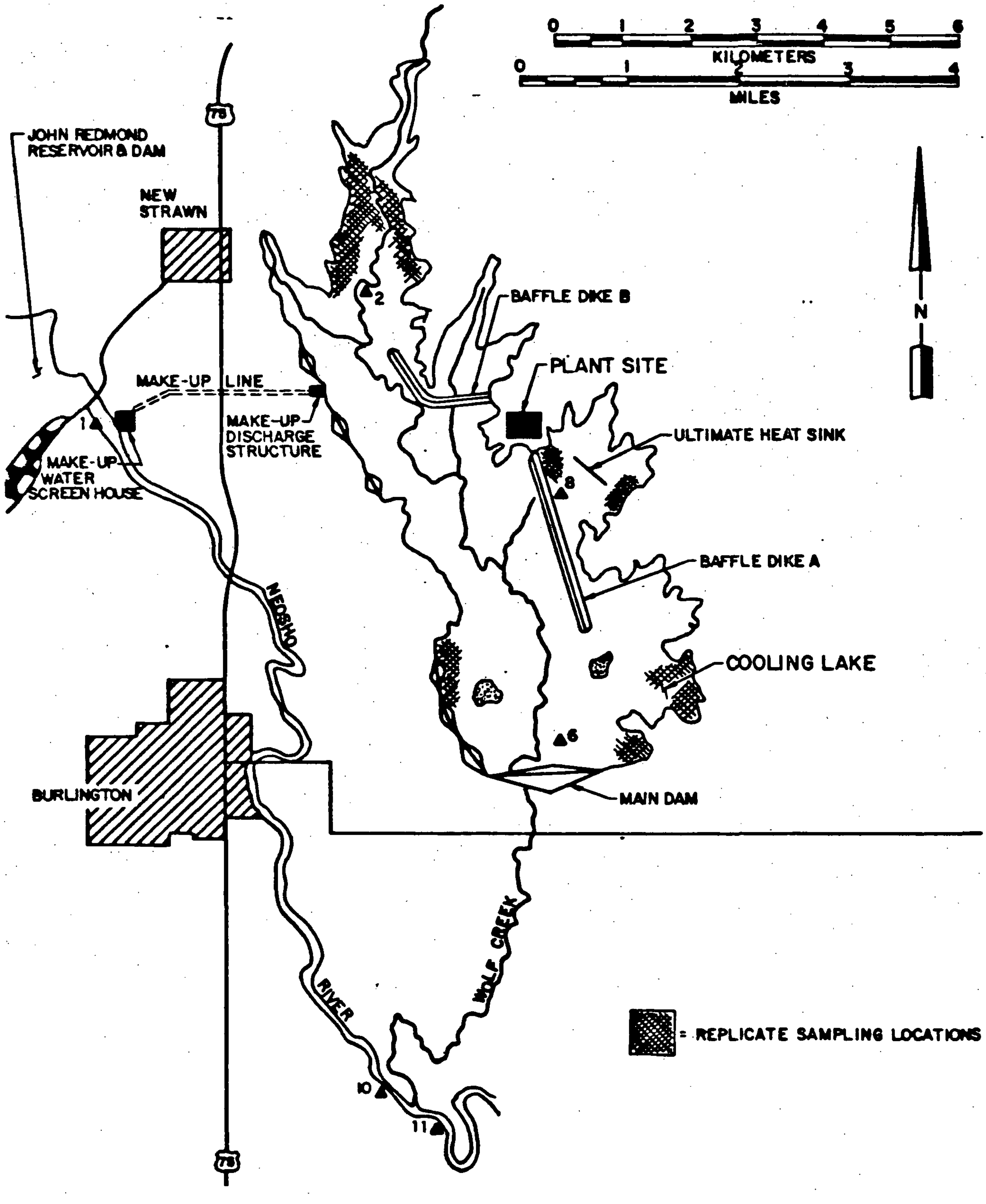


FIGURE 1. FISHERY SAMPLING LOCATIONS IN THE VICINITY OF WOLF CREEK GENERATING STATION, 1983.

The cooling lake has a limited drainage of 50.4 sq km (19.5 sq. miles) which will not provide adequate run-off to maintain WCCL following initiation of plant operations (Kansas Gas and Electric 1974). The limited nature of Wolf Creek in-flows will necessitate supplemental pumping of Neosho River water contractually obtained through the State of Kansas from JRR storage. The MUSH on the Neosho River in the tailwaters of JRR and associated transfer pipeline will provide needed water to WCCL.

The cooling lake was constructed to provide cooling water for WCGS and therefore, plant structures are dominant features on the lake. The circulating water system (CWS) can be considered the most influential of these structures. Capable of dissipating station operating heat, the CWS was designed for a maximum flow of 30.0 m^3/s (1114 cfs), and will result in a maximum 17.6°C (30°F) increase in circulating water temperature. However, the normal temperature increase in the main body of the lake will only range from 0.4°C (0.8°F) to 4.2°C (7.6°F).

The ultimate heat sink (UHS) constitutes another prominent WCCL feature. The UHS lies to the southeast of WCGS and forms a lake within WCCL. The UHS consists of a 40.8 ha (100.7 acre) excavated pool confined by an armoured, submerged dam. The UHS was designed to retain all water needed for essential station cooling in the event of CWS unavailability or main dam failure.

Baffle Dikes A and B are two noteworthy plant structures which are important to the WCCL fishery. These structures serve to minimize thermal impacts to WCCL by directing the flow of cooling water to permit maximum heat disipation. Additionally, these dikes provide extensive rip-rap habitat favorable to a number of gamefish.

The remaining aspects of WCCL are not directly associated with WCGS. The 49 ha (120 acres) of timber left standing for later inundation was intended to provide fishery habitat as well as assist in precipitation of suspended materials. The final WCCL feature of interest consists of the site rock quarry located in the southwest portion of WCCL. The majority of rock for the riprapped structures in WCCL was removed from this excavation. The quarry covered nearly 65 ha (160 acres) and had overburden replaced in excavated areas in an irregular manner to improve sub-surface topography.

For additional information on WCCL outlet structures, UHS operation, and expected WCCL operating scenarios, the WCGS Environmental Report - Operating License Stage (ER-OLS) (Kansas Gas and Electric 1981) should be consulted.

Filling of the cooling lake began in October 1980 and continued through November 1981. Approximately 23 billion gallons of water were pumped through the MUSH in 1981 with monthly pumping rates varying from nearly 49 million gallons in April 1980 to 3.4 billion gallons in October 1981. Storage water purchased from JRR at the rate of 26.5 million gallons/day (41 cfs) through a contract with the Kansas Water Resources Board. The cooling lake elevation rose from 320-329 m (1050-1079.5 feet) MSL, resulting in a surface area increase from 360-1580 ha (890-3900 acres). Surface water runoff filled the cooling lake to normal operating level 331.3 m (1087 feet) MSL by June 1982.

The limnology of WCCL has been studied since inundation began. Studies performed on WCCL have included chemical analyses, as well as primary productivity measurements and zooplankton surveys (Ecological Analysts, Inc. 1983). Those data obtained as a result of these efforts (Table 1, Figures 2 and 3) characterize the scenario "typical" of new impoundments. Following an early peak, nutrient levels and primary productivities have exhibited a decline to within the mesotrophic range (Wetzel 1975). The overall result of an evaluation of these data showed an impoundment with excellent water clarity which supports an intermediate level of primary producers and zooplankton.

Wolf Creek Cooling Lake Fishery Management Case History

Kansas Gas and Electric initiated the cooling lake fishery management program in mid-1978. This program represented a departure from typical electric utility industry courses of action because KG&E chose to implement it largely with company resources. The reasons for selection of this course of action are best explained through a discussion of early WCCL planning and theory.

Throughout the WCGS construction phase licensing process, WCCL was a prominent subject. Cooling lake discussions ranged from potential environmental impacts of lake discharges to the question of public access on the lake. However, the company could not commit to public access at that time for a variety of reasons, primarily regulatory in nature. Although there was an inability to commit to public utilization, the company became aware of the value of the aquatic resource represented by the lake. Discussions with Kansas Fish and Game Commission (KF&G) personnel were important in emphasizing this aspect of the cooling lake.

Negotiations on the possibility of KF&G stocking WCCL followed at this stage in project planning. The company was unable to take advantage of the KF&G offer to stock WCCL, however, because of the rapidly changing regulatory climate surrounding nuclear projects which precluded commitments on public utilization.

While discussions with KF&G made the cooling lake sport fishery potential apparent, company research indicated that it also had the

TABLE 1. SEASONAL MEAN CONCENTRATIONS OF WATER QUALITY PARAMETERS OBSERVED IN WOLF CREEK COOLING LAKE AT WOLF CREEK GENERATING STATION DURING 1981 - 1983.*(A)

PARAMETER	UNITS	1981			1982			1983		
		MIN	MAX	MEAN	MIN	MAX	MEAN	MIN	MAX	MEAN
Dissolved oxygen	mg/l	6.4	13.2	9.4	6.4	12.7	9.4	4.4	13.1	8.9
pH	units	7.8	8.2	7.9	7.5	8.3	7.8	7.5	8.3	7.9
Alkalinity	mg/l	109	171	156	125	210	167	123	164	144
Specific conductance	umhos/cm	260	586	436	316	446	407	365	435	376
Total dissolved solids	mg/l	279	530	369	142	298	234	207	483	278
Total suspended solids	mg/l	0	366	91	0	28	10.5	0	21	10.0
Turbidity	units	2	105	13.5	2.9	9	5.2	2	13	6
Potassium	mg/l	2.3	5.6	4.2	2.0	5.4	4.2	–(B)	–	–
Calcium	mg/l	36.5	120	63.5	40.9	57.5	49.1	30.3	48.4	41.2
Chloride	mg/l	15.3	38.1	25.7	12.5	18.0	14.8	11	22	15.4
Sodium	mg/l	9.4	34.2	19.1	2.0	15.5	11.0	–	–	–
Manganese	mg/l	0.01	0.19	0.08	0.001	0.11	0.057	0.02	0.16	0.07
Magnesium	mg/l	6.3	19.9	13.8	5.1	14.2	11.2	10.4	16.0	12.6
Sulfate	mg/l	28.6	115	71.0	35	53	44	34	49	41
Iron, total	mg/l	0.2	10.5	1.27	0.04	.67	0.26	0.02	1.09	0.69
Iron, soluble	mg/l	0.02	1.56	0.30	< 0.01	0.37	<0.15	< 0.01	0.12	<0.45
Color	units	1.0	17.6	4.8	< 1.0	10.2	4.6	–	–	–
Ammonia	mg/l	< 0.01	0.16	<0.05	< 0.01	0.27	<0.04	< 0.01	0.20	<0.55
Nitrate	mg/l	0.06	8.65	1.64	< 0.01	0.38	<0.13	< 0.01	0.77	<0.15
Nitrite	mg/l	< 0.01	0.02	<0.01	< 0.01	0.12	<0.03	< 0.01	0.05	<0.01
Total Organic Nitrogen	mg/l	0.13	0.81	0.52	0.14	2.49	0.81	< 0.10	0.96	<0.49
Orthophosphorus, soluble	mg/l	< 0.01	0.14	<0.04	< 0.01	0.21	<0.03	< 0.01	0.02	<0.01
Phosphorus, total	mg/l	0.01	0.45	<0.15	< 0.02	1.35	<0.26	–	–	–
Silica, soluble	mg/l	0.04	6.7	1.8	0.9	5.5	2.4	–	–	–
Biochemical oxygen demand	mg/l	1.3	4.4	2.8	1.2	4.9	2.6	0.88	3.5	1.96
Chemical oxygen demand	mg/l	4	73	<26.6	10	100	<36	22	150	<42
Total organic carbon	mg/l	4.2	8.8	6.0	6.1	8.3	6.9	–	–	–
Oil and grease	mg/l	< 3	71.8	<10.3	< 1.0	1.7	<1.1	< 3.0	3.7	<3.1
Copper	ug/l	< 0.2	6.9	<3.0	0.8	7.6	<4.8	2	8.3	4.2
Lead	ug/l	< 0.3	7.8	<2.7	< 1.0	4.0	<2.2	–	–	–
Zinc	ug/l	< 0.1	33.4	<16.4	4.3	80	<28.8	–	–	–

(A) Reproduced from Ecological Analysts, Inc. (1984).

(B) Data not available.

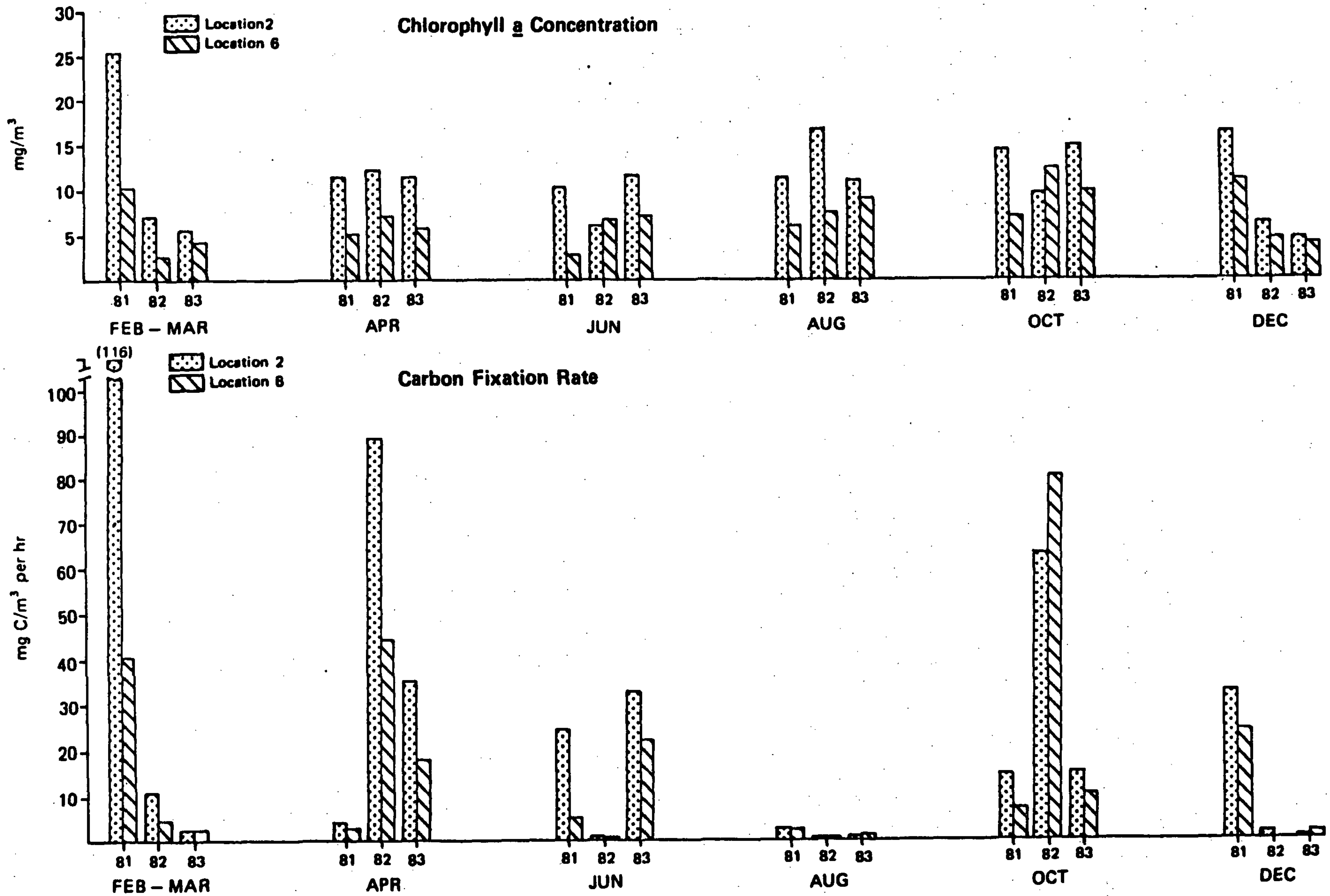


FIGURE 2. SPATIAL AND TEMPORAL VARIABILITY OF PHYTOPLANKTON IN THE COOLING LAKE AT WOLF CREEK GENERATING STATION, BURLINGTON, KANSAS, 1981 - 1983 (REPRODUCED FROM ECOLOGICAL ANALYSTS, INC. 1984).

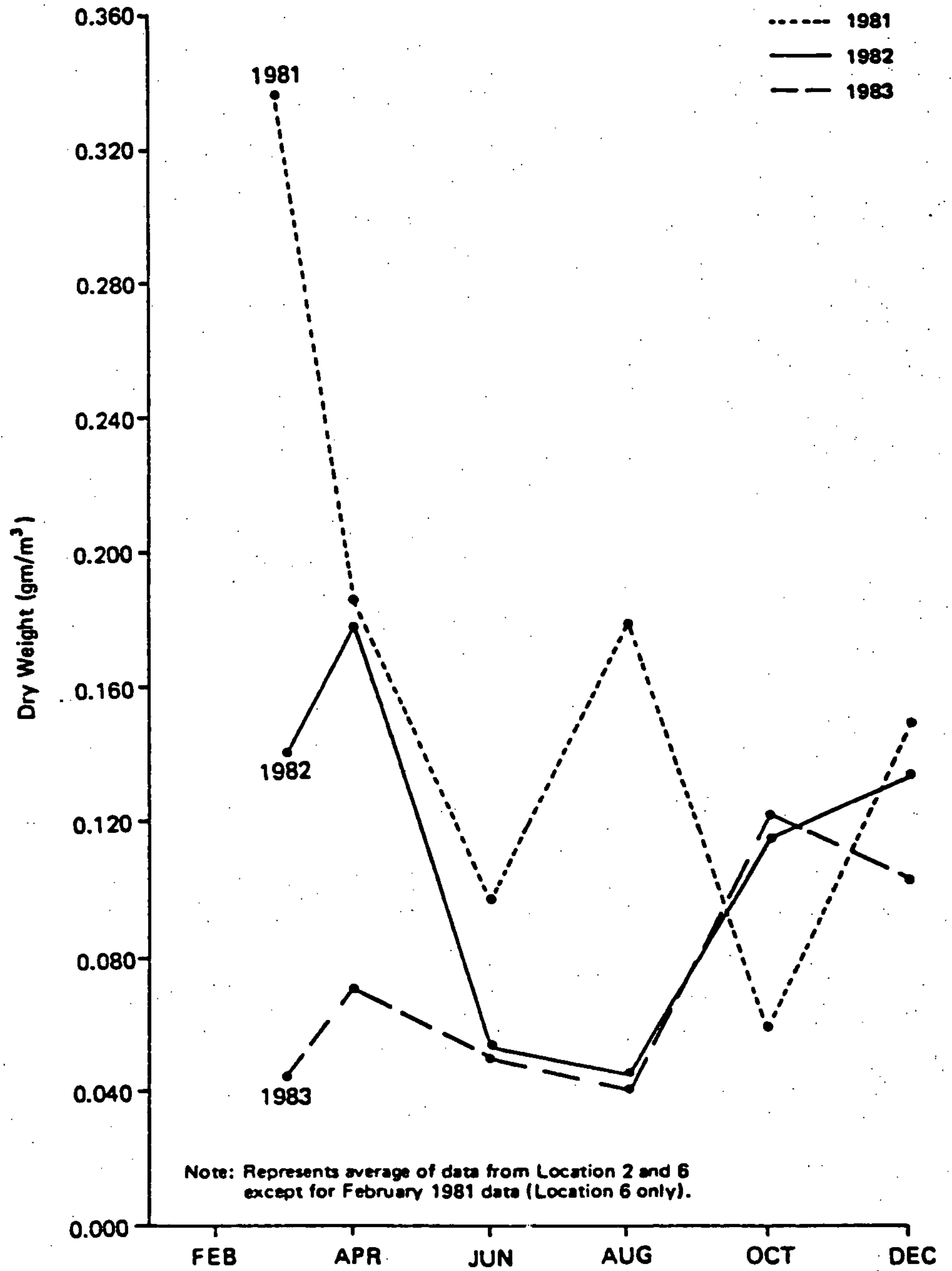


FIGURE 3. COMPARISON OF ZOOPLANKTON MEAN BIOMASS ESTIMATES FROM THE COOLING LAKE FOR WOLF CREEK GENERATING, 1981 - 1983 (REPRODUCED FROM ECOLOGICAL ANALYSTS, INC. 1984).

potential to possess a fishery which would benefit the plant. Data obtained through this research showed that plant benefits would be decreased maintenance costs and a diminished potential for catastrophic impingement episodes which cause plant shutdowns. Both of these benefits would be attributable to reduced numbers of impingement susceptable species, particularly gizzard shad (Dorosoma cepedianum), brought about by management activities.

Active management through stocking during lake fill has been shown to inhibit roughfish expansion. Specifically, predator species have been attributed with extensively reducing clupeid (shad) numbers and biomass. Predation by introduced walleye (Stizostedion vitreum) and white bass (Morone chrysops) contributed to reductions in numbers of shad (Jester 1972). Stroud (1949) attributed a reduction in gizzard shad numbers to heavy predation by walleye, largemouth bass (Micropterus salmoides), and northern pike (Esox lucius).

A major portion of biological control attributed to game fish comes from members of the genus Morone. In Keystone Reservoir, Combs (1978) found gizzard shad were the primary food item of adult striped bass (Morone saxatilis), comprising 83.4% of volume and occurring in 77% of stomachs sampled. Combs also noted that striped bass in Keystone,

> "....have the potential of reducing total numbers of gizzard shad, particularly those that may otherwise grow too large to be utilized for forage by most sport fishes."

Morris and Follis (1978) credited stripers with significant reductions in shad numbers in Lake Spence, Texas. In possibly the most dramatic example of shad control, Ware (1979) found excellent biological control was achieved within two years by striped bass in Lake Juliana. Original gizzard shad biomass, estimated at 73.5 pounds/acre, declined to between 0.2 and 27.5 pounds/acre. The final determination estimated an 80.5% decrease from the original population level. A similar study by Ware (1979) on Lake Hunter revealed a 50% decrease in shad abundance.

The fishery principles which come into play in the process described above relate to the concept of balance in warmwater fishery populations. The "correction" of unbalanced shad populations, by introduction of top predators in this case, results from moderate shad predation. A moderate level of exploitation leads to the desirable inverse relationship between adult stock and recruitment (Anderson 1973). This relationship is advantagous from a potential game fish harvest standpoint, and is also thought important in reducing dominant shad year classes largely responsible for catastrophic impingement.

In efforts to control roughfish (forage) biomass, care must be taken to avoid over exploitation. As cited by McCloskey (1980), the dynamics of gizzard shad populations are not well understood and over exploitation of this species could possibly lead to a "crash" of the forage base, followed by drastic decreases in the predator population. Given the potential for this scenario, regulation of predator species such as largemouth bass and Morone spp. becomes not only of prime importance but also the means by which the system is maintained.

It was in light of these justifications that KG&E chose to undertake the WCCL fishery management program. The program served to address two concerns; the first, establishment of a sport fishery in the event that public use of the cooling lake became possible in the future; and the second, creation of a cooling lake fishery which would enhance WCGS operating reliability.

Wolf Creek Cooling Lake Management Activities

The cooling lake fisheries management program can be broken into two phases; pre-impoundment and lake-filling. The goals of these two phases were dramatically different but three fundamental types of work were common to both.

The first activity consisted of complete removal of existing fish populations through rotenone applications. The procedure was performed on all water bodies within the Wolf Creek basin. While not commonly performed in midwestern management efforts, this step was felt to be vital in the establishment of predator species as the dominant fishery component. A situation where stocked fish gained a competitive advantage was expected to occur following the corresponding reduction/elimination of undesirable species. Additionally, the formation of dominant roughfish year classes, particularly common carp (Cyprinus carpio), was expected to be prevented. The elimination of the dominant carp year class often observed in the first year of impoundment (Triplett 1976) would then be translated into reduced detrimental impacts by this long-lived, undesirable species.

The second important technique applied throughout both management stages was the introduction of fathead minnows (Pimephales promelas) immediately after detoxification. This species was introduced with the sole purpose of providing an immediate, short-term forage supply for stocked fish. Fathead minnow was selected primarily because of the high reproductive potential it exhibits, and secondarily because of the favorable commercial availability of this species. Fathead minnows were stocked with the expectation that this species would be greatly reduced as the predators grew in size. An accelerated initial growth rate and improved survival of stocked species were two benefits expected from the early availability of fathead minnow young.

Logically, introduction of predator species was the third management activity. Because the end results desired were different for pre-impoundment and lake-fill stages, the nature of predator stocking efforts for each stage were also quite different.

Activities during the pre-impoundment stage were directed toward the goal of producing broodfish in sub-impoundments. These broodfish would then be capable of spawning upon inundation by WCCL. Stocking rates above published guidelines were utilized in some cases in an effort to obtain a maximum number of broodfish.

Conversely, lake-fill stocking plans were formulated using reduced numbers of predator species, often well below published guidelines. The reduced stocking rates represented an effort to develop a diversified, fast growing, quality predator base at a minimal cost to the company (L. Jirak, personal communication).

Pre-impoundment Efforts

Fishery management activities were initiated in July 1978 with the rotenone renovation of a small drainage within the future cooling lake basin. This drainage contained approximately 10 impoundments ranging from 0.10 ha (0.25 acre) to 3.2 ha (8.0 acres). The 3.2 ha pond was the focal point of 1978 management activities. Built to serve as a source of construction water, this pond was selected due to its low relative position in the basin.

Following detoxification, this pond was restocked with 80 largemouth bass fingerlings per ha (200 per acre) and ~2500 fathead minnow adults per ha (~6000 per acre). The largemouth bass stocking rate utilized in this case intentionally exceeded "normal" levels. High stocking rates were instituted in an attempt to limit growth, thereby keeping potential broodfish at a minimum size and in the pond, rather than on an illicit fisherman's stringer.

Mixed results were achieved in the primary 1978 pond. The main reason for the diminished results was a well meaning but misinformed and damaging "supplemental stocking" of bullheads by a local resident. Largemouth bass stocked reached 300mm by the end of the first year and were observed in good numbers through AC electrofishing despite the presence of large numbers of black bullhead (Ictalurus melas).

Largemouth bass populations remained at an acceptable level in the main 1978 pond and other drainage ponds up to inundation as WCCL filled in late 1980.

Pre-impoundment stocking continued in 1979 with the placement of more largemouth bass fingerlings in a second drainage. Additionally, smallmouth bass (Micropterus dolomeiui) adults were placed in selected individual sub-impoundments. As in 1978, 1979 largemouth bass fingerling stockings were done with the intent to raise broodfish (Table 2). However, 1979 smallmouth bass stockings utilized the inverse approach by placing a few adults in optimal habitat where they would be highly successful reproductively. The offspring produced would then grow to an intermediate size where they would remain until flooded into the cooling lake.

A total of 27 adult smallmouth bass were placed in two selected ponds. However, reproductive success could not be verified prior to the inundation of these ponds by the cooling lake. A more detailed summary of smallmouth bass stocking results has been presented in the post-impoundment discussion.

Fishery management efforts in 1980 consisted of two phases; UHS renovation/stocking and main lake basin renovation/stocking. The creation of two 1980 phases of work represented a departure from the original WCCL stocking plan which was necessitated by an altered lake-filling schedule. This schedule not only called for a delayed main dam closure, but also early filling of the ~120 ha (300 acre) UHS arm of the lake. Inundation of this cove was facilitated through construction of a temporary dam and subsequent pumping.

The inundation of the UHS mandated stocking designed to preclude unchecked roughfish expansion during filling. The first part of the UHS plan was implemented in early May through the rotenone renovation of 20 ponds and all casual water in the basin. This effort was followed in late May with the stocking of fathead minnows, bluegill (Lepomis macrochirus), and largemouth bass into the UHS, the 4 ha (10 acre) pool below the dam, and numerous drainage ponds. This delivery was followed in late June by walleye, striped bass, and channel catfish (Ictalurus punctatus) stockings into the UHS (Table 3). Stocking the UHS area within such a short time resulted from the accelerated time table for UHS fill which precluded the normal delay in predator stocking to permit optimal forage development.

The renovation of the balance of the WCCL basin concurrent with dam closure, and subsequent stocking as lake-fill began was the second phase of 1980 activities. The basin renovation process represented a critical step in the success of the WCCL fishery management program because it was instrumental in removing/reducing roughfish. Successful basin renovation involved accurate assessment of pond and creek volumes followed by acquisition of a sufficient quantity of rotenone.

Main dam closure for WCCL was accomplished in the fall of 1980, and concurrent with this process over 27.5 km (17 miles) of Wolf Creek and 60 or more ponds were poisoned with rotenone. These treatments occurred during late August, which was the height of a drought that lasted well into the fall. While the renovation process was scheduled for late summer to take advantage of the annual evaporative draw-down cycle, the severity of the drought greatly

TABLE 2. WOLF CREEK COOLING LAKE 1978 and 1979 SUB-IMPOUNDMENT STOCKING ACTIVITIES.

	SPECIES	#	#/ha (acre)	SIZE	LOCATION
1978	Fathead minnow	50,000	2500 (6250)	Sub-Adult & Adult	3.2 ha primary pond
		6,000	2500 (6250)	Sub-Adult & Adult	Secondary ponds
	Largemouth bass	1,600	80 (200)	5-10 cm (2-4")	3.2 ha primary pond
			150 (65)	265-10 cm (2-4")	Secondary ponds
1979	Fathead minnow	70,000	2350 (5800)	Sub-Adult & Adult	4.9 ha primary pond
		5,000	1200 (3000)	Sub-Adult & Adult	Secondary ponds
		12,000	8025 (20,000)	Sub-Adult & Adult	0.2 ha "small-mouth" pond
		40,000	6475 (16,000)	Sub-Adult & Adult	1.0 ha "small-mouth" borrow
	Bluegill	4,950	160 (400)	5-9 cm (2-3.5")	4.9 ha primary pond
		120	10 (25)	5-9 cm (2-3.5")	Secondary ponds
	Largemouth bass	2,400	80 (200)	7.5-10 cm (3-4")	4.9 ha primary pond
	Smallmouth bass	11	7 (18)	Adult (5) Sub-Adult (6)	0.2 ha "small-mouth" pond
		16	2.6 (6.5)	Adult (6) Sub-Adult (6)	1.0 ha "small-mouth" borrow

TABLE 3. WOLF CREEK COOLING LAKE ULTIMATE HEAT SINK STOCKING ACTIVITIES, 1980.

	SPECIES	#	#/ha (acre)	SIZE	LOCATION
May 23	Fathead minnow	70,000	2,800 (7,000)	Sub-Adult & Adult	Ultimate Heat (UHS)/Baffle Dike A pool
		20,000	-	Sub-Adult & Adult	Secondary UHS area ponds
	Bluegill	100	4 (10)	2.5-3.8 cm (1-1 1/2")	UHS/Baffle Dike A pool
		30	-	2.5-3.8 cm (1-1 1/2")	Secondary UHS area ponds
	Channel catfish	100	4 (10)	6.3-7.5 cm (2 1/2-3")	UHS/Baffle Dike A pool
		30	-	6.3-7.5 cm (2 1/2-3")	Secondary UHS area ponds
June 13	Fathead minnow	45,000	1,215 (3,000)	Sub-Adult & Adult	UHS pool
		10,000	400 (1,000)	Sub-Adult & Adult	UHS/Baffle Dike A pool
		10,000	-	Sub-Adult & Adult	Secondary UHS area ponds
	Bluegill	2,000	50 (130)	2.5-3.8 cm (1-1 1/2")	UHS pool
		950	38 (95)	2.5-3.8 cm (1-1 1/2")	UHS/Baffle Dike A pool
		200	-	2.5-3.8 cm (1-1 1/2")	Secondary UHS area ponds
	Channel catfish	60	-	15.2-20.3 cm (6 to 8")	Secondary UHS area ponds
		20	-	25.4-30.5 cm (10-12")	Secondary UHS area ponds
	Largemouth bass	100	4(A) (10)	2.5-5 cm (1-2")	UHS/Baffle Dike A pool
June 28	Walleye	7,000	9 (23)	2.5-5 cm (1-2")	UHS pool
June 30	Channel catfish	3,000	4 (10)	5-10 cm (2-4")	UHS pool
	Striped bass	1,200	1.5 (4)	3.8-10 cm (1 1/2-4")	UHS pool
	Largemouth bass	5,000	7 (17)	2.5-5 cm (1-2")	UHS pool
July 7	Walleye	5,000	7 (17)	2.5-5 cm (1-2")	UHS pool

(A) All stocking densities appearing prior to this asterisk are based on receiving body surface area at stocking. All stocking densities following this asterisk are based on "full pool" surface areas for the receiving bodies.

accelerated the drying process. This increased evaporation essentially eliminated large sections of Wolf Creek and greatly reduced creek pool and pond volumes. The elimination of flow and comprehensive inventory/treatment of water bodies resulted in effective renovations over the majority of the basin.

Post-impoundment Efforts

The completion of the Wolf Creek basin renovation represented the end of pre-impoundment work and the beginning of lake-fill stocking activities. Post-impoundment stocking was designed to produce a diversified, fast growing, quality predator base at a minimum cost to the company. Two concepts were incorporated into the stocking plan to facilitate that end.

The first involved the release of forage species soon after detoxification. These species included both long term forage types such as bluegill and golden shiners (*Notemigonus crysoleucas*), as well as fathead minnows. Once again fathead minnows were stocked to assure accelerated growth rates and improved survival of stocked species. The second concept was one of stocking predator species at rates below published guidelines. These reduced stocking rates were intended to achieve high survival and facilitate utilization of short-term forage with resultant accelerated growth (Leonard Jirak, personal communication).

Pursuant to this goal, the main stocking effort was initiated after basin detoxification in late 1980. This effort consisted of the release of large numbers of a variety of forage species, the prescribed channel catfish and blue catfish (*Ictalurus furcatus*) stockings, and limited numbers of predator species released in higher elevation subimpoundments (Table 4).

The spring of 1981 represented the most important period in the lake filling process and therefore planned 1981 stockings were critically reviewed during the winter of 1980-1981. During this time a literature search and discussions with other fishery biologists revealed information which indicated striped bass were not as well suited to heated impoundments as once thought (Sport Fishing Institute 1980). A decision to replace the main striped bass stocking with striped bass X white bass hybrids (*Morone saxatilis* X *M. chrysops*), nicknamed "wipers", was made based on this information. As with the striped bass, these hybrids were intended to play an important role in controlling shad in the cooling lake.

Having finalized stocking plans, the 1981 effort was initiated in mid-May with receipt of 50,000 wipers via air freight from Florida. Shortly after wiper stocking evidence of successful largemouth bass reproduction was observed. This reproduction was directly attributable to 1978 largemouth bass broodfish released by the rising WCCL in late January. Confirmation of this largemouth bass production permitted cancellation of 100,000 largemouth bass fingerlings

TABLE 4. WOLF CREEK COOLING LAKE POST RENOVATION 1980 STOCKING ACTIVITIES.

SPECIES	#	SIZE
Fathead minnow	327,500	Sub-Adult and Adult
Golden shiners	1,000	Adult
Channel catfish	50,000	5 - 10 cm (2 - 4")
Blue catfish	35,000	10 - 20 cm (4 - 8")
Bluegill	27,700	<5 cm (< 2")
Redear sunfish	2,000 (A)	5 - 15 cm (2 - 6")
Smallmouth bass	500 (A)	5 - 10 cm (2 - 4")
Largemouth bass	1,000 (A)	5 - 10 cm (2 - 4")
Black crappie	1,000 (A)	7.5 - 12.7cm (3 - 5")

(A) These species were stocked in uplying subimpoundments which were inundated during late-spring and early-summer of 1981.

scheduled for release in 1981.

Smallmouth bass reproduction was also observed early that year. The occurrence of smallmouth bass young-of-the-year (YOY) provided evidence that the smallmouth bass broodfish stockings in 1979 and early 1980 yielded positive results. This source of recruitable smallmouth bass was important because commercial supplies were limited to only a portion of the desired number.

Other 1981 predator stockings followed as the various species were supplied by vendors (Table 5).

Post-1981 Lake Stocking Activities

Stocking activities undertaken since 1981 have been greatly reduced from initial levels. Predator stockings have been accomplished only with the intent to bolster poor year classes, or in continuing efforts to diversify the WCCL fishery (Table 5). Exemplary of post-1981 stocking was the 1982 stocking of five million walleye fry. These fish represented an attempt to bolster the mediocre 1981 walleye year class caused by late arrival of these fish from a northern vendor.

TABLE 5. WOLF CREEK COOLING LAKE POST-IMPOUNDMENT STOCKING RECORD.

YEAR	MONTH(S)	SPECIES	NUMBER
1981	July	Black crappie	25,000
	Sept.	Blue catfish	40,500
	Oct.	Channel catfish	50,000
	July	Flathead catfish	3,640
	July	Smallmouth bass	1,830
	July	Spotted bass	3,400
	July	Striped bass	14,000
	May	Striped X white bass hybrid (Wiper)	50,000
	June-July	Walleye	82,500
1982	Nov.	Blue catfish	41,800
	April-June	Channel catfish	50,000
	June	Spotted bass	2,675
	April	Walleye (fry)	5,000,000
1983	Oct.	Flathead catfish	1,000
	April	Paddlefish	1,000
	April	Walleye (fry)	70,000

MATERIALS AND METHODS

Fishery monitoring was scheduled on both the Neosho River and WCCL during the period from March through November, 1983. A variety of sampling gears were selected for use to facilitate evaluation of Neosho River and WCCL fish populations. The methods utilized for the various gears were designed to adequately assess the condition of adult and juvenile classes of forage and predator species.

Neosho River

Adult and juvenile fish collections utilizing through electrofishing and seining, were scheduled on two occasions in the JRR tailwaters (Location 1). Electrofishing was scheduled in conjunction with WCGS radiological/environmental program collections. A single phase, variable voltage AC boat-mounted boom shocker was utilized for fish collections. Electrofishing output amperage was adjusted to from seven to nine amperes with a resulting variance in output voltage as Neosho River conductivity varied. Sampling was scheduled for a 30 minute period which represented boat travel along approximately 800 meters of shoreline. Shoreline seining was also scheduled at Location 1 to collect forage-sized fish. A 4.6 X 1.8 m seine with 0.3 cm Ace mesh was utilized to complete these collections.

In addition to Location 1 electrofishing and seining, qualitative sampling was scheduled at Locations 10 and 11 in November. These collections were planned for low flow conditions (~25 cfs) to verify the continued presence of the Neosho madtom in these riffle habitats.

Wolf Creek Cooling Lake

Fishery monitoring on WCCL was scheduled from March through October, 1983. This monitoring was designed to permit identification and evaluation of impacts to the WCCL fishery resulting from WCGS construction and start-up activities, as well as evaluation of the success of the KG&E fishery management program.

The cooling lake monitoring program generally followed the standardized efforts of the KF&G (Stafford 1979). This standardized sampling regime utilized a variety of gears, which each targeted a particular species or group of species. The use of this regime over the study period was designed to permit a complete characterization and subsequent evaluation of the WCCL fishery. The gear types, effort, locations, and sampling schedule which comprised this regime appear in Table 6, Figure 1, and as described in the following.

Fyke netting, consisting of eight net nights per month, was scheduled in April and again in May at Locations 2 and 6. April collections were designed to target walleye spawning activities as

TABLE 6. SUMMARY OF GEAR UTILIZED FOR FISH SURVEYS IN WOLF CREEK COOLING LAKE, 1983.

Gear Type	Description[A]	Unit of Effort	Locations
Fyke Net	Large frame, 1.2 x 1.5m (4 x 5 ft.) large, 2.5cm (1 inch) and small, 1.3cm (0.5 inch) bar mesh nylon trap nets	Four net nights per location	Location 2 -WCCL causeway -Evans cove Location 6 -Saddle dam 4 -Main dam
D.C. Electrofishing	Boat mounted pulsed D.C. boom shocker with Coffelt VVP-15 unit and 3500 watt generator	Two 15 minute sub-samples per location	Location 2 -West causeway -East causeway Location 6 -Saddle dam 4 -Allen's cove
Seining	15.2 x 1.8m (50 x 6 ft.) bag seine with 0.6 cm (0.25 inch) mesh	Two-modified Swingle swings per location	Location 2 -West causeway -East causeway Location 6 -Saddle dam 4 -Main dam, east end
Trawl	Semiballoon otter trawl with 4.9m (16ft.) head rope, 1.3cm (0.5 inch) mesh nylon with 0.3cm (0.13 inch) cod liner	Two-five minute trawls per location	Location 2 -Hess road -Levering area Location 6 -Saddle dam 4 -Service spillway
Gill Net	Uniform mesh flag nets 30.5 x 2.4m (100 x 8ft.) with monofilament panels of 2.5, 3.8, 6.4, 10.2cm (1.0, 1.5, 2.5, 4.0 inch) bar mesh	Four net nights per location.	Location 2 -WCCL causeway -Evans cove Location 6 -Saddle dam 4 -Main dam Location 8 -Baffle dike A, north end -UHS dam

(A) From A Manual of Survey Techniques for Reservoir Management, Kansas Fish and Game Commission.

water temperatures reached 8.9°C (48°F) while May efforts were targeted for spawning activities of the two WCCL *Pomoxis* species.

Electrofishing was scheduled monthly in May, June, July, and September at Locations 2 and 6. Standardized electrofishing efforts consisted of two 15 minute periods per location. The main components of the electrofishing unit were a 3500 watt generator, a Coffelt VVP-15 transformer unit, dead-man foot switch, and DC electrode array. A pulsed DC current of 5-10 amperes was used for all WCCL shocking activities.

Shoreline seining was scheduled monthly on WCCL from May through October. Seining efforts consisted of two modified Swingle swings per location using a 15.2 X 1.8 m bag seine with 0.6 cm mesh.

Trawling was scheduled monthly on WCCL from June through October. Two five minute samples were taken at each location with a semiballoon otter trawl.

Gill net collections were scheduled on WCCL in the month of October. Gill nets utilized consisted of uniform mesh flag monofilament panels. Scheduled net sets were a total of four net nights in each of three locations. The total net complement at each location included one net night for each size bar mesh.

During Neosho River and WCCL fishery monitoring a number of physical parameters were measured and recorded on field data sheets. Parameters measured in the Neosho included depth, water temperature, turbidity, flow velocity, and meteorological conditions while conductivity was also recorded following electrofishing efforts. Cooling lake parameters recorded were depth, water temperature, substrate type, secchi, turbidity, and meteorological conditions with conductivity also recorded for electrofishing efforts.

Fish collected during field activities were identified, measured (total length, mm), and weighed (g) in the field or identified, measured and weighed in the laboratory, depending on sample size and time constraints. Fish identified in the laboratory were preserved in 10% buffered formalin until they were processed.

Generally, the number of individuals of a given species collected permitted complete processing of all fish. However, if the total number of individuals of a certain species in a sample exceeded 25, then 25 plus one % of the total number were processed. The total number of individuals was recorded when sub-sampling was necessary and, in some cases, an aggregate weight determined. These values were recorded to facilitate annual abundance and total biomass comparisons. In those cases when a total species weight was not recorded, an extrapolated total weight was calculated from the product of the number of unprocessed individuals and a mean weight of the weighed fish. The use of this method permitted annual biomass percentages to be calculated from total 1983 catch data.

Data from all 1983 WCGS fishery collections were entered in the KG&E Sperry Univac Model 1100 computer. Cooling lake fishery data were then processed through the use of the Maintaining, Preparing and Producing Executive Reports (MAPPER) system with programs developed by KG&E Computer Services personnel. Length frequency figures were produced on an Apple LISA through the use of LISA-Calc and LISA-Graph programs.

In addition to commonly used interpretive calculations such as species composition, relative abundance, relative biomass, catch per unit effort (CPE), length frequency, and coefficient of condition (K_{TL}, Ricker 1975), several other analytical methods were utilized for data analysis. Proportional Stock Density (PSD) (Anderson 1976), traditional Relative Stock Density (RSD) (Wege and Anderson 1978; Anderson 1980), incremental Relative Stock Density (RSD) (Gablehouse 1983), and Relative Weight ($\underline{Wr}$), (Wege and Anderson 1978) were computations also performed on 1983 fisheries data. Length-weight equations adopted by KF&G were utilized for relative weight calculations on 1983 data. For two selected species a series of correction factors were applied to incremental catch data prior to PSD and RSD calculations (Wilis et al. 1983).

RESULTS AND DISCUSSION

Fishery monitoring on the Neosho River and Wolf Creek Cooling Lake resulted in the collection of 7771 fish representing 10 families and 32 species. Fishery surveys were accomplished as presented in Table 7.

Neosho River

Fish surveys at Location 1 yielded 2418 fish representing 16 species of eight families (Table 8). The more abundant fishes collected were gizzard shad (2204), red shiner (*Notropis lutrensis*) (109), channel catfish (32), flathead catfish (14), river carpsucker (*Carpiodes carpio*) (13), and freshwater drum (*Aplodinotus grunniens*) (12) (Table 9). Of these fish, 103 representing 13 species were collected through electrofishing at Location 1 (Table 10). Channel catfish was the species most frequently shocked (31.1%) while other common species included flathead catfish (*Pylodictus olivaris*) (13.6%), river carpsucker (11.7%), freshwater drum (11.7%), and gizzard shad (7.8%). In total these species comprised 75.9% of the electrofishing catch at Location 1. One blue sucker (*Cycleptus elongatus*), listed as rare in Kansas (Platt et al. 1974), was also collected during 1983. This species has been consistently collected from the study area since electrofishing was incorporated into the monitoring program in 1977.

The largest portion of the balance of fish collected during 1983 in the Neosho River were caught through seining at Location 1. A total of 2315 fish were seined at Location 1 during this study. Gizzard shad comprised 94.9% of the seine catch which represented the highest percentage of Location 1 seined fish for any species since 1976 (Table 11). These data should be qualified in light of the small number of Neosho River seine collections conducted in 1983.

Special surveys downstream in the Neosho River resulted in the collection of three Neosho madtoms. The Neosho madtom, classified as endangered in Kansas (Platt et al. 1974), has been collected consistently from the river since 1976 when sampling was increased to document the presence of this species in the vicinity of WCGS.

Overall, Neosho River collections provided a qualitative assessment of the fishery below JRR and also documented the continued presence of two species of special interest. These limited efforts were deemed sufficient for generally assessing potential river impacts in light of the static conditions of WCGS/river interfaces. No withdrawal of Neosho River water occurred at the MUSH in 1983 except for auxiliary raw water pumping which represents 1.5-3.0% of WCCL make-up pump rates.

TABLE 7. FISH SAMPLING SCHEDULE FOR PRE-OPERATIONAL PHASE ENVIRONMENTAL MONITORING PROGRAM AT WCGS, 1983.

	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.
WCCL									
Fyke Netting		X	X						
Electrofishing		X	X	X(A)	X(A)		X(A)		
Seining			X	X	X	X	X	X	
Trawling			X	X	X	X	X	X	
Gill Netting	X(B)							X	
Neosho River									
Electrofishing			X		X				
Seining				X(C)	X(C)				X(D)

(A) Electrofishing efforts included supplemental collections designed to more accurately sample WCCL bluegill, largemouth and smallmouth bass for (Wr) and PSD and RSD calculations.
(B) Supplemental effort completed to collect fish for the WCGS radiological/environmental monitoring program.
(C) Location 1 only.
(D) Locations 10 and 11 as water level permitted.

TABLE 8. CHECKLIST OF FISHES COLLECTED FROM THE NEOSHO RIVER AND WOLF CREEK COOLING LAKE DURING 1983.

Family and Scientific Name	Common Name	Collected from Neosho River	Collected from Cooling Lake
Lepisosteidae (gars)			
Lepisosteus osseus	Longnose gar	X	
Lepisosteus platostomus	Shortnose gar	X	
Clupeidae (herrings)			
Dorosoma cepedianum	Gizzard shad	X	X
Cyprinidae (carps and minnows)			
Cyprinus carpio	Common carp	X	X
Notemigonus crysoleucas	Golden shiner		X
Notropis buchanani	Ghost shiner	X	X
Notropis lutrensis	Red shiner	X	X
Pimephales promelas	Fathead minnow		X
Catostomidae (suckers)			
Carpiodes carpio	River carpsucker	X	
Cycleptus elongatus	Blue sucker	X	
Ictiobus bubalus	Smallmouth buffalo	X	
Ictiobus cyprinellus	Bigmouth buffalo		X
Ictaluridae (freshwater catfishes)			
Ictalurus furcatus	Blue catfish		X
Ictalurus punctatus	Channel catfish	X	X
Ictalurus melas	Black bullhead		X
Ictalurus natalis	Yellow bullhead		X
Pylodictis olivaris	Flathead catfish	X	
Noturus placidus	Neosho madtom	X	
Atherinidae (silversides)			
Labidesthes sicculus	Brook silverside		X

TABLE 8. (CONT.)

Family and Scientific Name	Common Name	Collected from Neosho River	Collected from Cooling Lake
Percichthyidae (temperate basses)			
Morone chrysops	White bass	X	X
Morone saxatilis	Striped bass		X
Morone saxatilis X _M. chrysops_	Wiper		X
Centrarchidae (sunfishes)			
Lepomis cyanellus	Green sunfish		X
Lepomis humilis	Orangespotted sunfish		X
Lepomis macrochirus	Bluegill		X
Micropterus dolomeiui	Smallmouth bass		X
Micropterus salmoides	Largemouth bass	X	X
Pomoxis annularis	White crappie	X	X
Pomoxis nigromaculatus	Black crappie		X
Percidae (perches)			
Percina caprodes	Logperch		X
Stizostedion vitreum	Walleye		X
Sciaenidae (drums)			
Aplodinotus grunniens	Freshwater drum	X	X

TABLE 9. SUMMARY OF 1983 NUMERICAL CATCH DATA FROM NEOSHO RIVER LOCATION 1.

Species	No. Fish Collected					
	Electrofishing	(%)	Seining	(%)	Total	(%)
Longnose gar	1	(1.0)	-		1	(<0.1)
Shortnose gar	4	(3.9)	-		4	(0.2)
Gizzard shad	8	(7.8)	2196	(94.9)	2204	(91.1)
Common carp	3	(2.9)	-		3	(0.1)
Ghost shiner	-		7	(0.3)	7	(0.3)
Red shiner	-		109	(4.7)	109	(4.5)
Notropis sp.	-		2	(0.1)	2	(0.1)
River carpsucker	12	(11.7)	1	(<0.1)	13	(0.5)
Smallmouth buffalo	5	(4.9)	-		5	(0.2)
Blue sucker	1	(1.0)	-		1	(<0.1)
Channel catfish	32	(31.1)	-		32	(1.3)
Flathead catfish	14	(13.6)	-		14	(0.6)
White bass	3	(2.9)	-		3	(0.1)
Largemouth bass	1	(1.0)	-		1	(<0.1)
White crappie	7	(6.8)	-		7	(0.3)
Freshwater drum	12	(11.7)	-		12	(0.5)
Total	103		2315		2418	

TABLE 10. NUMBER OF FISH COLLECTED WHILE ELECTROFISHING AT LOCATION 1, 1983.

Species	19 May	27 July	Total	(%)
Longnose gar	1	0	1	(1.0)
Shortnose gar	4	0	4	(3.9)
Gizzard shad	7	1	8	(7.8)
Common carp	2	1	3	(2.9)
River carpsucker	3	2	12	(11.7)
Smallmouth buffalo	1	4	5	(4.9)
Blue sucker	0	1	1	(1.0)
Channel catfish	7	25	32	(31.1)
Flathead catfish	1	13	14	(13.6)
White bass	3	0	3	(2.9)
Largemouth bass	1	0	1	(1.0)
White crappie	5	2	7	(6.8)
Freshwater drum	10	2	12	(11.7)
Total	45	50	103	

TABLE 11. SPECIES COMPOSITION AND RELATIVE ABUNDANCE (%) SEINED FROM LOCATION 1, 1976 THROUGH 1983.

	YEAR							
Species	1976	1977	1978	1979	1980	1981	1982	1983
Gizzard shad	70.1	9.1	56.3	21.7	2.1	28.2	3.4	94.5
Golden shiner	0.1	3.5	0.5	0.7	0.9	1.3	0.9	0.0
Ghost shiner	17.8	48.1	11.0	24.1	1.3	4.2	14.6	0.6
Red shiner	2.1	32.1	23.4	22.4	87.7	46.8	24.1	4.7
Fathead minnow	<0.1	1.0	0.0	0.9	0.0	0.0	20.1	0.0
Mosquitofish	0.2	0.0	2.2	0.0	0.3	1.0	9.6	0.0
Brook silverside	0.8	0.0	0.0	1.9	2.8	2.6	0.6	0.0
White bass	7.6	0.0	0.5	0.3	0.7	2.6	15.2	0.0
White crappie	0.3	2.2	3.1	25.5	0.4	12.2	4.3	0.0
Freshwater drum	<0.1	0.5	0.0	0.1	0.0	0.0	1.2	0.0
Other fish	0.9	3.5	3.0	2.4	3.8	1.1	26.1	0.1
Total Seined	2373	405	1871	683	1350	312	323	2328
No. Species	17	12	15	13	15	10	18	5
No. Collections	7	8	8	7	5	5	5	2

Wolf Creek Cooling Lake

Qualitative and Quantitative Data

Monitoring on WCCL in 1983 was performed in accordance with the schedule presented in Table 7. During scheduled and supplemental lake surveys a total of 5350 fish was collected (Table 12). This total more than doubled the total 1982 catch. The increased total 1983 catch was reflective of several factors, including a modest increase (~11%) in total units of effort allowed by improved equipment reliability, a ten-fold increase in fyke net catch, more than a doubling of the electrofishing catch, and an increase in the otter trawl catch by a factor of four. Of all gears, only collections by seine and gill nets resulted in a decreased catch from 1982. When viewed individually, the increased catch by the majority of gear types was not easily explained. However, the total 1983 catch was indicative of the maturing WCCL fishery and the increased reproductive potential of many species.

Nine families and 32 taxa were represented in 1983 WCCL collections (Table 8, Table 12 and Appendix B). The total number of taxa reflected inclusion of eight taxa not collected previously and the disappearance of two species caught in 1982. Bullhead minnow, and river carpsucker were those 1982 species not collected during this study. Bigmouth buffalo (Ictiobus cyprinellus), yellow bullhead (Ictalurus natalis), blue catfish, Centrarchidae spp., hybrid sunfish, Micropterus spp., Pomoxis spp., and logperch (Percina caprodes) were those taxa first recorded in 1983. The addition of eight taxa reflected both inclusion of three new taxonomic headings necessary for larval fish identifications as well as the appearance in collections of bigmouth buffalo, blue catfish, yellow bullhead, hybrid sunfish, and logperch.

A small number of the 32 total taxa collected in 1983 dominated the catch in terms of relative abundance, as was the case in 1981 and 1982. Seven species comprised nearly 82% of the total catch with black bullhead at the top of the list (22.2%), gizzard shad second (17.8%), Lepomis spp. the third most numerous (15.5%), followed by bluegill (11.0%), black crappie (Poxomis nigromaculatus) (6.9%), red shiner (4.4%), and finally largemouth bass (4.1%). However, predominant species caught in 1983 were not identical to those which occurred in 1982 (Table 13). The variability in the list was due to displacement of golden shiner, green sunfish (Lepomis cyanellus), and wiper from the list and replacement of these taxa with Lepomis spp., bluegill, and black crappie.

Changes in the predominant species from 1982 to 1983 were due to a variety of factors. Displacement of golden shiner and green sunfish was expected and indicative of the maturation of WCCL. Many facultative minnow species prevalent during lake-filling decrease in numbers as a reservoir ages, as do certain other species such as green sunfish (Carlander, 1969). The decrease of wipers, in terms

TABLE 12. ANNUAL CATCH OF WCCL SPECIES IN ALL SAMPLES WITH ALL GEAR TYPES, 1983

SPECIES	GEAR (A) EF #	EF %	OT #	OT %	SN #	SN %	GN #	GN %	FK #	FK %	TOTAL #	TOTAL %
Gizzard shad	75	16.1	360	28.2	226	19.1	42	6.9	216	11.9	919	17.2
Common carp	10	2.2	5	0.4	6	0.5	9	1.5	45	2.5	75	1.4
Golden shiner	12	2.6	–	–	31	2.6	–	–	7	0.4	50	0.9
Ghost shiner	–	–	–	–	22	1.9	–	–	–	–	22	0.4
Red shiner	1	0.2	–	–	303	25.7	–	–	–	–	304	5.7
Fathead minnow	–	–	–	–	1	0.1	–	–	–	–	1	<0.1
Smallmouth buffalo	3	0.7	–	–	–	–	7	1.1	–	–	10	0.2
Bigmouth buffalo	–	–	–	–	–	–	–	–	1	<0.1	1	<0.1
Blue catfish	–	–	–	–	–	–	1	0.2	–	–	1	<0.1
Black bullhead	19	4.0	–	–	5	0.4	192	31.3	928	51.0	1144	21.4
Yellow bullhead	1	0.2	–	–	–	–	–	–	1	<0.1	2	<0.1
Channel catfish	2	0.4	1	0.1	3	0.3	52	8.5	2	0.1	60	1.1
Brook silverside	4	0.9	–	–	88	7.5	–	–	–	–	92	1.7
White bass	4	0.9	1	0.1	31	2.6	107	17.5	17	0.9	160	3.0
Striped bass	–	–	–	–	–	–	3	0.5	1	<0.1	4	0.1
Wiper	–	–	–	–	2	0.2	93	15.2	2	0.1	97	1.8
Morone spp.	–	–	–	–	3	0.3	–	–	–	–	3	<0.1
Centrarchidae spp.	–	–	24	1.9	–	–	–	–	–	–	24	0.5
Green sunfish	69	14.8	9	0.7	31	2.6	1	0.2	38	2.1	148	2.8
Orangespotted sunfish	5	1.1	–	–	14	1.2	–	–	–	–	19	0.4
Bluegill	59	12.7	55	4.3	236	20.0	5	0.8	212	11.7	567	10.6
Lepomis spp.	–	–	794	62.3	3	0.3	–	–	–	–	797	14.9
Hybrid sunfish	5	1.1	–	–	2	0.2	–	–	2	0.1	9	0.2
Micropterus spp.	–	–	5	0.4	–	–	–	–	–	–	5	0.1
Smallmouth bass	26	5.5	1	0.1	4	0.3	–	–	1	<0.1	32	0.6
Largemouth bass	149	32.0	10	0.8	60	5.1	26	4.2	19	1.0	264	4.9
Pomoxis spp.	–	–	3	0.2	–	–	–	–	–	–	3	<0.1
White crappie	1	0.2	3	0.2	27	2.3	6	1.0	17	0.9	54	1.0
Black crappie	8	1.7	1	0.1	77	6.5	21	3.4	249	13.7	356	6.6
Logperch	3	0.7	1	0.1	4	0.3	–	–	–	–	8	0.2
Walleye	4	0.9	–	–	–	–	31	5.1	–	–	35	0.6
Freshwater drum	5	1.1	1	0.1	–	–	16	2.6	62	3.4	84	1.6
TOTAL FISH	465	100.0	1274	100.0	1179	100.0	612	100.0	1820	>99.8	5350	>99.9

(A) EF=Electrofishing, OT=Trawl, SN=Seine, GN=Gill Net, FK=Fyke Net.

TABLE 13. COMPARISON OF CATCH STATISTICS FROM WOLF CREEK COOLING LAKE AT WOLF CREEK GENERATING STATION, 1981-1983.(A)

Species	Relative Abundance (%) 1981(C)	1982(C)	1983(D)	Average Catch Rate(B) 1981	1982	1983
Gizzard shad	17.2	18.2	17.8	7.9	6.1	10.9
Common carp	2.0	1.2	1.4	0.9	0.4	0.9
Golden shiner	0.6	15.9	1.0	0.3	5.3	0.6
Ghost shiner	0.0	<0.1	<0.1	0.0	<0.1	<0.1
Red shiner	0.1	13.8	4.4	<0.1	4.6	2.7
Fathead minnow	13.5	1.8	0.0	6.2	0.6	0.1
Bullhead minnow	0.0	0.1	0.0	0.0	<0.1	<0.1
Bigmouth buffalo	0.2	0.0	<0.1	<0.1	0.0	0.1
Smallmouth buffalo	0.1	0.1	0.2	<0.1	<0.1	<0.1
Black bullhead	13.0	8.9	22.2	6.0	2.9	13.6
Channel catfish	1.8	2.0	1.2	0.8	0.7	0.7
White bass	0.1	4.0	2.6	<0.1	1.3	1.6
Striped bass	0.1	0.9	0.1	<0.1	0.3	<0.1
Wiper	20.7	6.1	1.6	9.5	2.0	1.0
Morone spp.	0.0	0.7	0.1	0.0	0.2	<0.1
Brook silverside	0.0	0.5	1.8	0.0	0.2	1.1
Green sunfish	0.8	6.5	2.9	0.4	2.2	1.8
Orangespotted sunfish	0.3	0.6	0.4	0.1	0.2	0.2
Bluegill	1.2	6.1	11.0	0.5	1.7	6.8
Lepomis spp.	1.3	1.8	15.5	0.6	0.6	9.5
Smallmouth bass	0.8	0.1	0.4	0.4	<0.1	0.2
Largemouth bass	21.0	5.8	4.1	9.7	1.9	2.5
White crappie	3.8	0.8	1.1	1.7	0.3	<0.1
Black crappie	0.5	2.6	6.9	0.2	0.9	0.6
Walleye	0.1	0.7	0.6	<0.1	0.2	0.4
Freshwater drum	0.6	1.5	1.5	0.3	0.5	0.9
Total No.	2,633	2,448	5,130	46.2	32.4	56.7
No. Units of effort	57	74	84			

(A) The 1981 and 1982 fyke netting data not included.
(B) Represents the total catch divided by the total number of units of effort (all gear types combined).
(C) Data for 1981 and 1982 reproduced from Ecological Analysts, Inc. (1982 and 1983).
(D) The 1983 data include fyke netting results.

of catch frequency, was also expected. The decreased catch rate of wipers was reflective of annual mortality and the corresponding lower density of this non-reproductive hybrid.

Additions to the 1983 predominant species list also reflect a variety of factors. The addition of Lepomis spp. to the list was a result of numerous larval sunfish collected in otter trawls. These larvae are indicative of reproduction by the 1981 sunfish year class, primarily bluegill. Ascension of bluegill and black crappie to the list of most frequently collected taxa resulted from recruitment of individuals to sizes more vulnerable to collection methods. Increasing catches verify establishment of these two sunfish species as key components of the cooling lake fishery.

Only two of the top seven species by relative abundance also appear among the top six in terms of relative biomass. The six species with the highest rank by relative biomass are common carp (19.6%), wiper (16.4%), largemouth bass (13.8%), channel catfish (11.4%), white bass (8.5%) and black bullhead (8.0%) (Table 14). These top six species represent nearly 78% of the total weight of all fish collected during the study. Most importantly, four of the six species were predator species (sport fish) while one was a panfish, and only the remaining species fell into the roughfish category.

With few exceptions, catch rates from the two locations in WCCL sampled the entire year exhibited high variability (Table 15). Annual average catch per unit effort (CPE) electrofishing was nearly identical between the upper end (Location 2) and the lower end (Location 6). Gizzard shad electrofishing CPE was higher at Location 2 in May and September but nearly identical in June and July. Electrofishing CPE for largemouth bass was variable by location throughout the year but was nearly identical for the annual average at each location.

The average annual CPE from fyke net sets was almost twice as high at Location 2 than Location 6. The Location 2 catch rate was bolstered by black bullhead and black crappie which were both caught at a rate nearly twice as high at the upper end of WCCL.

Seine collections on WCCL also included sampling at Location 8 in October. Catch rates annually were nearly identical between 2 and 6 while the Location 8 CPE was less than one-fourth of those means on the single sampling data. Other seining CPE values showed higher collection rates at Location 2 for gizzard shad, cyprinids, and white bass while bluegill and largemouth bass were seined more frequently at Location 6.

Location 2 otter trawl average catches were more than four times higher than Location 6 while Location 8 was only one-half that of Location 6. Of all taxa examined, gizzard shad CPE exhibited the greatest difference between locations. Average annual gizzard shad trawl CPE was 270 times higher at the upper end of WCCL.

TABLE 14. PERCENT BIOMASS (kg) OF WCCL SPECIES COLLECTED IN 1983 STANDARDIZED FISHERY SAMPLING REGIME.

SPECIES	kg	%
Common carp	96.1	19.6
Wiper	80.3	16.4
Largemouth bass	68.0	13.8
Channel catfish	56.2	11.4
White bass	41.7	8.5
Black bullhead	39.3	8.0
Gizzard shad	18.6	3.8
Bluegill	18.3	3.7
Black crappie	16.6	3.4
Walleye	14.1	2.9
Smallmouth buffalo	8.8	1.8
Green sunfish	7.4	1.5
Freshwater drum	6.5	1.3
Smallmouth bass	6.5	1.3
White crappie	5.4	1.1
Striped bass	2.3	0.5
Bigmouth buffalo	1.6	0.3
Hybrid sunfish	0.8	0.2
Golden shiner	0.8	0.2
Other taxa	1.2	0.3
TOTAL	490.5	100.0

TABLE 15. SPATIAL AND SEASONAL DISTRIBUTION OF FISH COLLECTED FROM WOLF CREEK COOLING LAKE DURING 1983.

		Catch Per Unit Effort (CPE)																	
		April Location		May Location		June Location		July Location		Aug. Location		Sept. Location		Oct. Location			Annual Average Location		
Gear[A]	Species	2	6	2	6	2	6	2	6	2	6	2	6	2	6	8	2	6	8
EF	Total CPE	–[B]	–	33.0	30.0	78.0	62.0	25.0	28.0	–	–	62.0	86.0	–	–	–	49.5	51.5	–
	Gizzard shad	–	–	11.0	0.0	11.0	9.0	8.0	10.0	–	–	25.0	1.0	–	–	–	13.8	5.0	–
	Largemouth bass	–	–	5.0	13.0	27.0	12.0	5.0	9.0	–	–	15.0	21.0	–	–	–	13.0	12.0	–
	Smallmouth bass	–	–	0.0	0.0	0.0	0.0	0.0	1.0	–	–	0.0	6.0	–	–	–	0.0	3.5	–
FK	Total CPE	7.6	7.6	9.7	2.2	–	–	–	–	–	–	–	–	–	–	–	8.7	4.9	–
	Black bullhead	4.6	4.1	3.8	0.1	–	–	–	–	–	–	–	–	–	–	–	4.2	2.1	–
	White crappie	<0.1	0.0	0.4	0.0	–	–	–	–	–	–	–	–	–	–	–	0.2	0.0	–
	Black crappie	0.2	1.4	2.6	0.1	–	–	–	–	–	–	–	–	–	–	–	1.4	0.8	–
	Largemouth bass	0.1	0.1	0.1	0.0	–	–	–	–	–	–	–	–	–	–	–	0.1	<0.1	–
SN	Total CPE	–	–	14.0	11.0	51.0	3.3	74.5	61.5	38.0	105.0	33.0	59.5	15.5	10.5	9.0	37.7	41.8	9.0
	Gizzard shad	–	–	2.0	0.0	0.5	0.5	36.0	42.0	18.0	2.0	3.5	0.0	6.5	1.0	0.0	11.1	7.6	0.0
	Cyprinids	–	–	2.5	9.5	30.5	0.5	6.0	13.5	2.5	19.0	13.0	0.0	2.5	0.5	1.5	9.5	7.2	1.5
	Black bullhead	–	–	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.5	0.0	0.0	0.3	0.0	0.0
	White bass	–	–	0.0	0.0	0.0	0.0	6.5	0.0	1.5	6.0	0.5	0.0	0.5	0.0	0.0	1.5	1.0	0.0
	Green sunfish	–	–	0.0	0.5	1.8	0.8	0.5	1.0	2.0	3.0	0.0	4.0	0.5	0.0	0.0	0.8	1.6	0.0
	Bluegill	–	–	2.0	0.0	13.3	0.0	3.0	1.5	3.0	43.5	5.0	20.0	3.5	5.0	5.0	5.0	12.5	5.0
	Largemouth bass	–	–	0.5	0.5	0.8	0.5	3.5	2.5	1.0	12.0	0.0	4.5	1.0	1.0	0.5	1.1	3.5	0.5
OT	Total CPE	–	–	–	–	4.5	0.5	36.0	37.5	443.5	54.0	1.0	0.5	14.0	0.0	13.0	99.8	21.1	13.0
	Gizzard shad	–	–	–	–	1.0	0.5	25.0	0.0	105.0	0.0	0.0	0.0	4.0	0.0	0.0	27.0	0.1	0.0
	Green sunfish	–	–	–	–	0.0	0.0	0.5	0.0	0.5	1.0	0.0	0.0	0.0	0.0	2.5	0.2	0.2	2.5
	Bluegill	–	–	–	–	0.5	0.0	0.0	0.5	2.5	5.5	0.0	0.0	8.5	0.0	5.5	2.4	1.2	5.5
	Largemouth bass	–	–	–	–	0.5	0.0	0.0	3.0	1.0	0.0	0.0	0.0	0.5	0.0	0.0	0.4	0.6	0.0
GN	Total CPE	–	–	–	–	–	–	–	–	–	–	–	–	3.5	2.5	1.3	3.5	2.5	1.3
	Gizzard shad	–	–	–	–	–	–	–	–	–	–	–	–	0.1	0.2	0.3	0.1	0.2	0.3
	Black bullhead	–	–	–	–	–	–	–	–	–	–	–	–	2.0	0.4	0.3	2.0	0.4	0.3
	Channel catfish	–	–	–	–	–	–	–	–	–	–	–	–	0.4	0.3	0.1	0.4	0.3	0.1
	White bass	–	–	–	–	–	–	–	–	–	–	–	–	0.6	0.3	0.1	0.6	0.3	0.1
	Striped bass	–	–	–	–	–	–	–	–	–	–	–	–	0.0	<0.1	0.1	0.0	<0.1	0.1
	Wiper	–	–	–	–	–	–	–	–	–	–	–	–	0.2	0.8	0.1	0.2	0.8	0.1
	Largemouth bass	–	–	–	–	–	–	–	–	–	–	–	–	0.1	0.1	0.1	0.1	0.1	0.1

(A) EF=Electrofishing, FK=Fyke Net, SN=Seine, OT=Otter Trawl, GN=Gill Net.

(B) Not sampled

NOTE: Unit of effort for EF=# per 30 minutes; FK=# per hour; SN=# per haul; OT=# per 5 minutes; and GN=# per hour.

Gill net CPE values exhibited generally decreasing catch rates from Location 2 south to Location 6 and across WCCL to Location 8. The wiper catch rate was the only exception to this trend, exhibiting a Location 6 CPE of 0.8 and a Location 2 CPE of 0.2. The higher catch rate for wipers at the lower end of WCCL reflected greater utilization of this limnetic portion of the impoundment.

In addition to variability in CPE by location, catch rates for important species also differed by gear type (Table 16). Changes in average annual CPE by gear were observed for several species. Gizzard shad exhibited CPE increases from 1982 for all gear types. Otter trawl annual CPE increased in 1983 by 33% while electrofishing and seining annual CPE values increased, but at a lesser degree. In total, 1983 gizzard shad CPE values indicated at least a stable population. Additionally, 1983 gizzard shad CPE values identified substantial reproduction and moderate recruitment of YOY.

Growth and Condition

As previously described, the 1983 WCCL fishery program was designed to target various types of fish throughout the study. As a result, 1983 data generally provided catches adequate for segregation. These data sets were utilized for the computational analyses which follow, thus reducing error caused by factors such as growth and changes in body condition over time. Discreet length frequency data were compiled to produce length frequency histograms for discreet data sets from selected WCCL species. In some cases data sets are presented which have less than the desired year of separation. Presentation of these data was necessary because of an inadequate catch of the species in question during the desired time frames.

Figure 4 illustrates 1982 and 1983 gizzard shad size distributions. Due to the poor catch of gizzard shad in the spring of 1982, fall 1982 data were presented. When compared to the spring 1983 catch histogram only limited growth was observed, as expected. However, these data provided evidence of over-wintering of pre-1981 broodfish (>290 mm) and the 1981 year class (170-230 mm).

Common carp length frequency data for 1982 and 1983 indicated the existence of two year classes and remaining pre-impoundment survivors (Figure 5). The 1981 year class was centered near 500 mm while the 1982 data were distributed near 280 mm. Changes between 1982 and 1983 data represented growth by the 1981 and 1982 year classes (ages II and III) of a maximum of 50 and 80 mm, respectively. These increases represented decreased growth rates from those observed in 1982. The reduction of growth rates was attributable to the disappearance of the large amounts of terrestrial vegetation present during lake-filling and the stabilization of WCCL pool level.

Figure 6 represents the length frequency histograms for channel

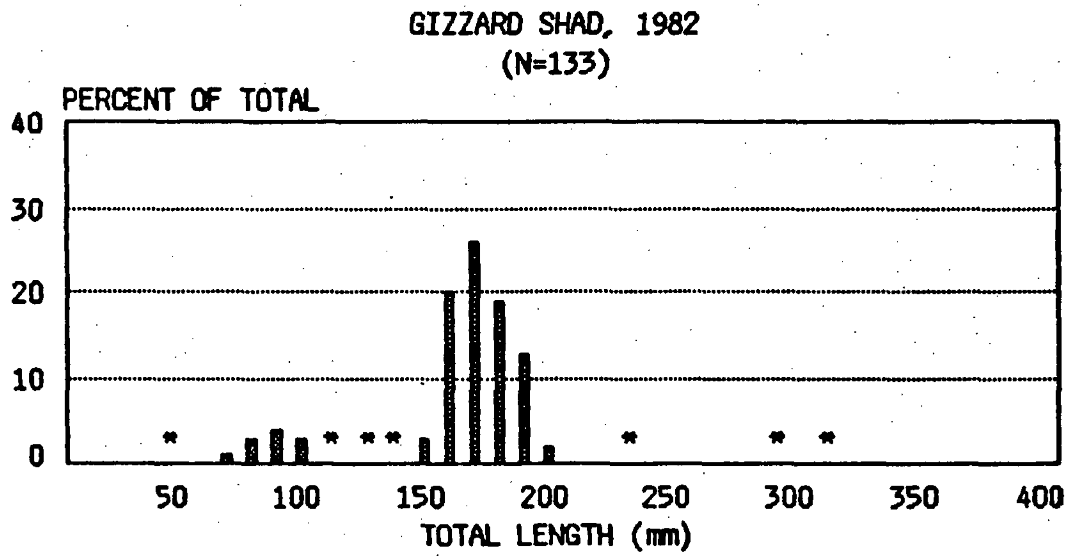
TABLE 16. AVERAGE ANNUAL CATCH PER UNIT EFFORT (CPE) BY GEAR TYPE FOR FISH COLLECTED FROM WOLF CREEK COOLING LAKE, 1981-1983.

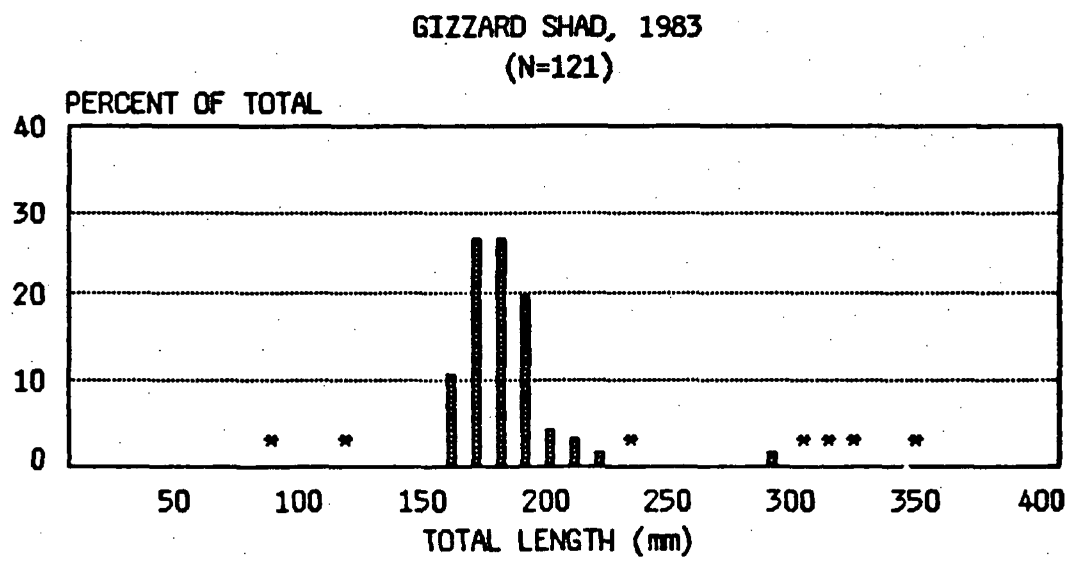
Species	Year	Gear (A)				
		FK	EF	SN	OT	GN
Gizzard shad	1981	-(B)	16.6	5.4	7.3	0.4
	1982	0.0	7.2	5.8	10.9	0.2
	1983	0.8	9.4	7.5	16.4	0.2
Black bullhead	1981	-	0.0	0.0	17.6	<0.1
	1982	0.2	1.3	3.3	0.0	0.3
	1983	3.6	2.4	0.2	0.0	0.9
Channel catfish	1981	-	0.0	1.5	<0.1	<0.1
	1982	0.0	0.0	0.3	0.0	0.2
	1983	<0.1	0.3	0.1	<0.1	0.2
White bass	1981	-	0.0	0.1	<0.1	<0.1
	1982	0.0	0.0	2.9	0.0	0.1
	1983	<0.1	0.5	1.0	<0.1	0.4
Striped bass	1981	-	0.0	0.0	0.0	<0.1
	1982	0.0	0.0	<0.1	0.0	<0.1
	1983	<0.1	0.0	0.0	0.0	<0.1
Wiper	1981	-	0.0	12.0	0.1	1.3
	1982	0.0	0.0	0.2	0.0	0.6
	1983	<0.1	0.0	0.1	0.0	0.4
Bluegill	1981	-	*(C)	*	*	*
	1982	<0.1	1.8	5.7	*	*
	1983	0.8	7.4	7.9	2.5	<0.1
Smallmouth bass	1981	-	*	*	*	*
	1982	0.0	0.3	0.1	0.0	*
	1983	<0.1	1.8	0.1	<0.1	0.0
Largemouth bass	1981	-	23.0	12.0	6.7	<0.1
	1982	<0.1	2.3	3.1	0.6	<0.1
	1983	0.1	12.5	2.0	0.5	0.1
White crappie	1981	-	*	*	*	*
	1982	0.1	0.0	0.1	*	<0.1
	1983	0.1	0.1	0.9	0.1	<0.1
Black crappie	1981	-	*	*	*	*
	1982	0.1	0.3	0.1	*	<0.1
	1983	1.0	1.0	2.6	0.5	0.1
Walleye	1981	-	*	*	*	<0.1
	1982	<0.1	0.0	0.3	*	<0.1
	1983	0.0	0.5	0.0	0.0	0.1
Total fish	1981	-	44.7	40.3	45.9	2.6
	1982	12.4	14.7	56.4	21.1	1.9
	1983	10.1	50.5	36.0	63.7	2.5

(A) FK = Fyke Net, EF = Electrofishing, SN = Seine, OT = Trawl, and GN = Gill Net.
(B) Fyke netting not performed in 1981.
(C) Data not calculated.

NOTE: Units of effort for FK = # per hour; EF = # per 30 minutes; SN = # per haul; OT = # per 5 minutes; and GN = # per hour.

LENGTH FREQUENCY

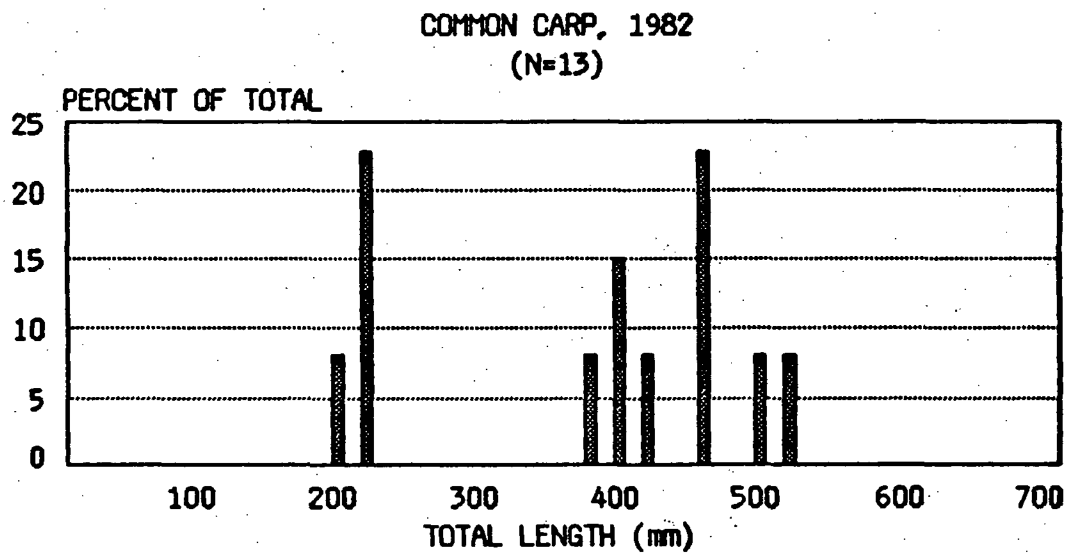




* - LESS THAN 1 % TOTAL CATCH

FIGURE 4. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF GIZZARD SHAD COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

LENGTH FREQUENCY



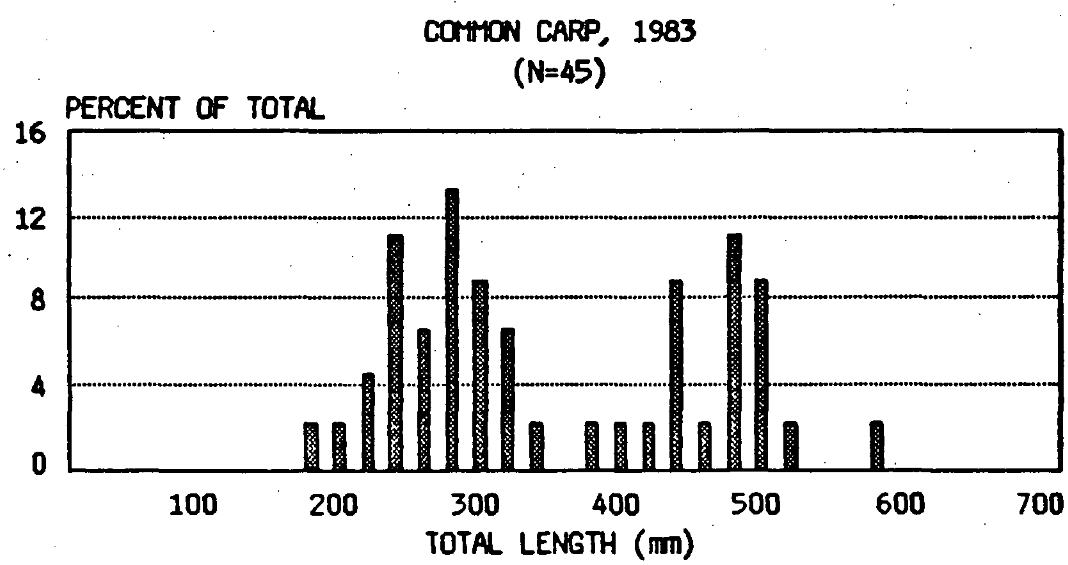
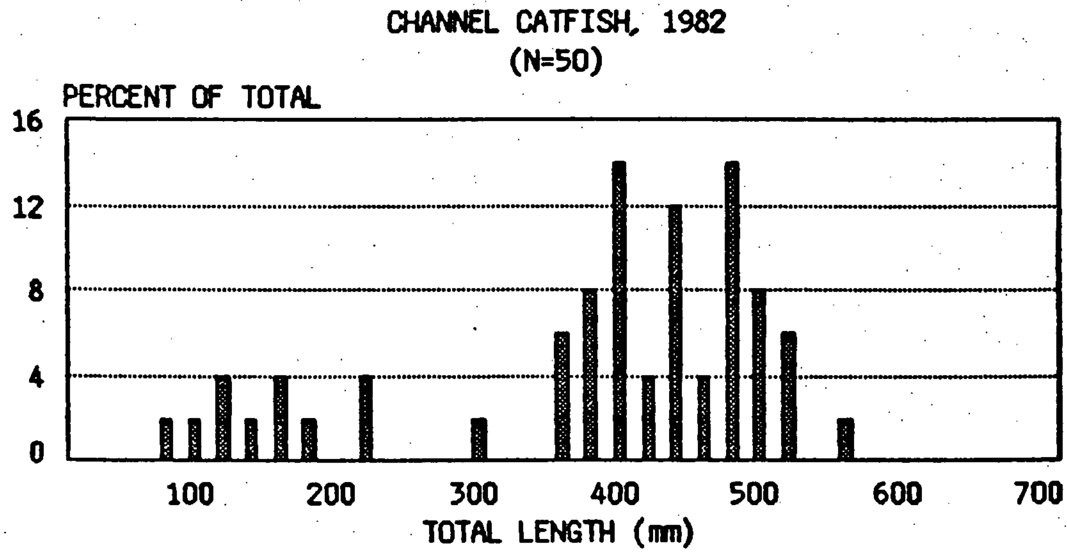


FIGURE 5. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF COMMON CARP COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

LENGTH FREQUENCY



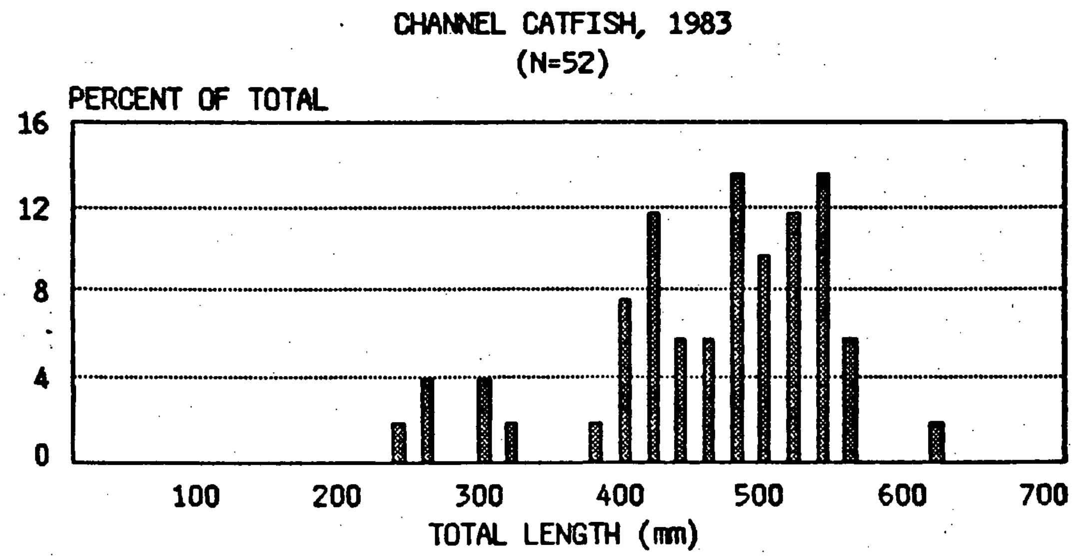


FIGURE 6. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF CHANNEL CATFISH COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

catfish in 1982 and 1983. This species exhibited a strong series of what appeared to be year classes. However, upon close examination and review of stocking records these year classes become less distinct. The clumping of channel catfish between 380 and 560 mm in 1983 data, earlier thought to be the pre-impoundment 1980 stocking (Ecological Analysts, Inc. 1983), is now thought to represent the overlap of the fall 1981 and April - June 1982 stockings. Given this, the 240-320 mm catfish observed in the 1983 histogram were thought to represent fish spawned in 1982 which lagged behind those individuals stocked in April and June of that year.

White bass length frequency histograms for 1982 and 1983 data appear in Figure 7. Characterization of white bass growth patterns was difficult as a result of confusion of Morone types in earlier studies (Ecological Analysts, Inc. 1982 and 1983). Those 1983 white bass data indicate that some overlap with the 1981 wiper year class had existed previously but that differential growth has segregated these Morone types. This differential growth was expected and, as identified by Prentice and Durocher (1981), will become more exaggerated in the future.

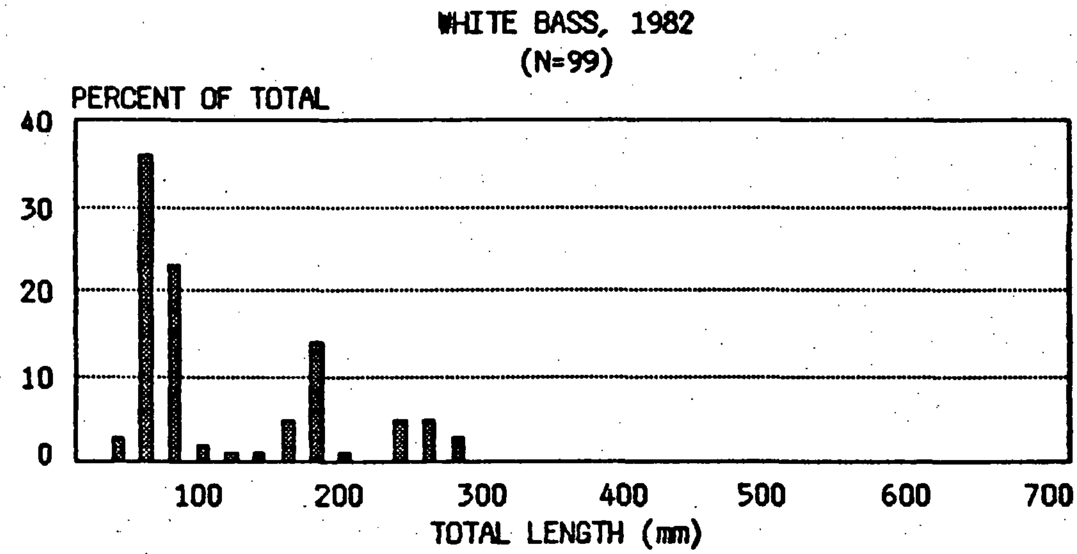
Figure 8 illustrates wiper length frequency histograms for 1982 and 1983. Growth of these striped X white bass hybrids slowed from the over 120 mm increase observed in 1982. The 1983 histogram indicated growth of 40-60 mm for wipers from 1982 to 1983. With a mean length of 416 mm for wipers collected in October, 1983 growth of these fish was nearly identical to both Lake Bastrop, Texas (Candall 1978) and the five year mean for age II wipers in Georgia (Germann and Bunch 1983), while slightly higher than the statewide Kansas average of 391 mm (Marteney 1983). However, the WCCL wiper growth rate was lower than the statewide average for Texas of 469 mm at age II (Prentice and Durocher 1981).

As with gizzard shad, limited 1982 catches of bluegill necessitated presentation of fall 1982 and spring 1983 length frequency data (Figure 9). Those 1983 data indicated existence of a good year class between 140 and 170 mm in the quality category. This group of fish was believed to be the 1981 year class produced by broodfish stocked in 1978, 1979, and early 1980. The 1982 year class exhibited a mean length of approximately 100 mm. These two bluegill year classes exhibited growth very similar to the rates given by Pflieger (1975) for a new Missouri reservoir.

Figure 10 presents length frequency data from 1982 and 1983 for largemouth bass in WCCL. Largemouth bass 1983 catch data indicated a continuation of good growth for the 1981 year class of between 80 to 120 mm. Those 1983 data suggest that since inundation WCCL largemouth bass growth for fish in the 1981 year class and older has been above the average for Kansas, while growth of the 1982 year class has been at or slightly below average (Carlander 1977).

The length frequency histogram for smallmouth bass collected in Sep-

LENGTH FREQUENCY



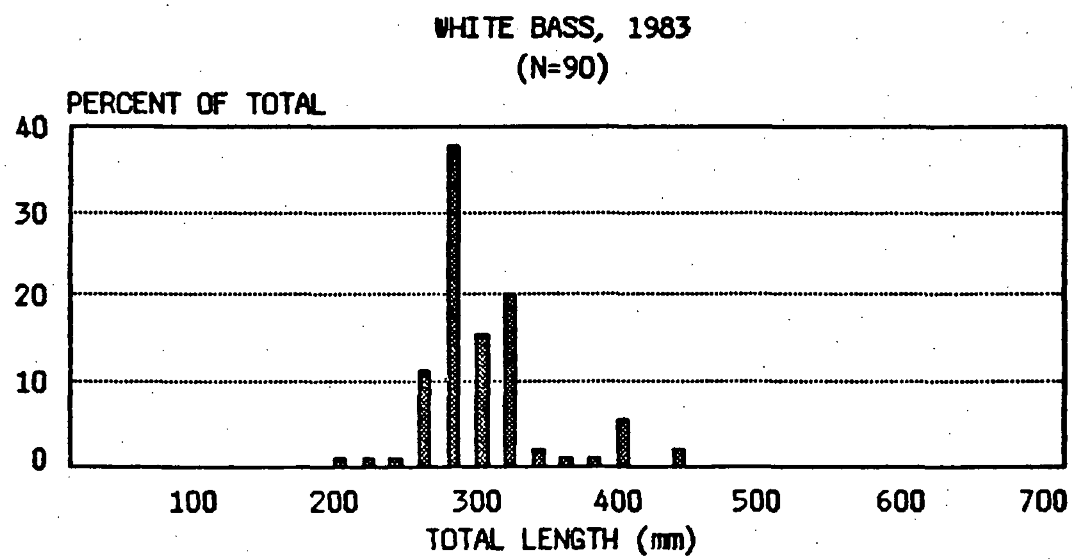
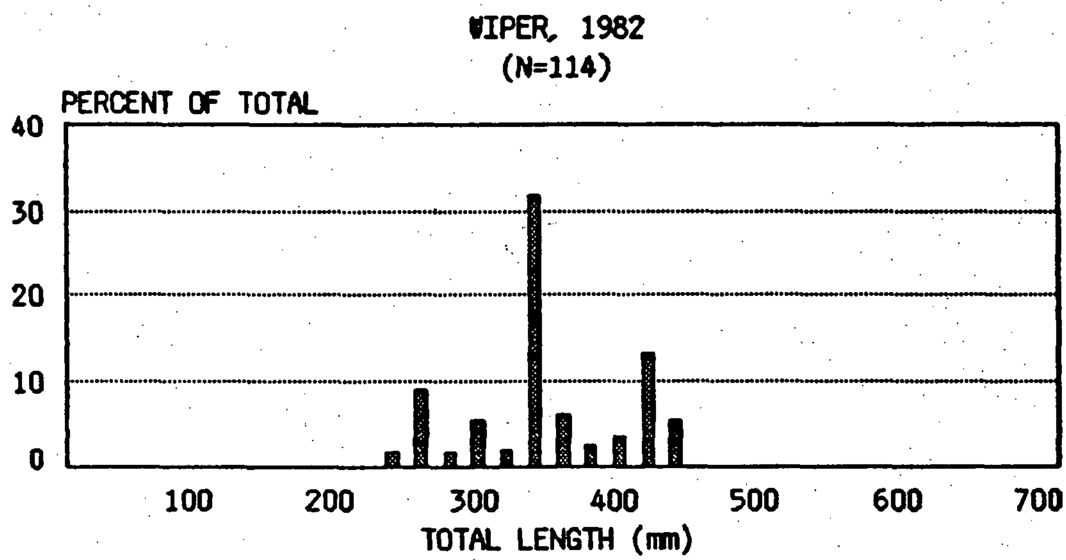


FIGURE 7. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF WHITE BASS COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

LENGTH FREQUENCY



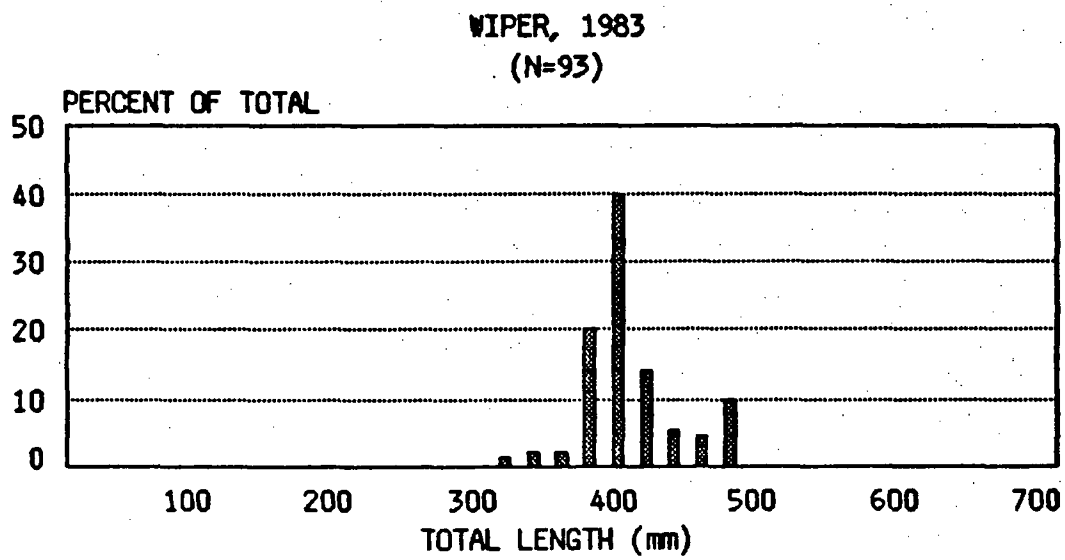
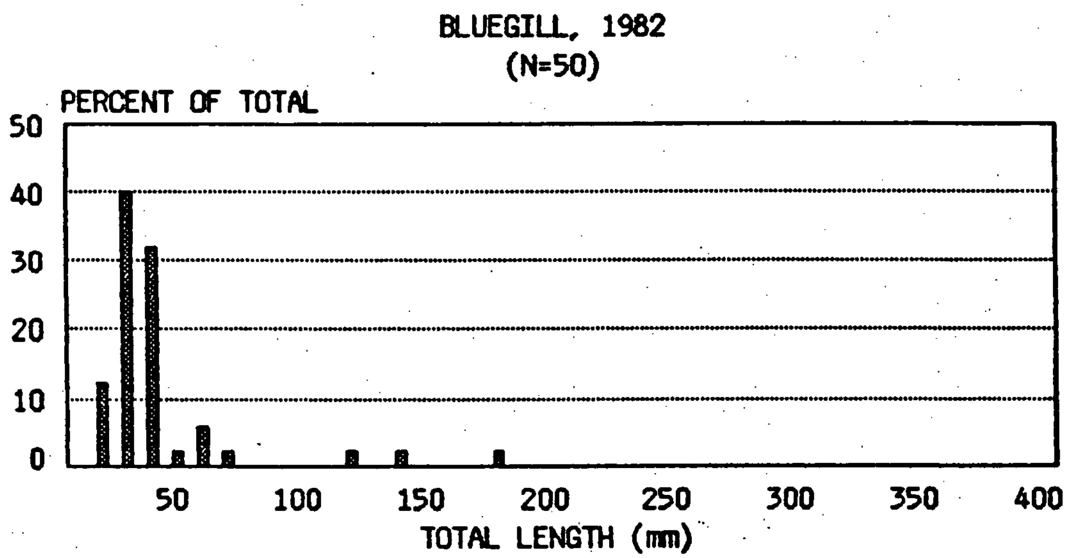
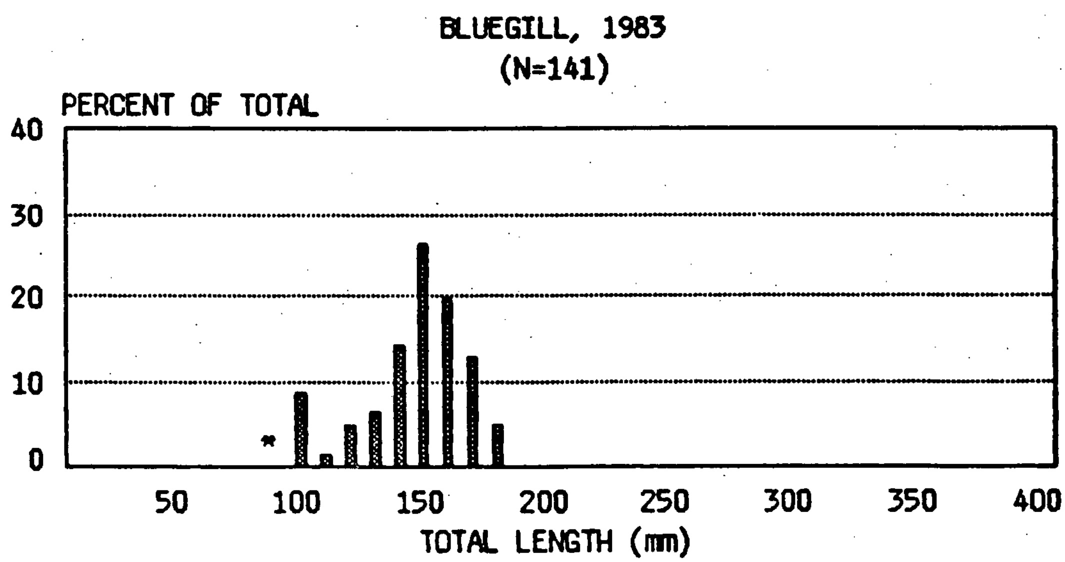


FIGURE 8. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF WIPER HYBRIDS COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

LENGTH FREQUENCY

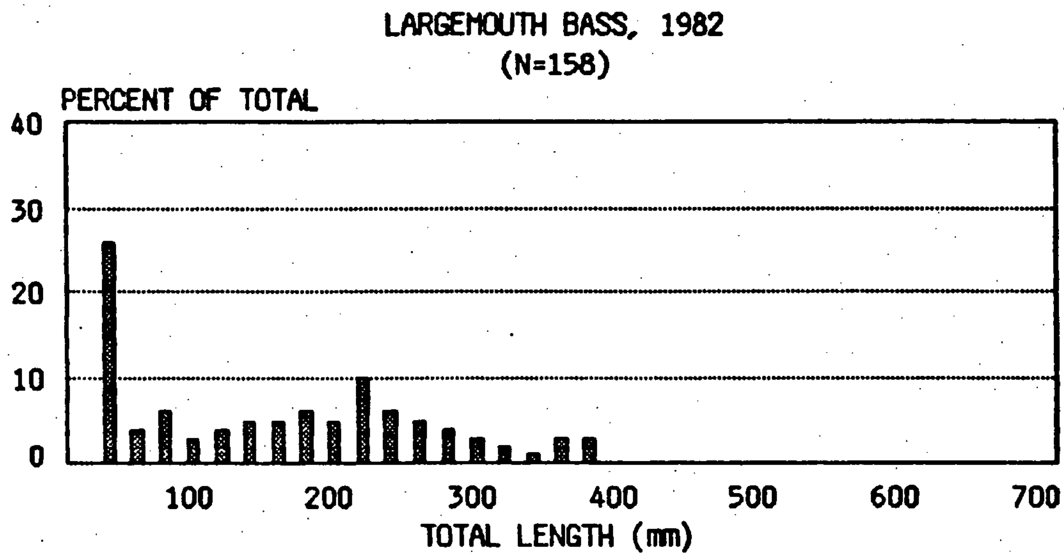




* - LESS THAN 1 % TOTAL CATCH

FIGURE 9. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF BLUEGILL COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

LENGTH FREQUENCY



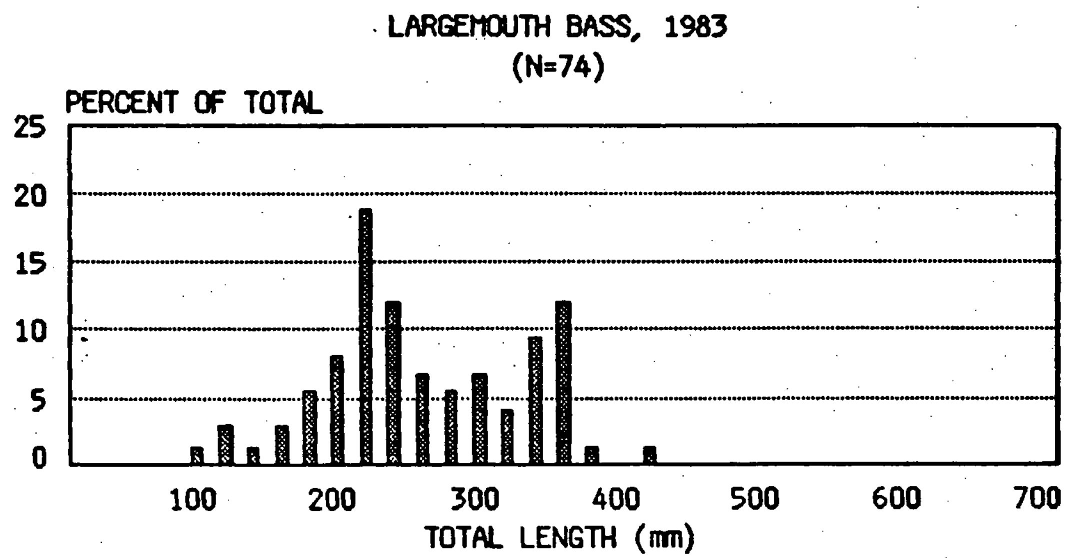


FIGURE 10. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF LARGEMOUTH BASS COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

tember 1983 appears in Figure 11. Due to an inadequate 1982 smallmouth bass catch, no comparison to these data could be made. Despite that fact, those data presented provide evidence of three year classes produced since inundation, and also those remaining pre-impoundment broodfish. Young-of-the-year smallmouth bass were found to be from 80-120 mm in September which was greater than the mean length (69 mm) observed for September YOY in Missouri but less than the average of 125 mm for Oklahoma October YOY (Carlander 1977).

No comparison was possible for white crappie (Pomoxis annularis) due to low 1982 catches. Those data presented in Figure 11 were from fish collected in April and May, 1983 in fyke nets. White crappie collected during that time period exhibited a definite year class at 250 mm with a second smaller grouping at 200 mm. The spike at 250 mm represented the 1981 year class while those fish near 200 mm were produced in 1982.

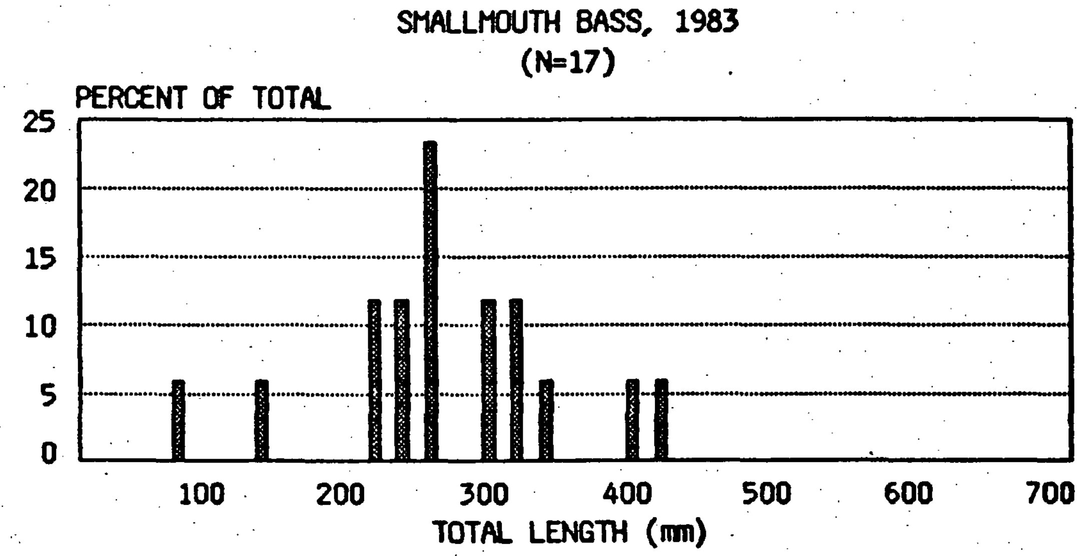
Figure 12 presents the length frequency histograms for black crappie in 1982 and 1983. As with gizzard shad, the inadequate spring 1982 black crappie catch necessitated presentation of fall data. When compared to the spring 1983 catch only limited growth was evident, as expected.

The WCCL walleye length frequency histograms for 1982 and 1983 appear in Figure 13. These data reflected a 1982 year class (I+) and 1983 YOY while walleye stocked in 1981 were absent or overlapped with larger members of the more numerous 1982 class. The poor representation of 1981 walleye (age II+) in fall collections was consistent with the mediocre success of this class previously identified (Ecological Analysts, Inc. 1983).

The condition of WCCL species was evaluated through the use of two computational methods, (Wr) and K_{TL}. In light of the advantages of (Wr), values for selected species have been presented and are discussed while K_{TL} data have been provided in Appendix B as a reference.

The (Wr) values of WCCL gizzard shad for April and October are presented in Table 17. These data indicated the condition of WCCL gizzard shad was below the 90-100 range. Although Anderson (1973) stated (Wr) values of greater than 100 indicated the desirable inverse relationship of young and adults, questions have been raised as to whether Kansas gizzard shad populations exhibit this pattern (David W. Willis, personal communication). Environmental effects have been postulated to override those factors responsible for the high (Wr) values described by Anderson (1973). Regardless, 1983 (Wr) values were within the range frequently observed in Kansas reservoirs (David W. Willis, personal communication), and were not thought to indicate an out-of-balance or over-exploited condition. Rather, these (Wr) values were thought to be consistent with the desirable inverse relationship of Anderson (1973), as modified by

LENGTH FREQUENCY



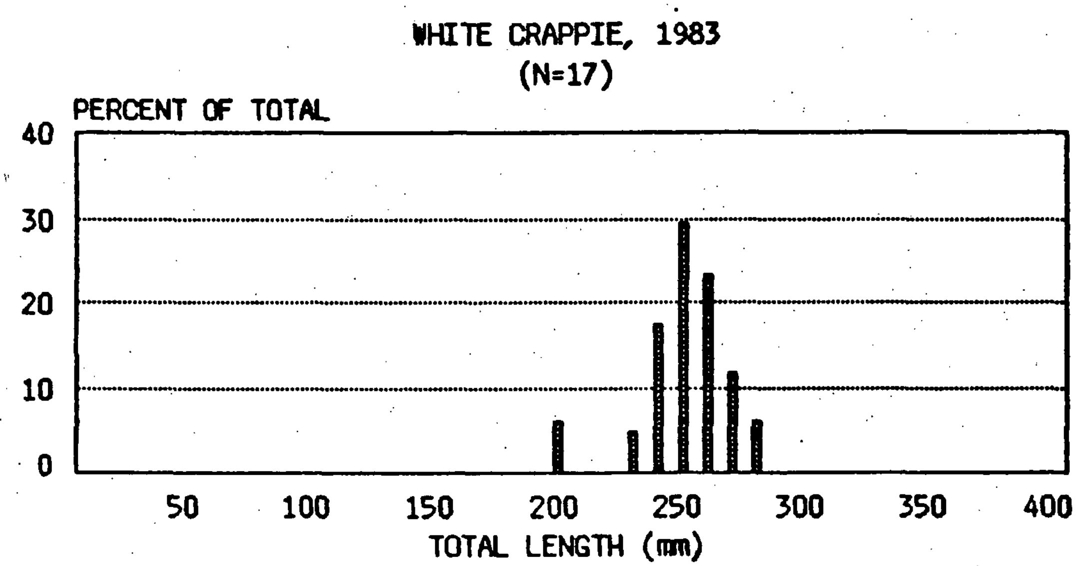
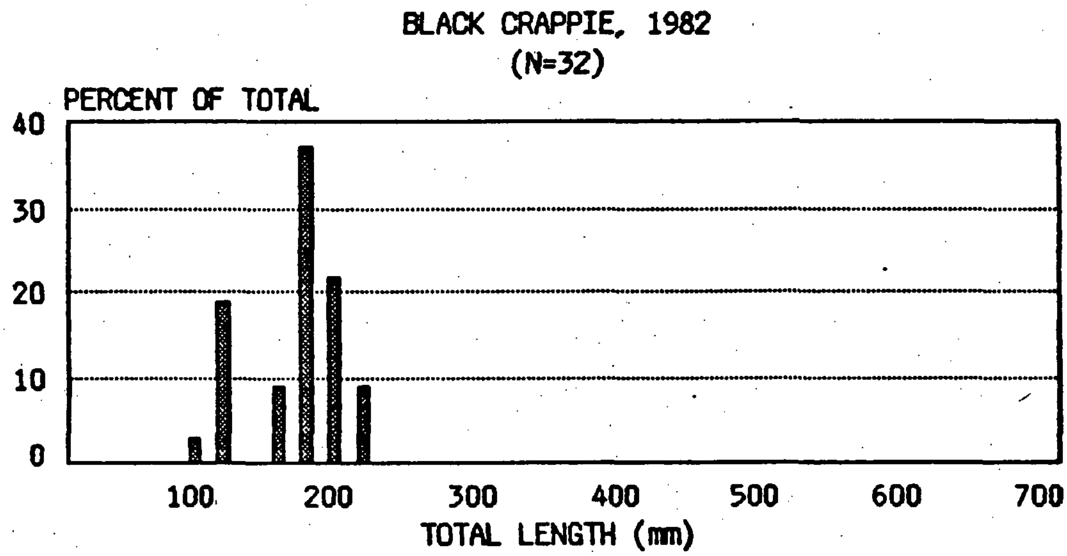


FIGURE 11. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF SMALLMOUTH BASS AND WHITE CRAPPIE COLLECTED FROM WOLF CREEK COOLING LAKE, 1983.

LENGTH FREQUENCY



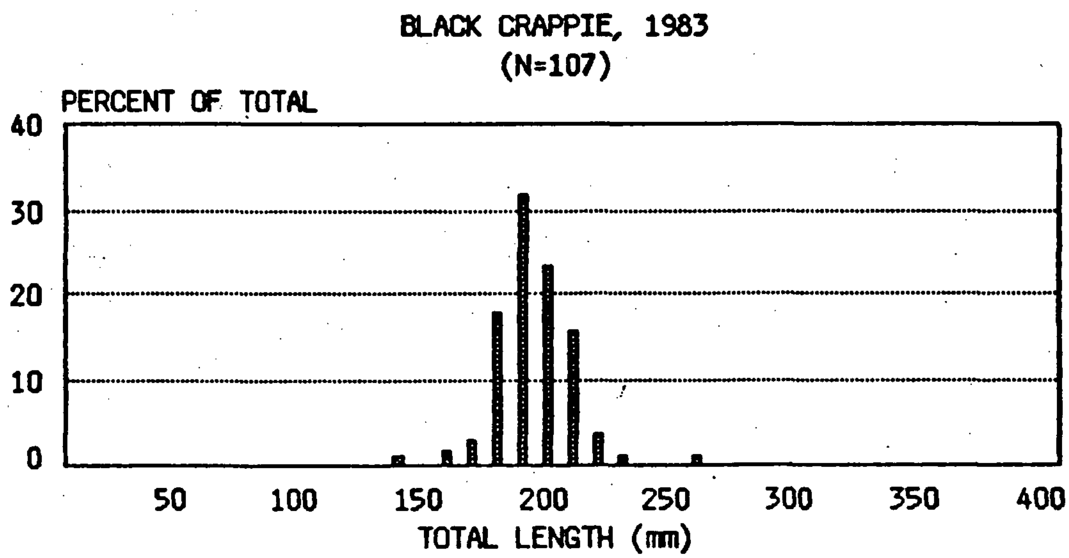
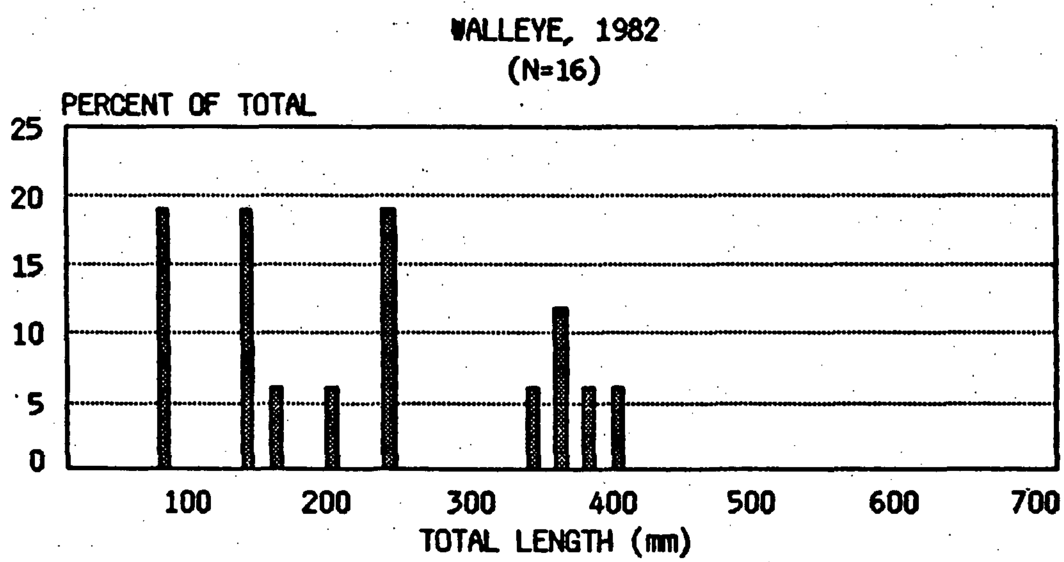


FIGURE 12. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF BLACK CRAPPIE COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

LENGTH FREQUENCY



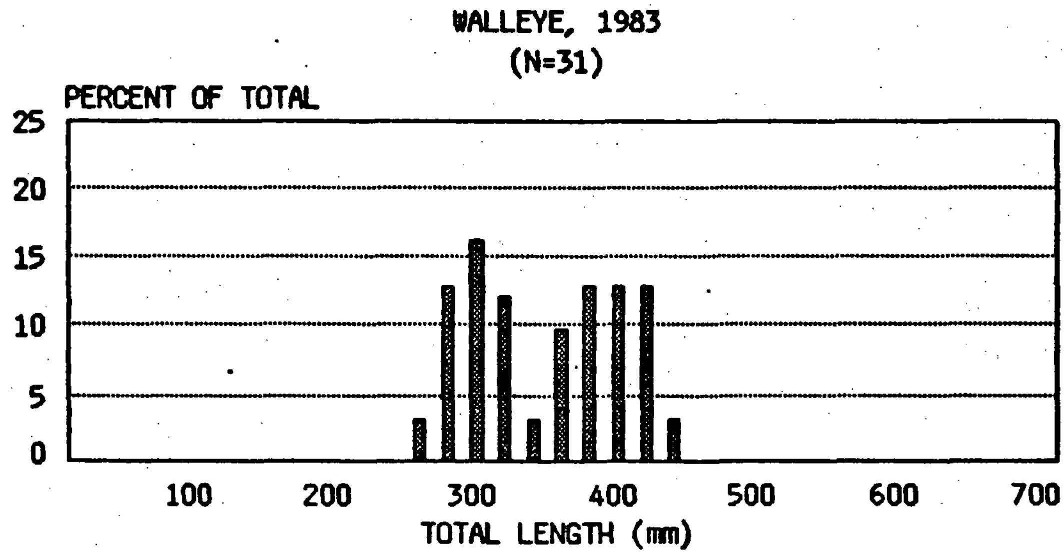


FIGURE 13. LENGTH-FREQUENCY DISTRIBUTIONS (PERCENT) OF WALLEYE COLLECTED FROM WOLF CREEK COOLING LAKE, 1982 - 1983.

TABLE 17. RELATIVE WEIGHT ($\underline{Wr}$) VALUES OF WOLF CREEK COOLING LAKE GIZZARD SHAD FOR SELECTED MONTHS, 1983.

CATEGORY	APRIL	MAY	JUNE	JULY	SEPT.	OCTOBER
STOCK (180-279 mm)						
$\overline{X}$	74.7	-	-	-	-	86.0
Range	58.7-89.5	-	-	-	-	70.0-103.7
N	50	-	-	-	-	37
QUALITY (>280 mm)						
$\overline{X}$	66.0	-	-	-	-	83.9
Range	56.2-78.8	-	-	-	-	76.6-96.6
N	3	-	-	-	-	4
MONTHLY $\overline{X}$	74.2	-	-	-	-	85.8
MONTHLY RANGE	56.2-89.5	-	-	-	-	70.0-103.7
TOTAL N	53	-	-	-	-	41

Kansas conditions (David W. Willis, personal communication).

Bluegill (Wr) data for 1983 appear in Table 18. These data illustrate the monthly variability of the bluegill size classes for 1983. A definite increase in mean (Wr) was apparent during the June and July spawning period, followed by lower averages for September and October. This cycle follows the bluegill pattern reported for other indices of condition (Bennett 1948 and Bennett 1970). The late summer and early fall (Wr) means fell close to the 95-100 range cited as optimal by Wege and Anderson (1978).

Relative Weight data for WCCL smallmouth bass appears in Table 19. Although the small sample size for this species precludes extensive analysis, WCCL smallmouth bass mean (Wr) values were found to be in the upper nineties.

As with bluegill, extensive largemouth bass collections permitted monthly (Wr) trend analysis (Table 20). Largemouth bass monthly (Wr) averages also exhibited a distinct cycle. Although this cycle was possibly reflective of the pre-spawn to post-spawn change in condition, Bennett (1970) states that largemouth bass do not show a seasonal cycle of plumpness, and cites Cooper et al. (1963) as having found evidence that largemouth bass condition changes rather sudddenly with changing feeding conditions. Despite this variability, largemouth bass mean (Wr) values were within the desirable 90-100 range thoughout 1983 which indicated a population in the balanced category of Wege and Anderson (1978).

Black crappie (Wr) values did not exhibit as great a variability as some other species (Table 21). This lack of (Wr) variability was not easily explained but was thought to reflect the delayed stocking of the 1981 year class which placed this species behind large numbers of previously stocked predators.

In addition to those species for which monthly (Wr) data have been presented, (Wr) data were compiled from a single month for two other species. Channel catfish and white crappie (Wr) values were calculated from October catch data (Table 22). For both species (Wr) values were near 90 for the total monthly mean. Channel catfish values in this range were thought satisfactory while a small white crappie sample size precluded meaningful discussion.

The length-weight relationship equations were calculated for selected species as a final step in the evaluation of WCCL fish condition (Table 23). As a group, these equations were similar to 1982 data (Ecological Analysts, Inc. 1983). Length-weight relationships for these species represented normal growth patterns.

Structural Indices and Comparative Data

Structural indices have been shown to be effective fishery manage-

TABLE 18. RELATIVE WEIGHT (Wr) VALUES OF WOLF CREEK COOLING LAKE BLUEGILL FOR SELECTED MONTHS, 1983.

CATEGORY	APRIL	MAY	JUNE	JULY	SEPT.	OCTOBER
STOCK (80–149 mm)						
$\bar{X}$	91.6	86.5	121.8	103.6	90.1	70.9
Range	81.1–114.0	61.5–112.3	91.7–167.6	88.2–133.3	48.5 124.2	57.6–80.6
N	17	32	11	5	12	3
QUALITY (150–199 mm)						
$\bar{X}$	85.3	95.0	106.7	99.4	86.4	77.9
Range	48.3–102.1	82.8–124.9	43.3–140.1	82.8–116.9	81.5–92.6	70.8–85.0
N	69	17	25	12	11	2
PREFERRED (200–249 mm)						
$\bar{X}$	–	–	–	104.2	–	–
Range	–	–	–	–	–	–
N	–	–	–	1	–	–
MEMORABLE (250–299 mm)						
$\bar{X}$	–	–	–	–	–	–
Range	–	–	–	–	–	–
N	–	–	–	–	–	–
TROPHY (>300 mm)						
$\bar{X}$	–	–	–	–	–	–
Range	–	–	–	–	–	–
N	–	–	–	–	–	–
MONTHLY $\bar{X}$	86.6	89.4	111.3	100.8	88.4	73.6
MONTHLY RANGE	48.3–114.0	61.5–124.9	43.3–167.6	82.8–133.3	48.5–124.2	57.6–85.0
TOTAL N	86	49	36	18	23	5

TABLE 19. RELATIVE WEIGHT ($\overline{Wr}$) VALUES OF WOLF CREEK COOLING LAKE SMALLMOUTH BASS FOR SELECTED MONTHS, 1983.

CATEGORY	APRIL	MAY	JUNE	JULY	SEPT.	OCTOBER
STOCK (180-279 mm)						
$\bar{X}$	-	-	97.7	-	97.9	-
Range	-	-	87.2-104.0	-	87.4-142.3	-
N	-	-	5	-	8	-
QUALITY (280-349 mm)						
$\bar{X}$	-	-	-	-	92.6	-
Range	-	-	-	-	87.3-96.4	-
N	-	-	-	-	3	-
PREFERRED (350-429 mm)						
$\bar{X}$	-	-	-	-	91.0	-
Range	-	-	-	-	79.0-101.1	-
N	-	-	-	-	3	-
MEMORABLE (430-509 mm)						
$\bar{X}$	-	-	-	-	-	-
Range	-	-	-	-	-	-
N	-	-	-	-	-	-
TROPHY (>510 mm)						
$\bar{X}$	-	-	-	-	-	-
Range	-	-	-	-	-	-
N	-	-	-	-	-	-
MONTHLY $\bar{X}$	-	-	97.7	-	95.3	-
MONTHLY RANGE	-	-	87.2-104.0	-	79.0-142.3	-
TOTAL N	-	-	5	-	14	-

TABLE 20. RELATIVE WEIGHT ($\overline{Wr}$) VALUES OF WOLF CREEK COOLING LAKE LARGEMOUTH BASS FOR SELECTED MONTHS, 1983.

CATEGORY	APRIL	MAY	JUNE	JULY	SEPT.	OCTOBER
STOCK (200–299 mm)						
$\bar{X}$	91.7	89.3	87.3	92.9	92.4	97.8
Range	77.5–103.8	76.3–102.7	62.0–110.7	91.7–94.2	71.3–106.5	82.0–125.3
N	10	6	35	2	28	21
QUALITY (300–379 mm)						
$\bar{X}$	136.9	108.8	101.3	98.9	93.1	93.3
Range	136.0–137.8	90.8–137.4	87.5–115.3	88.6–112.6	81.3–108.6	83.9–116.4
N	2	13	12	16	12	7
PREFERRED (380–509 mm)						
$\bar{X}$	161.7	–	125.1	–	90.0	118.1
Range	–	–	102.9–147.2	–	53.1–111.7	–
N	1	–	2	–	8	1
MEMORABLE (510–629 mm)						
$\bar{X}$	137.6	–	–	–	–	–
Range	–	–	–	–	–	–
N	1	–	–	–	–	–
TROPHY (>630 mm)						
$\bar{X}$	–	–	–	–	–	–
Range	–	–	–	–	–	–
N	–	–	–	–	–	–
MONTHLY $\bar{X}$	106.4	102.6	92.2	98.3	92.2	97.4
MONTHLY RANGE	77.5–161.7	76.3–137.4	62.0–147.2	88.6–112.6	53.1–111.7	82.0–125.3
TOTAL N	14	19	49	18	47	29

TABLE 21. RELATIVE WEIGHT ($\overline{Wr}$) VALUES OF WOLF CREEK COOLING LAKE BLACK CRAPPIE FOR SELECTED MONTHS, 1983.

CATEGORY	APRIL	MAY	JUNE	JULY	SEPT.	OCTOBER
STOCK (130–199 mm)						
$\bar{X}$	86.8	82.2	–	–	–	84.4
Range	68.3–140.4	75.7–89.7	–	–	–	62.5–95.6
N	45	14	–	–	–	11
QUALITY (200–249 mm)						
$\bar{X}$	82.9	85.8	–	–	–	90.7
Range	28.3–107.4	74.9–97.6	–	–	–	77.2–103.8
N	28	19	–	–	3	8
PREFERRED (250–229 mm)						
$\bar{X}$	–	98.9	–	–	–	–
Range	–	–	–	–	–	–
N	–	1	–	–	–	–
MEMORABLE (300–379 mm)						
$\bar{X}$	–	–	–	–	–	–
Range	–	–	–	–	–	–
N	–	–	–	–	–	–
TROPHY (>380 mm)						
$\bar{X}$	–	–	–	–	–	–
Range	–	–	–	–	–	–
N	–	–	–	–	–	–
MONTHLY $\bar{X}$	85.4	84.7	–	–	–	87.1
MONTHLY RANGE	28.3–140.4	74.7–98.9	–	–	–	62.5–103.8
TOTAL N	73	34	–	–	–	19

TABLE 22. RELATIVE WEIGHT (W_r) VALUES FOR SELECTED WOLF CREEK COOLING LAKE SPECIES COLLECTED IN 1983.

Species	Month		Stock	Quality	Catagories Preferred	Memorable	Trophy	Total
Channel catfish	Oct.		(240-409mm)	(410-609mm)	(610-709mm)	(710-909mm)	(>910mm)	
		$\overline{X}$	84.1	90.0	88.1	-	-	89.0
		Range	76.1-95.0	39.4-176.1	-	-	-	39.4-176.1
		N	8	40	1	-	-	49
White crappie	Oct.		(130-199mm)	(200-249mm)	(250-299mm)	(300-379mm)	(>380mm)	
		$\overline{X}$	99.0	79.4	-	-	-	89.2
		Range	87.1-108.7	75.2-82.5	-	-	-	75.2-108.7
		N	3	3	-	-	-	6

ment tools which facilitate population categorization (Anderson and Weithman 1978, Anderson 1980 and Gablehouse 1983). The use of structural indices in the interpretation of reservoir fisheries data, however, has lagged behind small impoundment application of these tools. Proportional Stock Density (PSD) and Relative Stock Density (RSD) values for selected WCCL species were calculated from discreet data sets. These calculations were performed to permit comparisons of the relative quality of the WCCL fishery, within the constraint of the existing literature (Table 24).

The PSD value in 1983 for WCCL gizzard shad was 10. While some disagreement exists as to cause of Kansas shad PSD values in this range, the author feels that this value was indicative of the desirable low to intermediate adult biomass range of Anderson (1973). Further, observed PSD and RSD values for predator species reflected a division of importance. Largemouth bass PSD and RSD values were comparable to the range recommended by Anderson (1978) where gizzard shad is a dominant prey species. Although cited for small impoundments, Gablehouse (1983) lists largemouth bass PSD and RSD values similar to those observed in 1983 for WCCL largemouth bass as representing values for a population of moderate density with largemouth bass as one of several species of equal importance in a balanced community. Bluegill PSD and RSD values in 1983 were also within cited desirable ranges for small impoundments. Novinger and Legler (1978) stated that equilibrium PSD values range from 20-60 but that bluegill PSD values of 40-60 provide sustained high quality bluegill utilization. Novinger and Legler elaborated that these elevated bluegill PSD values produced less than optimal largemouth bass populations. However, bluegill PSD values in this range may not prove detrimental to WCCL largemouth bass due to a variety of factors, such as enhanced largemouth bass recruitment in cooling impoundments (Electric Power Research Institute 1979).

Generalizations regarding PSD and RSD values for other species in Table 24 were difficult due to the lack of reservoir PSD and RSD data for these species. However, overall WCCL PSD and RSD values show a reservoir fishery with good numbers of individuals of several species capable of progressing to larger size categories. This trend resulted from management strategies used in the stocking program, and is expected to continue barring the onset of forage production problems.

In addition to the use of structural indices, qualitative means were utilized to facilitate comparisons of WCCL. Tables 25 and 26 present statewide largemouth bass stock plus catch rates and rankings based on these catch rates. Although impoundments of a wide variety of water quality, morphological, and age types are presented, WCCL ranks well. The favorable ranking of WCCL was valid, particularly when viewed with other similar impoundments such as Big Hill, Clinton, El Dorado, Hillsdale, La Cygne, Melvern, and Milford.

TABLE 23. LENGTH-WEIGHT RELATIONSHIPS FOR SELECTED WOLF CREEK COOLING LAKE SPECIES COLLECTED IN 1983.

Species	N	Month(s)	Length-Weight Relationship	Coef. of Correlation
Gizzard shad	53	Apr.	Log W = -4.79 + 2.85 LogTL	r = 0.96
Channel catfish	49	Oct.	Log W = -5.41 + 3.13 LogTL	r = 0.61
Bluegill	23	Sept.	Log W = -4.77 + 3.02 LogTL	r = 0.97
Smallmouth bass	14	Sept.	Log W = -4.77 + 2.96 LogTL	r = 0.98
Largemouth bass	49	June	Log W = -6.66 + 3.73 LogTL	r = 0.99
Black crappie	73	Apr.	Log W = -3.30 + 2.31 LogTL	r = 0.33

TABLE 24. PROPORTIONAL STOCK DENSITY (PSD) AND RELATIVE STOCK DENSITY (RSD) VALUES FOR SELECTED WOLF CREEK COOLING LAKE SPECIES.

	DATA SET			TRADITIONAL				INCREMENTAL[(A)]			
SPECIES	GEAR	MONTH(S)	N	PSD	RSD-P	RSD-M	RSD-T	RSD,S-Q	RSD,Q-P	RSD,P-M	RSD,M-T
Gizzard shad	Gill Net	Oct.	42.0	10	—	—	—	90	10	—	—
Gizzard shad	Gill Net	Oct.	–[(B)]	9	—	—	—	91	9	—	—
Common carp	Fyke Net	Apr.–May	33.0	52	—	—	—	48	52	—	—
Channel catfish	Gill Net	Oct.	49.0	84	—	—	—	16	82	2	—
White bass	Gill Net	Oct.	90.0	98	48	9	—	2	50	39	9
Wiper	Gill Net	Oct.	93.0	100	95	—	—	5	95	—	—
Bluegill	Fyke Net	Apr.–May	141.0	64	—	—	—	36	64	—	—
Largemouth bass	Electro-fish	May – June	64.0	41	3	—	—	59	38	3	—
Largemouth bass	Electro-fish	Sept.	47.0	43	17	—	—	57	26	17	—
Smallmouth bass	Electro-fish	Sept.	15.0	47	20	—	—	53	27	20	—
White crappie	Fyke Net	Apr.–May	17.0	100	71	—	—	—	29	71	—
Black crappie	Fyke Net	Apr.–May	107.0	45	1	—	—	55	44	1	—
Walleye	Gill Net	Oct.	31.0	42	—	—	—	58	42	—	—
Walleye	Gill Net	Oct.	–[(B)]	36	—	—	—	64	36	—	—

(A) Computational methods per Gablehouse (1983).
(B) Corrected data based on gill net catch efficiencies per Willis et al. (1983).

TABLE 25. STATEWIDE SPRING LARGEMOUTH BASS ELECTROFISHING CATCH DATA.

IMPOUNDMENT	MEAN HOURS EFFORT	MEAN STOCK + CATCH	MEAN STOCK +/ HOUR	MEAN PSD	MEAN RSD-P	MEAN RSD-M	YEARS INCLUDED
Big Hill	2.3	75.0	33.3	61	12	0	83
Clinton	3.4	89.0	32.2	74	20	1	81, 82, 83
El Dorado	2.3	59.0	25.7	54	2	0	83
Elk City	4.8	106.5	23.1	68	35	0	80, 81
Fall River	8.7	95.5	13.2	52	30	2	81, 83
Glen Elder	13.3	72.0	5.4	82	49	2	81
Hillsdale	1.8	48.0	26.2	19	4	0	83
La Cygne	1.7	114.0	87.7	59	22	0	81, 82, 83
Melvern	12.3	142.0	11.5	73	38	4	81
Milford	20.6	99.0	4.8	71	42	1	81
Norton	2.6	54.0	20.7	61	35	0	81, 82
Perry	17.2	120.5	6.9	45	28	5	80,81,82,83
Wolf Creek	2.2	62.0	28.2	41	3	0	83
Wolf Creek[A]	1.2	60.0	50.0	43	17	0	83
Mean of Means	6.7	85.5	26.4	57.4	24.1	1.1	

[A] Data from Wolf Creek September 1983 collections, performed after electrofishing unit repairs which improved performance to a level closer to Kansas Fish and Game electrofishing units.

TABLE 26. RANKING OF KANSAS IMPOUNDMENTS BY STOCK + LARGEMOUTH BASS CATCH RATES

IMPOUNDMENT	MEAN STOCK +/HOUR	# OF YEARS IN MEAN
1. LaCygne	87.7	3
2. Wolf Creek(A)	50.0	1
3. Big Hill	33.3	1
4. Clinton	32.2	3
5. Wolf Creek	28.2	1
6. Hillsdale	26.2	1
7. El Dorado	25.7	1
8. Elk City	23.1	2
9. Norton	20.7	2
10. Fall River	13.2	2
11. Melvern	11.5	1
12. Perry	6.9	4
13. Glen Elder	5.4	1
14. Milford	4.8	1

(A) Data from Wolf Creek September 1983 collections, performed after electrofishing unit repairs which improved performance to a level closer to Kansas Fish and Game electrofishing units.

Note: Catch rates from impoundments with a wide variety of water quality, morphological, and maturity types appear in this table. Therefore, comparisons of these catch rates should be made with consideration of these factors.

Wolf Creek Cooling Lake was also compared to other regional lakes in terms of relative biomass abundances (Table 27) and relative abundances (Table 28). The cooling lake compared favorably in terms of the minimal number of high ranking roughfish species and the relatively high number of prominent predator species exhibited.

TABLE 27. COMPARISON OF RELATIVE BIOMASS ABUNDANCES FOR SELECTED MID-WESTERN RESERVOIRS.

	RESERVOIRS					
SPECIES	Clinton (Ill.) (1981 ha) (A)	Shelbyville (Ill.) (4452 ha) (B)	Spence (Tex.) (6000 ha) (C)	Marion (Ks.) (2510 ha) (D)	Perry (Ks.) (4950 ha) (D)	Wolf Creek (Ks.) (2060 ha) (E)
Shortnose gar	—	—	—	—	—	—
Bowfin	—	3.7	—	—	—	—
Gizzard shad	5.8	38.2	32.8	31.3	31.1	3.7
Northern pike	—	—	—	2.4	—	—
Tiger musky	11.7	—	—	—	—	—
Common carp	43.3	25.7	22.1	51.2	31.7	14.4
Hornyhead chub	—	—	—		—	—
Golden shiner	—	—	—	0.3	—	0.1
Emerald shiner	—	—	—	—	—	—
Red shiner	—	—	—	0.2	—	<0.1
Redfin shiner	—	—	—	—	—	—
Ghost shiner	—	—	—	—	—	<0.1
Fathead minnow	—	—	—	—	—	<0.1
River carpsucker	—	1.4	8.9	5.8	7.2	—
Quillback	4.4	—	—	—	—	—
Highfin carpsucker	—	—	—	—	—	—
Smallmouth buffalo	—	—	—	—	0.4	1.3
Bigmouth buffalo	—	2.0	—	—	0.6	0.2
Black buffalo	—	—	—	—	—	—
Golden redhorse	2.1	—	—	—	—	—
Shorthead redhorse	1.7	—	—	—	—	—
Black bullhead	—	—	—	0.5	—	20.2
Yellow bullhead	—	0.4	—	—	—	<0.1
Channel catfish	—	—	5.1	<0.1	6.3	9.4
Flathead catfish	—	—	—	—	5.4	—
Blackstripe topminnow	—	—	—	<0.1	—	—
Brook silverside	—	—	—	<0.1	—	<0.1
White bass	—	3.3	—	0.5	—	8.2
Striped bass	—	—	—	—	0.4	0.3
Striped X white bass hybrid	—	—	—	—	—	14.1
Green sunfish	0.8	0.4	—	0.4	0.7	1.1
Orangespotted sunfish	—	—	—	0.2	—	<0.1
Bluegill	2.2	3.1	4.8	0.2	3.5	2.7
Hybrid sunfish	—	—	—	—	—	0.1
Longear sunfish	—	0.9	—	<0.1	—	—
Smallmouth bass	—	—	—	—	—	1.4
Largemouth bass	7.4	6.1	2.1	2.2	0.8	13 0
White crappie	2.2	1.1	2.0	0.3	5.6	0.8
Black crappie	—	—	—	<0.1	—	5.0
Logperch	—	—	—	<0.1	—	<0.1
Slenderhead darter	—	—	—	—	—	—
Walleye	12.1	6.3	—	0.2	—	2.2
Freshwater drum	—	2.0	17.4	3.3	6.2	1.4
Other taxa	—	—	4.8	0.1	<0.1	0.3
% of Total Biomass	93.7	94.5	100.0	>99.1	>99.9	100.0
Total # of Species	11	14	>9	22	14	27

(A) Data from Illinois Power Company (1982) (spring quarter 1980 collections).
(B) Data from Electric Power Research Institute (1979).
(C) Data from Crandall (1978) (August, 1978 cove rotenone sample).
(D) Data from D.W. Willis personal communication (Marion; August, 1975 cove rotenone sample and Perry; 1982 cove rotenone sample).
(E) Data from present study representing total annual biomass.

TABLE 28. COMPARISON OF RELATIVE ABUNDANCES FOR SELECTED MID-WESTERN RESERVOIRS.

SPECIES	RESERVOIRS Clinton (Ill.) (1981 ha) (A)	Shelbyville (Ill.) (4452 ha) (B)	Southerland (Neb.) (1080 ha) (C)	LaCygne (Ks.) (1050 ha) (D)	Perry (Ks.) (4950 ha) (E)	Wolf Creek (Ks.) (2060 ha) (F)
Shortnose gar	-	0.1	-	-	-	-
Bowfin	-	2.7	-	-	-	-
Gizzard shad	25.9	25.2	62.0	4.1	73.5	17.2
Tiger musky	1.3	-	-	-	-	-
Common carp	27.6	32.0	3.0	27.0	3.0	1.4
Golden shiner	-	-	-	<0.1	-	0.9
Red shiner	-	-	-	-	-	5.7
Ghost shiner	-	-	-	-	-	0.4
Fathead minnow	-	-	-	-	-	<0.1
Carpiodes spp.	-	-	3.0	-	-	-
River carpsucker	-	1.1	-	<0.1	0.9	-
Quillback	2.2	1.1	-	-	-	-
Highfin carpsucker	-	0.1	-	-	-	-
White sucker	-	-	8.0	<0.1	-	-
Smallmouth buffalo	-	0.2	-	-	-	0.2
Bigmouth buffalo	-	3.1	-	0.8	0.1	<0.1
Black buffalo	-	0.7	-	-	-	-
Golden redhorse	1.5	-	-	<0.1	-	-
Shorthead redhorse	1.2	0.8	-	-	-	-
Blue catfish	-	-	-	-	-	<0.1
Black bullhead	-	0.5	1.0	6.9	<0.1	21.4
Yellow bullhead	-	0.2	-	0.7	-	<0.1
Channel catfish	-	2.6	4.0	<0.1	0.6	1.1
Flathead catfish	-	0.2	-	-	<0.1	-
Blackstripe topminnow	-	<0.1	-	-	-	-
Brook silverside	-	0.2	-	-	-	1.7
Morone spp.	-	-	-	-	-	<0.1
White bass	-	3.5	1.0	-	0.6	3.0
Striped bass	-	-	-	-	-	0.1
Striped X white bass hybrid	-	-	-	-	<0.1	1.8
Centrarchidae spp.	-	-	-	-	-	0.5
Lepomis spp.	-	-	-	-	-	14.9
Green sunfish	5.3	0.8	-	1.8	2.0	2.8
Orangespotted sunfish	-	-	3.0	<0.1	0.2	0.4
Bluegill	14.9	2.9	-	22.5	7.8	10.6
Hybrid sunfish	-	-	-	0.4	-	0.2
Longear sunfish	-	0.9	-	-	-	-
Micropterus spp.	-	-	-	-	-	0.1
Smallmouth bass	-	-	-	-	-	0.6
Largemouth bass	6.8	5.6	-	1.4	0.4	4.9
Pomoxis spp.	-	-	-	-	-	<0.1
White crappie	3.3	2.3	-	32.4	5.2	1.0
Black crappie	-	1.0	-	1.8	-	6.6
Logperch	-	-	-	-	-	0.2
Yellow perch	-	-	9.0	-	-	-
Walleye	4.6	10.6	2.0	-	3.6	0.6
Freshwater drum	-	1.5	-	<0.1	-	1.6
Other taxa	-	-	-	-	<2.1	-
% of Total	94.6	100.0	96.0	100.0	100.0	100.0
Total # of Species	>11	26	>11	18	>16	27

(A) Data from Illinois Power Company (1982) (spring quarter 1980 collections).
(B) Data from Electric Power Research Institute (1979) (electrofishing, seine, and gill net collections).
(C) Data from R.G. King, personal communication (average annual species abundance, 1979 - 1983).
(D) Data from Triplett (1976) (total relative abundance, Nov. 1971 - Oct. 1974).
(E) Data from D.W. Willis, personal communication (1982 cove rotenone sample).
(F) Data from present study representing total annual relative abundance.

CONCLUSIONS

Fishery monitoring in WCCL and the Neosho River resulted in the collection of 7771 fish representing 10 families and 32 species. Neosho River surveys verified the continued occurrence of the blue sucker below John Redmond Reservoir in the vicinity of the MUSH as well as the Neosho madtom near the Wolf Creek confluence.

Wolf Creek Cooling Lake surveys revealed a total of 5350 fish from nine families and 32 taxa. Of these taxa, five new species were recorded while two species previously collected were not observed in 1983. Seven species comprised nearly 82% of the total WCCL catch. In order of decreasing catch frequency these species were black bullhead (22.2%), gizzard shad (17.8%), Lepomis spp. (15.5%), bluegill (11.0%), black crappie (6.9%), red shiner (4.4%), and largemouth bass (4.1%). Compared to the seven species which dominated in terms of catch frequency, six species totaled nearly 78% of total collected biomass. By relative biomass common carp ranked first at 19.6% followed by wiper (16.4%), largemouth bass (13.8%) channel catfish (11.4%), white bass (8.5%) and black bullhead (8.0%). Importantly, four of these six species were predator species, while one was a panfish, and only the remaining species fell into the roughfish category.

The growth of WCCL fishes continued in 1983, although at a slower rate than observed in 1982. Total growth for several species was similar to published ranges while growth of largemouth bass, channel catfish, and wipers remained above average. The condition of WCCL fish was evaluated through the use of Relative Weight (Wr) calculations. Mean (Wr) values for smallmouth bass and largemouth bass were within the 90-100 range cited as desirable while means for several other species fell close to 90.

Evaluations of the WCCL fishery through the use of structural indices also revealed satisfactory results. Largemouth bass Proportional Stock Density (PSD) and Relative Stock Density (RSD) values were comparable to the desirable range for systems with gizzard shad as a dominant prey species. Largemouth bass PSD and RSD values were also similar to those cited for a population of moderate density with largemouth bass as one of several species of equal importance in a balanced community.

Fishery monitoring on WCCL and the Neosho River revealed no detrimental effects resulting from WCGS construction. Cooling lake fishery data indicated that fishery management efforts prior to and following impoundment have resulted in a fishery which compares favorably with other Kansas and midwestern reservoirs. Extensive basin renovation efforts resulted in suppression of WCCL roughfish and enhanced gamefish populations. Relative abundance values, relative biomass values, and structural indices data reflected a desirable gamefish composition, as well as a low to intermediate gizzard shad biomass level.

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TABLE B-3. (CONT.)

SMALLMOUTH BASS

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND (K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT (g)	WEIGHT RANGE
APRIL	1	1.95	397	-	1220.0	-
JUNE	8	1.32	227	135-398	203.1	28- 760
JULY	2	1.26	248	245-250	190.0	185- 195
SEPT.	17	1.20	279	92-428	342.8	10-1150
OCT.	1	1.48	280	-	325.0	-
TOTAL N	29	ANNUAL MEAN 1.27	267	92-428	323.3	10-1220

LARGEMOUTH BASS

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND (K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT (g)	WEIGHT RANGE
APRIL	15	1.77	299	187-510	703.9	120-3200
MAY	22	1.45	294	124-370	457.3	20-1040
JUNE	63	1.27	266	106-501	341.7	12-2520
JULY	25	1.34	273	60-379	402.2	10- 920
SEPT.	50	1.38	296	135-430	409.6	36-1080
OCT.	26	1.37	290	207-418	366.9	138-1320
TOTAL N	201	ANNUAL MEAN 1.38	283	60-510	409.1	10-3200

WHITE CRAPPIE

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND (K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT (g)	WEIGHT RANGE
APRIL	2	2.70	242	200-283	332.5	305- 360
MAY	16	1.40	253	190-276	231.6	90-3450
OCT.	6	1.28	209	170-247	117.7	70- 166
TOTAL N	24	ANNUAL MEAN 1.48	241	170-283	211.5	70- 360

TABLE B-3. (CONT.)

BLACK CRAPPIE

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
MARCH	1	1.40	237	-	186.0	-
APRIL	73	1.37	196	143-235	102.6	46- 172
MAY	34	1.36	205	177-265	121.4	67- 300
JUNE	1	1.35	195	-	100.0	-
SEPT.	7	1.10	172	73-245	107.0	10- 240
OCT.	20	1.58	193	105-236	110.8	40- 221
TOTAL N	136	ANNUAL MEAN 1.38	197	73-265	109.3	10- 300

WALLEYE

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
MAY	1	0.85	269	-	166.0	-
SEPT.	3	0.85	391	320-438	536.7	280- 680
OCT.	31	0.85	360	276-442	418.6	205- 720
TOTAL N	35	ANNUAL MEAN 0.85	360	269-442	421.5	166- 720

FRESHWATER DRUM

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
APRIL	49	1.04	209	114-270	91.35	52- 190
MAY	3	1.03	203	189-212	86.00	70- 98
JUNE	1	0.81	201	-	66.00	-
JULY	1	1.12	261	-	200.00	-
OCT.	16	1.80	245	175-306	224.30	138- 324
TOTAL N	70	ANNUAL MEAN 1.21	218	114-306	122.7	52- 324

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Appendices for Preoperational

Phase Fishery Monitoring Report for

Wolf Creek Generating Station, 1983.

Appendix A

Water Quality Data

TABLE A-1. PHYSICAL MEASUREMENT RECORDED DURING FISH SURVEYS AT WOLF CREEK COOLING LAKE, 1983.

Date	Location	Gear	Water Temp (C°)	Secchi (M)	Turbidity (NTU)	Conductivity (µmhos/cm)	Depth (m)
11 APR	2	FK	8	0.3	24	-	-
	6	FK	6	1.0	4	-	-
12 APR	2	FK	10	0.3	30	-	-
	6	FK	8	1.3	4	-	-
12 MAY	2	FK	18	0.5	12	-	2.1
	6	FK	18	1.8	2	-	2.1
20 MAY	2	EF	19	0.3	23	350	0.6- 3.0
	6	EF	17	1.5	2	420	0.6- 6.1
26 MAY	2	SN	19	-	2	-	0- 1.2
	6	SN	19	-	2	-	0- 1.2
16 JUN	2	EF	20	0.5	16	290	0.6- 3.7
	6	EF	17	2.0	2	420	0.6- 3.0
15 JUN	2	OT	22	0.8	5	-	2.4- 3.7
	6	OT	22	1.8	2	-	1.5- 6.1
15 JUN	2	SN	22	0.8	5	-	0- 1.2
	6	SN	22	1.8	2	-	0- 1.2
23 JUN	2	SN	28	1.5	-	-	0- 1.2
	6	SN	24	2.0	-	-	0- 1.2
13 JUL	2	EF	29	1.0	6	360	0.6- 6.1
	6	EF	26	1.3	3	400	0.6- 3.0
13 JUL	2	OT	29	1.0	6	-	-
	6	OT	26	1.3	3	-	-
27 JUL	2	SN	27	-	4	-	0- 1.2
	6	SN	27	-	6	-	0- 1.2
11 AUG	2	SN	30	1.1	4	-	0- 1.2
	6	SN	26	1.7	2	-	0- 1.2
11 AUG	2	OT	30	1.1	4	-	1.5- 5.2
	6	OT	26	1.7	2	-	1.5- 6.7
12 SEP	2	SN	25	-	7	-	0- 1.2
	6	SN	24	-	2	-	0- 1.2
21 SEP	2	OT	19	-	3	-	1.2- 3.7
	6	OT	20	1.0	3	-	1.8- 4.6

TABLE A-1. CONT.

Date	Location	Gear	Water Temp (C°)	Secchi (M)	Turbidity (NTU)	Conductivity (µmhos/cm)	Depth (m)
26 SEP	2	EF	19	0.3	4	430	0.3- 3.0
	6	EF	16	1.1	2	420	0.3- 4.6
3 OCT	2	GN	20	1.0	5	-	2.4- 4.6
	6	GN	19	1.5	2	-	2.4- 4.3
	8	GN	20	1.1	3	-	2.4- 5.5
4 OCT	2	GN	20	0.7	7	-	2.7- 4.6
	6	GN	19	1.5	2	-	5.5-10.7
	8	GN	19	1.3	3	-	3.0- 6.1
26 OCT	2	OT	13	1.0	-	-	1.2- 3.4
	6	OT	14	1.3	-	-	2.1- 3.7
	8	OT	13	0.9	-	-	1.5- 8.5
28 OCT	2	SN	14	-	-	-	0- 1.2
	6	SN	13	1.2	-	-	0- 1.2
	8	SN	12	1.0	-	-	0- 1.2

Appendix B

Supplementary Fisheries Data

TABLE B-1. ANNUAL CATCH OF WCCL SPECIES BY GEAR TYPE WITHIN STANDARDIZED SAMPLING REGIME, 1983

SPECIES	GEAR (A) EF #	%	OT #	%	SN #	%	GN #	%	FK #	%	TOTAL #	%
Gizzard shad	75	18.7	360	28.2	226	20.9	40	7.3	216	11.9	917	17.8
Common carp	10	2.5	5	0.4	6	0.6	9	1.6	45	2.5	75	1.4
Golden shiner	12	3.0	—		31	2.8	—	—	7	0.4	50	1.0
Ghost shiner	—	—	—	—	2	0.2	—	—	—	—	2	<0.1
Red shiner	1	0.2	—	—	226	20.9	—	—	—	—	227	4.4
Smallmouth buffalo	3	0.7	—	—	—	—	7	1.3	—	—	10	0.2
Bigmouth buffalo	—	—	—	—	—	—	—	—	1	<0.1	1	<0.1
Black bullhead	19	4.7	—	—	5	0.5	190	34.4	928	51.0	1142	22.2
Yellow bullhead	1	0.2	—	—	—	—	—	—	1	<0.1	2	<0.1
Channel catfish	2	0.5	1	0.1	3	0.3	52	9.4	2	0.1	60	1.2
Brook silverside	4	1.0	—	—	88	8.2	—	—	—	—	92	1.8
White bass	4	1.0	1	0.1	31	2.8	81	14.7	17	0.9	134	2.6
Striped bass	—	—	—	—	—	—	3	0.5	1	<0.1	4	0.1
Wiper	—	—	—	—	2	0.2	77	13.9	2	0.1	81	1.6
Morone spp.	—	—	—	—	3	0.3	—	—	—	—	3	0.1
Centrarchidae spp.	—	—	24	1.9	—	—	—	—	—	—	24	0.5
Green sunfish	69	17.1	9	0.7	31	2.8	1	0.2	38	2.1	148	2.9
Orangespotted sunfish	5	1.2	—	—	14	1.3	—	—	—	—	19	0.4
Bluegill	59	14.6	55	4.3	236	21.8	5	0.9	212	11.7	567	11.0
Lepomis spp.	—	—	794	62.3	3	0.2	—	—	—	—	797	15.5
Hybrid sunfish	5	1.2	—	—	2	0.2	—	—	2	0.1	9	0.2
Micropterus spp.	—	—	5	0.4	—	—	—	—	—	—	5	0.1
Smallmouth bass	14	3.5	1	0.1	4	0.4	—	—	1	<0.1	20	0.4
Largemouth bass	100	24.8	10	0.8	59	5.5	23	4.2	19	1.0	211	4.1
Pomoxis spp.	—	—	3	0.2	—	—	—	—	—	—	3	0.1
White crappie	1	0.2	3	0.2	27	2.5	6	1.1	17	0.9	54	1.1
Black crappie	8	2.0	1	0.1	77	7.1	21	3.8	249	13.7	356	6.9
Logperch	3	0.7	1	0.1	4	0.4	—	—	—	—	8	0.2
Walleye	4	1.0	—	—	—	—	30	5.4	—	—	34	0.6
Freshwater drum	5	1.2	1	0.1	—	—	7	1.3	62	3.4	75	1.5
TOTAL FISH	404	100.0	1274	100.0	1080	100.0	552	100.0	1820	>99.8	5130	>99.9

(A) EF=Electrofishing, OT=Trawl, SN=Seine, GN=Gill Net, FK=Fyke Net.

TABLE B-2. PERCENT BIOMASS (kg) OF FISH SPECIES COLLECTED DURING ALL 1983 WCCL FISHERY SAMPLING

SPECIES	kg(A)	%
Black bulllhead	134.9	20.2
Common carp	96.1	14.4
Wiper	93.9	14.1
Largemouth bass	86.6	13.0
Channel catfish	62.8	9.4
White bass	54.5	8.2
Black crappie	33.5	5.0
Gizzard shad	24.5	3.7
Bluegill	18.3	2.7
Walleye	14.8	2.2
Freshwater drum	9.7	1.4
Smallmouth bass	9.4	1.4
Smallmouth buffalo	8.8	1.3
Green sunfish	7.4	1.1
White crappie	5.4	0.8
Striped bass	2.3	0.3
Bigmouth buffalo	1.6	0.2
Hybrid sunfish	0.8	0.1
Golden shiner	0.8	0.1
Other taxa	1.9	~0.3
TOTAL	668.0	~100.0

(A) Value represents biomass collected with all gear types, including supplemental efforts.

TABLE B-3. AVERAGE MONTHLY COEFFICIENT OF CONDITION (K_{TL}) FOR SELECTED WCCL SPECIES, 1983.

GIZZARD SHAD $K(_{TL})$

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
APRIL	95	0.83	185	92-350	54.8	10- 395
MAY	37	0.77	196	160-315	57.4	32- 192
JUNE	20	0.98	202	165-335	96.4	38- 410
JULY	18	0.98	212	196-231	93.2	65- 125
SEPT.	26	1.10	169	92-243	62.4	10- 150
OCT.	42	0.93	233	194-295	122.5	58- 260
TOTAL N	238	ANNUAL MEAN 0.89	197	92-350	74.4	10-410

COMMON CARP

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
MARCH	1	1.41	527	-	2060.0	-
APRIL	42	1.65	355	190-585	890.2	125-2900
MAY	6	1.56	477	336-532	1720.0	740-2320
JUNE	5	1.33	496	321-582	1762.0	450-2560
SEPT.	2	1.47	499	421-577	1910.0	1140-2680
OCT.	8	1.35	452	408-506	1285.0	880-2200
TOTAL N	64	ANNUAL MEAN 1.57	397	190-585	1136.0	125-2900

SMALLMOUTH BUFFALO

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
MARCH	2	2.10	204	204-204	178.0	130- 226
JUNE	1	1.75	455	-	1650.0	-
SEPT.	2	1.89	384	343-425	1095.0	780-1410
OCT.	5	1.85	349	342-434	914.0	730-1370
TOTAL N	10	ANNUAL MEAN 1.85	349	204-455	876.6	130-1650

TABLE B-3. (CONT).

BLACK BULLHEAD

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
APRIL	190	1.34	195	155–350	105.2	48– 510
MAY	32	1.39	216	162–348	177.9	58– 850
JUNE	9	1.55	201	176–238	135.3	83– 250
JULY	2	1.69	220	210–230	180.0	160– 200
SEPT.	6	1.42	225	209–245	164.5	125– 220
OCT.	83	1.39	207	177–345	127.7	74– 570
TOTAL N	322	ANNUAL MEAN 1.37	201	155–350	120.6	48– 850

CHANNEL CATFISH

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
APRIL	1	0.79	211	–	74.0	–
MAY	1	0.80	206	–	70.0	–
JUNE	7	1.05	468	418–510	1109.0	650–1580
SEPT.	1	0.97	515	–	1320.0	–
OCT.	52	0.89	469	240–628	1022.0	115–2350
TOTAL N	62	ANNUAL MEAN 0.90	461	206–628	1006.0	70–2350

WHITE BASS

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
MARCH	7	1.28	270	256–281	253.6	200– 300
APRIL	17	1.46	328	101–400	625.7	16–1080
MAY	2	1.08	306	259–352	337.0	174– 500
JUNE	1	1.14	309	–	335.0	–
SEPT.	2	1.26	300	295–304	337.5	310– 365
OCT.	90	1.29	309	200–451	395.0	162–1240
TOTAL N	119	ANNUAL MEAN 1.31	310	101–451	417.2	16–1240

STRIPED BASS

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
MARCH	1	1.09	318	–	350 0	–
APRIL	1	1.14	334	–	425.0	–
OCT.	2	1.07	414	410–418	760.0	720– 800
TOTAL N	4	ANNUAL MEAN 1.09	370	318–418	573.8	350– 800

TABLE B-3. (CONT).

WIPER

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
APRIL	1	1.37	394	-	840.0	-
MAY	1	1.35	388	-	790.0	-
JUNE	1	1.16	370	-	590.0	-
OCT.	93	1.30	416	320–495	955.6	320–1640
TOTAL N	96	ANNUAL MEAN 1.30	415	320–495	948.9	320–1640

GREEN SUNFISH

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
APRIL	17	1.68	138	67–298	44.88	12– 125
MAY	36	1.88	149	111–198	67.25	22– 174
JUNE	37	2.02	146	96–210	70.97	16– 255
JULY	3	1.97	157	149–173	77.00	65– 96
SEPT.	14	1.85	123	80–167	40.07	11– 94
OCT.	1	1.78	160	-	73.00	-
TOTAL N	108	ANNUAL MEAN 1.89	143	67–298	61.81	12– 255

BLUEGILL

MONTHS COLLECTED	MONTHLY N	MONTHLY $\bar{X}$ COND(K)	MEAN TL (mm)	TL RANGE (mm)	MEAN WEIGHT(g)	WEIGHT RANGE
APRIL	95	2.40	157	101–185	86.27	40– 178
MAY	49	1.96	137	92–182	56.47	10– 130
JUNE	14	2.14	155	75–180	91.86	10– 148
JULY	13	2.22	157	92–200	92.54	15– 195
SEPT.	29	1.82	117	36–177	44.55	10– 109
OCT.	5	2.68	156	130–187	91.20	50– 140
TOTAL N	205	ANNUAL MEAN 2.19	146	36–200	74.15	10– 195

28. Available information regarding trends in the Neosho River fish populations.

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

• Current and historic flow records for the Neosho River.

• A statement is made in the 5th paragraph of Enclosure 2 to WM 06-0046 (November 17, 2006) that the state of Kansas has not required entrainment monitoring and will not require it for the 316(b) determination. Please provide documentation from KDHE regarding this issue.

• Larval fish monitoring data as described in Paragraph 6 of Enclosure 2 to WM 06-0046 (November 17, 2006).

• If available, information on the location of the spawning areas for the various fish species in CCL.

• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

• Possible cold shock impacts to gizzard shad is mentioned in Section 2.2 of the ER (WCGS, 1990). If there have been any incidents of cold shock to gizzard shad or other fish, please provide supporting data.

• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

Audit needs

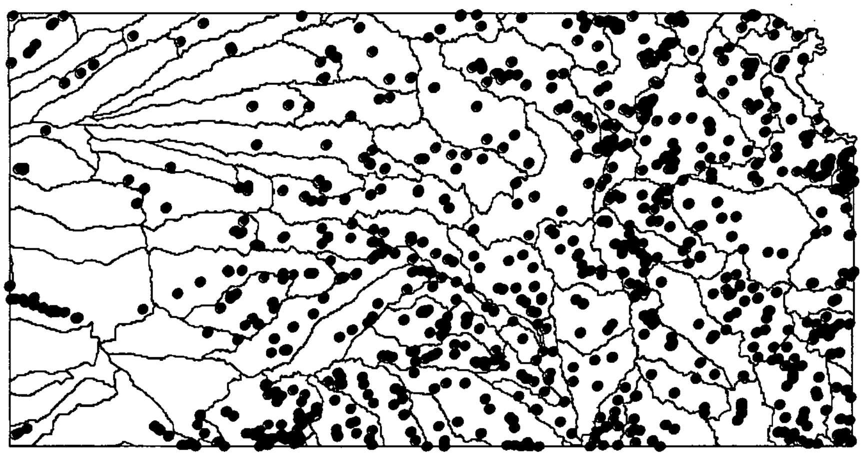
"Available information regarding trends in the Neosho River fish populations"

The Kansas Department of Wildlife and Parks has completed stream monitoring and assessments within Kansas, including the Neosho River Basin. Data summaries are available in "Kansas Department of Wildlife & Parks Stream Monitoring and Assessment Program Sub-watershed Report, February 2006." The title pages and applicable Neosho River Basin sections are attached for reference.

In addition, Neosho River fishery trends before and after operation of Wolf Creek Generating Station were assessed by WCNOC. A summary of the monitoring results is provided in EA, 1988, Operational Phase Environmental Monitoring Program Final Report.

Kansas Department of Wildlife & Parks
Stream Monitoring and Assessment Program
SUB-WATERSHED REPORT

February 2006



Prepared for:

Kansas Alliance for Wetlands and Streams
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KAWS

Prepared by:

KANSAS WILDLIFE & PARKS

Kansas Department of Wildlife & Parks
Environmental Services Section
Stream Monitoring and Assessment Program
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BACKGROUND

The data for this project was compiled from 1,117 Kansas Department of Wildlife and Parks (KDWP) stream assessment surveys from 1994 thru 2004.

The data was primarily evaluated using an Index for Biological Integrity (IBI). This method uses twelve metrics that combine many different biological factors from sampling fish. Expectation criteria are developed for each of these metrics and are assigned a score of zero thru ten. After the data is compiled and summarized, a final score is calculated, thus the IBI score. The higher the IBI score, the greater the stability exhibited by the fish community.

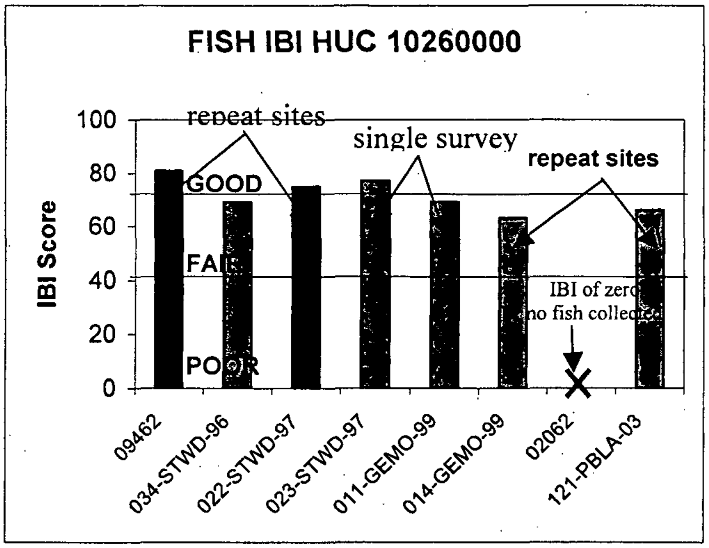
These metrics were based on weighted metrics from an IBI designed from an EPA Region 7 study.

- Total number of native fish species.
- Number of native family richness.
- Total number of individuals collected.
- Number of sensitive species.
- Proportion of tolerant individuals.
- Number of native benthic species
- Number of native water column species.
- Number of long-lived species
- Proportion of individuals of introduced species
- Proportion of individuals as carnivores.
- Proportion of individuals as insectivores and invertevores
- Proportion of individuals as omnivores and herbivores

What the IBI score represents regarding stability of the fish community:

- >=70 good
- 40-69.9 fair
- <40 poor

The colored IBI graph for each HUC represents the IBI score for each survey. The medium blue color bars represent one survey. Matching colored bars represent a repeat survey of same site location.



The abbreviation SINC, means Species In Need of Conservation by the Kansas Department of Wildlife and Parks.

The data was also evaluated through invertebrate samplings.

Macroinvertebrate Biotic Index (MBI):

- calculated using the following formula:

  MBI = (n * t)/N

  n = number of organisms within taxa
  t = tolerance rating of taxa

N= sum of number of individuals of rated taxa

Not all organisms collected in sample are used in MBI calculation. For example, few beetles and no hemipterans are used.

Taxa	*tolerance value*
Unionidae	1.5
Plecoptera	1.5
Other Ephemeroptera	3
Oligoneuriidae	3
Calopterygidae	3.5
Trichoptera (non-Hydropsychidae)	3.5
Heptageniidae	3.5
Megaloptera	3.5
Elmidae or Dryopidae	3.5
Amphipoda	4
Tipulidae	4
Baetidae	4
Turbellaria	4
Anisoptera	4.5
Hydropsychidae	4.5
Caenidae	4.5
Leptohyphidae	4.5
Potamanthidae or Ephemeridae	5
Pisidiidae	5
Cambaridae	5
Asellidae	5.5
Coenagrionidae	5.5
Simuliidae	6
Chironomidae (non-Chironomus)	6
Other Gastropoda	6
Planorbidae	6.5
Lymnaeidae	7
Physidae	9
Hirudinea	9
Other Diptera	10
Oligochaeta	10
Chironomus or red Chironomidae	11

The rating scale used to interpret MBI data is still under review and may be refined in the near future.

MBI Range

≤ ***4.5***: No impact from Nutrient and Oxygen demanding pollutants.

4.51 – 5.39: Moderate Impact

≥ ***5.4***: High Impact

This score will decrease in value as the health of a stream increases. This is converse to IBI values.

Insect richness:

- Number of individual species that are present at each site.
- Unknown species were not counted.

EPT:

- Proportion of individual Ephemeroptera, Plecoptera, and Trichoptera species out of the total number of individual species present.

Generally speaking, species richness is lower as you go west across the state. Changes in habitat availability (substrate, woody debris) and permanence of water affect species distributions. Many of the state's freshwater mussels, fishes and aquatic insects do not range into western Kansas.

IBI scores, richness values, and EPT scores are generally lower for the western streams because of the extreme conditions of the high plains. Because of this, streams should only be compared to other streams in the same area (or HUC, river basin). For instance, maximum IBI scores will not be the same for Cimarron River basin sites as for Neosho River basin sites. When interpreting EPT or insect richness values, compare numbers within the HUC. Higher values are generally indicative of higher quality stream sites.

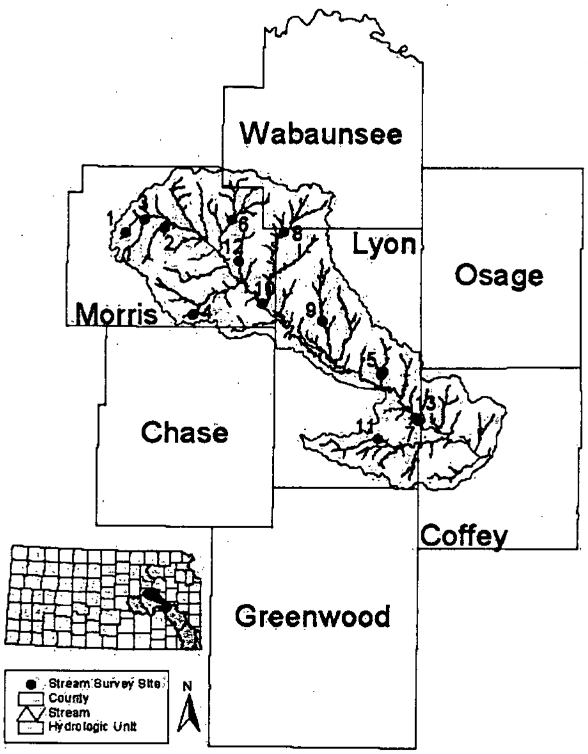
Biological data are highly variable and all watersheds with poor quality sites should be examined (ground-truth) for potential impacts to the aquatic community. It is possible that the timing or condition of the sample, not poor watershed land-use, may have affected the site rating.

Raw water quality data are also included with every report. These data are not lab certified results and should be interpreted with caution.

Fish and mussels sampled within each HUC are listed within each report.

Neosho River Basin
HUC 11070201

LOCATION



- This HUC consists of 13 sites (16 samples).
- Sites were surveyed between 1994-2003.

BIOLOGICAL HIGHLIGHTS

- 5 samples were not impacted by nutrient and oxygen demanding pollutants, 5 were moderately impacted, and 5 were highly impacted (see figure 1).
- The overall MBI value for this HUC was 4.82, indicating this area is moderately impacted by nutrient and oxygen demanding pollutants.
- 52 species of fish were surveyed (see fish species collected, page 2)
  - Threatened – Neosho madtom
  - SINC species – spotted sucker
- 27 species of freshwater mussels were surveyed (see mussel species collected, page 3)
  - Endangered – Neosho mucket
  - Threatened – Ouachita kidneyshell
  - SINC species – creeper, deertoe, fatmucket, fawnsfoot, spike, Wabash pigtoe, yellow sandshell

Site #	Stream Name	Co	Yr	Insect Rich	EPT	MBI	Fish Rich
1	Level	MR	95	3	*		2
2	Cat/Crooked	MR	95	4	*	1.78	10
3	WF Neosho	MR	95	8	*	4.33	15
4	East	MR	94	8	*	6.87	10
4			00	14	0.29	6.02	9
5	Badger	LY	95	10	*	5.87	24
5			96	9	*	5.24	24
5			97	10	*	5.07	21
6	Munkers	MR	96	14	0.007	3.95	26
7	Neosho	LY	96	21	0.661	4.77	30
8	Rock	LY	97	18	0.554	5.31	21
9	Allen	LY	97	20	0.569	5.6	20
10	Neosho	MR	95	7	*	8.04	13
11	Eagle	LY	97	13	0.825	4.28	17
12	Big John	MR	97	9	*	4.06	18
13	Neosho	LY	03	19	0.578	4.91	28

*Fewer than 100 individual insects collected
Highlighted rows represent different sampling events at the same location; Rich = richness

SUMMARY

This HUC could be considered in good health based on the information available at this time.

- Protection efforts should be utilized to maintain the Neosho madtom and spotted sucker populations as well as the various species of endangered, threatened, and SINC mussel species.
- Additional surveys should be performed as the opportunities arise to continue assessment of this HUC.
- A water quality table is presented on page 3.

Stream Picture (see page 3)

Neosho River Basin
HUC 11070201

Water Quality Table

Site#	H20 Temp C	Conductivity mS	Turbidity FTU	TDS mg/l	Dissolved Oxygen mg/l	pH	Alkalinity mg/l	Chlorides mg/l	Ammonia mg/l	Nitrates mg/l	Phosphorus mg/l
1	21	627	382.45	NA	0.165	7.82	NA	NA	NA	NA	NA
2	17	473	18.15	NA	9.98	8.47	NA	NA	NA	NA	NA
3	17	469	50	NA	7.43	8.12	NA	NA	NA	NA	NA
4	20	464	10	249	4.2	7.6	262	11	0.07	0.9	0.05
4	23	560	NA	290	4.6	7.55	NA	NA	NA	NA	NA
5	28	575	38.45	NA	10.22	7.96	NA	NA	NA	NA	NA
5	20	556	9	NA	7.615	8.12	NA	NA	NA	NA	NA
5	16	587	9	NA	8.5	8.62	NA	NA	NA	NA	NA
6	20	531.5	7	NA	8.35	7.93	NA	NA	NA	NA	NA
7	26	546.5	29	NA	7.9	8.37	NA	NA	NA	NA	NA
8	18	455	7	NA	8.095	8.03	NA	NA	NA	NA	NA
9	20	646	7.5	NA	7.3	8.27	NA	NA	NA	NA	NA
10	28	450	93	230	5.7	7.74	NA	NA	NA	NA	NA
11	24	424.5	15.5	NA	8.7	7.85	NA	NA	NA	NA	NA
12	22	468.5	2.5	NA	7.4	8.1	NA	NA	NA	NA	NA
13	26	781	28	380	4.2	8.4	221	16	0.05	3.7	0.38

TDS = total dissolved solids

Fish Species Collected

bigmouth buffalo
black buffalo
black bullhead
blackstripe topminnow
bluegill
bluegill X green sunfish hybrid
bluntface shiner
bluntnose minnow
brook silverside
bullhead minnow
cardinal shiner
central stoneroller
channel catfish
common carp
common shiner
creek chub
fathead minnow
flathead catfish
freshwater drum
ghost shiner
gizzard shad
golden redhorse
golden shiner
green sunfish
green sunfish X bluegill hybrid
largemouth bass
logperch
longear sunfish
longnose gar
mimic shiner
Neosho madtom
orangespotted sunfish
orangethroat darter
red shiner
redfin shiner
river carpsucker
rosyface shiner
sand shiner
shorthead redhorse
shortnose gar
slender madtom
slenderhead darter
smallmouth buffalo
southern redbelly dace
spotted bass
spotted sucker
stonecat
suckermouth minnow
warmouth
western mosquitofish
white bass
white crappie
wiper
yellow bullhead

Neosho River Basin
HUC 11070201

Mussel Species Collected

Asian clam	mapleleaf	pondhorn
bleufer	monkeyface	pondmussel
creeper	Neosho mucket	round pigtoe
deertoe	Ouachita kidneyshell	spike
fatmucket	paper pondshell	threehorn wartyback
fawnsfoot	pimpleback	threeridge
fragile papershell	pink papershell	Wabash pigtoe
giant floater	pistolgrip	white heelsplitter
lilliput	plain pocketbook	yellow sandshell

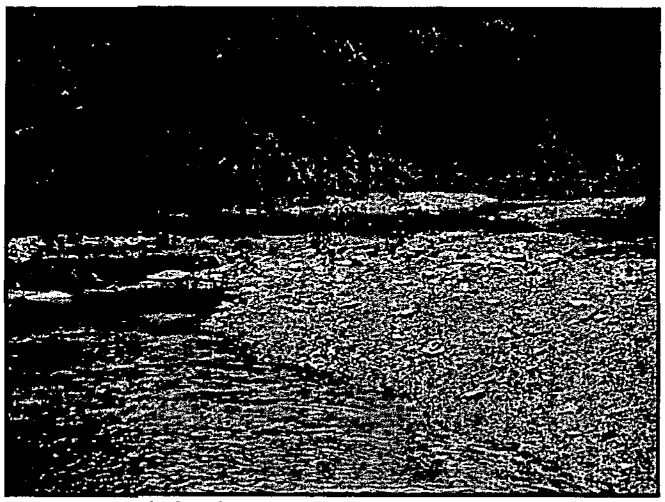


Image 1. Rock Creek, Lyon Co.

Neosho River Basin
HUC 11070201

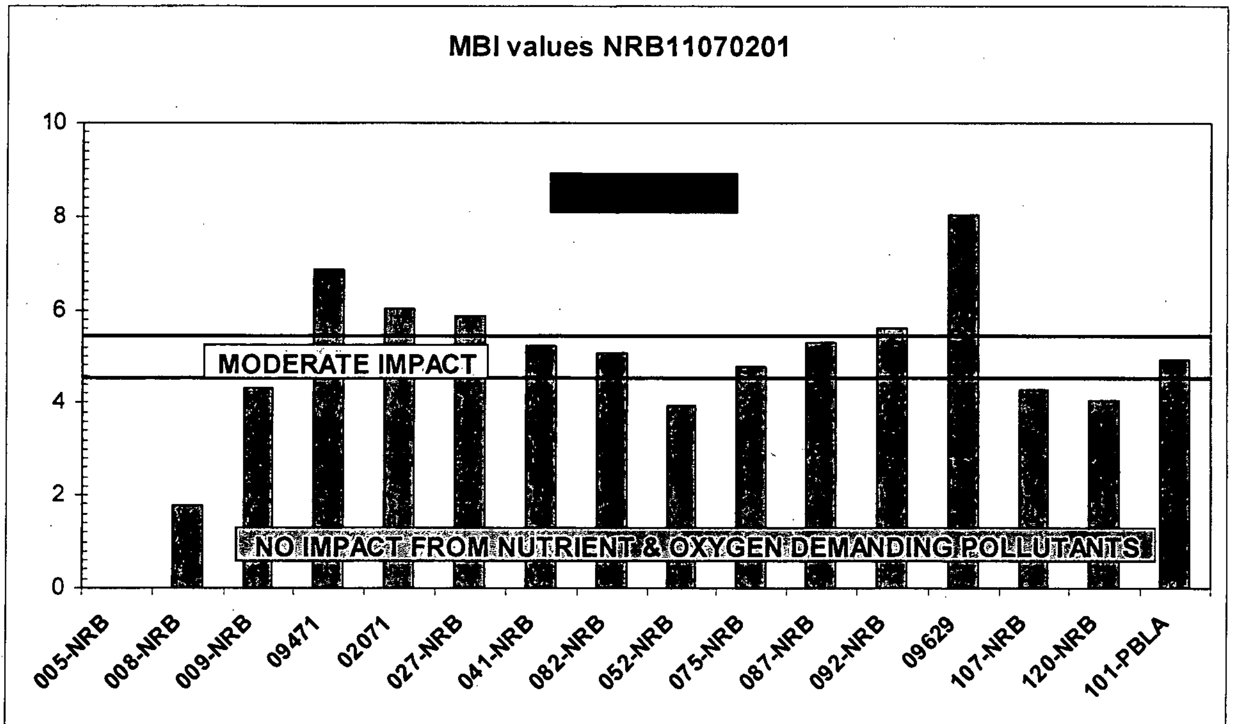


Figure 1. Graph of MBI values for HUC 11070201

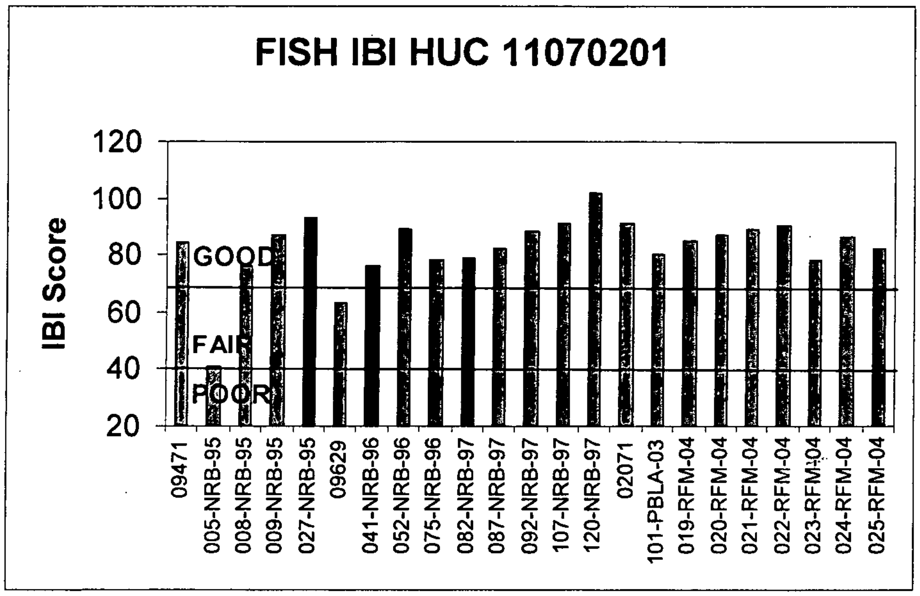
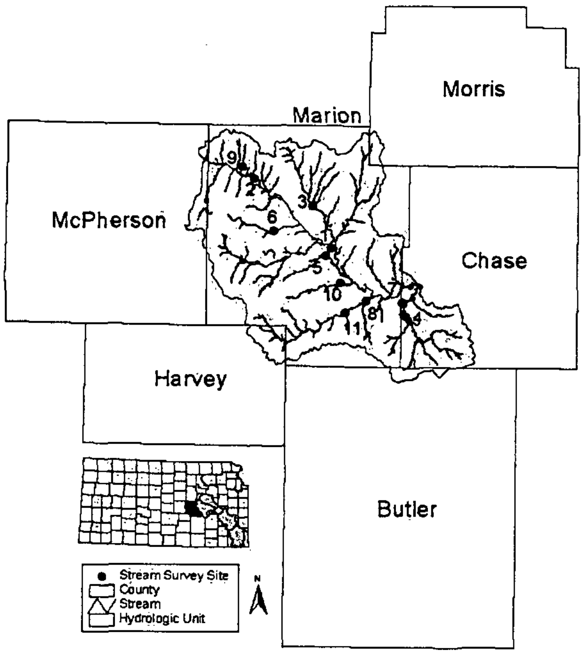


Figure 1. Graph of IBI values for HUC 11070201

Neosho River Basin
HUC 11070202

LOCATION



- This HUC consists of 11 sites (15 samples).
- Sites were surveyed between 1994-2001.

Site #	Stream Name	Co	Yr	Insect Rich	EPT	MBI	Fish Rich
1	Cottonwood	MN	94	5	*	6.17	24
1			00	19	0.244	4.59	18
2	NF Cottonwood	MN	96	15	0.363	5.89	16
3	Mud	MN	96	13	*	5.38	16
3			97	9	*	5	20
4	Cedar	CS	00	20	0.578	4.02	33
5	Spring Branch	MN	96	11	*	4.92	19
6	French	MN	96	6	*	5.76	16
7	Cedar	CS	97	23	0.598	3.89	32
7			01	23	0.598	5.99	22
8	Spring	MN	97	18	*	4.22	20
9	NF Cottonwood Trib	MN	95	8	*	9.75	8
9			01	14	0.011	10.07	6
10	Catlin	MN	97	15	0.715	3.91	24
11	Doyle	MN	97	18	0.41	4.31	26

*Fewer than 100 individual insects collected
Highlighted rows represent different sampling events at the same location; Rich = richness

BIOLOGICAL HIGHLIGHTS

- 5 samples were not impacted by nutrient and oxygen demanding pollutants, 4 samples were moderately impacted, and 6 samples were highly impacted (see figure 1).
- The overall MBI value for this HUC was 5.46 indicating it was moderately impacted by nutrient and oxygen demanding pollutants.
- Relatively good IBI scores throughout HUC.
- 48 species of fish were surveyed (see fish species collected, page 2)
  - SINC species – brindled madtom, spotted sucker
  - Threatened – Topeka shiner
- 23 species of freshwater mussels were surveyed (see mussel species collected, page 3)
  - SINC species – creeper, fawnsfoot, spike, Wabash pigtoe, yellow sandshell
  - Threatened – flutedshell

SUMMARY

This HUC could be considered in good health based on the information available at this time.

- Protection efforts should be utilized to maintain the Topeka shiner, bindled madtom, and spotted sucker populations as well as the various species of endangered, threatened, and SINC mussel species listed.
- Additional surveys should be performed as the opportunities arise to continue assessment of this HUC.
- A water quality table is presented on page 2.

Neosho River Basin
HUC 11070202

Water Quality Table

Site#	H20 Temp C	Conductivity mS	Turbidity FTU	TDS mg/l	Dissolved Oxygen mg/l	pH	Alkalinity mg/l	Chlorides mg/l	Ammonia mg/l	Nitrates mg/l	Phosphorus mg/l
1	24	942	35	466	7	8.3	223	55	0.09	3	0.06
1	25	680	170	350	5.4	7.83	NA	NA	NA	NA	NA
2	26	835	16.5	NA	6.45	7.96	NA	NA	NA	NA	NA
3	23	1305	7.5	NA	5.8	7.94	NA	NA	NA	NA	NA
3	2	748	106.5	NA	NA	7.95	NA	NA	NA	NA	NA
4	22	200	390	95	7.6	NA	128	10	0.41	NA	0.13
5	23	1055	5.5	NA	5.15	7.89	NA	NA	NA	NA	NA
6	22	2800	14.5	NA	4.25	7.75	NA	NA	NA	NA	NA
7	18	289.5	79	NA	7.995	7.97	NA	NA	NA	NA	NA
7	20	1299	13	9.89	9.4	8.5	263	7	0.11	1.4	0.08
8	17	546	13	NA	8.055	7.78	NA	NA	NA	NA	NA
9	20	1742	26	9.89	8.1	8.3	406	31	0.55	4.3	0.28
9	19	990	26	500	3.5	7.96	NA	NA	NA	NA	NA
10	23	1070	10	NA	6.85	8.05	NA	NA	NA	NA	NA
11	23	1820	9.5	NA	8.5	8.2	NA	NA	NA	NA	NA

TDS = total dissolved solids

Fish Species Collected

bigmouth buffalo
black buffalo
black bullhead
blackstripe topminnow
bluegill
bluntface shiner
bluntnose minnow
brindled madtom
brook silverside
cardinal shiner
central stoneroller
channel catfish
channel darter
common carp
creek chub
fantail darter
fathead minnow
flathead catfish
freshwater drum
gizzard shad
golden redhorse
golden shiner
green sunfish
largemouth bass
logperch
longear sunfish
longnose gar
mimic shiner
orangespotted sunfish
orangethroat darter
red shiner
redfin shiner
river carpsucker
sand shiner
shorthead redhorse
slenderhead darter
slim minnow
smallmouth buffalo
spotted bass
spotted sucker
stonecat
suckermouth minnow
Topeka shiner
walleye
western mosquitofish
white bass
white crappie
yellow bullhead

Neosho River Basin
HUC 11070202

Mussel Species Collected

Asian clam	lilliput	pondmussel
bleufer	mapleleaf	spike
creeper	paper pondshell	threehorn wartyback
fawnsfoot	pimpleback	threeridge
fingernail clam	pink papershell	Wabash pigtoe
fluted shell	pistolgrip	white heelsplitter
fragile papershell	plain pocketbook	yellow sandshell
giant floater	pondhorn	

Neosho River Basin
HUC 11070202

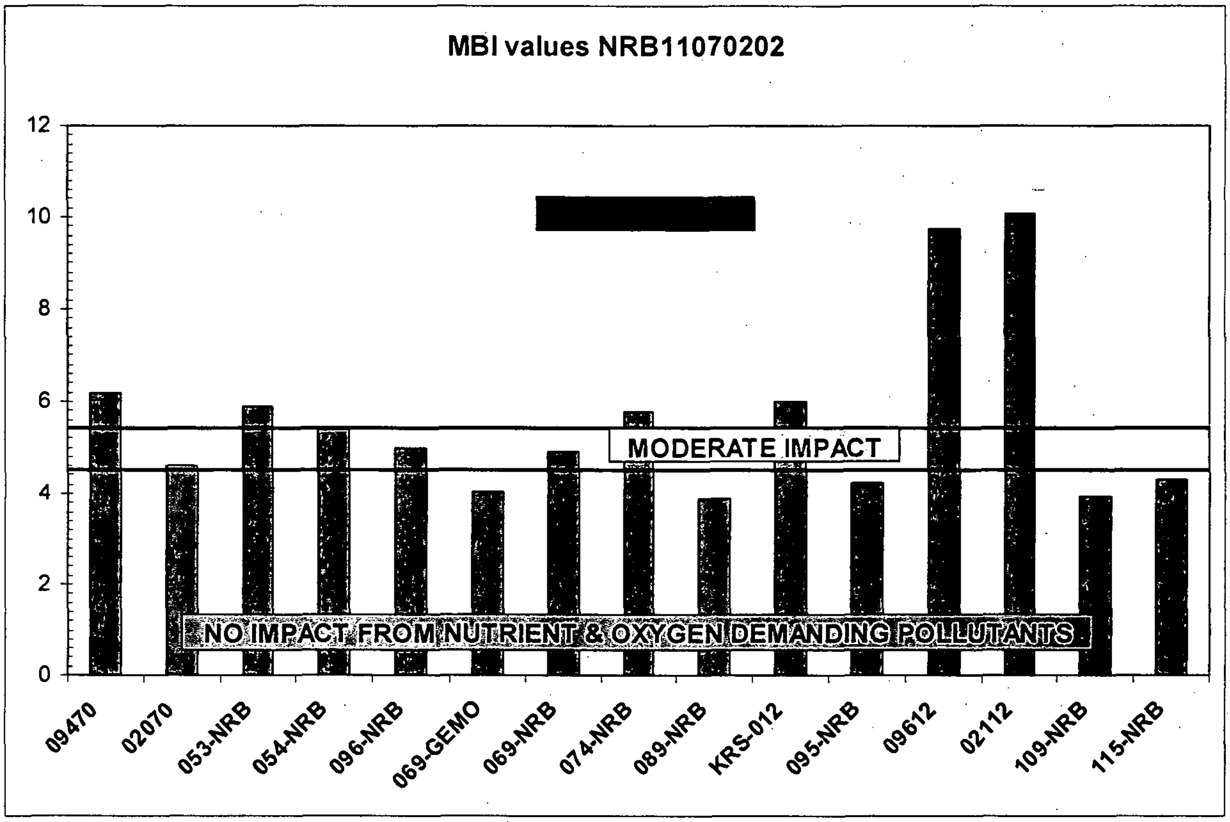


Figure 1. Graph of MBI values for HUC 11070202

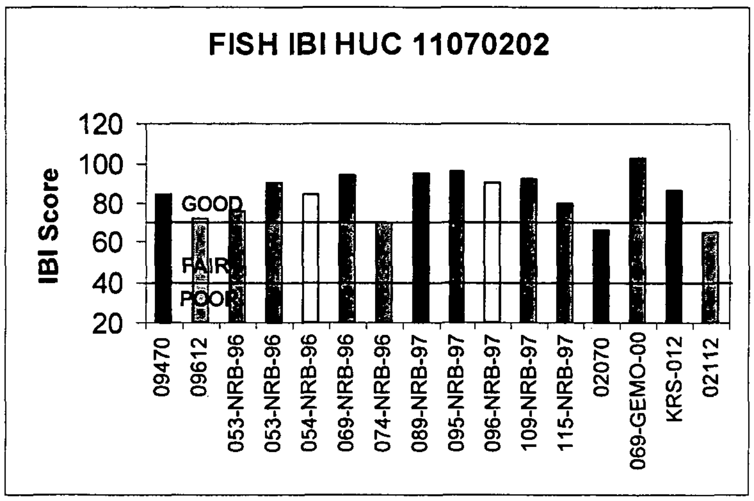
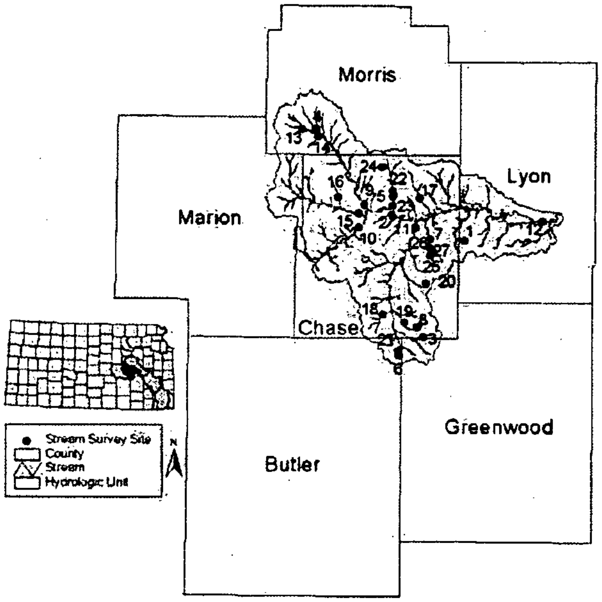


Figure 2. Graph of IBI values for HUC 11070202

Neosho River Basin
HUC 11070203



SUMMARY

This HUC could be considered in good health based on the information available at this time.

- Protection efforts should be utilized to maintain the Neosho madtom and Topeka shiner populations as well as the various species of endangered, threatened, and SINC mussel species.
- Additional surveys should be performed as the opportunities arise to continue assessment of this HUC.
- A water quality table is presented on page 3.

- This HUC consists of 27 sites (38 samples).
- Sites were surveyed between 1995-2003.

BIOLOGICAL HIGHLIGHTS

- 20 samples showed no impact from nutrient and oxygen demanding pollutants, 4 samples were moderately impacted, and 14 samples were highly impacted (see figure 1).
- The overall MBI value for this HUC was 5.44, indicating this area is just on the low side of being highly impacted.
- Low number of introduced species.
- 53 species of fish were surveyed (see fish species collected, page 4).
    - Threatened species – Neosho madtom, Topeka shiner
- 26 species of freshwater mussels were surveyed (see mussel species collected, page 4)
    - SINC species – creeper, fawnsfoot, round pigtoe, spike, Wabash pigtoe, yellow sandshell
    - Threatened species – flutedshell, Ouachita kidneyshell
    - Endangered species – Neosho mucket

Palmer creek, Tallgrass Prairie Preserve, Chase Co.

Neosho River Basin
HUC 11070203

Site #	Stream Name	Co	Yr	Insect Rich	EPT	MBI	Fish Rich
1	Jacob	LY	95	3	*	4.5	15
2	Spring	CS	95	5	*	1.58	10
3	Cannonball	CS	95	7	*	3.88	7
4	Three Mile	MR	95	8	*	3.88	19
5	Fox	CS	95	12	*	2.92	23
5			02	18	0.642	5.25	24
6	Thurman	BU	95	12	*	3	15
7	Bloody	CS	95	11	*	8.12	27
7			96	9	*	5.52	22
7			97	13	*	3.79	23
8	Little Cedar	CS	95	13	*	5.42	15
9	Diamond	CS	95	8	*	4.01	27
10	Cottonwood	CS	95	7	*	4.09	24
10			96	18	0.755	4.4	19
10			97	15	0.558	3.3	32
11	SF Cottonwood	CS	95	13	*	3.74	24
11			96	23	0.79	4.55	36
11			97	15	0.355	3.68	35
12	Cottonwood	LY	95	7	*	3.63	17
13	Camp	MR	96	15	0.06	5.97	21
14	Six Mile	MR	96	27	0.588	4.98	23
14			97	21	0.592	3.94	29
15	Middle	CS	96	17	0.644	4.18	24
15			97	15	*	3.61	26
16	Collett	CS	96	20	0.608	4.62	16
16			97	15	0.724	4.13	16
17	Peyton	CS	97	16	0.474	5.79	18
18	Mercer	CS	97	12	*	5.64	18
19	Little Cedar	CS	97	18	*	4.58	20
20	EB Sharpes	CS	95	9	*	8.99	3
20			01	11	0.014	10.6	2
21	SF Cottonwood	BU	00	19	*	7.55	15
22	Fox	CS	02	21	0.626	6.25	20
23	Fox	CS	02	18	*	7.14	298
24	Palmer	CS	02	13	*	6.82	8
25	Little Bloody	CS	03	17	0.314	7.75	14
26	Little Bloody	CS	03	17	0.419	5.01	20
27	Bloody	CS	03	17	0.339	7.31	16

*Fewer than 100 individual insects collected
Highlighted rows represent different sampling events at the same location; Rich = richness

Neosho River Basin
HUC 11070203

Water Quality Table

Site#	H20 Temp C	Conductivity mS	Turbidity FTU	TDS mg/l	Dissolved Oxygen mg/l	pH	Alkalinity mg/l	Chlorides mg/l	Ammonia mg/l	Nitrates mg/l	Phosphorus mg/l
1	17	522	20	NA	9.355	8.27	NA	NA	NA	NA	NA
2	15	461	9.335	NA	9.015	8.39	NA	NA	NA	NA	NA
3	17	348.5	2.5	NA	7.895	8.1	NA	NA	NA	NA	NA
4	19	234.5	141.15	NA	7.11	7.65	NA	NA	NA	NA	NA
5	20	464	9.05	NA	7.115	7.99	NA	NA	NA	NA	NA
5	24	462	10	224	4.5	8.8	200	6.2	0.05	0.4	0.33
6	20	428	4.65	NA	5.255	7.61	NA	NA	NA	NA	NA
7	23	707	5	NA	5.955	7.49	NA	NA	NA	NA	NA
7	19	1230	3.5	NA	5.75	7.69	NA	NA	NA	NA	NA
7	25	508	5	NA	9.78	8	NA	NA	NA	NA	NA
8	20	494.5	5.85	NA	5.445	7.44	NA	NA	NA	NA	NA
9	24	574	36	NA	7	8.37	NA	NA	NA	NA	NA
10	25	652	203.5	NA	5.695	7.8	NA	NA	NA	NA	NA
10	29	980	30.5	NA	5.95	8.14	NA	NA	NA	NA	NA
10	26	787	37	NA	6.25	8.3	NA	NA	NA	NA	NA
11	25	492	53.1	NA	6.67	8.02	NA	NA	NA	NA	NA
11	24	419.5	14.5	NA	5.7	8.06	NA	NA	NA	NA	NA
11	26	463	8	NA	6.45	8.23	NA	NA	NA	NA	NA
12	26	770	NA	NA	6.165	7.98	NA	NA	NA	NA	NA
13	18	701	23.5	NA	7.9	8.16	NA	NA	NA	NA	NA
14	25	658	NA	NA	6.4	8.2	NA	NA	NA	NA	NA
14	25	639.5	6.5	NA	5.45	8.35	NA	NA	NA	NA	NA
15	21	526	13	NA	6.4	8.13	NA	NA	NA	NA	NA
15	24	424.5	23	NA	10.8	8.2	NA	NA	NA	NA	NA
16	21	535.5	1.5	NA	5.9	7.81	NA	NA	NA	NA	NA
16	19	543	2	NA	7.05	8.03	NA	NA	NA	NA	NA
17	18	428.5	8	NA	8.45	8.44	NA	NA	NA	NA	NA
18	19	199	50.5	NA	8.15	7.93	NA	NA	NA	NA	NA
19	20	236	25	NA	7.885	7.87	NA	NA	NA	NA	NA
20	15	2070	25	11.26	11.7	8.3	243	7.4	0.07	1.8	0.13
20	16	580	3	290	3.2	7.35	NA	NA	NA	NA	NA
21	25	510	0	247	8.4	8	250	24	0.03	1	0.03
22	24	443	18	214	5.6	8.7	209	9.2	0.27	0.3	0.08
23	26	503	19	243	5.3	8.4	247	6	0.02	0	0.16
24	22	574	0	279	4.5	8.5	311	6.2	0.01	0.5	0.38
25	22	509	55	246	6.8	8.1	228	3	0.05	0.8	0.01
26	22	517	44	250	6.6	8.1	207	4	0.05	0.4	0.01
27	25	473	61	229	4.6	8.1	196	8	0.15	1.4	0.02

TDS = total dissolved solids

Neosho River Basin
HUC 11070203

Fish Species Collected

black buffalo
black bullhead
black crappie
blackstripe topminnow
bluegill
bluegill X green sunfish hybrid
bluntface shiner
bluntnose minnow
brook silverside
bullhead minnow
cardinal shiner
central stoneroller
channel catfish
channel darter
common carp
creek chub
fantail darter
fathead minnow
flathead catfish
freckled madtom
freshwater drum
ghost shiner
gizzard shad
golden redhorse
golden shiner
green sunfish
largemouth bass
logperch
longear sunfish
longnose gar
mimic shiner
Neosho madtom
orangespotted sunfish
orangethroat darter
red shiner
redfin shiner
river carpsucker
rosyface shiner
sand shiner
shorthead redhorse
shortnose gar
slenderhead darter
slenderhead darter X logperch
slim minnow
smallmouth buffalo
spotted bass
spotted gar
spotted sucker
stonecat
suckermouth minnow
Topeka shiner
western mosquitofish
white bass
white crappie
yellow bullhead

Mussel Species Collected

black sandshell
bleufer
creeper
fawnsfoot
fingernail clam
fluted shell
fragile papershell
giant floater
lilliput
mapleleaf
monkeyface
Neosho mucket
Ouachita kidneyshell
pimpleback
pink papershell
pistolgrip
plain pocketbook
pondhorn
pondmussel
round pigtoe
spike
threeridge
Wabash pigtoe
wartyback
white heelsplitter
yellow sandshell

Neosho River Basin
HUC 11070203

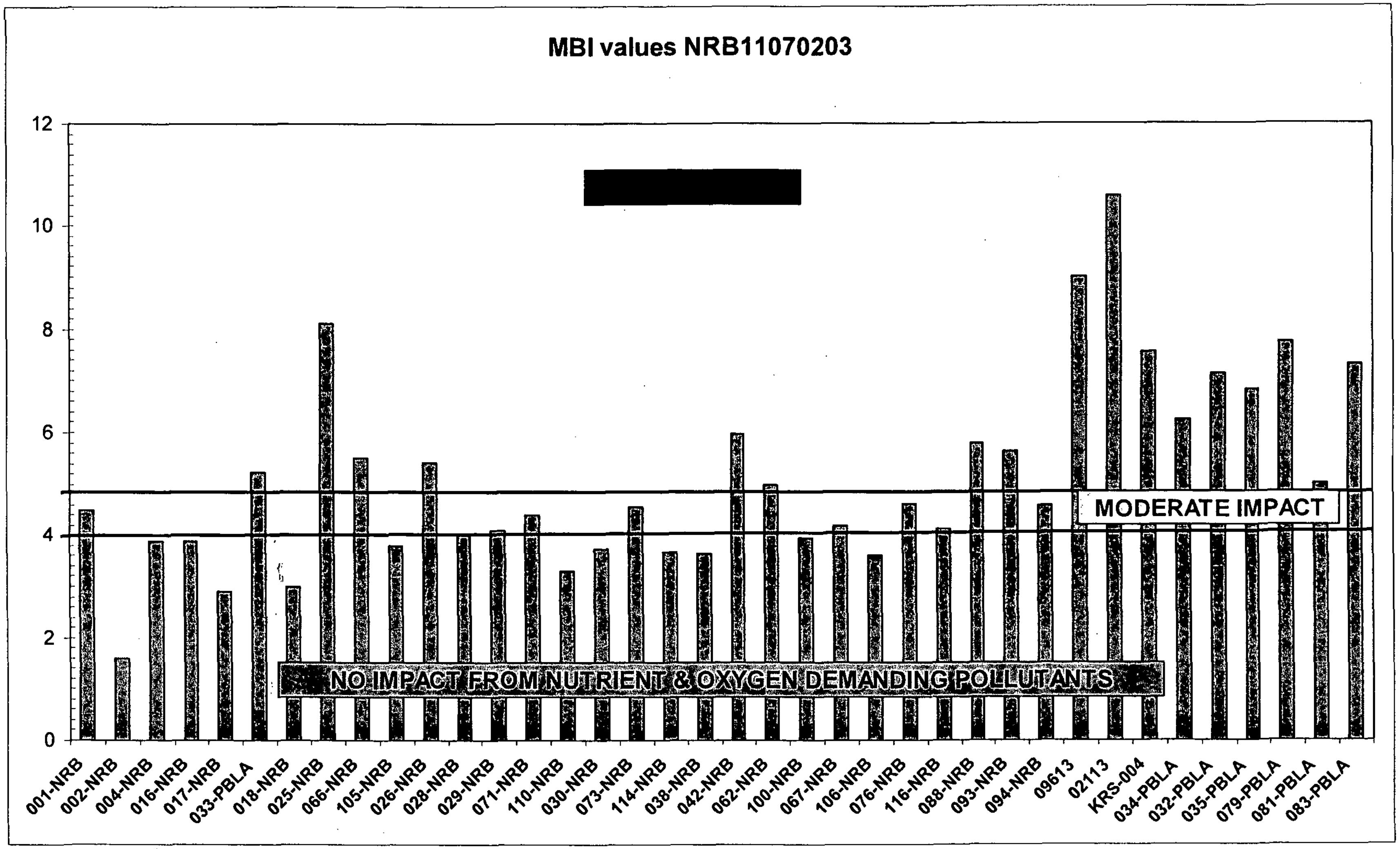
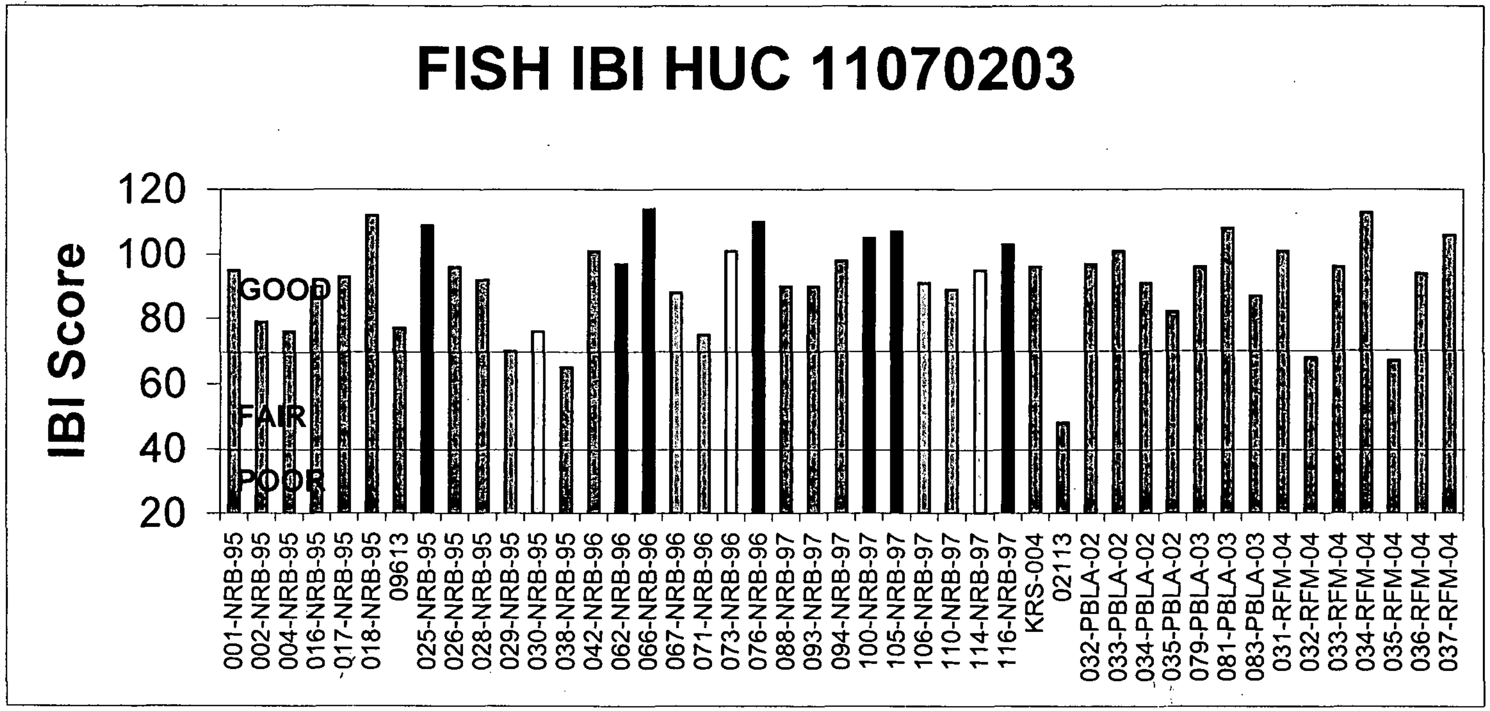


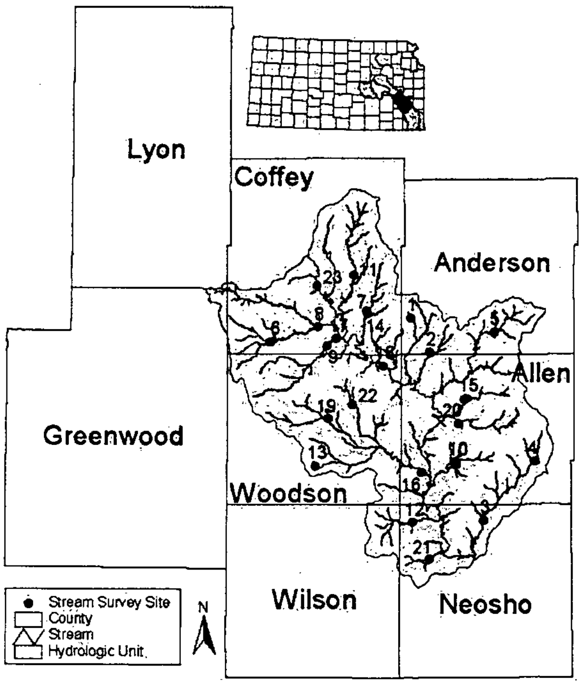
Figure 1. Graph of MBI values for HUC 11070203

Neosho River Basin
HUC 11070203



Neosho River Basin
HUC 11070204

LOCATION



- This HUC consists of 23 sites (30 samples).
- Sites were surveyed between 1994-2000.

BIOLOGICAL HIGHLIGHTS

- 12 samples were not impacted by nutrient and oxygen demanding pollutants, 9 samples were moderately impacted, and 8 samples were highly impacted (see figure 1).
- The overall MBI value for this HUC is 5.1, indicating that this area has been moderately impacted by nutrient and oxygen demanding pollutants.
- 51 species of fish were surveyed (see fish species collected, page 4)
  - Threatened – Neosho madtom
  - SINC – spotted sucker
- 32 species of freshwater mussels were surveyed (see mussel species collected, page 4)
  - Threatened – butterfly, flutedshell, Ouachita kidneyshell
  - Endangered – Neosho mucket, rabbitsfoot
  - SINC – creeper, fatmucket, fawnsfoot, round pigtoe, spike, Wabash pigtoe, wartyback, washboard, yellow sandshell

SUMMARY

This HUC could be considered in good health based on the information available at this time.

- Protection efforts should be utilized to maintain the Neosho madtom and spotted sucker populations as well as the various species of endangered, threatened, and SINC mussel species.
- A water quality table is presented on page 3.

Site #	Stream Name	Co	Yr	Insect Rich	EPT	MBI	Fish Rich
1	Little Indian	AN	95	11	*	4.21	14
2	Martin Trib	An	95	3	*	4.5	7
3	Big	NO	95	7	*	4.38	
4	Big	AL	95	6	*	4.4	21
5	Deer	AN	95	9	*	2.89	19
5			96	23	0.414	5.65	17
5			97	15	*	4.92	19
6	S Big	CF	94	14	*	5.58	23
6			00	15	0.115	4.96	18
7	Crooked	CF	94	1	*	0	14
7			00	9	0	8.34	14
8	S Big	CF	95	7	*	5.07	29
9	Turkey	CF	95	5	*	4.25	24
10	Coal	AL	95	10	0.061	4.47	23
11	Long	CF	96	7	*	7.78	10
11			97	16	*	3.77	15
12	Village	NO	96	16	*	6.08	18
13	S Owl	WO	96	16	*	6.1	25
14	Crooked	CF	96	9	*	5.15	24
15	Rock	AL	96	20	0.359	4.8	24
15			97	14	*	3.97	25
16	Owl	AL	96	11	*	4.79	17
16			97	9	*	4.87	24
17	Turkey	CF	96	16	0.723	5.47	25
18	Neosho	WO	96	19	0.755	4.41	22
19	Owl	WO	97	10	*	6.08	17
20	Elm	AL	97	9	0.352	3.4	21
21	Turkey	NO	97	11	*	3.75	27
22	Cherry	WO	97	9	*	4.53	15
23	Neosho	CF	97	10	*	3.48	27

*Fewer than 100 individual insects collected
Highlighted rows represent different sampling events at the same location; Rich = richness

Neosho River Basin
HUC 11070204

Water Quality Table

Site#	H20 Temp C	Conductivity mS	Turbidity FTU	TDS mg/l	Dissolved Oxygen mg/l	pH	Alkalinity mg/l	Chlorides mg/l	Ammonia mg/l	Nitrates mg/l	Phosphorus mg/l
1	20	171	83.5	NA	5.5	7.77	NA	NA	NA	NA	NA
2	23	195.5	24.15	NA	6.505	7.61	NA	NA	NA	NA	NA
3	27	290.5	NA	NA	5.24	7.55	NA	NA	NA	NA	NA
4	22	346.5	17.2	NA	6.575	7.99	NA	NA	NA	NA	NA
5	22	393	26.3	NA	6.945	7.86	NA	NA	NA	NA	NA
5	24	272	33	NA	4.5	7.7	NA	NA	NA	NA	NA
5	24	418.5	22	NA	NA	7.9	NA	NA	NA	NA	NA
6	25	1388	26	684	6.5	7.8	100	73	0.19	0	0.03
6	25	580	33	300	4.2	7.9	NA	NA	NA	NA	NA
7	24	293	51	142.5	6.8	8	166	4	0.55	0	0.04
7	23	240	47	130	8.2	6.9	NA	NA	NA	NA	NA
8	25	332.5	NA	NA	4.29	7.54	NA	NA	NA	NA	NA
9	23	258	998.5	NA	4.995	7.33	NA	NA	NA	NA	NA
10	24	321.5	116	NA	5.395	7.54	NA	NA	NA	NA	NA
11	20	371	10	NA	3.1	7.6	NA	NA	NA	NA	NA
11	17	342	29.5	NA	7.55	7.5	NA	NA	NA	NA	NA
12	19	309	59.5	NA	5.55	7.49	NA	NA	NA	NA	NA
13	24	275	23.5	NA	5.65	8.41	NA	NA	NA	NA	NA
14	24	248	41	NA	3.7	7.59	NA	NA	NA	NA	NA
15	26	348.5	NA	NA	3.13	7.54	NA	NA	NA	NA	NA
15	24	186	79.5	NA	4.395	7.7	NA	NA	NA	NA	NA
16	27	297	NA	NA	5.45	7.72	NA	NA	NA	NA	NA
16	24	262.5	30.5	NA	8.225	7.6	NA	NA	NA	NA	NA
17	25	297	21	NA	5.65	7.94	NA	NA	NA	NA	NA
18	28	435.5	15.5	NA	7.7	8.46	NA	NA	NA	NA	NA
19	18	224.5	134.5	NA	7.67	7.52	NA	NA	NA	NA	NA
20	17	417.5	10	NA	7.86	7.91	NA	NA	NA	NA	NA
21	24	216	55	NA	7.94	7.67	NA	NA	NA	NA	NA
22	25	359.5	32	NA	4.9	7.35	NA	NA	NA	NA	NA
23	25	419.5	14.5	NA	7.45	8.25	NA	NA	NA	NA	NA

TDS = total dissolved solids

Neosho River Basin
HUC 11070204

Fish Species Collected

bigmouth buffalo
black buffalo
black bullhead
black crappie
blackstripe topminnow
bluegill
bluegill X green sunfish hybrid
bluegill X longear sunfish
bluegill X orangespotted sunfish
bluegill X warmouth
bluntnose darter
bluntnose minnow
brook silverside
bullhead minnow
central stoneroller
channel catfish
common carp
fantail darter
fathead minnow
flathead catfish
freckled madtom
freshwater drum
ghost shiner
gizzard shad
golden redhorse
golden shiner
green sunfish
Johnny darter
largemouth bass
logperch
longear sunfish
longnose gar
mimic shiner
Neosho madtom
orangespotted sunfish
orangethroat darter
red shiner
redfin darter
redfin shiner
river carpsucker
rosyface shiner
shortnose gar
slenderhead darter
slim minnow
smallmouth buffalo
spotted bass
spotted sucker
stonecat
suckermouth minnow
walleye
warmouth
western mosquitofish
white bass
white crappie
yellow bullhead

Mussel Species Collected

Asian clam
black sandshell
bleufer
butterfly
creeper
fatmucket
fawnsfoot
fingernail clam
fluted shell
fragile papershell
giant floater
lilliput
mapleleaf
monkeyface
Neosho mucket
Ouachita kidneyshell
pimpleback
pink papershell
pistolgrip
plain pocketbook
pondhorn
pondmussel
rabbitsfoot
round pigtoe
spike
threehorn wartyback
threeridge
Wabash pigtoe
wartyback
washboard
white heelsplitter
yellow sandshell

Neosho River Basin
HUC 11070204

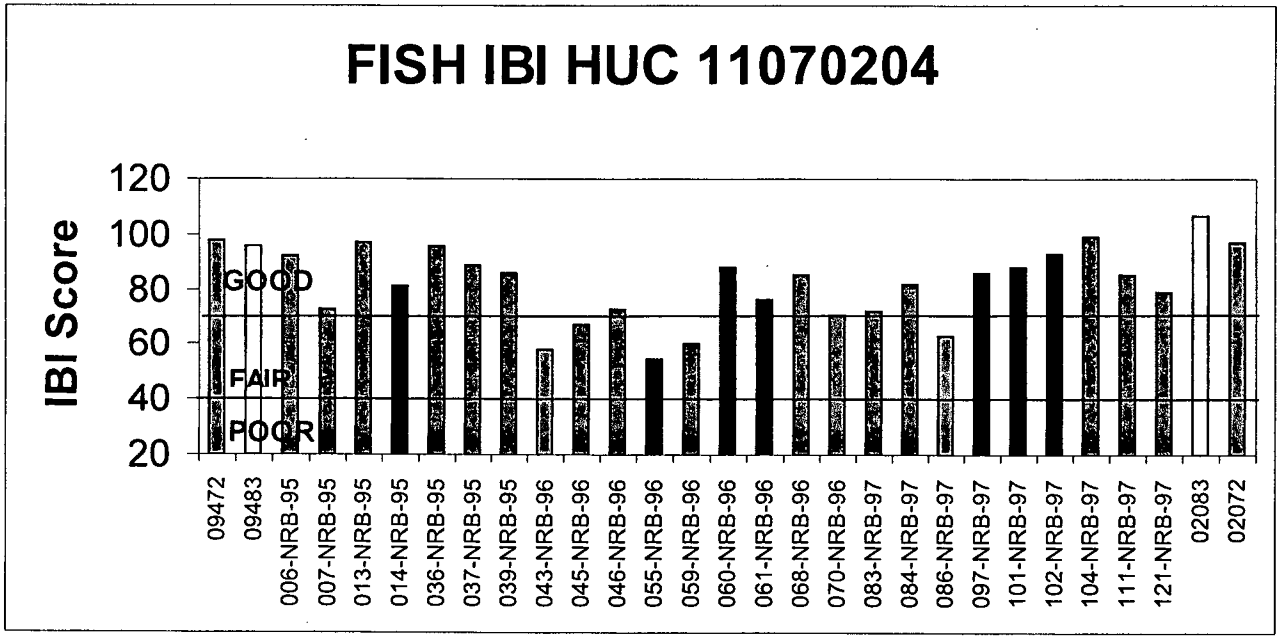
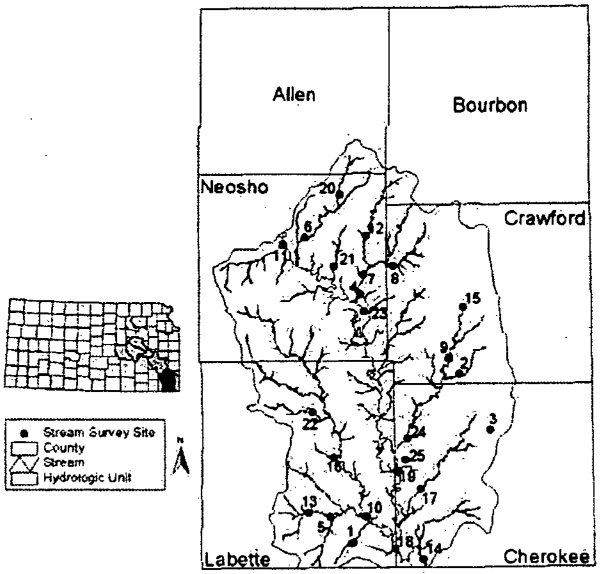


Figure 2. Graph of IBI values for HUC 11070204

SUB-WATERSHED REPORT

Neosho River Basin
HUC 11070205



- This HUC consists of 25 sites (36 samples).
- Sites were surveyed between 1995-2002.

BIOLOGICAL HIGHLIGHTS

- 12 samples were not impacted by nutrient and oxygen demanding pollutants, 12 were moderately impacted, and 12 were highly impacted (see figure 1).
- The overall MBI value for this HUC was 5.51, indicating it is on the low side of being highly impacted.
- 62 species of fish were surveyed (see fish species collected, page 4).
  - Threatened – Neosho madtom
  - SINC – blue sucker, bluntnose darter, gravel chub, river darter, slough darter, spotted sucker, stippled darter
  - New state collection of an inland silverside
- 25 species of freshwater mussels were surveyed (see mussel species collected, page 4).
  - Threatened – butterfly
  - Endangered – Neosho mucket, rabbitsfoot
  - SINC – fatmucket, round pigtoe, spike, Wabash pigtoe, yellow sandshell

SUMMARY

This HUC could be considered in good health based on the information available at this time.

- Protection efforts should be utilized to maintain the Neosho madtom population and SINC species of fish, as well as the various species of endangered, threatened, and SINC mussel species.
- Additional surveys should be performed as the opportunities arise to continue assessment of this HUC.
- A water quality table is presented on page 3.

Neosho River Basin
HUC 11070205

Site #	Stream Name	Co	Yr	Insect Rich	EPT	MBI	Fish Rich
1	Turkey	LB	95	8	*	4.57	19
1			96	12	*	5.51	22
1			97	9	*	9.59	22
2	Limestone	CR	95	8	*	4.03	21
2			96	14	*	5.45	23
2			97	12	*	4.01	26
3	Little Cherry	CK	95	11	*	4.5	10
4	Downey	NO	95	9	*	5.63	25
4			96	4	*	5.09	12
4			97	4	*	3.5	21
5	Hackberry	LB	95	9	*	4.47	22
6	Canville	NO	95	9	0.408	3.54	16
7	Flat Rock	NO	95	8	*	7.88	23
8	Walnut	CR	95	7	*	4.33	24
9	Lightning	CR	95	6	*	6.75	19
9			96	15	0.675	5.04	26
9			97	10	0.203	4.33	29
10	Labette	LB	95	7	*	4.5	29
11	Elk	NO	95	6	*	3.9	20
12	Flat Rock	NO	96	14	*	6.09	16
12			97	12	0.298	6.62	22
13	Hackberry	LB	96	16	*	5.05	21
14	Fly	CK	96	9	*	7.32	16
15	Lightning	CR	96	16	0.355	5.26	25
16	Spring	LB	96	12	*	7.31	23
16			97	10	*	4.42	26
17	Cherry	CK	96	18	0.379	5.28	22
18	Neosho	LB	96	15	0.745	4.28	32
19	Wolf	CK	97	14	*	4.82	29
20	Canville	NO	95	11	0.458	6.63	20
20			01	21	0.049	7.76	18
21	Four Mile	NO	97	9	*	4	23
22	Bachelor	LB	97	15	*	4.87	27
23	Neosho	NO	97	9	*	3.8	26
24	Lightning	CK	02	23	0.235	6.69	27
25	Deer	CK	02	8	*	5.01	11

Neosho River Basin
HUC 11070205

Water Quality Table

Site#	H20 Temp C	Conductivity mS	Turbidity FTU	TDS mg/l	Dissolved Oxygen mg/l	pH	Alkalinity mg/l	Chlorides mg/l	Ammonia mg/l	Nitrates mg/l	Phosphorus mg/l
1	19	403.5	10.17	NA	7.32	8.24	NA	NA	NA	NA	NA
1	21	375	12.5	NA	5.85	8.06	NA	NA	NA	NA	NA
1	20	433.5	8	NA	6.65	7.74	NA	NA	NA	NA	NA
2	23	925	29.15	NA	5.725	7.59	NA	NA	NA	NA	NA
2	21	303.5	80.5	NA	5.55	7.58	NA	NA	NA	NA	NA
2	27	744.5	14.5	NA	4.6	7.67	NA	NA	NA	NA	NA
3	21	836	1.3	NA	5.81	6.13	NA	NA	NA	NA	NA
4	23	312	35	NA	1.84	7.26	NA	NA	NA	NA	NA
4	23	800	76	NA	4.7	7.35	NA	NA	NA	NA	NA
4	25	213.5	26	NA	7.53	7.46	NA	NA	NA	NA	NA
5	27	339	13.8	NA	6.06	7.46	NA	NA	NA	NA	NA
6	23	422	34.5	NA	2.735	7.51	NA	NA	NA	NA	NA
7	26	269	113.3	NA	2.36	7.29	NA	NA	NA	NA	NA
8	21	149	999	NA	5.07	6.98	NA	NA	NA	NA	NA
9	25	192	594	NA	3.91	7.28	NA	NA	NA	NA	NA
9	23	307	12.5	NA	4.55	7.52	NA	NA	NA	NA	NA
9	25	348	12.5	NA	5.35	7.48	NA	NA	NA	NA	NA
10	26	174.5	502	NA	5.12	7.39	NA	NA	NA	NA	NA
11	24	383	NA	NA	5.53	7.46	NA	NA	NA	NA	NA
12	20	396.5	2.5	NA	5.05	7.93	NA	NA	NA	NA	NA
12	18	418	7	NA	5.99	7.96	NA	NA	NA	NA	NA
13	21	235.5	32.5	NA	5.7	7.39	NA	NA	NA	NA	NA
14	23	221	46.5	NA	4.65	7.35	NA	NA	NA	NA	NA
15	18	355.5	10	NA	6.6	7.81	NA	NA	NA	NA	NA
16	24	326.5	12.5	NA	3.4	7.5	NA	NA	NA	NA	NA
16	21	313	45.5	NA	6.98	7.57	NA	NA	NA	NA	NA
17	24	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
18	26	305	14.5	NA	6.55	7.86	NA	NA	NA	NA	NA
19	20	547	2	NA	4.555	7.28	NA	NA	NA	NA	NA
20	27	290	21	150	3.5	7.63	NA	NA	NA	NA	NA
20	26	NA	31	NA	6.5	8.5	135	10	0.03	2.4	0.04
21	26	535.5	2.5	NA	5.2	7.7	NA	NA	NA	NA	NA
22	22	211.5	12	NA	5	7.67	NA	NA	NA	NA	NA
23	25	433	31.5	NA	7.85	8.37	NA	NA	NA	NA	NA
24	25	401	28	192.6	7.3	8.9	118	8.1	0.02	0.4	0.37
25	26	2200	16	1108	2.6	8.5	160	2.1	0.06	0.3	0.5

TDS = total dissolved solids

Neosho River Basin
HUC 11070205

Fish Species Collected

bigmouth buffalo
black buffalo
black bullhead
black crappie
blackstripe topminnow
blue sucker
bluegill
bluegill X green sunfish hybrid
bluegill X longear sunfish
bluegill X warmouth
bluntface shiner
bluntnose darter
bluntnose minnow
brook silverside
bullhead minnow
central stoneroller
channel catfish
channel darter
common carp
creek chub
emerald shiner
fantail darter
fathead minnow
flathead catfish
freckled madtom
freshwater drum
ghost shiner
gizzard shad
golden redhorse
golden shiner
grass carp
gravel chub
green sunfish
inland silverside
largemouth bass
logperch
longear sunfish
longnose gar
mimic shiner
Neosho madtom
orangespotted sunfish
orangethroat darter
red shiner
redear sunfish
redfin darter
redfin shiner
river carpsucker
river darter
shorthead redhorse
slenderhead darter
slenderhead darter X logperch
slim minnow
slough darter
smallmouth buffalo
spotted bass
spotted gar
spotted sucker
stippled darter
stonecat
suckermouth minnow
warmouth
western mosquitofish
white bass
white crappie
white sucker
yellow bullhead

Mussel Species Collected

Asian clam
bleufer
butterfly
fatmucket
fragile papershell
giant floater
lilliput
mapleleaf
monkeyface
Neosho mucket
paper pondshell
pimpleback
pink papershell
pistolgrip
plain pocketbook
pondhorn
pondmussel
rabbitsfoot
round pigtoe
spike
threehorn wartyback
threeridge
Wabash pigtoe
white heelsplitter
yellow sandshell

Neosho River Basin
HUC 11070205

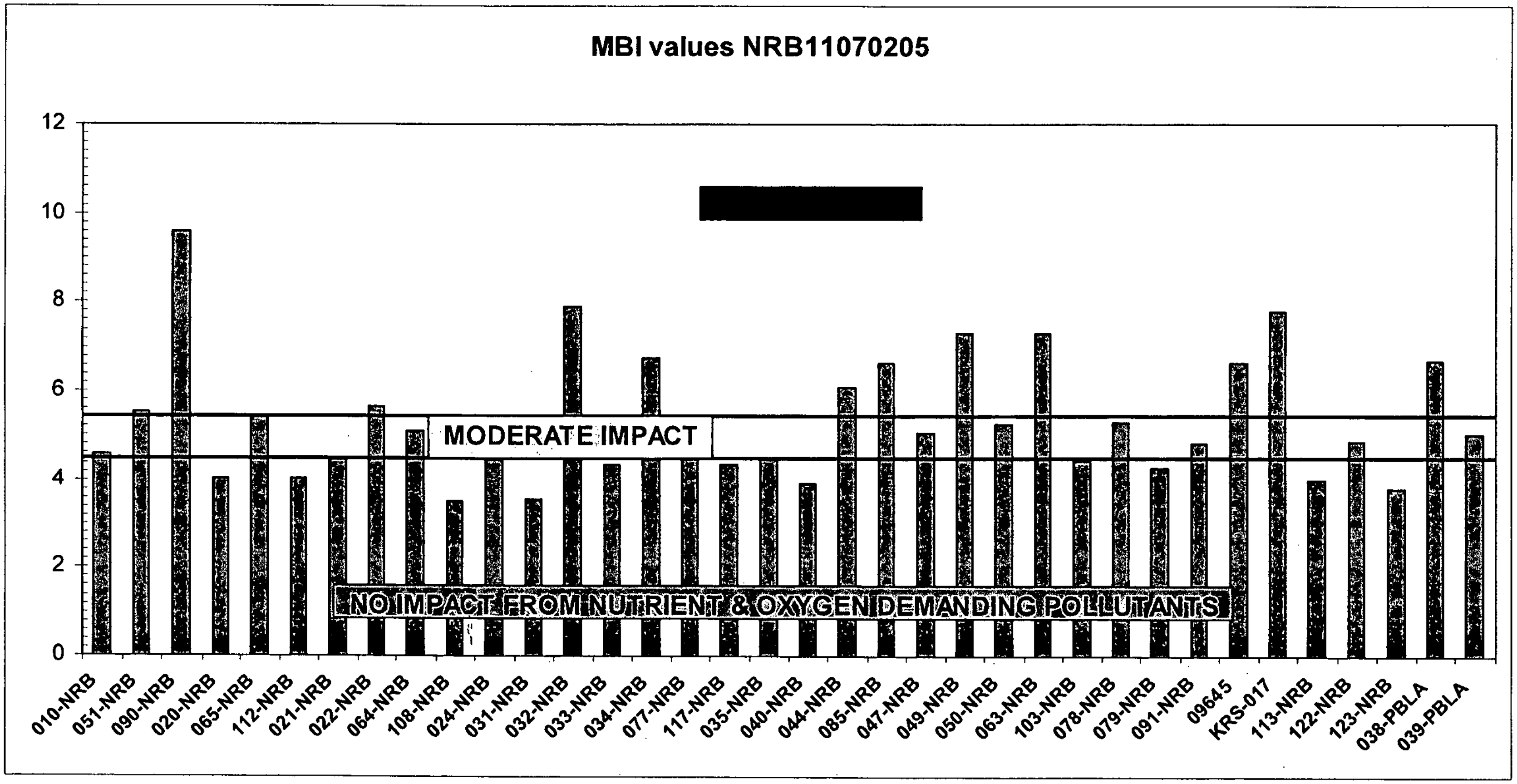


Figure 1. Graph of MBI values for HUC 11070205

Neosho River Basin
HUC 11070205

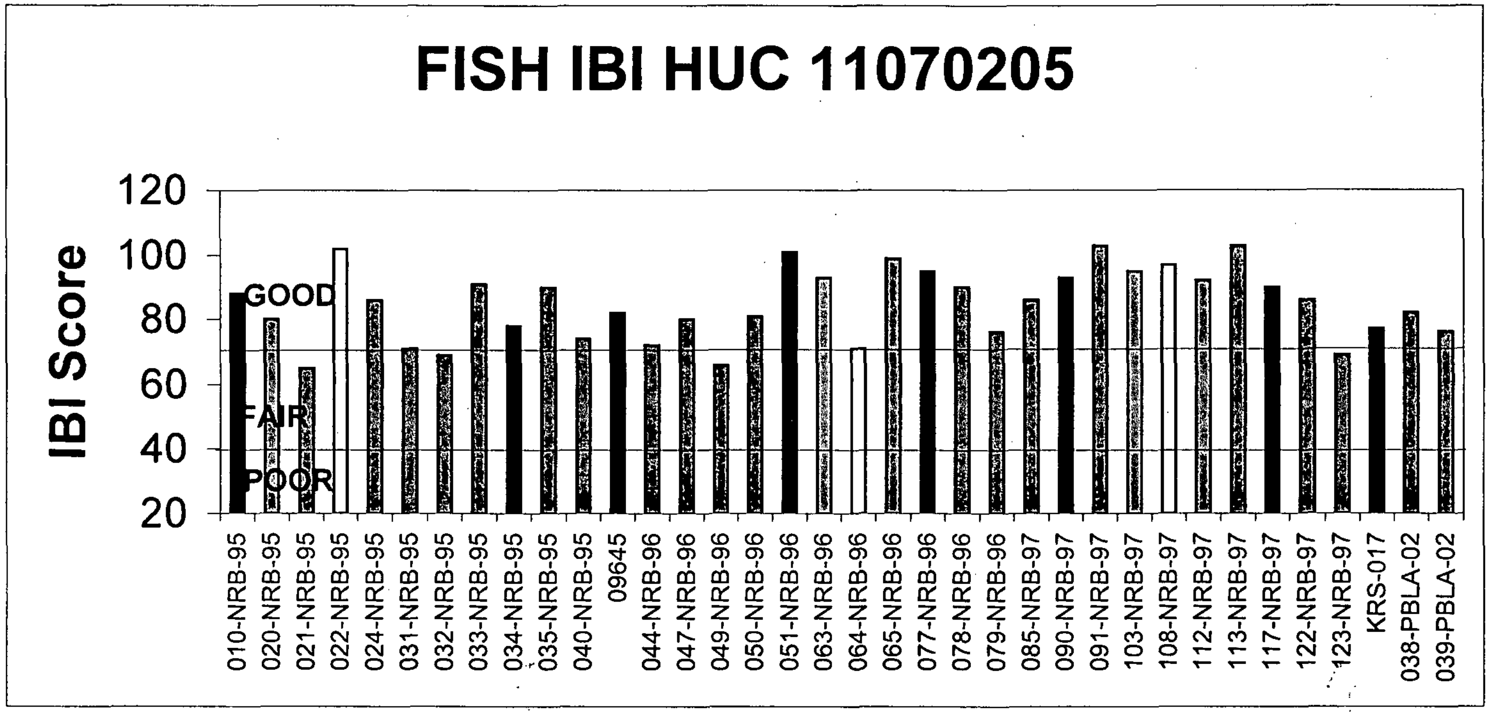
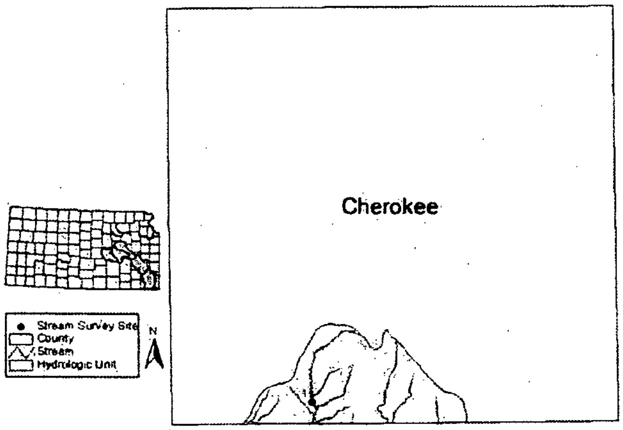


Figure 2. Graph of IBI values for HUC 11070205

Neosho River Basin
HUC 11070206

LOCATION



- This HUC consists of 1 site (1 sample).
- Site was surveyed in 1995.

BIOLOGICAL HIGHLIGHTS

- The one sample in this HUC showed no impact from nutrient and oxygen demanding pollutants. The MBI score was 3.94 (see figure 1).
- 20 species of fish were surveyed (see fish species collected, page 2)
  - SINC – slough darter, spotted sucker
- No mussels have been surveyed in this HUC

Site #	Stream Name	Co	Yr	Insect Rich	EPT	MBI	Fish Rich
1	Four Mile	CK	95	9	*	3.94	20

*Fewer than 100 individual insects collected
Highlighted rows represent different sampling events at the same location; Rich = richness

SUMMARY

- Based on the information from one sample, this area would be considered in good health.
- Further surveys should be performed as the opportunity arises to gain further understanding of the fish and aquatic invertebrates of this HUC.
  - Assess populations of SINC fish species
  - Survey for mussel species
- A water quality table is presented on page 2.

Neosho River Basin
HUC 11070206

Water Quality Table

Site#	H20 Temp C	Conductivity mS	Turbidity FTU	TDS mg/l	Dissolved Oxygen mg/l	pH	Alkalinity mg/l	Chlorides mg/l	Ammonia mg/l	Nitrates mg/l	Phosphorus mg/l
1	21	170.5	13.5	NA	3.505	6.84	NA	NA	NA	NA	NA

TDS = total dissolved solids

Fish Species Collected

black bullhead
blackstripe topminnow
bluegill
bluegill X green sunfish hybrid
bluntnose darter
bluntnose minnow
brook silverside
channel catfish
golden shiner
green sunfish
largemouth bass
orangethroat darter
red shiner
redfin shiner
river carpsucker
slough darter
spotted sucker
warmouth
western mosquitofish
white crappie
yellow bullhead

Mussel Species Collected

No mussels were collected in this HUC

Neosho River Basin
HUC 11070206

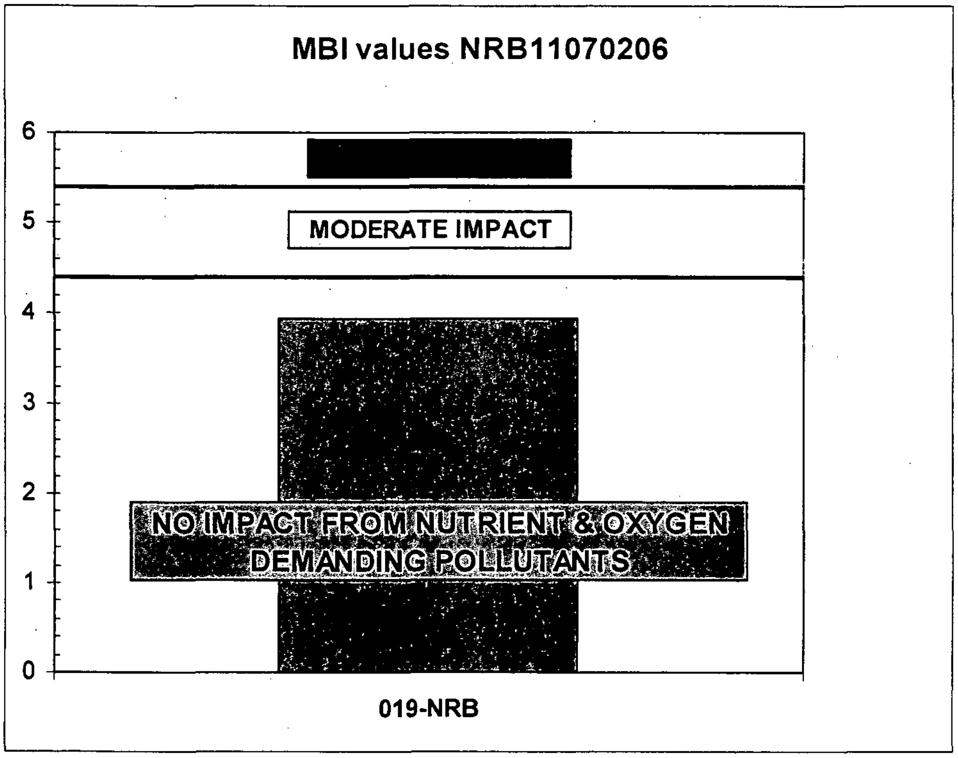


Figure 1. Graph of MBI value for HUC 11070206

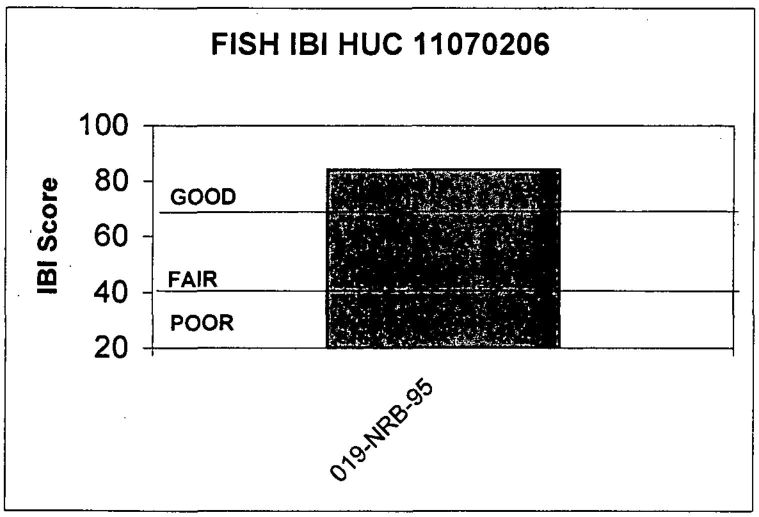
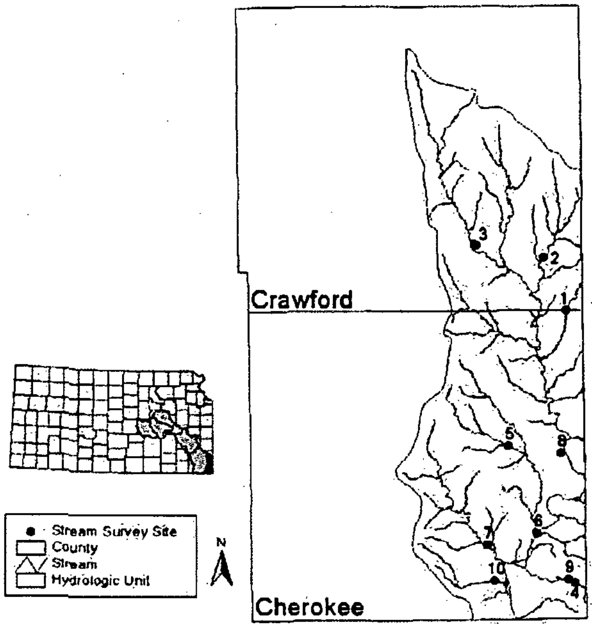


Figure 2. Graph of IBI values for HUC 11070206

SUB-WATERSHED REPORT

Neosho River Basin
HUC 11070207

LOCATION



- This HUC consists of 10 sites (17 samples).
- Sites were surveyed between 1995-2002.

BIOLOGICAL HIGHLIGHTS

- 6 samples were not impacted by nutrient and oxygen demanding pollutants, 3 were moderately impacted, and 8 were highly impacted (see figure 1).
- The overall MBI value for this HUC is 5.33, indicating the area is moderately impacted by nutrient and oxygen demanding pollutants.
- 63 species of fish were surveyed (see fish species collected, page 2 & 3).
    - Threatened – redspot chub
    - SINC – banded darter, banded sculpin, bluntnose darter, gravel chub, greenside darter, northern hogsucker, Ozark minnow, river redhorse, slough darter, speckled darter, spotfin shiner, spotted sucker, stippled darter
- 24 species of mussel were surveyed (see mussel species collected, page 3)
    - Endangered – ellipse, Neosho mucket, rabbitsfoot, western fanshell
    - Threatened – flutedshell, Ouachita kidneyshell
    - SINC – creeper, round pigtoe, spike, Wabash pigtoe, yellow sandshell

Site #	Stream Name	Co	Yr	Insect Rich	EPT	MBI	Fish Rich
1	Taylor Branch	Ck	95	5	*	6.88	15
2	Little/E Cow	CR	95	8	*	4.5	13
3	Cow	CR	95	9	*	4.5	19
3			96	14	0.195	5.65	24
3			97	12	*	4.56	26
3			02	23		5.96	20
4	Shoal	CK	95	7	*	3.42	23
4			96	19	*	5.76	30
4			97	15	*	4.07	33
5	Shawnee	CK	96	15	*	5.95	15
6	Short	CK	96	9	*	6.11	7
7	Brush	CK	96	21	0.478	5.64	24
8	Spring	CK	96	17	0.443	4.57	31
8			97	17	0.407	3.7	39
9	Shoal	CK	95	17	0.61	4.33	25
9			00	21	0.571	5.91	27
10	Willow	CK	97	9	*	4.94	20

*Fewer than 100 individual insects collected
Highlighted rows represent different sampling events at the same location; Rich = richness

SUMMARY

This HUC could be considered in good health based on the information available at this time.

- Efforts should be utilized to maintain the redspot chub population and SINC species of fish, as well as the various species of endangered, threatened, and SINC mussel species.
- Additional surveys should be performed as the opportunities arise to continue assessment of this HUC.
- A water quality table is presented on page 2.

Stream photo (see page 3)

Neosho River Basin
HUC 11070207

Water Quality Table

Site#	H20 Temp C	Conductivity mS	Turbidity FTU	TDS mg/l	Dissolved Oxygen mg/l	pH	Alkalinity mg/l	Chlorides mg/l	Ammonia mg/l	Nitrates mg/l	Phosphorus mg/l
1	19	174	228	NA	7.52	7.61	NA	NA	NA	NA	NA
2	22	1060	16	NA	6.61	7.58	NA	NA	NA	NA	NA
3	24	1165	38	NA	5.09	7.4	NA	NA	NA	NA	NA
3	26	978	20	479	3.4	8.4	249	6.9	0.01	0.1	0.24
3	25	357	36.5	NA	3.7	7.48	NA	NA	NA	NA	NA
3	25	534	50.5	NA	NA	7.53	NA	NA	NA	NA	NA
4	24	289.5	16.2	NA	7.99	7.97	NA	NA	NA	NA	NA
4	26	343	2.5	NA	6.7	7.98	NA	NA	NA	NA	NA
4	25	351.5	4.5	NA	6.1	7.78	NA	NA	NA	NA	NA
5	18	205.5	18	NA	5.2	7.35	NA	NA	NA	NA	NA
6	26	501	0.5	NA	9.7	7.49	NA	NA	NA	NA	NA
7	25	450.5	8.5	NA	3.65	7.72	NA	NA	NA	NA	NA
8	27	373	3	NA	5.65	7.78	NA	NA	NA	NA	NA
8	25	421.5	6	NA	6.75	8.2	NA	NA	NA	NA	NA
9	25	360	4	190	4.6	7.28	NA	NA	NA	NA	NA
9	22	309	8	159	6.4	8.3	162	15	0.05	2.8	0.15
10	25	341.5	5.5	NA	NA	7.49	NA	NA	NA	NA	NA

TDS = total dissolved solids

Fish Species Collected

banded darter
banded sculpin
bigeye shiner
black buffalo
black bullhead
black crappie
blackstripe topminnow
bluegill
bluegill X green sunfish hybrid
bluegill X longear sunfish
bluegill X orangespotted sunfish
bluntface shiner
bluntnose darter
bluntnose minnow
brook silverside
fantail darter
flathead catfish
gizzard shad
golden redhorse
golden shiner
gravel chub
green sunfish
greenside darter
Johnny darter
largemouth bass
logperch
longear sunfish
longnose gar
northern hogsucker
orangespotted sunfish
orangethroat darter
river redhorse
rock bass
rosyface shiner
shorthead redhorse
slender madtom
slenderhead darter
slim minnow
slough darter
smallmouth bass
smallmouth buffalo
speckled darter
spotfin shiner
spotted bass
spotted sucker
stippled darter
stonecat

Neosho River Basin
HUC 11070207

Fish Species Collected

bullhead minnow
cardinal shiner
central stoneroller
channel catfish
channel darter
common carp
creek chub
Ozark minnow
red shiner
redear sunfish
redfin darter
redfin shiner
redspot chub
suckermouth minnow
warmouth
western mosquitofish
white crappie
white sucker
yellow bullhead

Mussel Species Collected

Asian clam
creeper
ellipse
fluted shell
fragile papershell
giant floater
mapleleaf
Neosho mucket
Ouachita kidneyshell
paper pondshell
pimpleback
pink papershell
pistolgrip
plain pocketbook
pondhorn
pondmussel
rabbitsfoot
round pigtoe
spike
threeridge
Wabash pigtoe
western fanshell
white heelsplitter
yellow sandshell


Image 1. Spring River, Cherokee Co.

Neosho River Basin
HUC 11070207

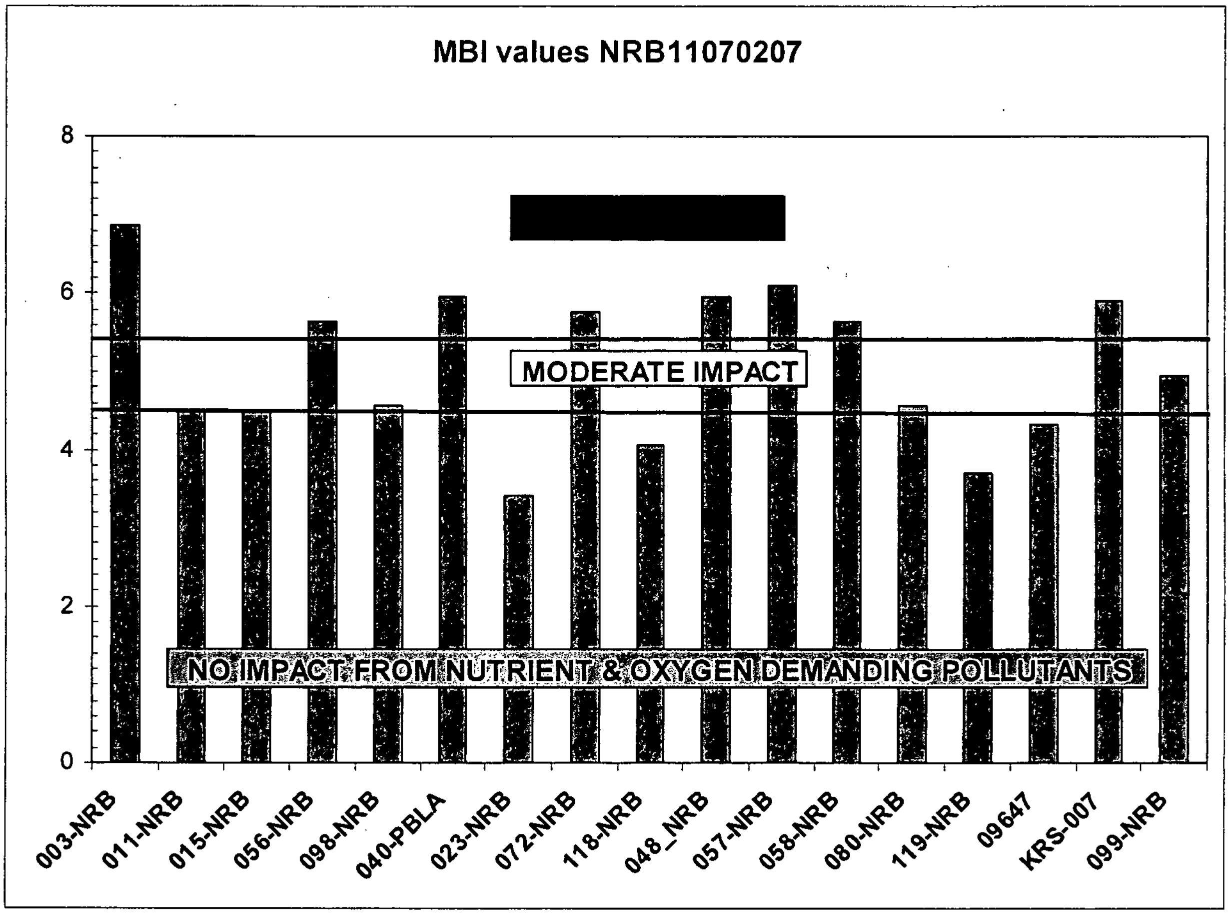


Figure 1. Graph of MBI values for HUC 11070207

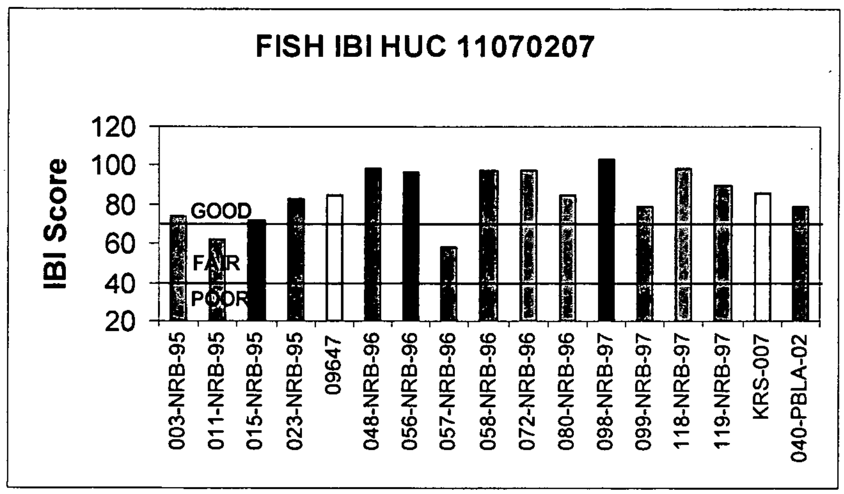


Figure 2. Graph of IBI values for HUC 11070207

Audit needs

"As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy."

The Watershed Restoration and Protection Strategy (WRAPS) program in Kansas is a process to engage stakeholders to identify plan and implement water quality measures. See the attached WRAPS brochure for more information.

In the Neosho River basin, several WRAPS projects are in the implementation phase. Two are in the Neosho River headwaters, and include the Marion Lake WRAPS, which includes the watershed above Council Grove Reservoir. A third WRAPS, includes the watershed of Eagle Creek in Lyon and Coffey Counties, which empties into the Neosho River immediately upstream of John Redmond Reservoir. A copy of the Eagle Creek WRAPS is attached.

Presently, there are efforts to develop a WRAPS for the remainder of the Neosho River watershed above John Redmond Reservoir not included in the above mentioned WRAPS. The Kansas Department of Health and Environment and the Kansas State Research and Extension are leading the effort. It is currently in the stakeholder recruitment phase. WCNOC has attended the preliminary planning sessions as a stakeholder in the process. Good Neosho River quality and its benefits to John Redmond Reservoir is in WCNOC's best interest due to the need for long-term make-up water for the plant's cooling lake. Copies of e-mail correspondence and meeting agenda are attached to demonstrate WCNOC involvement.

• Drawings and a detailed description of the circulating water system/service water system/essential service water system.

• Discharge Monitoring Reports for the last 12 month period.

• Whole effluent toxicity testing documentation or reports conducted at the facility (and as specified in the facilities National Pollutant Discharge Elimination Systems [NPDES] permit).

• Item D.21 of the Facilities NPDES permit states that information required by the 316(b) Phase II regulations shall be submitted to Kansas Department of Heath & Environment (KDHE) in accordance with the dates indicated in the Phase II regulations. Please describe the steps conducted to date by WCNOC to comply with this permit requirement and provide any data collected to date in support of this submission.

• Current and historic flow records for the Neosho River.

• A statement is made in the 5th paragraph of Enclosure 2 to WM 06-0046 (November 17, 2006) that the state of Kansas has not required entrainment monitoring and will not require it for the 316(b) determination. Please provide documentation from KDHE regarding this issue.

• Larval fish monitoring data as described in Paragraph 6 of Enclosure 2 to WM 06-0046 (November 17, 2006).

• If available, information on the location of the spawning areas for the various fish species in CCL.

• Bathymetric map of CCL.

• Available information regarding the initial stocking of CCL and subsequent stocking efforts.

• Available information regarding trends in the Neosho River fish populations.

• As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

• Additional details regarding the detailed assessment of impingement currently being prepared by WCNOC staff (as cited in Enclosure 3 to WM 06-0046, November 17, 2006).

• Possible cold shock impacts to gizzard shad is mentioned in Section 2.2 of the ER (WCGS, 1990). If there have been any incidents of cold shock to gizzard shad or other fish, please provide supporting data.

• Within Section 2.2 of the ER, it is noted that WCNOC develops annual fishery monitoring reports and management plans. Please have available the most recent publication of each of these reports.

29. As discussed in Enclosure 1 to WM 06-0046 (November 17, 2006), please provide any information available regarding WCNOC's stakeholder participation in the Watershed Restoration and Protection Strategy.

How will WRAPS projects be funded?

There are four basic stages in the WRAPS process, all of which qualify for funding through a variety of sources. The four stages are:

1. Development: Stakeholder recruitment, determine interest, document stakeholder decision.
2. Assessment: review watershed conditions, trends, develop expectations of the watershed and management measures in use, identify restoration and protection needs and watershed model.
3. Planning: Establish goals, identify actions that may achieve goals, develop cost estimates, select strategy, identify stakeholder implementation strategies.
4. Implementation: Secure resources needed to execute plan, monitor and document progress, revise plan as needed.

Selected Funding Sources:

A WRAPS fund is being established to finance projects. For SFY 2006, $2 million is proposed. This will require that the 2005 legislature appropriate $800 thousand from the Kansas Water Plan to be matched with $1.2 million EPA Section 319 grant funds from FFY 2006. Other funds that may be available to WRAPS projects include:

State Conservation Commission:

*Water Resources Program, NPS Pollution Program Riparian & Wetland, Watershed Dam Construction Program, Buffer Initiative Program.

Natural Resource Conservation Service:

*Environmental Quality Incentives Program: Base and Water Conservation, Wetland Reserve Program, Wildlife Habitat Incentives Program, Public Law 566, Farm and Ranchland Protection Program, Grassland Reserve Program.

Ks Department of Wildlife and Parks:

*Wildlife Habitat Improvement Program, Community Lakes Program, Biological Monitoring Program.

Farm Service Agency:
*Conservation Reserve Program

Watershed Restoration and Protection Strategy - WRAPS

Assuring Kansas' watersheds produce the goods and services Kansas citizens expect.

Kansas Natural Resources Sub-cabinet

Kansas Department of Wildlife & Parks

Kansas Department of Health & Environment

Kansas Department of Agriculture

Kansas Water Office

State Conservation Commission

Kansas Corporation Commission

Kansas Animal Health Department

For additional information contact:
Kerry Wedel, Ks Water Office 785-296-3185
Don Snethen, Ks Dept. of Health & Environment 785-296-5567
WWW.KSWRAPS.ORG

Watershed Restoration and Protection Strategy - WRAPS

What is WRAPS?

Kansas Natural Resources Sub-Cabinet

WWW.KSWRAPS.ORG

What is a WRAPS?

A Watershed Restoration and Protection Strategy is a planning and management framework intended to engage stakeholders in a process to:

* Identify watershed restoration and protection needs

* Establish management goals

* Create a cost effective action plan to achieve goals

* Implement the action plan

In addition to the WRAPS framework, a report is generated that records the stakeholders' decisions concerning goals, the plan to achieve the goals, and the resources required to execute the plan.

Why WRAPS?

WRAPS efforts are needed to address a variety of water resource concerns statewide. These concerns include water quality, public water supply reservoir protection, flooding issues, and wetland and riparian habitat protection or restoration.

What is the WRAPS Work Group?

The WRAPS Work Group is comprised of the members of the Kansas Natural Resources Sub-Cabinet and other state and federal agencies that have accepted an invitation from the sub-cabinet to be a member of the Work Group.

The Work Group is to assure that all Kansas' water resources meet the expectations of all stakeholders by facilitating a collaborative relationship among state, federal, local government and private sector interests so that financial, programmatic and technical assistance resources are directed to the priority water resource needs of Kansas' citizens.

State and federal agencies to be invited to join the WRAPS Work Group include the Natural Resource and Conservation Service, the United States Geological Survey, Kansas State University, Kansas Biological Survey, the Environmental Protection Agency, Corps of Engineers, the US Fish and Wildlife Service, the Bureau of Reclamation, the Farm Service Agency, Rural Development, State and Extension Forestry, Ks Geological Survey and the Ks Department of Transportation.

What is the Ks Watershed Partnership?

The Kansas Watershed Partnership purpose is to assure that all Ks water resource stakeholders are implementing the WRAPS by providing advice to the WRAPS work group and promoting stakeholder participation in WRAPS projects.

Partners are composed of any public or private organization that applies for membership and accepts the Statement of Principles and the duties and obligations within the Partnership Agreement.

How Do I get involved in the WRAPS Process?

1. Identify Watershed Stakeholders: Cities, Landowners, Agencies, Watershed Districts, Conservation Groups, etc. Form a Watershed Stakeholders Committee and identify a sparkplug to lead the WRAPS effort and chair the committee.

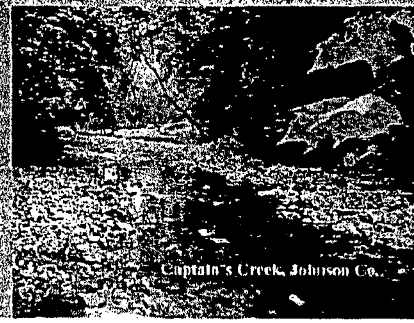
2. Assess Watershed Conditions & Needs: (KDHE produces draft reports which discuss Total Maximum Daily Loads, designated uses, potential pollution sources, etc.) In addition, review other applicable reports that address resource conditions in the watershed. Review the reports with the committee and add local knowledge to the report.

3. Prepare a Pollutant Source Inventory: Work with agencies to identify potential pollution sources. Inventory other resource conditions and needs where applicable.

4. Determine Watershed Goals: These could include meeting Total Maximum Daily Loads, protecting a public water supply, enhancing recreation, etc.

5. Prepare an Implementation Plan: The committee writes a plan that includes: actions needed to achieve watershed goals; responsible parties to implement each action; cost estimates to implement actions; available funding; and an implementation schedule.

6. Statement of Adoption: Agencies and committee members issue Statements of Adoption to finalize the process and the WRAPS plan.



Captain's Creek, Johnson Co.

Haines Daniel E

From: Robert Wilson [rwilson@agecon.ksu.edu]

Sent: Monday, December 04, 2006 2:22 PM

To: Wedel, Kerry; Haslett, Susan SWT; Gnau, Chris; tstiles@kdhe.state.ks.us; Titus, JoBea - Council Grove, KS; bruce.wells@ks.usda.gov; ssattert@kdhe.state.ks.us; katie.miller@ks.nacdnet.net; Haines Daniel E; Hammond Robert A; amayo@flinthillshealth.org; debbe.schopper@ks.nacdnet.net; ksthomas@lcwb.coop; denise.benteman@ks.nacdnet.net; brees@oznet.ksu.edu; mholder@oznet.ksu.edu; spbrown@ksu.edu

Cc: ljames@oznet.ksu.edu; joseph.hecht@ks.usda.gov; keith.beatty@emporia.ws; john.conway@ks.usda.gov; crensink@oznet.ksu.edu; kristi.vogts@ks.nacdnet.net; robert.harkrader@ks.usda.gov; gay.spencer@ks.usda.gov

Subject: agenda for Neosho WRAPS meeting on Dec. 5

Importance: High

Please find attached the agenda for the meeting on Tuesday, December 5 to discuss the WRAPS projects for the Neosho Headwaters & Lower Cottonwood watersheds.

The meeting is scheduled for 10:00am to 1:00pm with a working lunch (provided) at the Lyon County Extension Office located at 618 Commercial St. in downtown Emporia.

Parking is available in the public lot behind the building. Use the back entrance of the building to access the meeting room.

If you need additional directions, please contact the Lyon County Extension Office directly at 620-341-3220.

Looking forward to seeing you on Tuesday!

NEOSHO HEADWATERS & LOWER COTTONWOOD
WATERSHED RESTORATION & PROTECTION STRATEGY (WRAPS)

Agency Coordination Meeting
December 5, 2006
10:00am – 1:00pm
Lyon County Extension Office
Emporia, Kansas

AGENDA

1. Welcome & introductions
   Group

2. Recap of previous meetings & current status of WRAPS projects in Neosho Basin
   Robert Wilson, K-State Research & Extension

3. Overview of water quality impairments in the Neosho Headwaters & Lower Cottonwood watersheds
   Tom Stiles, KDHE Watershed Planning Section

4. Overview of John Redmond Reservoir Sedimentation Study
   Kerry Wedel & Chris Gnau, Kansas Water Office

5. Discussion of local watershed issues & concerns
   Group

6. Relationship/integration with other WRAPS projects in watersheds (Twin Lakes & Eagle Creek)
   Group

7. Next steps/future direction
   Group

Funding for this WRAPS project provided by Kansas Department of Health & Environment –
Watershed Management Section through EPA Section 319 Nonpoint Source Pollution Control Program

Haines Daniel E

From: Robert Wilson [rwilson@agecon.ksu.edu]

Sent: Tuesday, January 30, 2007 4:51 PM

To: Haines Daniel E; ksthomas@lewb.coop; amayo@flinthillshealth.org; Titus, JoBea - Council Grove, KS; marylou.ponder@ks.nrcs.gov; Vogts, Kristi - Burlington, KS; denise.benteman@ks.nacdnet.net; katie.miller@ks.nacdnet.net; bruce.wells@ks.usda.gov; Brian Rees

Subject: stakeholder names for Neosho Headwaters and Lower Cottonwood WRAPS

Importance: High

Thank you for participating in the meeting on December 5 in Emporia where we discussed WRAPS projects for the Neosho Headwaters and Lower Cottonwood watersheds.

You agreed to help us identify folks in these watersheds that might be interested in being a part of the WRAPS process and/or serving on a local leadership team. These could be producers/farmers that you have worked with on BMP implementation projects, board members from your organization, local government staff, rural water districts, watershed districts, or anyone else that might have an interest or stake in water and natural resource related issues.

We discussed the idea of inviting these folks to some informal meetings and tours this winter/spring to educate them about WRAPS and to ask for their input in identifying local issues or problems of concern.

Would you please send me contact information (names, addresses, e-mail if available) for the folks that you identified? If you could share this information by February 9 that would be most helpful.

I will also be following up in a separate e-mail later this week to identify potential dates & locations for the stakeholder meetings.

Thanks for your continued interest and support of these WRAPS projects!

ROBERT M. WILSON
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K-State Research & Extension
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COFFEY COUNTY REGIONAL

WATERSHED RESTORATION AND PROTECTION STRATEGY

WITH

EAGLE CREEK PROJECT IMPLEMENTATION PLAN

COFFEY, WOODSON, and LYON COUNTIES

KANSAS

Partially funded through an Environmental Protection Agency (EPA) Section 319 Grant C9007405-9 administered by the Kansas Department of Health and Environment (KDHE)

COFFEY COUNTY REGIONAL

WATERSHED RESTORATION AND PROTECTION STRATEGY

COFFEY, WOODSON, and LYON COUNTIES

KANSAS

December 15, 2005

Includes strategy focus for:

Eagle Creek
HUC 11 (HUC14): 11070201040 (030, 040, 050)

With Stakeholder and Conservation Needs Information for:

Big Creek
HUC 11 (HUC14) 11070204010 (040, 050, 060)

Turkey Creek
HUC 11 (HUC14) 11070204020 (020)

Long/Scott Creeks
HUC 11 (HUC14) 11070204010 (020)

Crooked Creek
HUC 11 (HUC14) 11070204020 (030)

Partially funded through an Environmental Protection Agency (EPA) Section 319 Grant C9007405-9 administered by the Kansas Department of Health and Environment (KDHE)

(NPS # K3-035)

COFFEY COUNTY REGIONAL

WATERSHED RESTORATION AND PROTECTION STRATEGY

EXECUTIVE SUMMARY

This report is the Watershed Restoration and Protection Strategy (WRAPS) for the Eagle Creek watershed in the counties of Lyon, Coffey, and a small portion of Greenwood. Water quality impairments (TMDL) addressed are dissolved oxygen and copper in Eagle Creek, and eutrophication and siltation in Olpe City Lake. The watershed's contribution to eutrophication and siltation in John Redmond Reservoir, as well as logjam issues in Eagle Creek and the Neosho River at John Redmond Reservoir are included.

The scope of this project initially included, in addition to Eagle Creek, the watersheds of Big, Turkey, Long/Scott, and Crooked Creeks in Lyon, Woodson, Coffey and Greenwood counties. These watersheds have been removed from the project implementation plan presented in this WRAPS due to larger WRAPS development being initiated in the area, and grant funding priorities. Planning information for these watersheds was collected, and is valuable for reference purposes.

The assessment and planning phase of this WRAPS included three primary data gathering efforts. First was input from an advisory group comprised of invited stakeholders. Second was input from the general public within the selected watersheds. Finally, a best management practice (BMP) needs inventory was completed.

Stakeholder input identified best management practices that watershed landowners and producers would most likely accept and use to address water quality issues. Buffer areas, information and education, and grazing management were ranked important. Conservation needs inventory indicated that streamside buffer strip is lacking in the Eagle Creek watershed.

A demonstration project is proposed to establish and promote a Harvested Riparian Buffer Best Management Practice. Public input identified a need for the practice to encourage land use compatibility, primarily winter grazing, with water quality protection. The goal of the practice is to reduce potential for excess nutrient and sediment inputs from croplands to the streams and impoundments in the watershed, thus addressing TMDL concerns.

The project implementation plan is based on the stakeholder information and BMP inventory data gathered. The plan focuses on information and education needs. The BMP's identified includes buffers, stock water development, conservation tillage, grazing management, and fencing incentives. Funding sources are also identified.

Load reductions for nitrogen, phosphorus, biochemical oxygen demand, and total suspended solids are needed to set goals to meet water quality goals and expectations, including TMDL's. The Kansas Department of Health and Environment, Bureau of Water, Watershed Management Section, will provide load reduction estimates through use of the Environmental Protection Agency Spreadsheet Tool for Estimating Pollutant Load (STEPL) model. For more information see http://.it.tetratech-ffx.com/stepl/.

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EAGLE CREEK

WATERSHED RESTORATION AND PROTECTION STRATEGY

SECTION 1.0 INTRODUCTION

This Watershed Restoration and Protection Strategy (WRAPS) has been formulated to address water quality issues in the Eagle Creek watershed in the counties of Lyon, Coffey, and a small portion of Greenwood. Total maximum daily load (TMDL) for pollutants have been established for the watershed, and include low dissolved oxygen and copper for Eagle Creek; and excessive eutrophication and siltation for Olpe City Lake, which is within the watershed. The watershed's contribution to excessive eutrophication, siltation and logjam issues to nearby John Redmond Reservoir will also be addressed. This report represents the planning stage, and presents the project implementation plans with the goal of reducing non-point source pollutants, thus restoring and protecting water quality above and beyond that needed to reduce the identified impairments.

The scope of this project initially included, in addition to Eagle Creek, the watersheds of Turkey Creek in north Woodson and south Coffey counties, Big Creek in southwest Coffey, extreme northeast Greenwood, and northwest Woodson counties, and the Long/Scott and Crooked Creeks in central Coffey county. These watersheds have been removed from the project implementation plan presented in this WRAPS due to larger WRAPS development being initiated in the area, and grant funding priorities. Planning information for these watersheds was collected, and is valuable for reference purposes with this WRAPS, as well as others that may be developed. These data are presented and summarized within this report.

There were two main components during the planning phase that were heavily used to prepare the WRAPS implementation plan presented. They included:

1. Identify water quality protection practices and the extent that landowners and stakeholders will most likely implement the practices. These were determined using stakeholder and public meetings within the watersheds.

2. Determine the degree of current water quality practices and those necessary to improve or maintain water quality. This included identifying existing funding sources and additional funding needs. This was accomplished by Conservation District staff inventory of existing practices and needs.

SECTION 2.0 WATERSHED DESCRIPTIONS

Land use in the watersheds presented in this WRAPS are typical of east-central Kansas. Cropland and native tallgrass rangeland dominate, with tame pastures and hay meadows common. Trees and brush are common along stream courses. Figure 1 illustrates the general land use types.

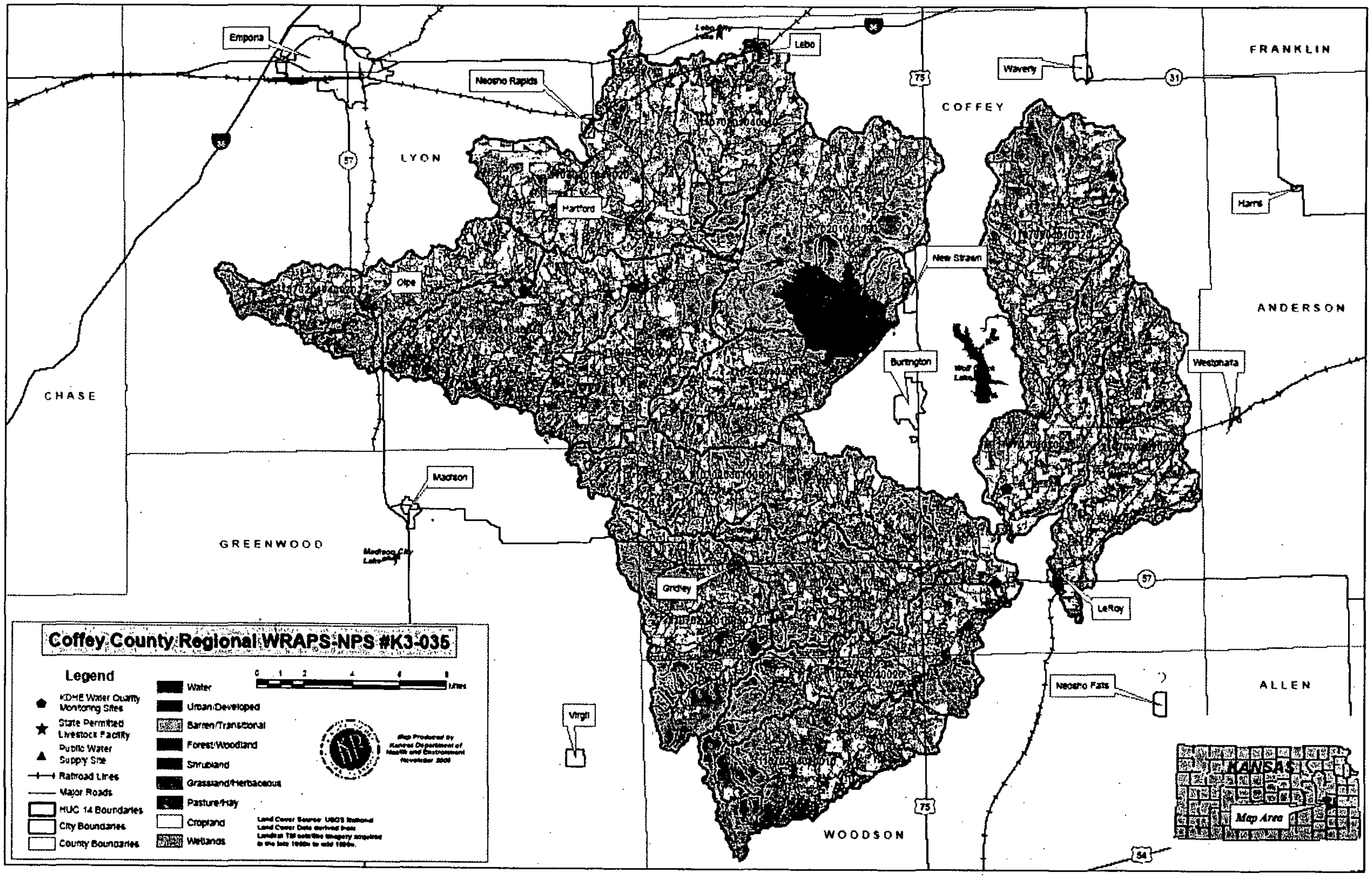

Figure 1. **General location and land use types for the target Eagle Creek watershed, reference TMDL streams Big and Turkey Creeks, and reference non-TMDL streams Long/Scott and Crooked Creeks in Lyon, Coffey, Woodson, and Greenwood counties. Additional watersheds included for reference.**

2.1 Eagle Creek

The watershed of Eagle Creek [HUC 11 (HUC14): 11070201040 (030, 040, and 050)] is the target area for this WRAPS. It is within the Neosho River headwaters sub-basin. The stream's main stem segments are in south-central Lyon County, and flow easterly to its confluence with the Neosho River in west-central Coffey County (Figure 1). A small segment, approximately 119 acres (0.2 %), of the watershed lies within Greenwood County (Table 1).

Land use in the Eagle Creek watershed is primarily agricultural, consisting of grassland for grazing and haying production (61.2 %), and cropland (30.3 %, Table 1, Figures 2 and 3). Olpe is the only city within the watershed. The Olpe City Lake (HUC 14: 11070201040030) is in the headwaters area of this watershed.

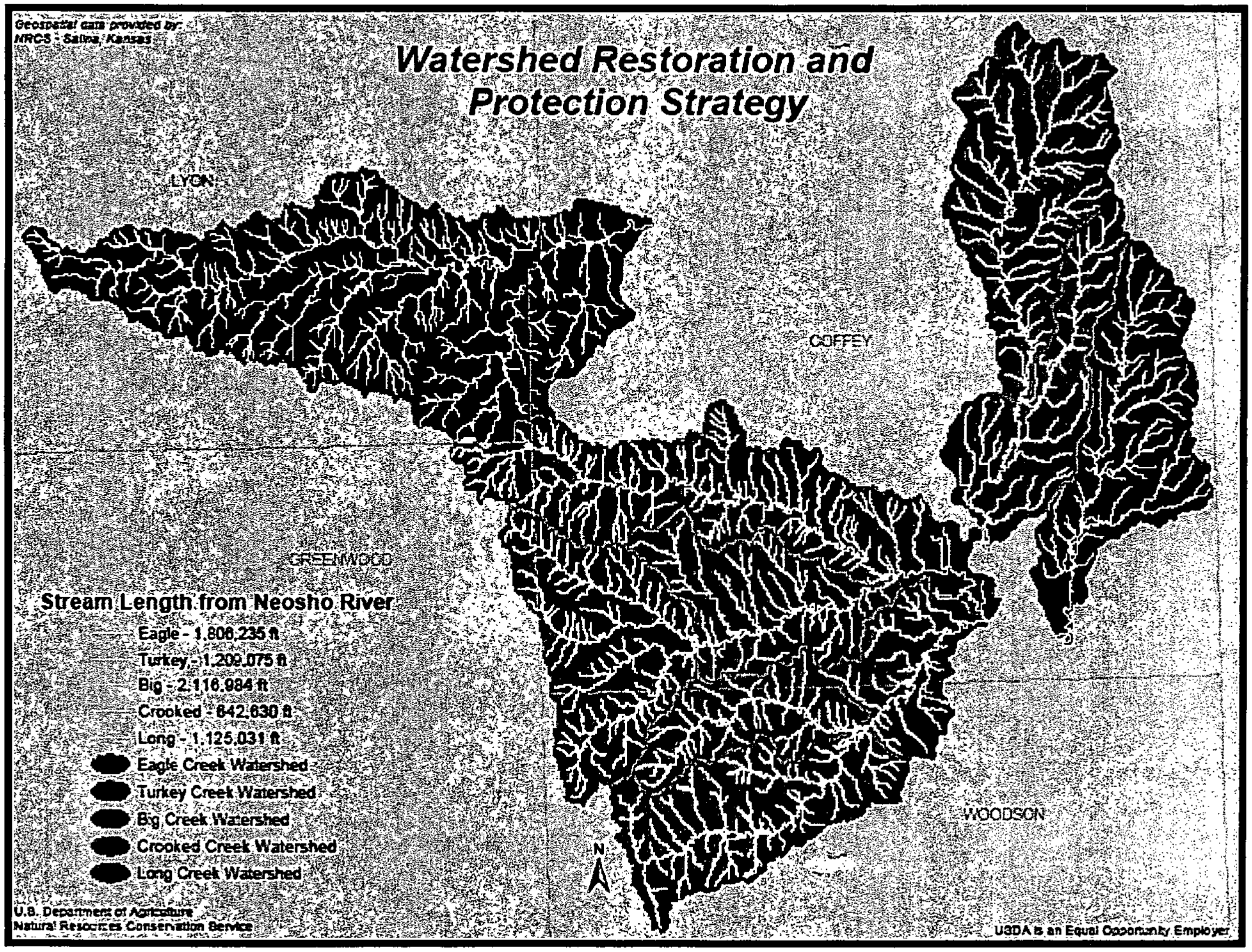

Figure 2. Streamside length (ft) of all tributaries in the target Eagle Creek watershed, reference TMDL streams Big and Turkey Creeks, and reference non-TMDL streams Long/Scott and Crooked Creeks in Lyon, Coffey, Woodson, and Greenwood counties.

Table 1. Acreage and percent composition of cropland, permanent (grass/riparian) vegetative cover, and established buffer Best Management Practice (BMP) within selected watersheds. Remaining percentages consist of land uses not identified below include urban, industrial, roads, quarry, woodlots, and other miscellaneous types.

			Area (acres) and percent composition of land use types							
WRAPS Status	Watershed	County	Total of All types	Cropland	% Cropland	Grass (1) Cover	% Grass Cover	Buffer BMP	% Total with Buffer BMP	% Cropland with Buffer BMP
Target Stream	Eagle Creek	Coffey	12,372	3,672	29.7	7,654	61.9	88	0.7	2.4
		Lyon	61,177	18,660	30.5	37,444	61.2	56	0.1	0.3
		Greenwood	119	UA	UA	UA	UA	UA	UA	UA
		Total	**73,668**	**22,332**	**≥30.3**	**45,098**	**≥61.2**	**≥144**	**≥0.2**	**≥0.6**
Reference with TMDL	Big Creek	Coffey	71,681	17,126	23.9	50,446	70.4	280	0.4	1.6
		Woodson	7,266	524	7.2	6,719	92.5	0	0	0
		Lyon	285	105	36.8	180	63.1	0	0	0
		Greenwood	5447	492	9.0	4,406	80.9	UA	UA	UA
		Total	**84,679**	**18,247**	**21.5**	**61,751**	**72.9**	**≥280**	**≥0.3**	**≥1.5**
	Turkey Creek	Coffey	9604	2308	24.0	6231	64.9	1.3	<0.1	0.1
		Woodson	39,242	6969	17.5	29,419	75.0	13.0	<0.1	0.2
		Total	**48,846**	**9177**	**18.8**	**35,650**	**73.0**	**14.3**	**<0.1**	**0.1**
Reference w/o TMDL	Long/Scott Creeks	Coffey	51,859	16,844	32.5	32,191	62.1	533.2	1.0	3.2
	Crooked Creek	Coffey	27,150	9874	36.4	14,465	53.3	288.6	1.1	2.9

(1) Grass includes all native and tame species grazed, hayed, or unused, within the watersheds, not including buffer BMP.

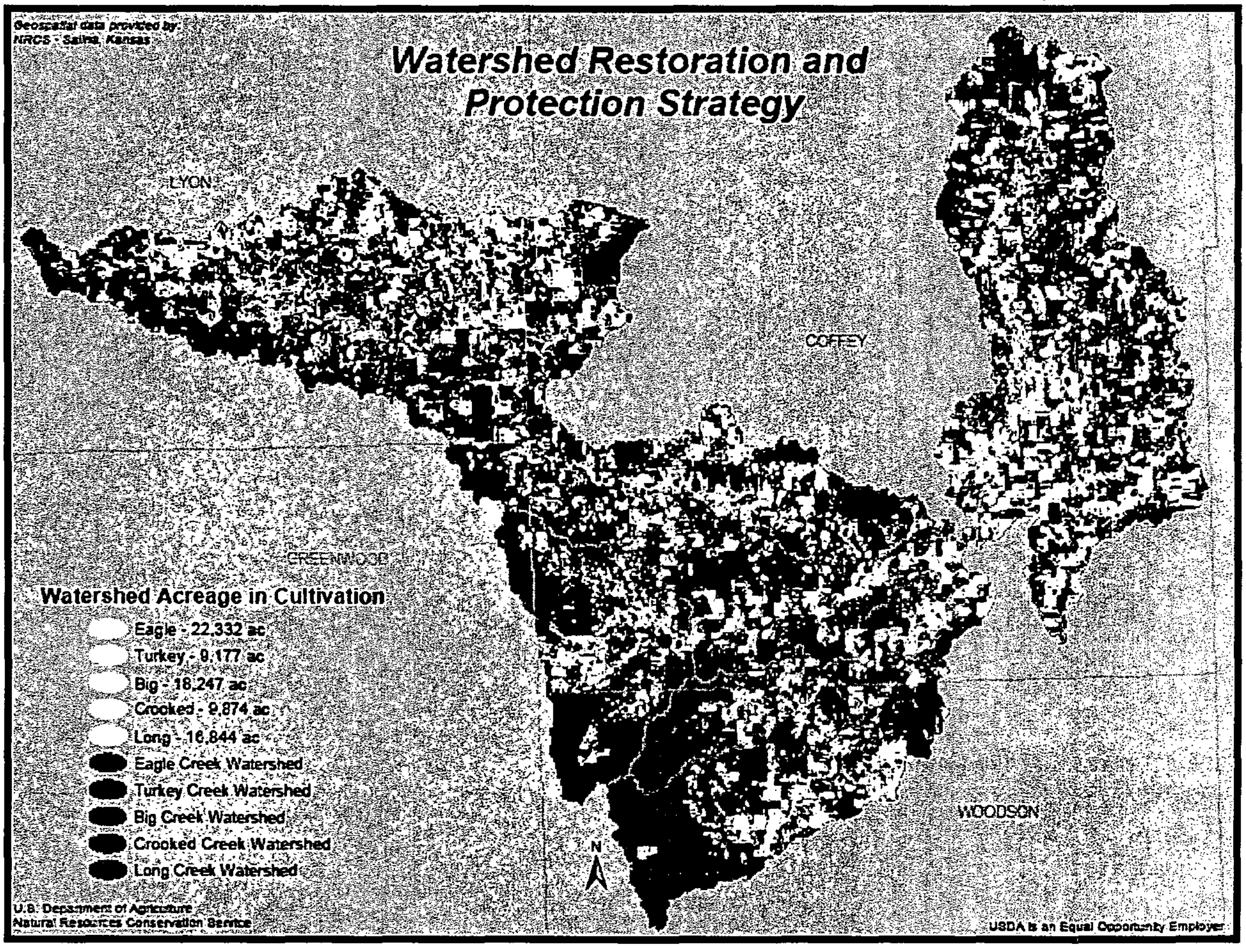

Figure 3. Cropland acreage in the target Eagle Creek watershed, reference TMDL streams Big and Turkey Creeks, and reference non-TMDL streams Long/Scott and Crooked Creeks in Lyon, Coffey, Woodson, and Greenwood counties.

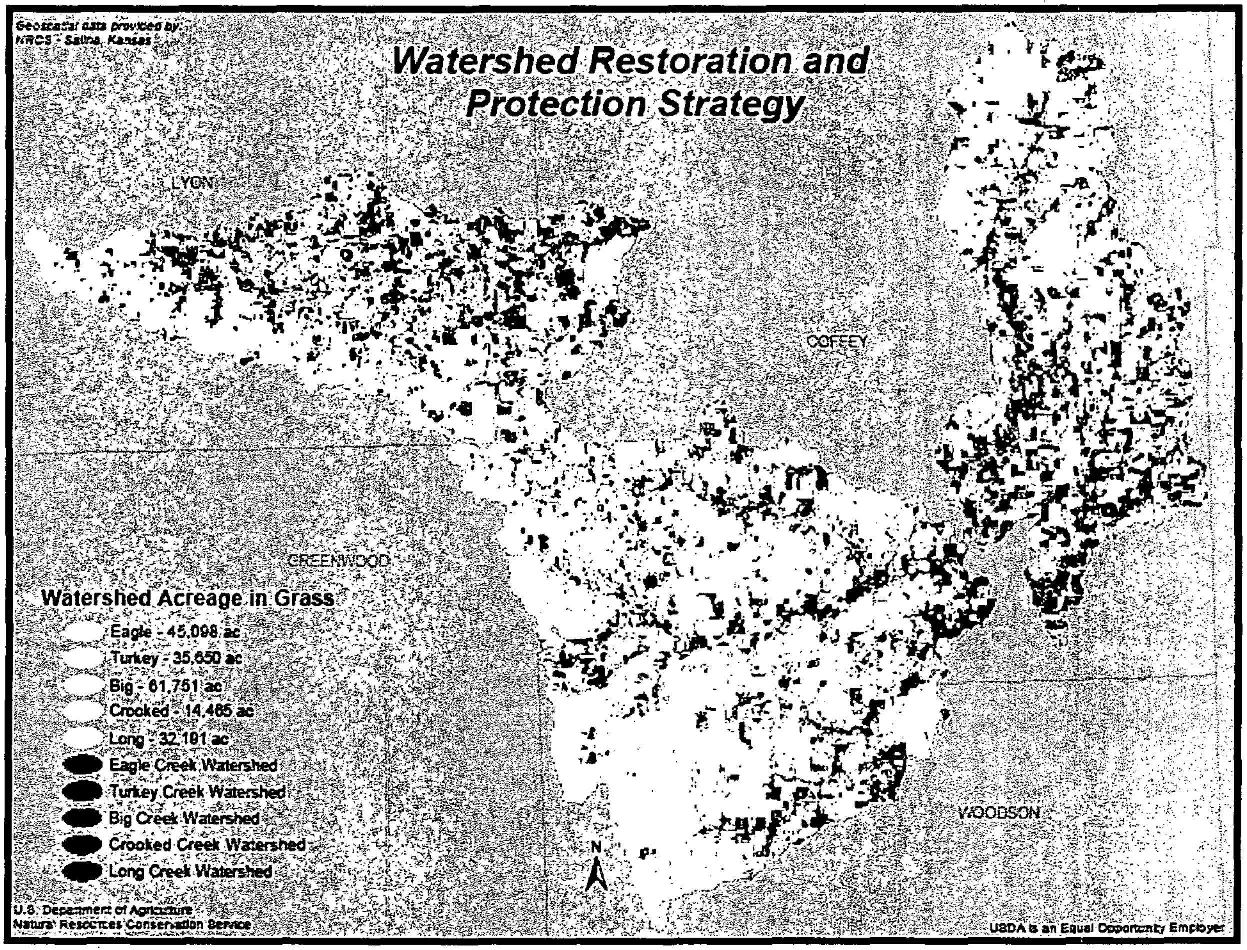

Figure 4. Grassland acreage in the target Eagle Creek watershed, reference TMDL streams Big and Turkey Creeks, and reference non-TMDL streams Long/Scott and Crooked Creeks in Lyon, Coffey, Woodson, and Greenwood counties.

2.2 Reference TMDL Streams

For the purposes of this report, the watersheds of Big Creek [HUC 11 (HUC 14): 11070204010 (040, 050, and 060)] and Turkey Creek [HUC 1 (HUC1 14): 11070204020 (020)] will be considered as reference streams with TMDL water quality impairments. They are not part of the WRAPS implementation plan presented later.

Small headwater areas of Big Creek are located in Lyon, Woodson, and Greenwood Counties. The majority of the watershed is within southwest Coffey County (Figure 1). The main stem segments flow easterly to its confluence with the Neosho River near Le Roy, in southeast Coffey County. The watershed has a higher percentage (72.9) of grassland cover due to larger tracts of native rangeland in the headwater areas (Table 1). Cropland is concentrated in the downstream areas, comprising 21.5 percent of the watershed.

Most of the Turkey Creek watershed is in northwest Woodson County. Main stem segments flow northeasterly to the streams confluence with the Neosho River near Le Roy in Coffey County (Figure 1). As with Big Creek, the drainage has a larger percentage of grassland (73) due to the prevalence of native rangeland in the headwater areas. Cropland is also concentrated in the lower reaches (18.8 percent, Table 1).

2.3 Reference non-TMDL Streams

The watershed of Long/Scott Creeks [HUC 11 (HUC 14): 11070204010 (020)] and Crooked Creek [HUC 11 (HUC 14): 11070204020 (030)] will be considered as reference streams that do not have TMDL water quality impairments. Both watersheds are in east central Coffey County, with main stem segments flowing southerly to their confluence with the Neosho River near Le Roy (Figure 1). Cropland and grassland percentages are similar to the Eagle Creek watersheds, but have higher percentages of cropland, due to less native rangeland in the headwater areas, than Big and Turkey Creeks (Table 1).

SECTION 3.0 WATER QUALITY IMPAIRMENTS AND ISSUES

3.1 Eagle Creek

3.1.1 Dissolved Oxygen

The primary pollutant concern within the stream is low dissolved oxygen (DO), for which a total maximum daily load (TMDL) has been established. Nutrient enrichment from agricultural sources, likely animal wastes and fertilizer runoff, is suspected to contribute to periodic low DO conditions. The implementation priority for addressing low DO has been rated as high. Refer to TMDL summary at www.kdheks.gov/tmdl for further information.

3.1.2 Copper

Copper is another pollutant considered as excessive in Eagle Creek, and for which a TMDL has been established. The periodic high copper occurrences are likely from non-point sources, of which agricultural land runoff is a major contributor. The implementation priority to reduce copper in Eagle Creek has bee assessed as low, however, best management practices (BMP) applied to the watershed to address DO and sedimentation concerns in the stream will likely reduce copper inputs. Refer to TMDL summary at www.kdheks.gov/tmdl for further information.

3.2 Olpe City Lake

The Olpe City Lake (HUC 14: 11070201040030) is southwest of Olpe, and within the Eagle Creek watershed. It currently has designated TMDL's for eutrophication and siltation. The implementation priority for the lake has been rated as high. Designated uses for the lake is for primary and secondary contact recreation, expected aquatic life support, and food procurement. WRAPS implementation using best management practices within the Eagle

Creek watershed, which will include the lake's watershed, will address agricultural non-point sources of nutrients and sediments to the lake. Refer to TMDL summary at www.kdheks.gov/tmdl for further information.

3.3 John Redmond Reservoir

Eagle Creek's confluence with the Neosho River is immediately upstream of the conservation pool of John Redmond Reservoir (JRR). This federal reservoir provides water storage for flood control, industrial and municipal use. Water quality impairments that have been identified for JRR include eutrophication and siltation (www.kdhe.gov/tmdl). The reservoir TMDL's have an implementation priority of medium. Implementation of this WRAPS will reduce the Eagle Creek watershed's contribution of nutrients and sediments to JRR.

A significant logjam currently exists at the Eagle Creek confluence with the Neosho River. A much larger jam occurs immediately downstream of Eagle Creek where the Neosho River enters JRR. The logjams have not been considered a pollutant impairment, however, there exists local and regional concerns with changing stream flows and negative recreational impacts. It appears that these jams occur due to normal delta-forming dynamics characteristic where rivers meet pooled water. Sedimentation and debris (log) collection at this point appears to be a normal consequence of JRR flooding and operation. Tree addition to watercourses over time is considered a natural phenomenon, occasionally exacerbated by ice storm and flooding events. However, implementation of this WRAPS is expected to increase riparian area function, reduce flood velocity effects, and sediment additions. These benefits are expected over time to reduce the Eagle Creek watershed's contribution of logs and sediments to the JRR logjam.

SECTION 4.0 ASSESSMENT AND PLANNING

The assessment and planning phase of this WRAPS included three primary data gathering efforts. First was input from an advisory group comprised of invited stakeholders. Second was input from the general public within the selected watersheds. Finally, a conservation needs inventory was completed.

4.1 Advisory Group

An invited stakeholders meeting was held on May 6, 2004 at Burlington, Kansas. Invited were selected residents, landowners/producers, local government officials, conservation districts, state and federal conservation agencies, and non-government organizations. Invitees were selected that were expected to represent diverse technical interests. Twenty-three attendees participated in the meeting. Data gathered from the Advisory Group was subsequently used as focus material for the general public meetings. Attendees and interests represented are presented in Attachment 1.

4.1.1 Goal and Objectives

This group was presented the goal to provide input and direction to the WRAPS project so that water quality improvement resources can be targeted towards practices most likely to be applied by local landowners and stakeholders.

The group's objectives to meet the goal were to:

1. Identify and prioritize which practices are needed that will most likely be accepted, and

2. Identify what incentives, methods, or mandates that landowners and stakeholders would accept that will promote identified practices.

4.1.2 Issues Discussed

To fulfill the first objective, twenty-one issues were brought forward and discussed as follows:

1. Buffer/filter strip promotion
2. Riparian Area enhancement
3. Conservation Reserve Program (CRP) enrollment increases
4. Maintaining ground cover on expiring CRP acreage
5. Sensitive land acquisition
6. Shallow-water area development
7. Limiting livestock from streams (fencing)
8. Improved grazing animal management (rates, distribution, etc)
9. Livestock waste management (winter feeding areas)
10. Household sanitation programs
11. Cropland nutrient management
12. Tillage management enhancement
13. Rangeland management (nongrazing, i.e. brush control)
14. Stream bank erosion control
15. Recreation
16. Alternative livestock water source development
17. Chemical application management
18. Roadside management (clippings and erosion)
19. Improper disposal of animals, clippings, trash
20. Salt water discharges from oil drilling
21. Information and education

4.1.3 Ranked Issues

To rank the issues brought forward, the Advisory Group members listed the top five issues as they related to their areas of influence. These top five priorities were tallied to rank the conservation issues and practices that they felt were most needed. Seventeen issues received votes and are listed in Table 3. Items not selected were deleted from list.

Table 2. Conservation Practices Ranked by Advisory Group

Rank	Practice	% attendees ranked in top five
1	Information and education	61
2	Buffer/filter strip promotion	61
3	Improved grazing animal management (rates, distribution)	43
4	Livestock waste management (winter feeding areas)	39
5	Crop nutrient management (incorporate fertilizer, soil testing)	39
6	Alternative livestock water source development	35
7	CRP enrollment increases	26
8	Tillage management (no till)	26
9	Chemical application managements	17
10	Limiting livestock from streams (fencing)	13
11	Stream bank erosion control and stabilization	13
12	Riparian area protection/enhancement	9
13	Maintaining expiring CRP ground cover	4
14	Household sanitation programs	4
15	Rangeland management (brush control)	4
16	Roadside/ditch management (clippings and erosion)	4
17	Salt water discharges from oil drilling	4

4.1.4 Methods to Enhance Participation

To fulfill the second objective, methods were discussed that would promote acceptance by landowners and producers in the watersheds. They are discussed below as they relate to the ranked practices.

1. Information and Education

   This was one of the areas the group considered as a top priority to address all water quality concerns. Increased knowledge and insight by the landowners and producers was considered crucial to their accepting and applying conservation practices. Generally, it was felt that this was lacking, and that this issue would be involved with nearly all the other items prioritized. To address this concern, the group felt the WRAPS should:

   a. provide outreach to targeted audiences

   b. increase face-to-face contact with landowner/producers on conservation concerns

   c. increase farm demonstrations and field days on water quality issues and conservation

   d. solicit individual conservation-minded leaders to help with farm demonstrations and field days to increase interest by watershed neighbors

e. provide promotional items, such as hats or jackets to advertise efforts and spark local interest

f. provide meals, etc to promote attendance to farm demonstrations and field days

g. saturate watersheds with information via media, mailing, one-on-one contact, etc, about available programs, improvement efforts and successes

h. encourage and support attendance of landowner/producers to local and regional conferences, demonstrations, or classes. Examples may include No-till on the Plains, Kansas Environmental Leadership Program, and range management classes or workshops.

i. help landowner/producers coordinate use of existing conservation programs.

2. Buffer/filter Strip Promotion

The establishment of buffer or filter strips along streams was considered one of the most practical ways to reduce excess sediment and nutrient loads to improve water quality in the watersheds. To promote these, the WRAPS should:

a. increase information and education (see practice 1)

b. make current buffer program more compatible with livestock operations by allowing grazing during winter season with little or no program benefit reductions. It was felt that a grazed filter strip would have greater net benefits than filter strips not being installed due to current grazing prohibitions.

c. Increase cost-share incentives for buffer strip establishment

d. Provide for incentives for temporary fencing to allow cropland grazing, thus maintaining landowner/producer land use flexibility.

3. Improved Grazing Animal Management

This item relates to encouraging proper grazing rates, and improving grazing distribution on rangelands within the watersheds. This practice would address sedimentation, fecal coliform bacteria, and dissolved oxygen concerns. The WRAPS should include:

a. management incentives to establish and maintain grazing plans

b. provisions for technical assistance with grazing plans

c. information and education outreach (see practice 1)

d. financial assistance with fencing, etc.

e. monitor rangeland versus cropland contributions to TMDL problems, primarily dissolved oxygen.

4. Livestock Waste Management

This item addressed primarily cattle feeding areas during winter periods to reduce sediment, nutrient loads, and fecal coliform bacteria. WRAPS should include:

a. information and education outreach (see practice 1)

b. increase incentives and cost-share to install buffers, fencing, etc to control winter-feeding area runoff

c. increase technical assistance on waste management or feeding practices

d. provide incentives to limit winter feeding area impacts.

5. Crop Nutrient Management

This item addresses dissolved oxygen and copper concerns in the steams that can be caused by excessive nutrient runoff from common cropping practices. WRAPS should:

a. increase information and education outreach (see practice 1)

b. increase or offer incentives for crop management practices that reduce nutrient loss to streams. Examples may include fertilizer incorporation and soil testing enhancements

c. provide or subsidize specialized equipment, such as fertilizer incorporation tools

d. increase technical assistance for crop nutrient and soil testing enhancements

e. provide for appropriate buffer/filter strip grazing allowances so that cropland nutrient runoff reductions can be obtained during the growing seasons.

6. Alternative Livestock Water Source Development

Providing water sources for grazing animals other than within streams will reduce nutrient loading and fecal coliform bacteria concerns. The WRAPS should:

a. increase information and education outreach (see practice 1)

b. offer financial assistance for stock water development, such as pit ponds or well supplies.

c. increase technical assistance for grazing management.

7. Conservation Reserve Program Enrollment

Encouraging the enrollment of cropland into the CRP practices will address sediment and nutrient loads suspected to be causing dissolved oxygen and copper TMDL problems in the target watershed. Such enrollments may include new sign-ups, continuous CRP, or re-enrollment. The WRAPS should:

a. provide information and education on program availability (see practice 1)

b. offer financial assistance, including increased signing bonuses and cost share for ground cover establishment

c. provide for buffer/filter strip grazing where applicable to maintain surrounding non-CRP land use options

8. Tillage Management

This issue will address dissolved oxygen and copper concerns that are suspected to be caused by sediment and nutrient runoff for common cropping practices. The WRAPS should:

a. increase information and education outreach (see practice 1)

b. offer financial incentives for crop management practices that reduce sediment loss to streams. Examples may include crop management plans, or conversion to no-till practices.

c. provide or subsidize specialized equipment, such as no-till drills or planters. Intentions would be to familiarize landowner/producers with what is available on the market so they can purchase for themselves what works best in their operation.

d. provide for appropriate buffer/filter strip grazing allowances so that cropland sediment runoff reductions can be obtained during growing seasons.

9. Chemical Application Management

This item addresses proper herbicide use which may not be directly responsible for identified water quality concerns, however, is integral with proper range, crop and noxious weed management. Methods to enhance include:

a. improved information and education outreach (see practice 1)

b. provide or subsidize specialized equipment, such as spot sprayers

10. Limiting Livestock from Streams

This item addresses fecal coliform and nutrient addition concerns in target streams. Methods include:

a. improved information and education outreach (see practice 1)

b. provide incentives to exclude grazing animals from streams, especially when alternative water sources are developed (see practice 6).

11. Streambank Erosion Control

This item addresses sediment inputs from eroding banks that may contribute to sediment and copper concern in the target stream. WRAPS should:

a. establish buffer strips (see practice 2)

b. provide financial incentives for bank and stream bank projects to stabilize erosion.

12. Remaining Ranked Practices

The remaining six practices were identified by less ten percent of the Advisory Group. They were all considered important, and are indicative of the diversity of interests and expertise within the group. They involve practices to manage existing streamside and watershed vegetation, household waste system, and specific pollutant inputs, such as salt water from oil drilling.

4.2 General Public Input

Four public meeting were held to present the Advisory Group results and to solicit input. Public input to developing this WRAPS implementation plan produced valuable information from four public meetings. Public input revealed that information and education on conservation issues, buffer strip establishment, and grazing management were most needed. These meetings were held in locations to target Eagle, Turkey, and Big Creeks as follows:

Location	Date	Attendance
Olpe	May 17, 2004	44
Gridley	May 18, 2004	14
Yates Center	May 18, 2004	21
LeRoy	May 19, 2004	8
		Total 87

4.2.1 Issues Discussed

The attendees considered the Advisory Group's list of practices needed to improve or protect water quality and added the following:

1. identify specific areas contributing to water quality problems (ie fecal coliform sources) with increased sampling.

2. increase cost share for BMP's to 100 percent.

3. target pest management, specifically serecia lespedeza, to maintain range quality.

4. encourage or provide landowner/producer water sampling program to allow them to see their impacts or improvements.

5. measure and address urban runoff contributions to streams.

6. discourage grassland conversion to cropland.

4.2.2 Ranked Issues

Attendees ranked the practices as to which was most important and most likely to be accepted and implemented in their areas. Each attendee chose their top five practices/issues. The highest ten by percentage are presented in Table 3. The rankings show variation by watershed landowner/producer concerns, however, several practices were common to all. To characterize the public input priorities, ranking results were combined for all meetings. This combined ranking will be used to direct future WRAPS activities. The top ten overall rankings were:

1. buffer/filter strip promotion

2. livestock waste management (winter feeding areas)

3. information and education

4. CRP enrollment

5. identify sources and increase monitoring

6. alternative livestock water source development

7. tillage management enhancement

8. chemical application management

9. maintaining ground cover on expiring CRP acreage

10. increase cost-share availability to 100%.

Table 3. Conservation practices ranked by general public for target streams.

Meeting Location	Target watershed	Practice ranked as top five concern
Olpe	Eagle Creek	1. Buffer/filter strip promotion 2. Livestock waste management (winter feeding areas) 3. Identify sources and increase monitoring 4. Information and education 5. CRP enrollment 6. Alternative livestock water source development (away from streams) 7. Chemical application management 8. Urban runoff 9. Tillage management enhancement 10. Increase cost-share to 100% with more varied programs.
Yates Center	Turkey creek	1. Buffer/filter strip promotion 2. Information and education 3. Tillage management enhancement 4. Stream-bank erosion control 5. Alternative livestock water source control 6. Limit saltwater discharges from oil drilling 7. Livestock waste management (winter feeding areas) 8. Identify sources and increase monitoring 9. Pest management (serecia lespedeza) 10. Equally ranked CRP enrollment, maintain expiring CRP ground cover, improved grazing animal management, and increase cost-share to 100%.
Gridley/Leroy	Big creek	1. Improved grazing animal management (rates, distribution, etc) 2. Buffer/filter strip promotion 3. CRP enrollment 4. Household sanitation 5. Information and education 6. Limiting livestock from streams (fencing) 7. Rangeland management (nongrazing, i.e. brush control) 8. Alternative livestock water source development 9. Chemical application management 10. Equally ranked tillage mgt and salt discharges

4.2.3 Methods to Enhance Participation

Attendees at the public meetings discussed and agreed with the Advisory Group items presented to address the ranked practices. Public input provided two additional items that could help landowners/producers accept and implement the ranked practices. These were:

1. increase local cost-share with EQUIP activities to encourage participation, and,

2. provide for haying of buffer/filter strip grass cover to keep land use options available will encourage installation of buffer strips.

4.3 Conservation Needs Inventory

Existing conservation practices and land use types were inventoried and compared to determine where efforts should be prioritized. Land use results were from geospatial data provided by the Natural Resource Conservation Service (NRCS). Conservation Reserve Program (CRP) and Environmental Quality Incentives Program (EQIP) data were gathered from the Farm Service Agency (FSA) and NRCS. Buffer BMP data were from records provided by the Lyon, Coffey, and Woodson County Conservation Districts, and NRCS.

4.3.1 Buffer BMP

When compared to acreage data, streamside length data were most useful with regards to implied buffer effectiveness (Table 4, Figures 1, 4, 5, and 6). Watershed cropland ranged from 19.2 to 27.5 percent of total stream lengths, including all tributaries. Percent grassland ranged from 40.6 to 55.9. The difference most notable between the Eagle Creek watershed (WRAPS target stream), Big and Turkey Creeks (reference streams with TMDL's), and Long/Scott and Crooked Creeks (reference streams without TMDL's) was the length of streamside cropland protected with buffer/filter strips (Table 4). Streams with TMDL impairments had less than 24 percent, by length, of streamside cropland with a buffer BMP. Non-TMDL streams had greater than 80 percent, by length, with established buffer BMP (Figure 7). These results demonstrate need for installing conservation buffer BMP in the Eagle Creek watershed.

Using 80 percent of streamside length as a target for buffer BMP establishment in the Eagle Creek watershed, and an average of 50 feet in buffer width, then 454 acres of buffer will be needed (496,656 total cropland streamside length). This WRAPS will propose to use information and education efforts and proposed incentives to accomplish this.

Table 4. Percent of stream length adjacent to cropland, permanent (grass) vegetative cover and established buffer Best Management Practice (BMP) on selected streams. Percent remaining percentages consist of land uses not identified below include urban, industrial, roads, quarry, woodland, and other miscellaneous types.

			Length (ft) and percent composition of land use types adjacent to water courses							
WRAPS Status	Watershed	County	Total of All types	Cropland	% Cropland	Grass (1) Cover	% Grass Cover	Buffer BMP	% Total with Buffer BMP	% Cropland with Buffer BMP
Target Stream	Eagle Creek	Coffey	249,393	48,716	19.5	137,265	55.0	38,332	15.4	78.7
		Lyon	1,556,842	447,940	28.8	785,728	50.5	30,710	2.0	6.9
		Total	**1,806,235**	**496,656**	**27.5**	**922,933**	**51.1**	**69,042**	**3.8**	**13.9**
Reference with TMDL	Big Creek	Coffey	1,775,174	476,829	26.9	910,123	51.3	121,964	6.9	25.6
		Woodson	195,389	19,303	9.9	158,282	81.0	0	0	0
		Lyon	3,457	981	28.3	2,477	71.7	0	0	0
		Greenwood	142,964	16,511	11.5	112,532	78.7	UA	UA	UA
		Total	**2,116,984**	**513,624**	**24.3**	**1,183,394**	**55.9**	**≥121,964**	**≥5.8**	**≥23.7**
	Turkey Creek	Coffey	196,902	38,089	19.3	97,978	49.7	566	0.3	1.9
		Woodson	1,012,173	193,855	19.1	560,686	55.4	8090	0.8	4.2
		Total	**1,209,075**	**231,944**	**19.2**	**658,664**	**54.5**	**8656**	**0.7**	**3.7**
Reference w/o TMDL	Long/Scott Creeks	Coffey	1,125,031	280,770	24.9	550,765	48.9	232,262	20.6	82.7
	Crooked Creek	Coffey	642,630	147,379	22.9	260,991	40.6	125,714	19.5	85.3

(1) Grass includes all native and tame species grazed, hayed, or unused, adjacent to streams, not including buffer BMP.

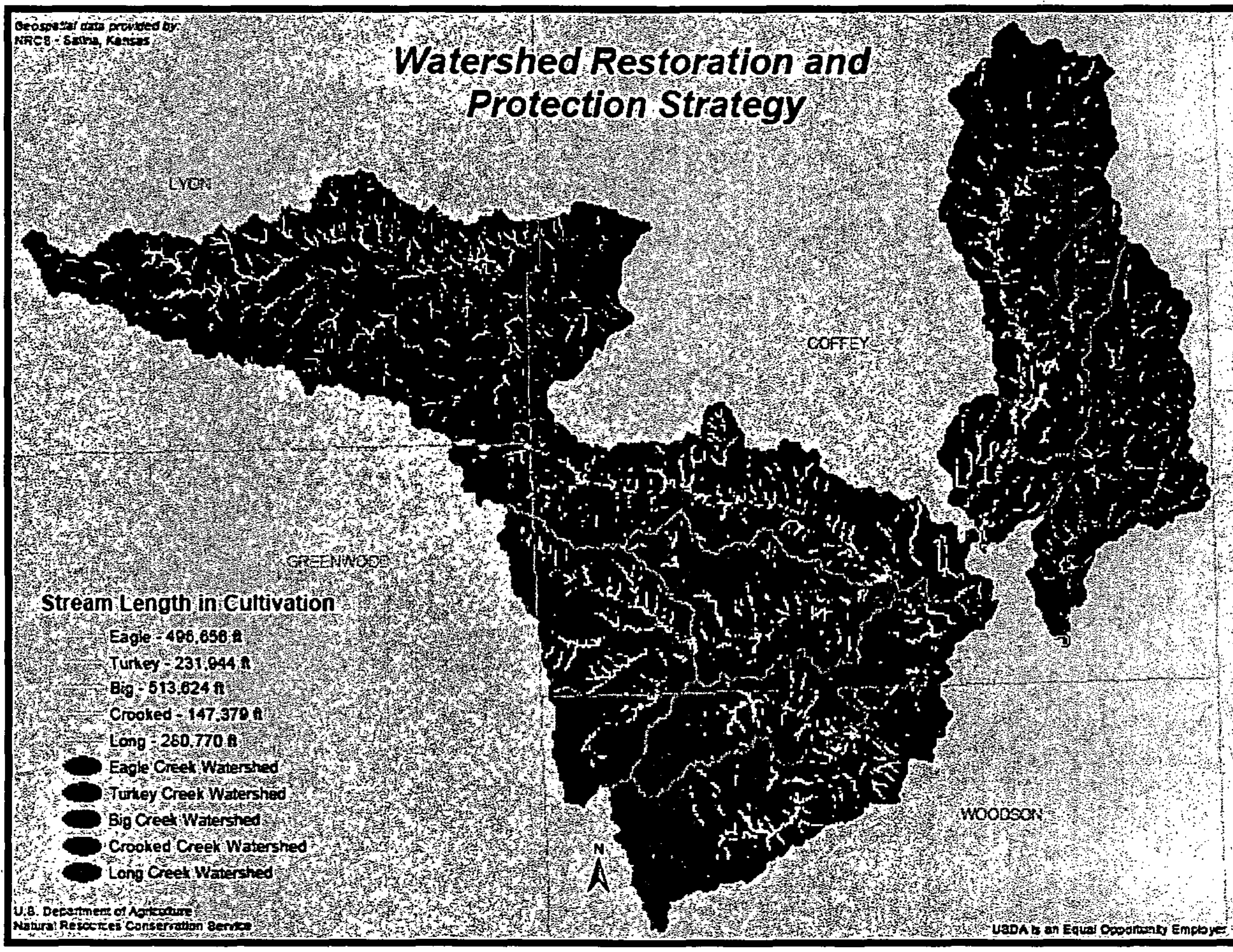

Figure 5. Streamside cropland length within the target Eagle Creek watershed, reference TMDL streams (Big and Turkey Creeks), and reference non-TMDL streams (Long/Scott and Crooked Creeks) in Lyon, Coffey, Woodson, and Greenwood counties.

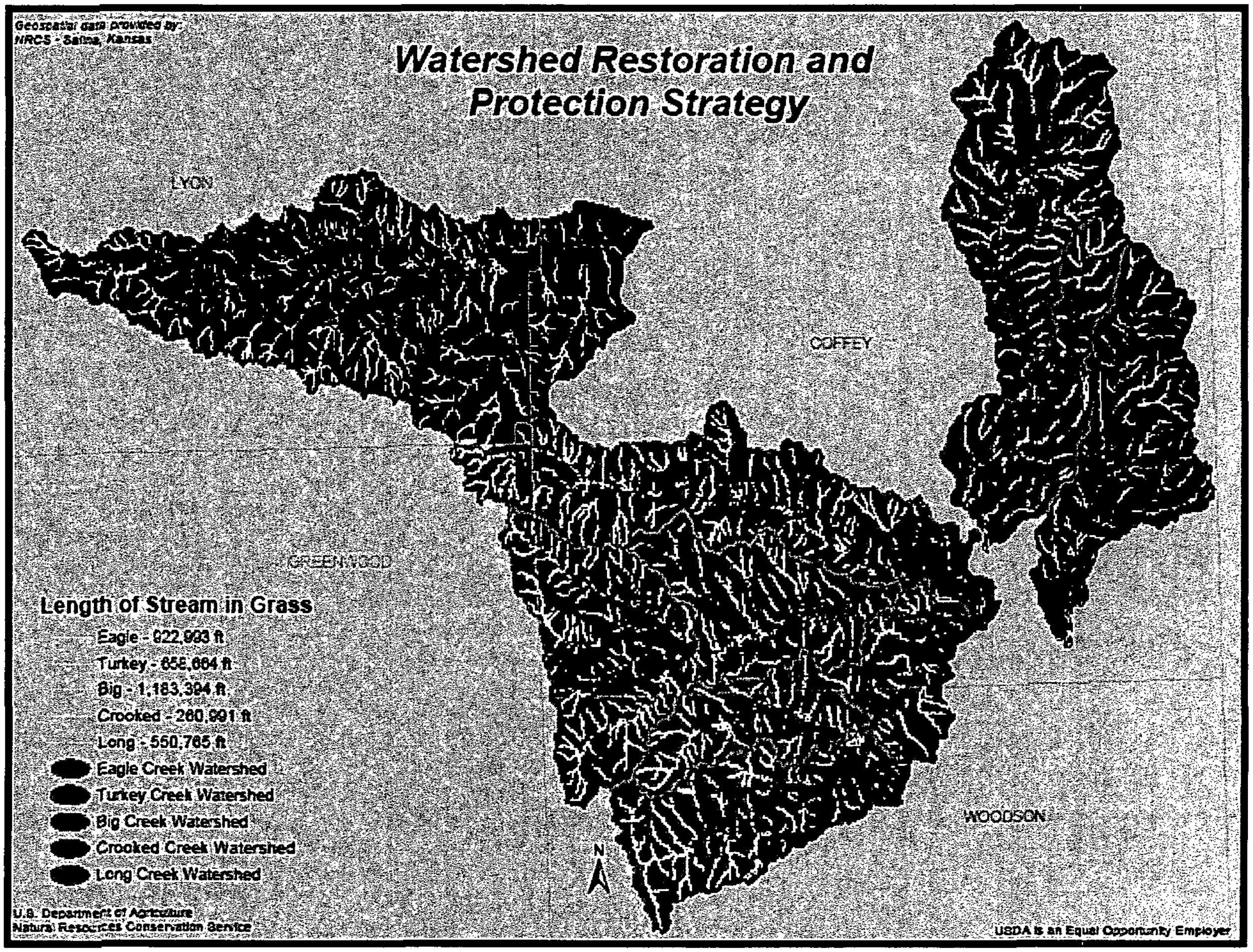

Figure 6. Streamside grassland length within the target Eagle Creek watershed, reference TMDL streams (Big and Turkey Creeks), and reference non-TMDL streams (Long/Scott and Crooked Creeks) in Lyon, Coffey, Woodson, and Greenwood counties.

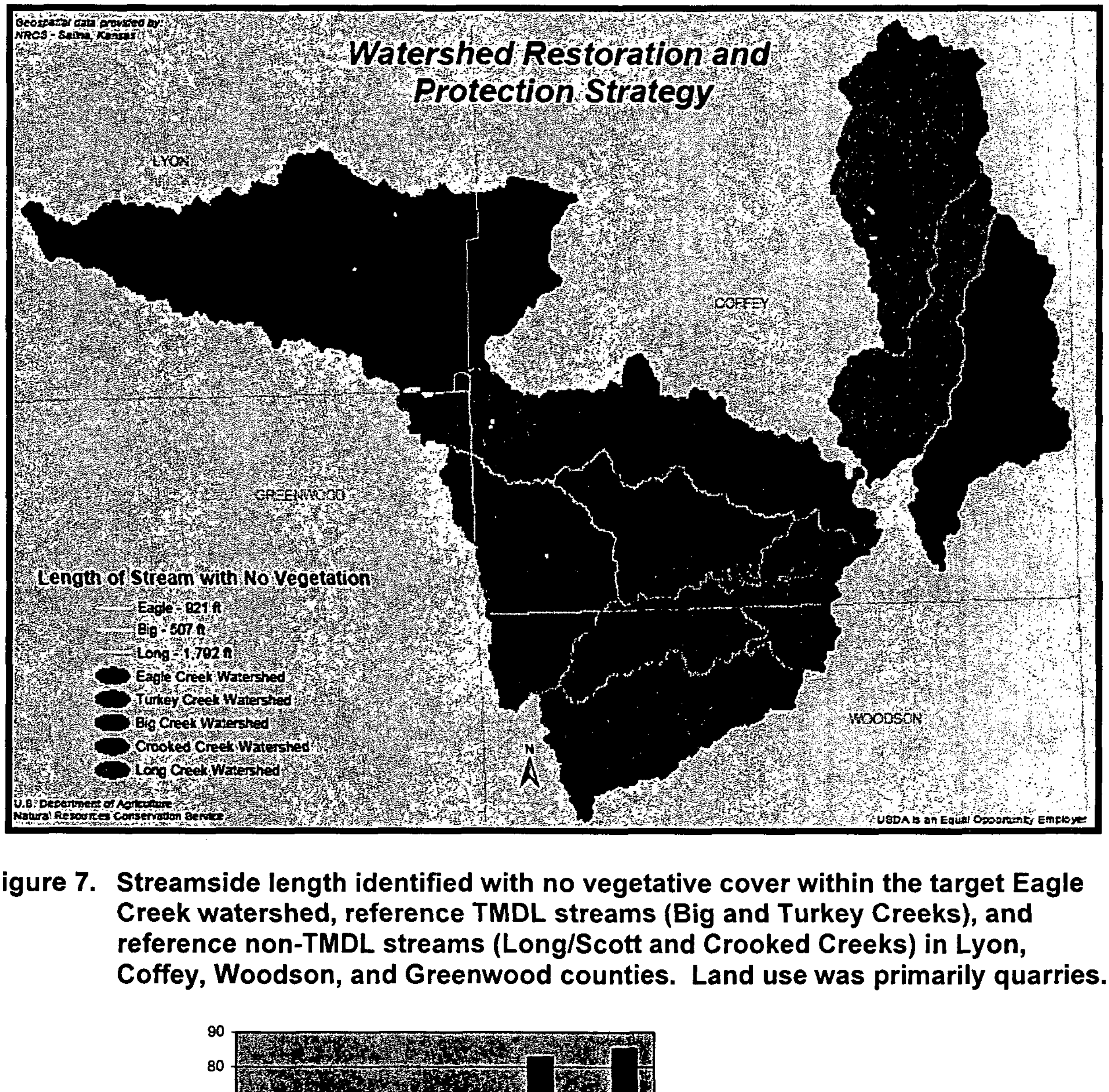

Figure 7. Streamside length identified with no vegetative cover within the target Eagle Creek watershed, reference TMDL streams (Big and Turkey Creeks), and reference non-TMDL streams (Long/Scott and Crooked Creeks) in Lyon, Coffey, Woodson, and Greenwood counties. Land use was primarily quarries.

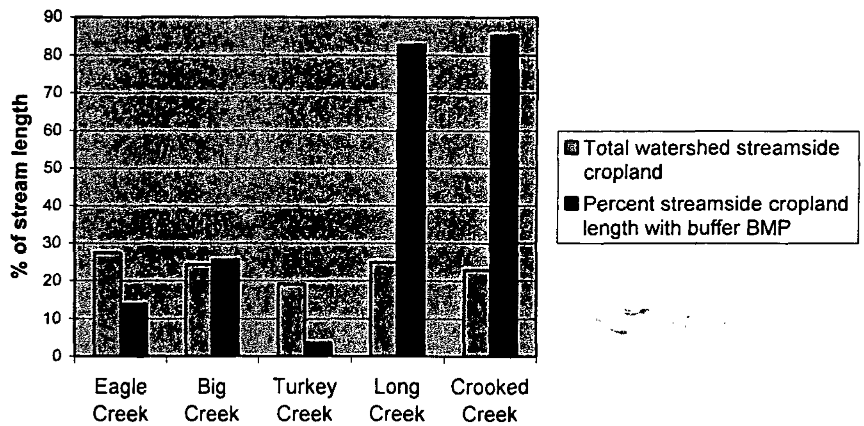

Figure 8. Established buffer strip comparison between target Eagle Creek watershed, reference TMDL streams (Big and Turkey Creeks), and reference non-TMDL streams (Long/Scott and Crooked Creeks) in Lyon, Coffey, Woodson, and Greenwood counties.

4.3.2 Livestock Inventories and Waste Management Goals

The numbers of cattle that are summer grazed on rangeland and confined for feeding during winters were estimated using available NASS data (Table 5). Farm numbers with winter concentrated cattle were also estimated. The numbers represent animals, primarily cows kept by cow/calf producers year-around, that are typically concentrated and fed during winter periods. The feeding areas are potentially adjacent to streams and waterways, and can contribute to low dissolved oxygen from nutrient loading, sedimentation, and eutrophication within the watersheds. Average winter concentration range from 40 to 47 animals per farm, which is less than required for permitting (300 animal units for Concentrated Animal Feeding Operations, and 1000 animal units for NPDES permitted operations). Permitted livestock facilities have waste management systems designed to minimize water quality impacts, and thus are not part of this WRAPS (Figure 1).

For the target Eagle Creek watershed, winter concentrated animals were approximately equal to the total animal units allowed in permitted facilities (Table 5). It is the goal of this WRAPS, using available professional judgment, to partner with landowner/producers to install BMP's on at least 50 percent (25 farms), or 1140 cows. The proposed schedule for this would be 25 percent (~6 farms) the first two years, then 25 percent the remaining three years of this WRAPS. BMP's may include buffer strips, harvested riparian buffers, grazing management plans, fencing, and/or alternate water source development (Table 7).

4.3.3 Conservation Reserve Program (non-buffer program)

Conservation Reserve Program (CRP) acreages and contract expirations were also tabulated to determine amount and timing when grass and permanent vegetation covers may be converted back to cropland (Table 6). Some of these acreages may or may not be adjacent to streams. Within the Eagle Creek watershed over 2700 CRP acres, or nearly four percent of the watershed, are due to expire over the next 10 years (Figures 8 through 16) Some contracts may be extended, depending on USDA program criteria and landowner desires. A need exists to promote landowner retention of vegetative cover on these acres. This WRAPS should promote converting these acres to grazing or haying land uses through information and education efforts, as well as fencing and stock watering development incentives.

4.3.4 Environmental Quality Incentives Program

A review of USDA Environmental Quality Incentives Program (EQIP) contracts by watershed was also completed (Figure 17). Administered by the NRCS, EQIP provides a voluntary conservation program to promote agricultural production and environmental quality. As of this report, EQIP was not prevalent in the target Eagle Creek Watershed. This demonstrates a need to promote the use of this program via WRAPS information and education activities.

Table 5. Estimated livestock (cattle) inventory on selected streams.

WRAPS Status	Watershed	County	Total Livestock in Permitted Facilities (1)	Total Cattle (2)	Summer Grazing Only (3)	Concentrations not Requiring Permitting: Estimated Winter Fed Cattle (4)	Farms Feeding Cattle in Winters	Average Number of Animals per Farm
Target Stream	Eagle Creek	Coffey		1,265	970	295	7	42
		Lyon		9,949	7,964	1,985	42	47
		Total	**2260**	**11,214**	**8,934**	**2,280**	**49**	**47**
Reference with TMDL	Big Creek	Coffey		7,460	5,721	1,739	43	40
		Woodson		874	638	241	5	48
		Lyon		89	71	18	<1	na
		Greenwood		740	532	208	2	104
		Total	**238**	**9,163**	**6,957**	**2,206**	**50**	**44**
	Turkey Creek	Coffey		1,003	769	234	6	39
		Woodson		4,676	3,384	1,292	27	48
		Total	**75**	**5,679**	**4,150**	**1,526**	**33**	**46**
Reference w/o TMDL	Long/Scott Creeks	Coffey	0	5,366	4,115	1,251	31	40
	Crooked Creek	Coffey	0	2,836	2,175	661	16	41

(1) As reported in applicable TMDL summaries.

(2) Cattle numbers were obtained from the USDA NASS (www.nass.usda.gov) for each respective county. Numbers were adjusted for each watershed's proportion of the total county acreage.

(3) Cattle estimates assumed as summer rangeland grazed only (ie stockers 500 to 800 lbs.) and removed each year to state permitted feed lots typically not within the watersheds.

(4) Cattle, winter-fed, were derived from beef cow inventory as reported by NASS. These estimates were assumed to be from cow\calf producers, which likely feed throughout winter periods in concentrations less than State permitting requirements.

Table 6. Conservation Reserve Program acreage subject to contract expiration by watershed from 2005 through 2014. No contracts are scheduled to expire in 2005.

WRAPS Status	Watershed	County	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Target Stream	Eagle Creek	Coffey	0	0	160	0	0	0	0	35	0	23
		Lyon	0	0	1781	298	49	277	0	27	41	18
		Total	**0**	**0**	**1941**	**298**	**49**	**277**	**0**	**62**	**41**	**41**
Reference with TMDL	Big Creek	Coffey	8	0	981	345	156	68	10	81	64	276
		Woodson	0	0	26	0	40	0	0	0	0	0
		Lyon	0	0	0	0	0	0	0	0	0	0
		Total	**8**	**0**	**1007**	**345**	**196**	**68**	**10**	**81**	**64**	**276**
	Turkey Creek	Coffey	0	0	64	0	0	0	2	0	0	74
		Woodson	0	0	0	11	4	21	0	0	205	0
		Total	**0**	**0**	**64**	**11**	**4**	**21**	**2**	**0**	**205**	**74**
Reference w/o TMDL	Long/Scott Creeks	Coffey	0	0	815	401	237	28	32	197	88	219
	Crooked Creek	Coffey	87	0	269	255	10	3	144	114	10	112

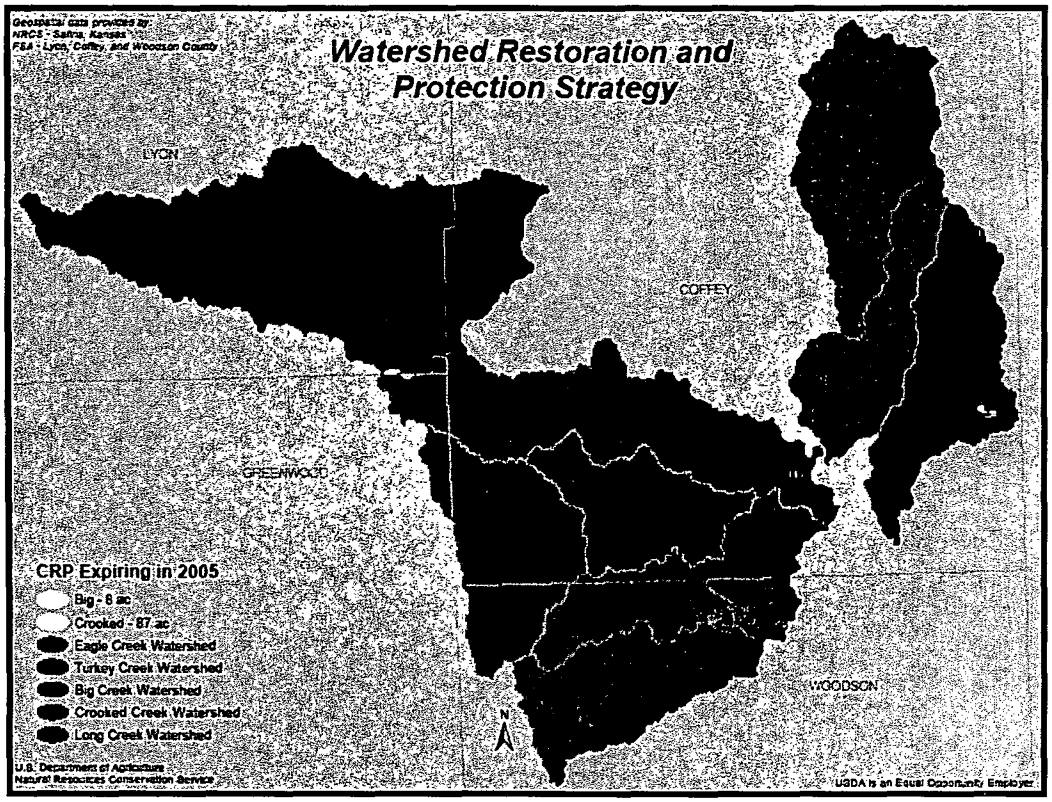

Figure 9. Conservation Reserve Program (non buffer) contracts scheduled to expire in 2005. No contracts are scheduled to expire during 2006.

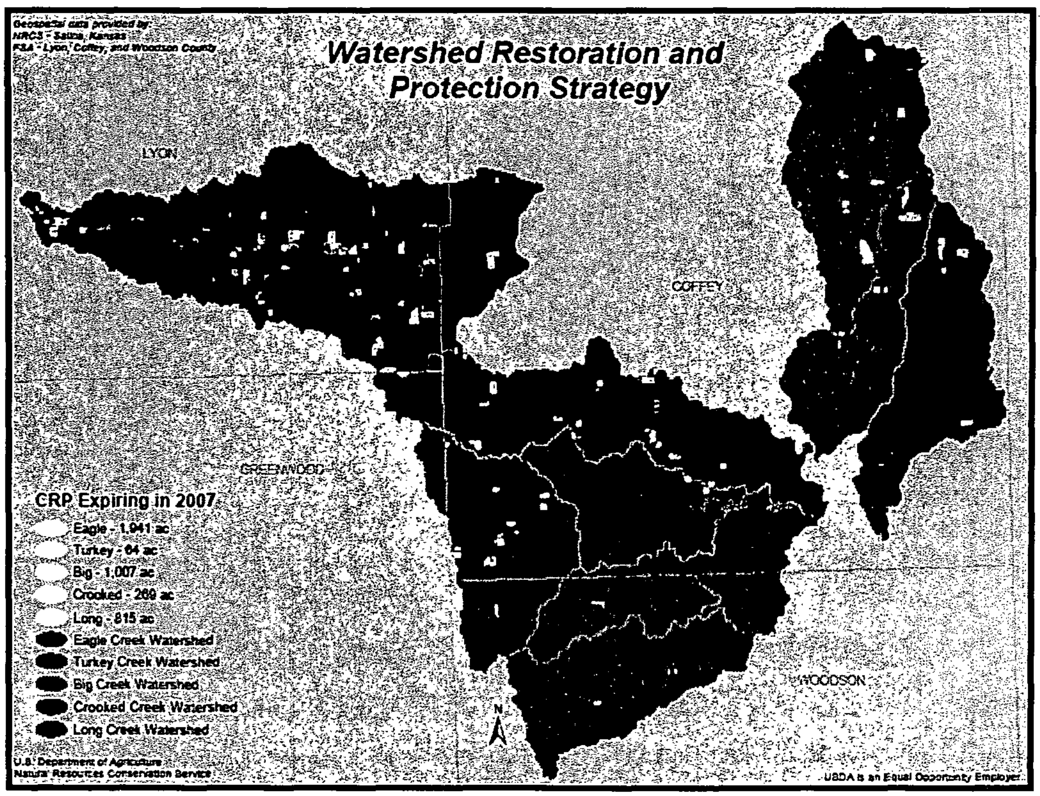

Figure 10. Conservation Reserve Program contracts scheduled to expire in 2007.

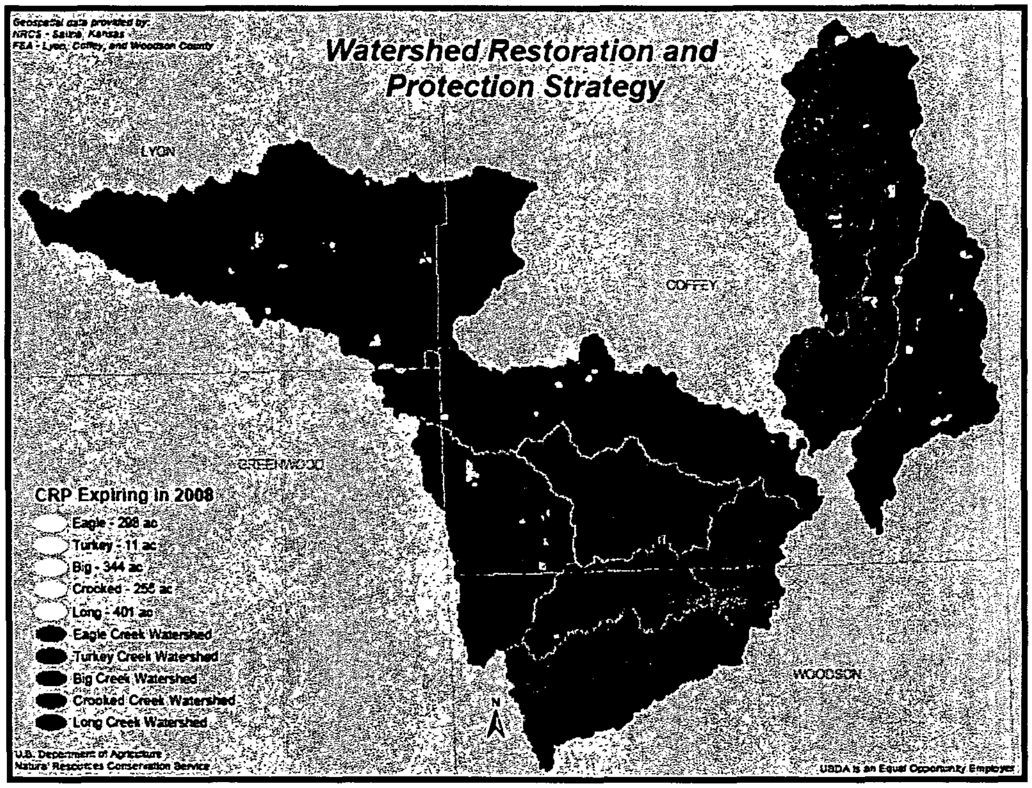

Figure 11. Conservation Reserve Program contracts scheduled to expire in 2008.

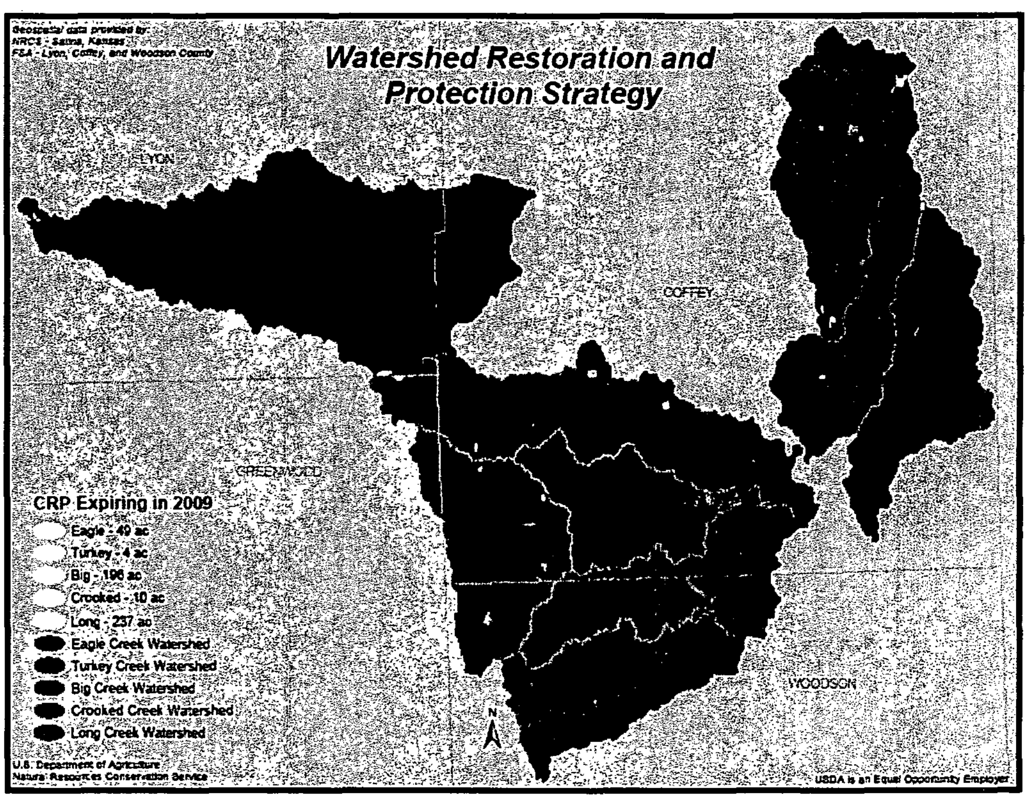

Figure 12. Conservation Reserve Program contracts scheduled to expire in 2009.

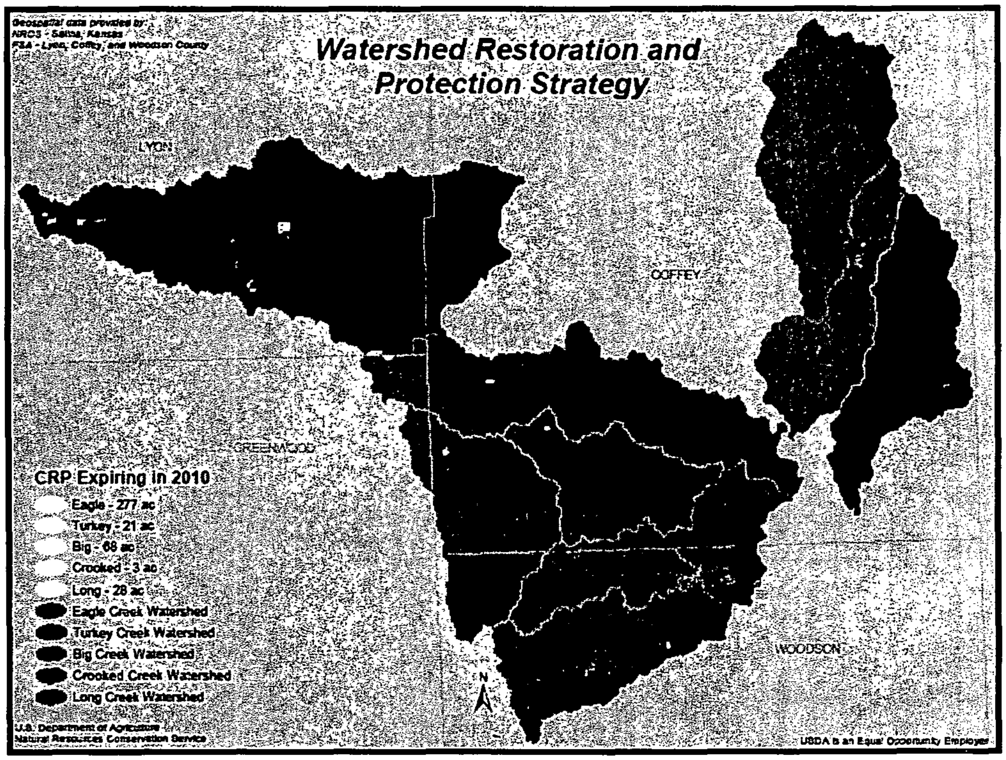

Figure 13. Conservation Reserve Program contracts scheduled to expire in 2010.

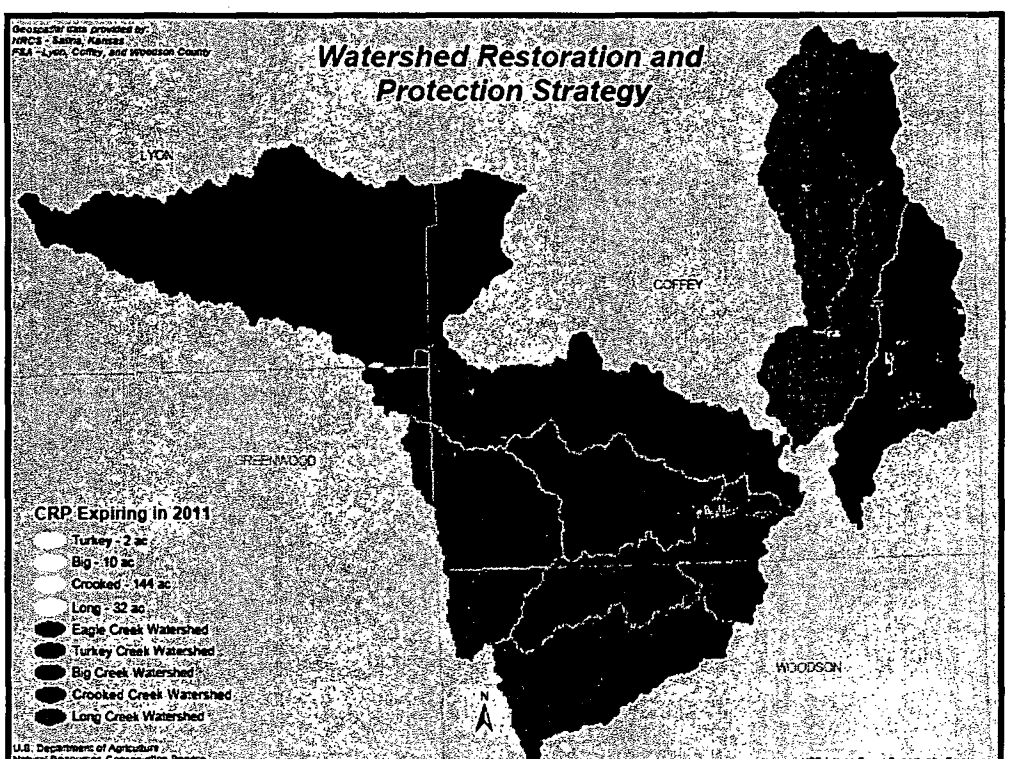

Figure 14. Conservation Reserve Program contracts scheduled to expire in 2011.

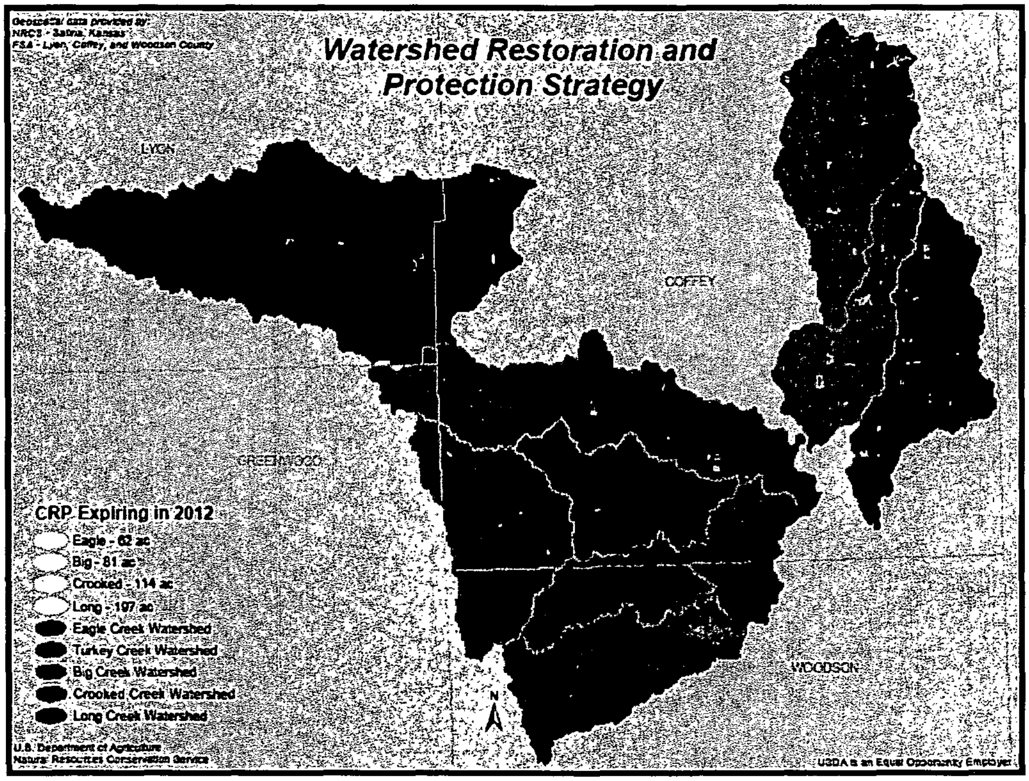

Figure 15. Conservation Reserve Program contracts scheduled to expire in 2012.

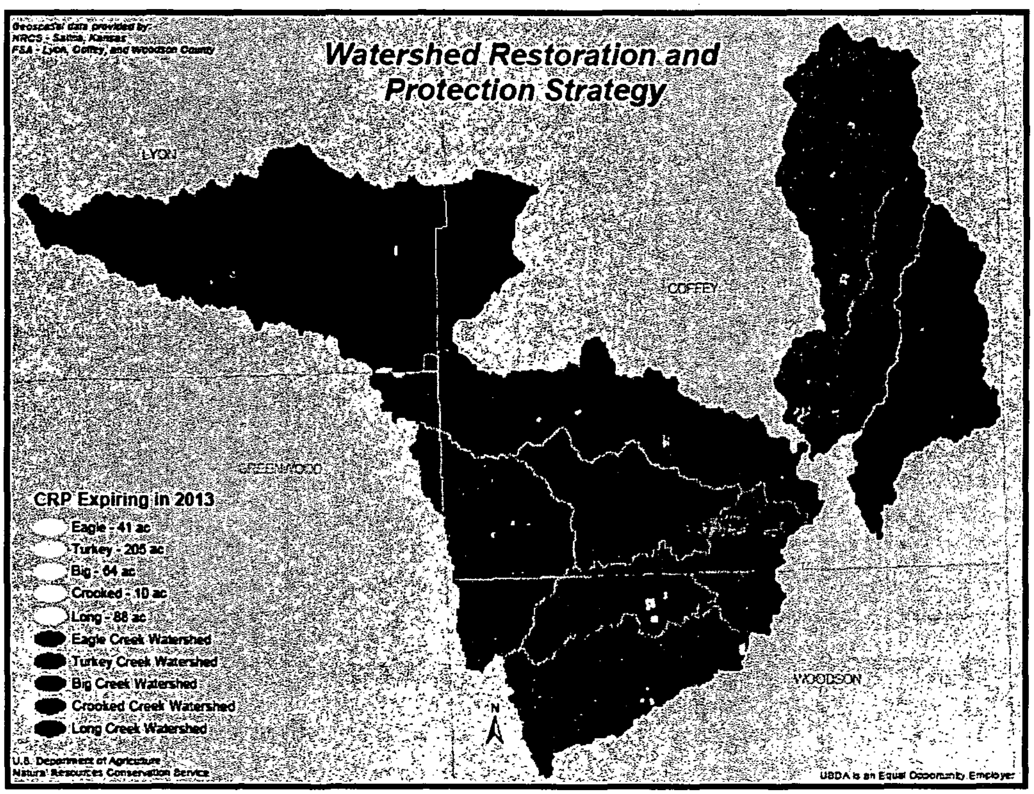

Figure 16. Conservation Reserve Program contracts scheduled to expire in 2013.

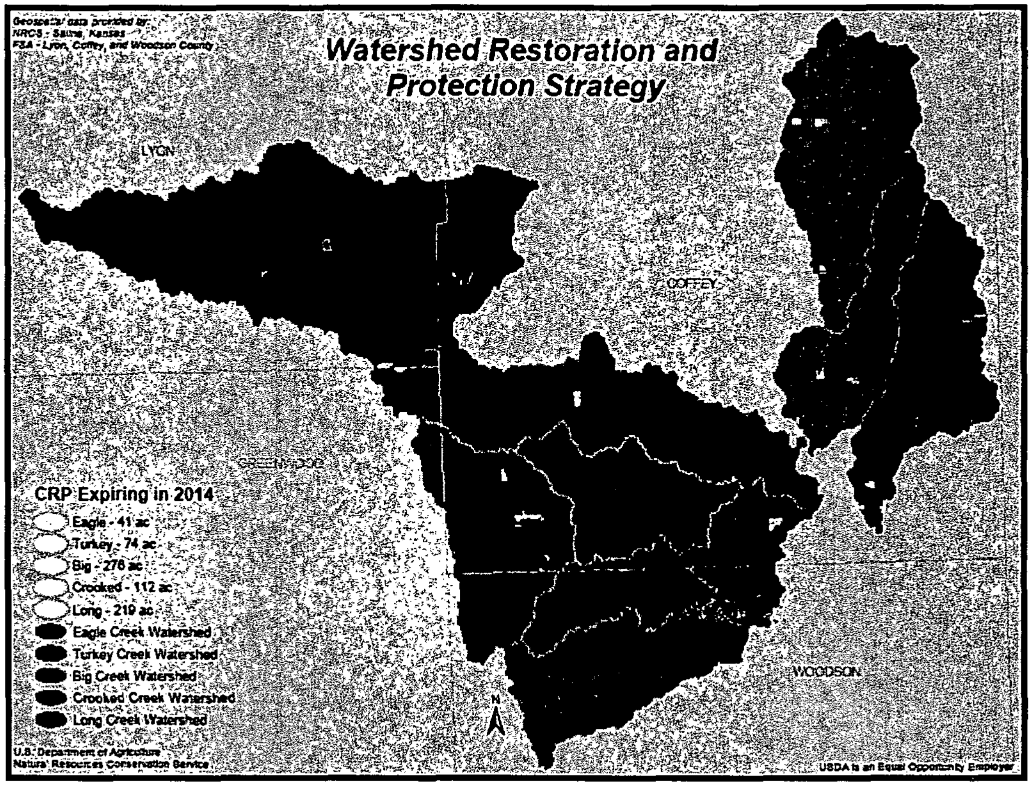

Figure 17. Conservation Reserve Program contracts scheduled to expire in 2014.

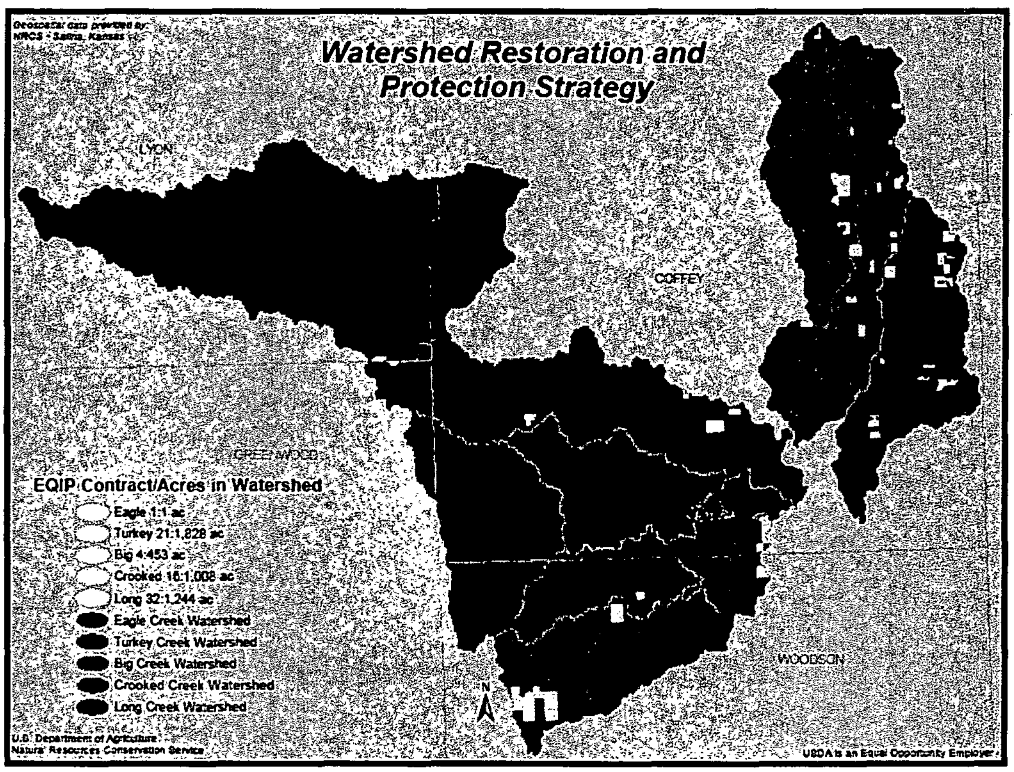

Figure 18. Environmental Quality Incentives Program use in the selected watershed, spring 2005.

SECTION 5.0 EAGLE CREEK PROJECT IMPLEMENTATION PLAN

The goal of this implementation plan is to reduce the nutrient and sediment inputs primarily from agricultural non-point sources within the Eagle Creek watershed. This goal will address the identified TMDL water quality impairments. The activities summarized below (Table 7) are expected to also improve general water quality, wildlife habitat, and foster landowner/producer partnerships to increase conservation awareness and pride in the watershed.

The majority of funding is expected to come from existing USDA and Conservation District programs. These include CRP, EQIP, and cost share programs. This WRAPS effort will target three main areas needing funding beyond current programs. These are:

1. administration, including information and education efforts
2. incentive enhancements to existing programs, and
3. incentives not in current programs to be managed as innovative demonstration projects that may have wider applications if successful.

5.1 WRAPS Oversight

The Eagle Creek WRAPS will be a cooperative effort between the Coffey and Lyon County Conservation Districts, which will be responsible for any 319 grant spending. An Eagle Creek WRAPS oversight committee will be established consisting of two members designated by the Lyon County, and one by the Coffey County CD's. This committee may be expanded at this ratio if deemed appropriate by the CD's. This committee will meet on a quarterly basis, as a minimum. This committee will conduct periodic stakeholder workshops to ensure continued grass-roots participation in the WRAPS. Stakeholder input will be solicited routinely. Stakeholders will include those participating in this WRAPS. Efforts to include municipality and other stakeholders will be completed.

The committee will hire a WRAPS Coordinator to manage the effort. The coordinator will utilize available Conservation District resources, maximize use of existing conservation programs in the watershed, and direct information and education efforts.

5.2 Demonstration Project

This WRAPS has identified an opportunity for establishing and demonstrating a Harvested Riparian Buffer BMP that may have application in other watersheds. In the Eagle Creek watershed, excess nutrients likely from cropland agriculture have been identified as contributing to low dissolved oxygen, a TMDL for the stream. Likewise, sediments from cropland also contribute to the stream and reservoirs in the watershed. Public input identified that streamside buffer strips on such croplands were not being established using current USDA programs due to forage harvest restrictions, thus limiting land use for remaining acres, primarily winter grazing. It was felt that permanent ground cover would increase water quality protection over winter-grazed cropland areas without such buffer areas. During the crop-growing season, the strips would provide maximum benefits, filtering cropland sediment, herbicides, and excess nutrients from the streams.

Consequently, this WRAPS proposal has set aside incentive money to establish buffer strips that will have similar water quality benefits of current USDA CRP programs. The intent is not to circumvent current program restrictions, but to enhance the use of buffers with permanent cover along the streams. This demonstration project would not include annual payments as in CRP program. It will be to encourage buffer establishment in streamside areas typically not productive for row crops. The WRAPS committee and Coordinator, using available technical input from grassland, grazing, cropland, and water quality experts and data, will establish specifications for the Harvested Riparian Area BMP with the goal of maximizing watershed protection. The following areas will be addressed, fully expecting others to be considered, as the specifications are developed and demonstrated:

1. grass species mix
2. timing of grazing
3. number of animals per acre
4. other acreage availability/grazing distribution
5. non-stream watering sources
6. winter feed bunk/hay locations
7. haying timing and restrictions
8. landowner commitment to maintain

Harvested Riparian Buffer BMP incentives will be determined by the WRAPS committee, with Coordinator input, and may include:

1. establishment cost share (100%)
2. technical advice
3. increased stock water development cost-share for producer/landowners with buffered streams
4. increased fencing cost-share for grazing management for producer/landowners with buffered streams

A cooperating producer/landowner will be solicited as a model demonstration for this pilot BMP. The WRAPS committee and Coordinator will fully advertise and promote the practice. The success will be measured by the degree of acceptance and use by producer/landowners in the watershed that otherwise would not consider establishing riparian buffer areas on their croplands. The reduction of excess nutrients and sediment loads in watershed, and such loads to waters downstream will be another measure of success.

Load reductions for nitrogen, phosphorus, biochemical oxygen demand, and total suspended solids are needed to set goals to meet water quality goals and expectations, including TMDL's. The Kansas Department of Health and Environment, Bureau of Water, Watershed Management Section, will provide load reduction estimates through use of the Environmental Protection Agency Spreadsheet Tool for Estimating Pollutant Load (STEPL) model. For more information see http://.it.tetratech-ffx.com/stepl/.

Table 7. Implementation plan and proposed budget for the Eagle Creek WRAPS project from January 2006 through December 2011.

Goal: To reduce non-point sources of excess nutrient and sediments loads to Eagle Creek to solve dissolved oxygen, copper, eutrophication, and siltation concerns.

Objectives to Obtain Goal:

1. local information and education program
2. landowner/producer acceptance and use of BMP's

Action	Responsibility	Estimated cost	WRAPS grant %	Proposed time frame	Supporting entities	Supporting fund sources
1. GENERAL OVERSIGHT						
A. WRAPS Project Management	Lyon (LY) and Coffey (CO) Cons Dist Managers	$15,840	30	5-year project life	LY and CO Cons Dist Board of Supervisors	LY and CO Cons Dist
B. Establish WRAPS Partnership Committee	LY and CO Cons Dist Board of Supervisors	0	0	January 2006	na	na
C. Select WRAPS Coordinator	WRAPS Partnership Committee	0	0	February 2006	LY and CO Cons Dist Board of Supervisors	LY and CO Cons Dist
D. WRAPS Coordinator Labor	WRAPS Partnership Committee	$17,160	60	5-year project life	LY and CO Cons Dist	

Action	Responsibility	Estimated cost	WRAPS grant %	Proposed time frame	Supporting entities	Supporting fund sources
2. INFORMATION AND EDUCATION						
A. WRAPS Coordinator labor	WRAPS Committee	$34,320	60	5-year project life	LY and CO Cons Dist	
B. Volunteer labor Includes: 1. field demo prep 2. producer demo efforts 3. guest speakers 4. civic group participation 5. NGO participation	WRAPS Coordinator	$22,800	0	5-year project life	LY and CO Cons Dist NRCS FSA KDWP SCC KSU Ext RC&D KRC KAWS USFWS County Comm	
C. Supplies, travel, contractual Includes: 1. meals, workshop/fair display, promotional items, paper, copying 2. mileage 3. handouts, newsletter fold machine, digital camera, office supplies	WRAPS Coordinator	$20,840	10 100 100	5-year project life	LY and CO Cons Dist	LY and CO Cons Dist

Action	Responsibility	Estimated cost	WRAPS grant %	Proposed time frame	Supporting entities	Supporting fund sources
D. Promote use of Kansas Livestock Environmental Stewardship (KLES) self assessment website tool Includes: 1. On-line at www.oznet.ksu.edu 2. Print our survey for producers to complete 3. Identify incentives or partner for door prizes for completing self assessments, etc.	WRAPS Coordinator	included with above	na	5-year project life	LY and CO Cons Dist KSU Ext	n
3. BEST MANAGEMENT PRACTICES - GENERAL						
A. Rentals, contractual, travel Includes: 1. native grass drill rent 2. no-till equipment rent 3. tree planter rent 4. demo equip rent 5. mileage	WRAPS Coordinator	$9,000	60	5-year project life	LY and CO Cons Dist	LY and CO Cons Dist
B. WRAPS Coordinator labor Includes: 1. buffer/strip design 2. pond surveying 3. fence measurement 4. native grass drill oversight 5. no-till equip oversight 6. rented equip oversight 7. grass seeding setup	WRAPS Partnership Committee	$17,160	60	5-year project life	LY and CO Cons Dist NRCS	LY and CO Cons Dist SCC

Action	Responsibility	Estimated cost	WRAPS grant %	Proposed time frame	Supporting entities	Supporting fund sources
C. Volunteer labor Includes: 1. producer labor 2. tree planting 3. civic group habitat development	WRAPS Coordinator	$12,400	0	5-year project life		
4. Best Management Practices Enhancements to existing programs						
A. Buffer/strip stand establishment 1. $6.5/acre for target 454 acres (above cost-share from existing programs)	WRAPS Coordinator	$2,951	60	5-year project life	LY and CO Cons Dist NRCS	LY and CO Cons Dist SCC NRCS (CRP)
B. Fencing for ponds, streams, alternative water source developement Includes additional cost-share to USDA and Cons Dist programs, 15% at $1.5/ft for 10 miles	WRAPS Coordinator	$7,920	60	5-year project life	LY and CO Cons Dist NRCS	LY and CO Cons Dist NRCS
5. Best Management Practices Incentives not provided in existing programs						
A. Nutrient management, urban and cropland 1. soil testing, $2.25 for 1000 tests 2. Alternative water source development	WRAPS Coordinator	$2,250	60	5-year project life	LY and CO Cons Dist KSU Ext NRCS	LY and CO Cons Dist

Action	Responsibility	Estimated cost	WRAPS grant %	Proposed time frame	Supporting entities	Supporting fund sources
B. Demonstration of Harvested Riparian Buffer BMP. Includes $65 per acre stand establishment cost for 50 acres (43,560 streamside feet 50ft wide, with estimated seed cost of $7 pls at 7 lbs pls per acre = $49, plus $16 equipment and labor per acre)	WRAPS Coordinator WRAPS Partnership Committee	$3,250	60	5-year project life	LY and CO Cons Dist	LY and CO Cons Dist SCC
C. Fencing incentive on expiring CRP acreages. Intended to promote vegetative cover. Includes 4 miles at 65% cost share at $1.5 per foot	WRAPS Coordinator WRAPS Partnership Committee	$13,728	60	5-year project life	LY and CO Cons Dist	LY and CO Cons Dist NRCS
Proposal	**Project Total**	**$179,619**				
Proposal	**Grant % Total**	**$80,405**				
Proposal	**Contribution Total**	**$99,214**				

ATTACHMENTS

TO

EAGLE CREEK

WATERSHED RESTORATION AND PROTECTION STRATEGY

1. Advisory Group meeting attendees and interests represented
2. Land use types by HUC Code for Coffey County area watersheds

Attachment 1. Advisory Group meeting attendees and interests represented.

Attendee	Representing	Phone/e-mail	Address
Nancy Alley	District Manager, Coffey County Conservation District	620-364-2182 nancy.alley@ks.nrcs.usda.gov	USDA, 313 Cross Burlington, KS 66839
Warren Bell	KSU Extension Watershed Specialist, Lower Neosho	620-625-3113 wbell@oznet.ksu.edu	211 W. Butler Yates Center, KS 66783
Andy Burr	Soil Conservationist, NRCS, Coffey County	Currently at 785-462-7482	915 E. Walnut St. Colby, KS 67701
Pat Collins	Woodson County Conservation District, Chairman	620-468-9801	1039 Violet Rd Piqua, KS 66761
Marilyn Eccles	Environmental Health Services, Coffey County	320-364-8631 cchdenv@coffeycountyks.org	110 S. 6th Coffey County Courthouse Burlington KS 66839
Kris Ethridge	District Conservationist, NRCS, Woodson County	620-625-3292	USDA, 704 S. Fry Yates Center, KS 66787
Robert Harkrader	District Conservationist, NRCS, Coffey County	620-364-2182	USDA, 313 Cross Burlington, KS 66839
Leonard Jirak	District Fisheries Biologist, KDWP	620-364-5552 leonardj@wp.state.ks.us	540 16th Rd. Hartford, KS 66854
Don Jones	Water Quality Program Manger, State Conservation Commission	785-296-3600 djones@scc.state.ks.us	109 SW 9th, Suite 500, Mills Bldg Topeka, KS 66612
Dale Kirkham	Kansas Rural Center	620-583-5247 dalekirkham@msn.com	Eureka, KS 67045
Wilfred Lehman	Landowner/producer, Coffey County	620-964-2557	2171 7th Terrace, LeRoy, KS 66857
Glen Massoth	Woodson County Conservation District, Supervisor	620-625-2465	110 E. Mary St. Yates Center, KS 66761
Gene Merry	Coffey County Commissioner	620-364-8683	110 S. 6th Coffey County Courthouse Burlington KS 66839
Charles Nickel	Landowner/producer, Coffey County	620-964-9507	899 Reaper Road LeRoy, KS 66857
Doug Peine	Executive Director, FSA, Coffey and Allen Counties	620-364-2182 doug.peine@ks.usda.gov	USDA, 313 Cross Burlington, KS 66839
Rick Porter	Lake Region Resource Conservation and Development	785-242-2073 rick.porter@ks.usda.gov	121 E. Second St. Ottawa, KS 66067
Lauren Pringle	Woodson County Conservation District, Supervisor	620-537-7581	370 Highway 75 Yates Center, KS 66783
Henry Rolf	Landowner/producer, Coffey County	785-489-2457	2067 11th Rd LeRoy, KS 66857

Attachment 1(cont).

Attendee	Representing	Phone/e-mail	Address
Carl Rogers	Coffey County Conservation District, Supervisor	620-364-8801	422 Kennebec St Burlington, KS 66839
Roy Rodgers	Landowner/producer, Coffey County	620-364-9258	635 Lynx Rd Gridley, KS 66852
Gail Thornbrugh	District Manager, Woodson County Conservation District	620-625-2431 gail.thornbrugh@ks.nrcs.usda.gov	USDA, 704 S. Fry Yates Center, KS 66787
Kristi Vogts	District Manager, Lyon County Conservation District	Currently at 620-364-2182 Kristi.vogts@ks.nacdnet..net	USDA, 313 Cross Burlington, KS 66839
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Beth Rowlands	Technical support from KDHE	785-842-4600 browland@kdhe.state.ks.us	KDHE, NE Dist Office, 800 West 24th St. Lawrence, KS 66720
Mary Lou Ponder	Moderator/Coffey County Buffer Coordinator	620-364-2182 marylou.ponder@ks.nacd.net	USDA, 313 Cross Burlington, KS 66839
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Attachment 2. Land use types by HUC Code for Coffey County area watersheds.

Watershed	HUC14 Code	Acreage by Land Use Types (1) Water	Urban	Barren	Forest	Shrub	Grass	Pasture/ Hay	Crop	Wetland	Total
Eagle Creek	11070201040030	320	173	0	816	649	10,638	3,409	7,102	204	23,312
		218	2	215	736	246	9,823	4,524	6,654	725	23,143
		157	3	10	1,127	679	10,426	5,221	8,408	338	26,369
Big Creek	11070204010060	403	22	1	1,437	587	17,067	8,525	9,779	754	38,575
	11070204010040	338	180	2	621	620	14,422	5,033	4,578	334	26,127
	11070204010050	240	7	1	704	620	8,164	5,014	3,998	337	19,085
Turkey Creek	11070204020020	188	24	12	1,521	726	10,964	6,334	4,682	563	25,014
	11070204020010	222	24	22	921	455	9.945	6,811	4,477	385	23,260
Long/Scott Creeks	11070204010020	220	8	38	1,388	156	15,980	4,215	8,868	319	31,193
	11070204010030	145	14	2	1,039	44	6,561	4,035	7,950	256	20,045
Crooked Creek	11070204020030	135	272	4	1,884	214	6,404	7,823	9,562	526	26,824

(1) Acreages based on KDHE sources (see Figure 1), and may be slightly different than totals shown in the WRAPS document. Differences are not considered significant, and are presented here to further characterize the watersheds.

KANSAS WATER PLAN

BASIN PLANNING AND IMPLEMENTATION PROCESS

Background

The *Kansas Water Plan* is based upon a comprehensive, watershed oriented approach to planning. A watershed is an area defined by a boundary within which all water ultimately drains into one body of water. The interconnections within the watershed that define the action of the hydrological cycle in that area must be considered in managing water resources. The recharge areas where the surface conditions interact most readily with the water under the surface are considered as part of the system defining the watershed. In addition, the specific precipitation patterns, topography, soil types and land use patterns are features that make each watershed unique. This scope provides a framework for consideration of all water related issues.

In 1985 the Kansas Water Office adopted the 12 major river basins as planning areas. K.S.A. 82a-903 directs that the *Kansas Water Plan* include sections corresponding with water planning areas. These were submitted to the Kansas legislature who then directed the agency to prepare basin plans as part of the *Kansas Water Plan* (1985 Session Laws of Kansas, Chapter 341.) Figure 1 shows the major river basins in Kansas.

Purpose

Hundreds of public and private organizations and thousands of individuals share the responsibility to manage the state's water resources. It is essential that organizations at all levels, local, state, federal and frequently other states, act in a coordinated fashion to achieve common objectives in water resource management.

The *Kansas Water Plan* is formulated and used for the general purpose of accomplishing the coordinated management, conservation and development of the water resources of the state. Numerous state water-related agencies cooperate with the office in formulation of the *Kansas Water Plan* (K.S.A. 82a-903). Input is also received from various local and federal agencies, as well as organizations and individuals. Once formulated, the Plan then becomes a useful tool for coordinated efforts to address water issues in the state.

Figure 1

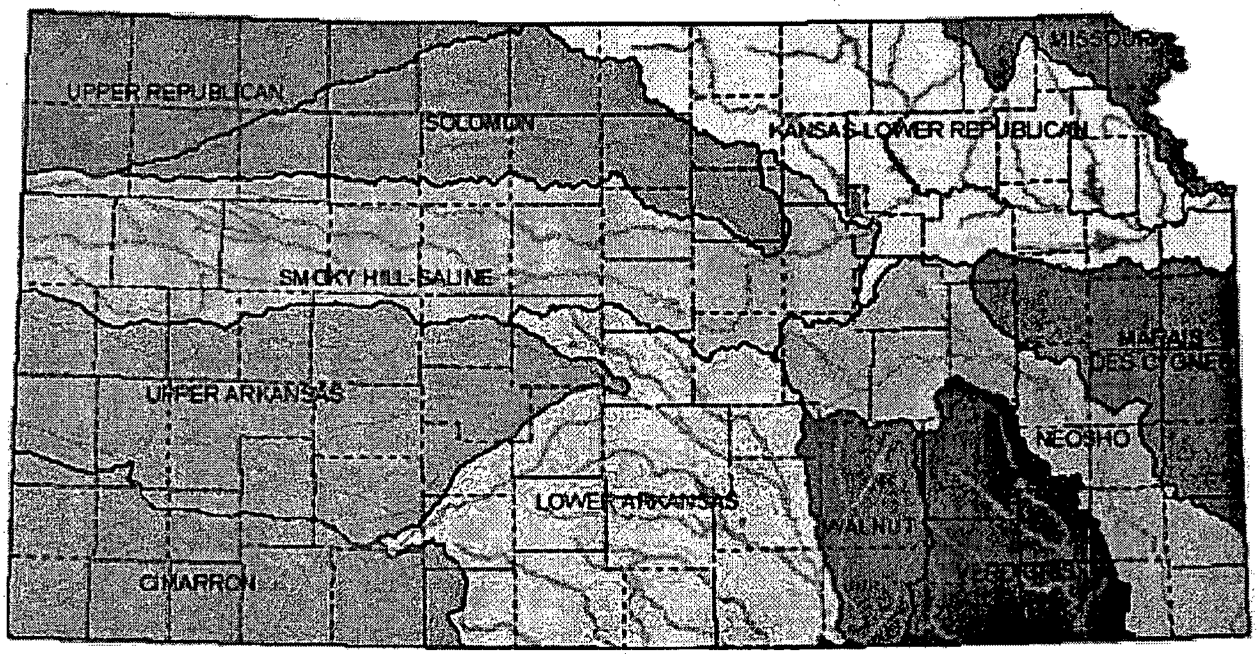


Figure 2 depicts the concept of a management process that involves federal, state, and local entities. Each agency has a management process. K.S.A. 82a-931 contains a declaration of the state's intention to coordinate state planning with local and national planning.

The *Kansas Water Plan* integrates those water resource management processes through identification of basin priority issues.

Basin Planning Process

Basin planning and implementation involves numerous agencies, organizations and individuals in identifying and resolving complex water resource issues. The need to seek public input in the planning process is set out in K.S.A. 82a-903 and states that: ". . . the Kansas Water Office and the Kansas Water Authority shall seek advice from the general public and from committees consisting of individuals with knowledge of and interest in water issues and in the water planning areas." Basin advisory committees were established in 1985 to meet that need. These committees are made up of volunteer citizens located within each of the 12 major river basins in the state. The committees meet at least quarterly in various locations throughout the basins. All meetings are publicized and the public is encouraged to attend. Each committee has 11 members representing water use categories of municipal, other public water suppliers, domestic, irrigation, industry and recreation, as well as at-large members. Representatives of various water-related agencies serve as advisors to each committee.

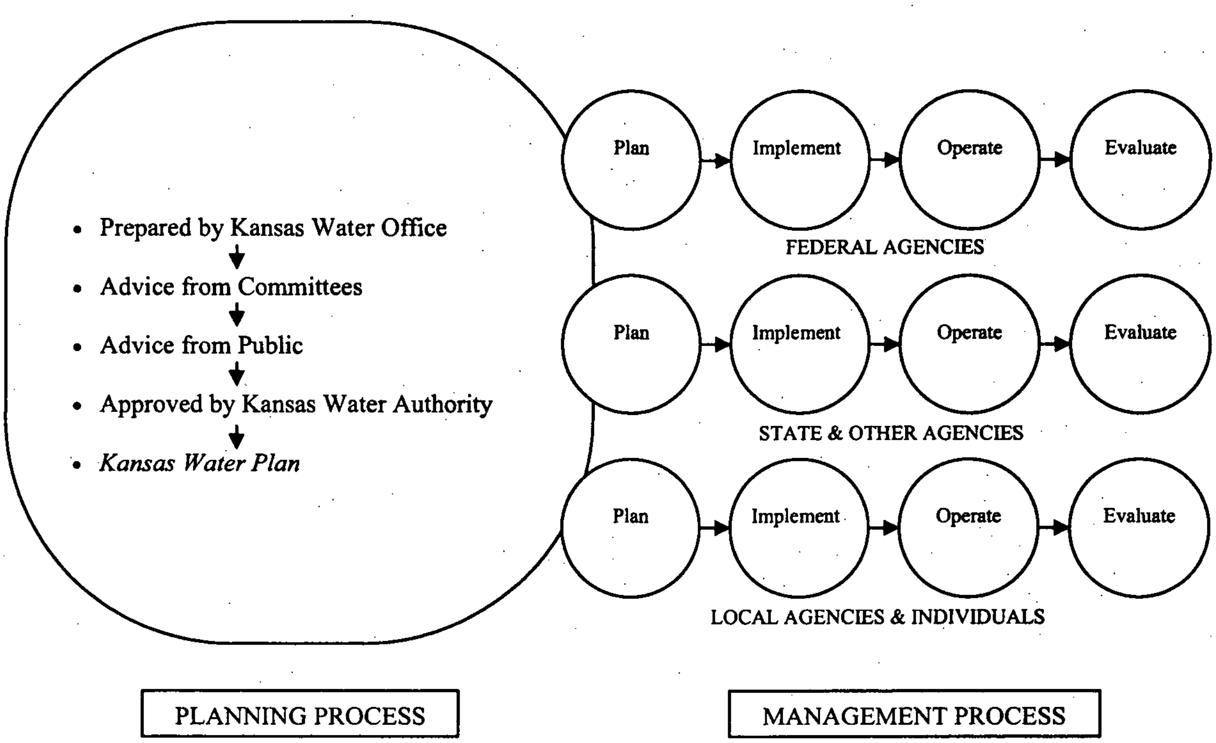
Basin issues are identified by the basin advisory committees and a group of interagency advisors as part of the **basin planning process**. A listing of current committee members is available on-line at www.kwo.org. Once identified, issues are reviewed and discussed with various organizations and individuals through a series of public meetings and hearings before being approved as part of the Kansas Water Plan by the Kansas Water Authority.

Implementation Process: Agency Management Planning

The basin sections of the Kansas Water Plan include priority issues in the basin that represent significant water resource problems or needs. These issues have been identified through the basin planning process as needing attention in addition to the regular operations of on-going programs. This may involve an enhanced level of funding or increased interagency coordination.

Basin priority issues included in the Kansas Water Plan may be considered by an interagency team of state program managers as part of an **agency management planning** process. This process is used to develop management strategies to effectively utilize state program resources to address water issues identified in the basin sections of the Kansas Water Plan.

Figure 2



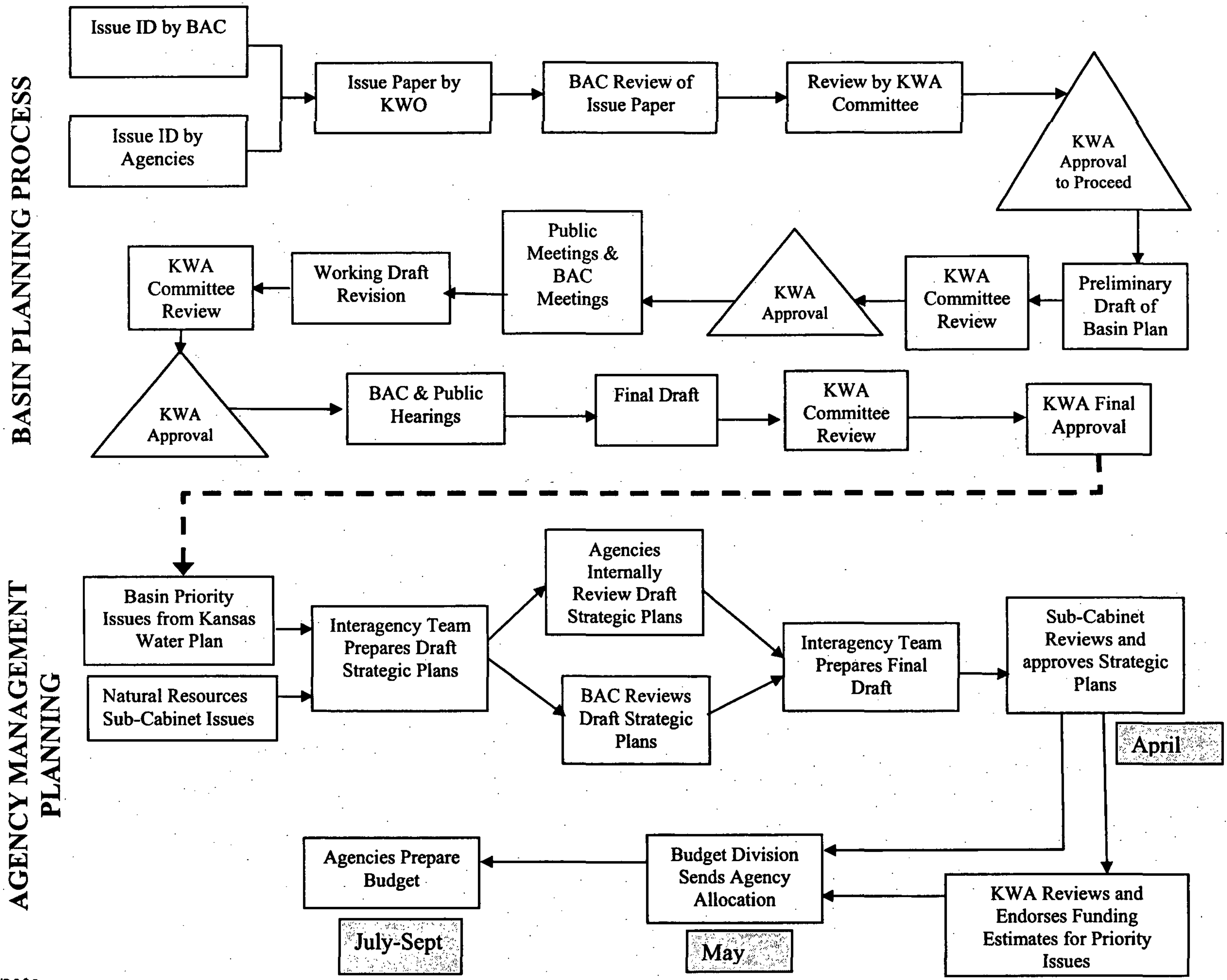
The basin planning and implementation process is shown in Figure 3.

The State of Kansas has numerous water related programs designed to address a variety of water resource problems and needs. These programs are operated by various state agencies and can be active in any or all of the major river basins in a given year. These programs address a variety of water issues in the basins, in addition to priority issues identified in the following basin sections. A description of these agency programs is provided in the publication State and Federal Water Programs prepared by the Kansas Water Office.

Current Water Plan

In July 2003, the Kansas Water Authority adopted the FY 2005 Kansas Water Plan. This plan was reformatted to provide more focused attention on the priority issues that were contained within the plan and which may be addressed through the agency management planning process. This plan will be retained as the current plan for up to 5 years, however basin sections can be modified at any time to add new issues or significantly modify existing issues if needed.

Figure 3
COORDINATION OF BASIN PLANNING AND IMPLEMENTATION



KANSAS WATER PLAN

Neosho Basin Section

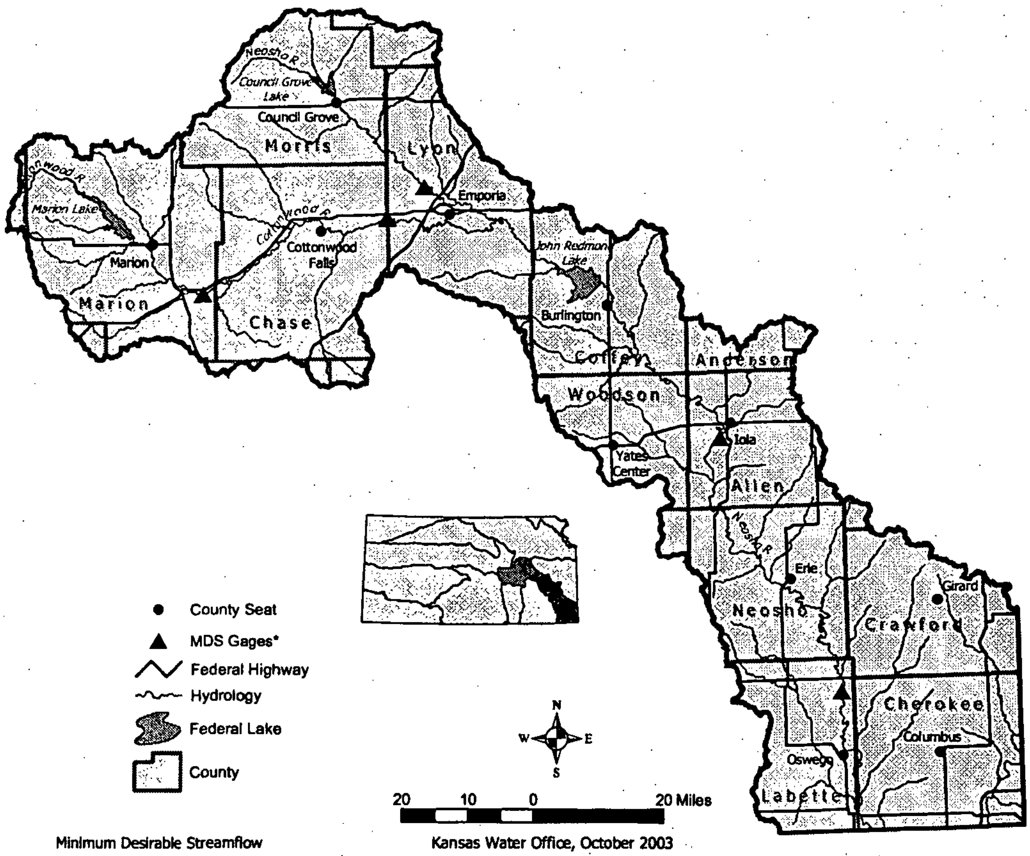


Figure 1

November 18, 2004

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Basin Advisory Committee

The Neosho Basin Advisory Committee is a key part of the Kansas water planning process. The eleven members, representing diverse water interests, ensure public input. The committee typically meets quarterly; all meetings are open to the public. The committee helps identify basin priority issues and other water-related concerns, and provides advice to the Kansas Water Authority in their review of the *Kansas Water Plan*. Members serve four year terms.

Additional information on the Neosho Basin Advisory Committee is available on the Kansas Water Office website: www.kwo.org.

BASIN DESCRIPTION

The Neosho Basin covers approximately 6,300 square miles and encompasses all or parts of 18 counties in southeastern Kansas. The major streams in the basin are the Neosho River and its tributary, the Cottonwood River and the Spring River in the southeast portion of the basin. The Neosho and Spring Rivers join the Arkansas River in Oklahoma. There are three major reservoirs in the river system: Council Grove, Marion and John Redmond lakes (See Figure 1). Ground water is found in alluvial deposits along major streams. There were an estimated 174,000 residents in the basin in the year 2000, and the population is projected to grow to nearly 195,000 by the year 2040.

This basin illustrates major demographic changes taking place in Kansas. In the past 40 years, two trends have dominated the state. Rural counties have lost population, sometimes more than 10 percent every decade. Urban counties are gaining population, particularly in the Wichita and Kansas City areas. Typical of these trends are two adjacent counties, Chase and Lyon. Chase County had a population of 3,921 in 1960 and a population of 3,030 in 2000. Lyon County had a population of 26,928 in 1960 and a population of 35,935 in 2000.

The annual precipitation in the basin varies from approximately 30 inches in the western-most part of the basin to almost 42 inches in the southeast. Approximately 70 percent of this precipitation falls between April and September. Ten to 18 inches of snow falls in an average winter. Average temperatures vary from 35 degrees in the winter to 78 degrees in the summer.

The local economy is based primarily on agriculture and general manufacturing. The major crops grown in the basin include wheat, grain sorghum and soybeans. The production of beef cattle is another important part of the area's agricultural economy. The production of oil and gas is a relatively small but important component of the economy. A significant amount of coal, lead and zinc mining occurred historically in the southeastern portion of the basin. Strip mining of coal is the only one of these mining activities, which continues today. Another important component of the local economy is the only nuclear powered generating plant in Kansas, located near Burlington. The Wolf Creek plant is the largest single water user in the basin.

Nearly 80 percent of water used in the basin is from surface sources (2000 water use). Over 48 percent of water used is for municipal use, making it the highest use type in the basin, followed by 32 percent for industrial use, almost 12 percent for recreation and 7 percent irrigation. Significant water management entities in the basin include conservation districts throughout the basin, the See-Kan, Flint Hills and Lake Region Resource Conservation and Development areas and 15 active watershed districts. By virtue of its responsibility for three major reservoirs, the Corps of Engineers is another important water manager in the basin.

BASIN PRIORITY ISSUE:
Management of Ozark Plateau Aquifer System and Spring River
November 25, 2003

ISSUE:

The Ozark Plateau Aquifer system and the Spring River are water resources shared by Kansas, Missouri and Oklahoma which require increased interstate cooperation and management to meet current and long term growth demands, provide good quality water, and meet minimum desirable streamflow.

DESCRIPTION:

There have been dramatic declines in the static water level of the Ozark Plateau aquifer in far southeast Kansas. This confined aquifer moves into southeast Kansas from the Ozark Plateau high in Missouri. Rapidly growing demand, particularly in Missouri, have lead to the declines. A study commissioned by Missouri American Water Company projects possible water shortages in as few as ten years, if drought conditions should exist and there are increasing water demands with the expected continued growth in the region. Ground water flow in the Ozark Plateau aquifer moves out of Missouri into the southeastern corner of Kansas and into Oklahoma. Increased withdrawals in Missouri will impact the amount of water flowing into Kansas.

The Ozark aquifer was heavily used during lead and zinc mining operations from the late 1880s up into the 1950s. There has been a 30 percent increase in ground water use in southeast Kansas from 1982 to 2000, with approximately 94 percent of the total water use municipal.

Jasper and Newton Counties, Missouri, have had strong population growth (roughly 16 percent from 1990 – 2000) that has led to an increased water demand. All the high capacity wells in Jasper and Newton Counties are drilled into the Ozark aquifer. Some of the well fields have been unable to meet their production goals. As new wells are installed, pumping interference becomes increasingly likely.

Over the past twenty years, a number of water users in Cherokee and Crawford counties drawing from the Ozark aquifer have reported significant water level declines. The City of Galena has had a 400 foot drop in the static water level; 100 feet of that decline just in one year. Over the past twenty years, the water level has dropped 50 to 70 feet in the City of Riverton and Cherokee Rural Water District No. 8's wells, and roughly 20 feet in the City of Pittsburg's well.

The ground water declines are also contributing to water quality problems. The recharge to this aquifer is from the overlying Springfield Aquifer, which has numerous mining and industrial contaminants. Declines in the lower aquifer induce recharge from the overlying aquifer. In addition, the declines in southeast Kansas have caused an eastward migration of brine water, with increasing total dissolved solids, chloride concentrations and hardness, from south central Kansas. A number of public water supply wells have been abandoned due to taste and odor problems with the brine transition water.

Long term solutions need to be developed for the Missouri-Kansas-Oklahoma region. The Spring River and other surface water sources are being evaluated to meet future demand for Joplin and surrounding communities. The Spring River may provide a supplemental source of water for Kansas communities, although historically it has had a low average minimum flow and may not be suitable as a sole source supply. Kansas wants to assure that development of additional sources will be sustainable. There are many threatened and endangered species in southeast Kansas streams. A Minimum Desirable Streamflow exists on the Spring River. The Spring River is open to new appropriations in Kansas. Differences in water management and regulatory controls are one challenge to interstate cooperation. For example, Missouri has little regulatory control on the quantity of water used. Disputes are currently handled through civil suits.

The Tri-State Water Resources Coalition, a citizen advisory committee organized in January 2003 by the Missouri American Water Company, has been studying strategies to "develop a good quality water resource to ensure growth of the geographical area." (Tri-State Water Resource Coalition By-Laws). The 13-member Board of Directors has one Kansas member, and the rest from Missouri. The Kansas Water Office, Kansas Department of Health and Environment, and Kansas Department of Agriculture – Division of Water Resources have met with the Missouri Department of Natural Resources on this interstate issue.

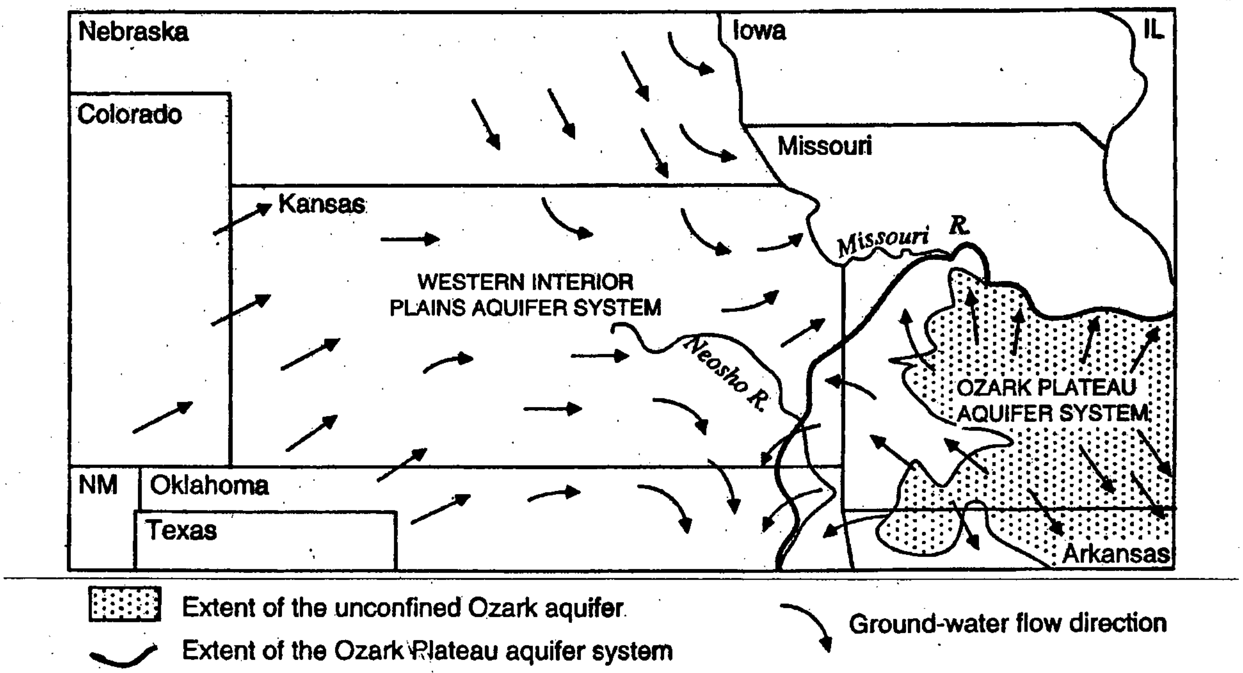


Figure 2. From Macfarlane, 1998.

KANSAS WATER PLAN OBJECTIVES:

- By 2015, achieve sustainable yield management of Kansas surface and ground water sources outside of the Ogallala aquifer and areas specifically exempt by regulation. Sustainable yield management would be a goal that sets water management criteria to ensure long term trends in water use will move as close as possible to stable ground water levels and maintenance of sufficient streamflows.

- By 2010, ensure that all public water suppliers have the technical, financial and managerial capability to meet their needs and Safe Drinking Water Act requirements.

- By 2010, less than 5 percent of public water suppliers will be drought vulnerable.

RECOMMENDED ACTIONS:

1. Develop an inter-agency strategy to address the complex water issues of multi-state cooperative management, ground water declines and quality, public water supply concerns, and instream flow protection for aquatic life and minimum desirable streamflow.

2. Obtain additional data on the ground and surface water resources in southeast Kansas, and the impact of increasing development.

REFERENCES:

Branscum, Iona, *Water Supply Management Issues of the Cambro-Ordovician Aquifer in Southeast Kansas,* talk presented at Kansas and the Future of Kansas conference, March, 2002.

Imes, J.L. and L.F. Emmett, 1994, *Geophydrology of the Ozark Plateaus Aquifer System in parts of Missouri, Arkansas, Oklahoma and Kansas*, U.S. Geological Survey Professional Paper 1414-D, 127 p.

Kansas Water Authority, July 2003, *Kansas Water Plan, Fiscal Year 2005 Update*, Kansas Water Office, 257 p.

Macfarlane, Allen P., 1998, *Is Sustainability a Viable Concept in the Management of Confined Aquifers in Kansas? In:* Perspectives in Sustainable Development of Water Resources in Kansas, M. Sophocleous, ed. Kansas Geological Survey Bulletin 239.

Scott, C. et al, 1990, *Geohydrology and Water Quality of the Roubidoux Aquifer, Northeastern Oklahoma*, U.S. Geological Survey Open-file Report 90-570, 110 p.

Tri-State Water Resource Coalition By-Laws, August 1, 2003, 4p.

Wittman, Jack, et al, February 2003, *Source of Supply Investigation for Southwestern Missouri*, Whittman Hydro Planning Associates, for Missouri-American Water Company, 93 p.

BASIN PRIORITY ISSUE:
Protecting and Enhancing Instream Flow
November 18, 2004

ISSUE:
The Neosho River has been having increasingly frequent low flow problems. Low flows have caused aquatic life stress and more frequent administration of water rights. Low flows can also result in poorer quality water. The Neosho River from the USGS gages near Iola to Parsons will be evaluated, and management strategies developed to protect and enhance streamflow.

DESCRIPTION:
The droughts of 2000, 2002, and 2003 have raised concern about streamflow in several basins in Kansas. Administration of junior water rights to meet Minimum Desirable Streamflow on the Neosho has become more frequent and longer in duration. The Neosho River is closed to new appropriations during the irrigation season (May to September). There continue to be new water right permit applications for off-season diversions, particularly for recreational uses. These activities highlight a larger concern of adequately providing and protecting minimum flow in the Neosho and other Kansas' streams to maintain their ecological functions and processes. The State has a responsibility to protect minimum streamflows.

The Neosho River is an area of high biological importance in Kansas. The Kansas Department of Wildlife and Parks has identified the following priority issues related to stream flows and reservoir management: populations of freshwater mussels, populations of sensitive species such as the Neosho madtom, and populations that have declined from historic levels such as the paddlefish.

The Neosho River will be evaluated from the USGS stream gage near Iola to the stream gage near Parsons by an interagency technical advisory committee. The Committee is to identify key factors that contribute to the flow problems. The stream reach will be evaluated to determine the streamflow trend and whether minimum desirable streamflow (40 cfs at Iola, and 50 cfs at Parsons) is achieved at a frequency no less than the historical achievement at the time of enactment.

This committee will evaluate the hydrology, water use data, aquatic life requirements, and water quality to recommend a minimum flow rate goal. This recommendation would serve as a guide to work towards. The recommendation of identifying minimum streamflows is consistent with KS.A. 82a-928(i), and should consider a rate that works towards sustainable yield management. The Committee is to balance the instream flow rates with the need and value of water in diversionary, beneficial uses. The recommended flow rates would be a compromise between beneficial instream flows and the value of the water for development.

The committee will make recommendations on possible options to protect or enhance a minimum flow in a stream reach. For any specific area, there will be various options and limitations based on the hydrology, water uses, and water management of that watershed, stream and stream reach. Some of the authorities and programs to protect and enhance streamflow include:

- Minimum Desirable Streamflows (K.S.A. 82-703(b));
- Rules and Regulations to implement the Kansas Water Appropriation Act, including that any new water right for beneficial use, except for domestic use, temporary use or a term permit, must not cause the safe yield of a water supply to be exceeded (K.A.R. 5-3-10), and a new water right cannot impair the ability to meet "a flow rate that allows water to flow past the first riffle below the point of diversion (K.A.R. 5-3-15(c)(3))";
- Statutory authority of the Chief Engineer to ascertain whether a proposed use will prejudicially and unreasonably affect the public interest (K.S.A> 82a-711).
- The water right purchase program (K.S.A. 2-1915) for the voluntary retirement of water rights as a means for stream or aquifer recovery.
- Reservoir Management operations, including timing and quantities of releases.

If current authorities do not appear adequate to provide streamflow protection or enhancement in a specific situation, the committee may consider seeking a new authority to allow instream water rights. If this is advised, a thorough review through the water planning process would occur. Any proposals to protect or restore streamflow would work within the legal framework of the Kansas Water Appropriation Act and related statutes, rules and regulations. Options to enhance streamflow include purchasing, leasing or donation of existing water rights.

KANSAS WATER PLAN OBJECTIVES:

- By 2015, achieve sustainable yield management of Kansas surface and ground water sources outside of the Ogallala aquifer and areas specifically exempt by regulation.

- By 2015, meet minimum desirable streamflow at a frequency no less than the historical achievement for the individual sites at time of enactment.

- By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

RECOMMENDED ACTIONS:

1. Implement the interagency strategic plan to evaluate the instream flow on the Neosho River between Iola and Parsons. As progress is made, share information with the Neosho Basin Advisory Committee and the public for input.

REFERENCES:

Kansas Water Authority, July 2003, *Kansas Water Plan, Fiscal Year 2005 Update, Protecting and Enhancing Instream Flow,* Kansas Water Office.

Kansas Water Authority, January 1986, *Kansas Water Plan, Management Section, Subsection: Minimum Desirable Streamflows*, Kansas Water Office, pp.1- 12.

K.S.A. 82a-730 *et al*, Kansas Water Appropriation Act.

Pope, David L., Chief Engineer, Division of Water Resources, Kansas Department of Agriculture, September 22, 2000, *Rules and Regulations Kansas Water Appropriation Act*, pp. 102.

Water Issue Strategy Team (Kansas Department of Agriculture – Division of Water Resources, Kansas Department of Health and Environment, Kansas Water Office, Kansas Department of Wildlife and Parks, State Conservation Commission), July 16, 2003, *Water Issue Strategic Plan: Evaluation and Protection of Instream Flows*, 5p.

BASIN PRIORITY ISSUE:
Watershed Protection and Restoration
November 25, 2003

ISSUE:

The protection and restoration of watersheds with impaired water quality and watersheds above public water supply reservoirs, is high priority in the Neosho Basin. Three main areas of focus are included in this effort: 1) Achievement of Total Maximum Daily Loads (TMDLs); 2) Source water protection; and 3) Restoration and protection of wetland and riparian areas.

DESCRIPTION:

Water quality protection and improvement is primarily addressed at the watershed level. There are regulatory and non-regulatory programs to protect and improve water quality. Surface water quality monitoring is conducted to assess the level of pollutants in the water. If monitoring indicates that a river segment or other water body is consistently violating water quality standards, the water is deemed water quality impaired. Water bodies not meeting water quality standards for their designated use(s) are identified on the 303(d) list. The 303(d) list is used to identify those waters targeted for the development of Total Maximum Daily Loads (TMDLs). A TMDL is the maximum amount of a pollutant that a water body can receive without violating water quality standards. Since pollution can arrive via point and nonpoint sources, the TMDL process attributes responsibility for the pollutant loads among those contributing sources.

The Section 303(d) list submitted to and approved by the Environmental Protection Agency in 1998, identified 69 river segments and 13 lakes in the Neosho Basin as water quality impaired. Among the streams, the greatest number of impairments was caused by excessive levels of fecal coliform bacteria. Among the lakes eutrophic conditions indicative of excessive algae production and dissolved oxygen depletion were the predominant cause of impairment. Additional lake impairments were caused by pH, siltation, and fecal coliform bacteria. Each parameter causing impairment requires a TMDL. Many of the stream segments, configured in a watershed setting, have a TMDL applied to them as a whole.

Recognizing that resources for implementation of actions to achieve TMDLs are finite, a priority of high, medium, or low has been established. Neosho basin TMDL priorities will be re-evaluated in 2007. Table 1 provides information on rivers and lakes within the basin that are designated a high priority for TMDL implementation. Figure 3 shows the location of these watersheds within the basin. The Neosho basin water quality is also a concern in Oklahoma, particularly for nutrient loading in the Grand River and Grand Lake.

A component of the TMDL process is to quantify the cost to implement best management practices and technical assistance necessary to address the impairments. The State Conservation Commission has prepared a "needs inventory" to estimate costs associated with reducing nonpoint source pollution in this basin, and guide implementation of best management practices. Programs are targeted at achieving high priority TMDL goals.

TABLE 1 NEOSHO BASIN HIGH PRIORITY TMDLS			
MAP ID	WATERBODY	IMPAIRMENTS	HUC 11 WATERSHEDS
STREAM SEGMENTS			
1	Allen (Dows) Creek	DO	1107020180
2	Neosho Headwaters	FCB	11070201010
3	Turkey Creek	DO	11070204020
4	Canville Creek	DO	11070205010
5	Cherry Creek	DO	11070205060
6	Labette Creek	DO	11070205040 & 050
7	Eagle Creek	DO	11070201040
8	Spring River	Metals (zinc, lead, copper, cadmium)	11070207160, 170 & 190
9	Shawnee Creek	DO	11070207160
LAKES			
10	Council Grove Lake	E; Silt	11070201010
11	Marion Lake (Marion Reservoir)	E	11070202010
12	Olpe City Lake	E, Silt	11070201040(030)

Key:
E: Eutrophication, biological community impacts and excessive nutrient/organic loading
FCB: Fecal Coliform Bacteria
HUC: U.S. Geologic Survey Hydrologic Unit Code
DO: Dissolved Oxygen lower than 5 ppm in stream
Silt: Observed siltation and/or chronic turbidity that impacts development of trophic state

The Kansas Department of Health and Environments TMDL website is - http://www.kdhe.state.ks.us/tmdl.index.htm

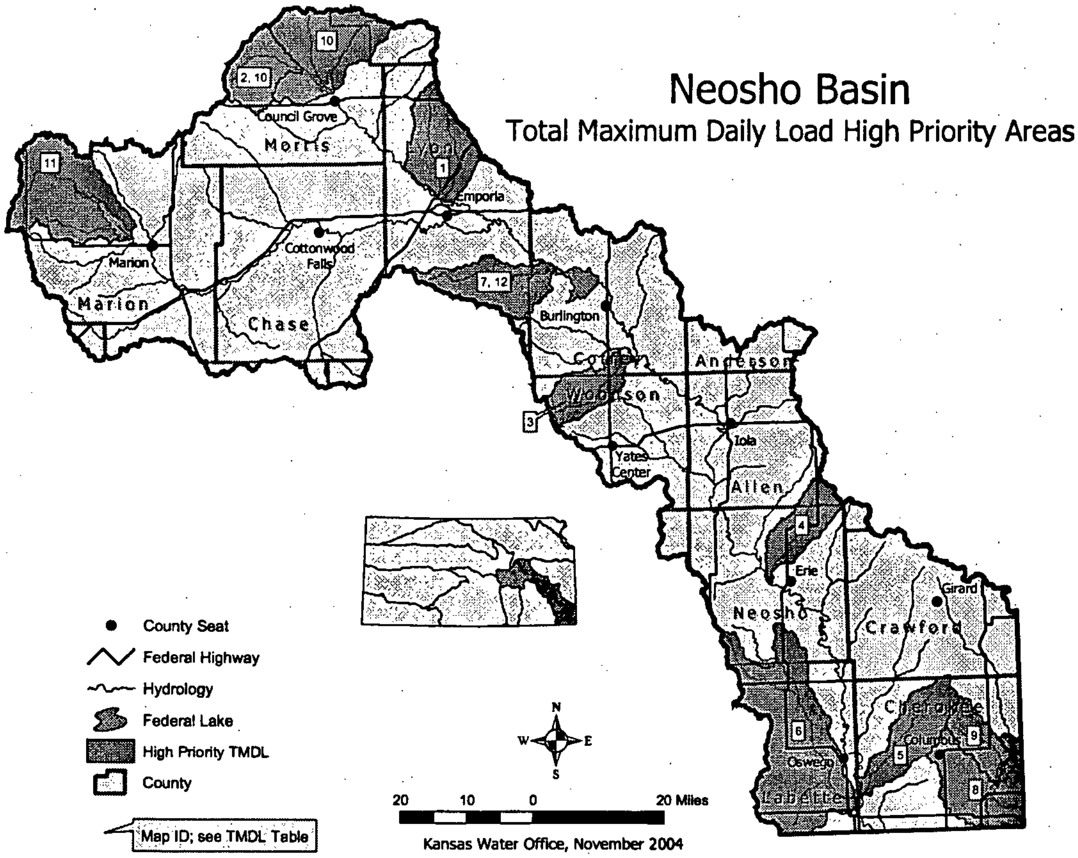


Figure 3

All the counties in the Neosho Basin, except Chase County, have adopted state approved sanitary/environmental codes, and participate in the Local Environmental Protection Program which helps implement environmental protection strategies of the Kansas Water Plan. Five public water supplies were recommended by the United States Environmental Protection Agency (EPA) for participation in the five year, 2003 atrazine monitoring program. This atrazine risk reduction program includes runoff prevention in watersheds feeding the public water supply. These types of activities can help reduce pollution loading in the watersheds.

Source Water Assessments are being completed for all public water supplies across the state, either by the public water supplier or utility, or Kansas Department of Health and Environment. Fifty-nine public water suppliers in the Neosho Basin have completed, or are in the process of conducting, source water assessments which involve delineation of the source water assessment area, an inventory of potential contamination sources, and a susceptibility analysis. These assessments use a standardized system to identify all potential sources of pollution to surface water within the contributing watershed, and conduct a susceptibility analysis to evaluate the threat from each potential pollutant to the water supply. Under the Source Water Assessment program, about two thirds of the Neosho basin has been designated as critical area for protecting public water supplies, as defined by the stream reaches with a 24-hour or less travel time to a surface water diversion point. Much of the information from the assessment and risk rating can be used to develop Watershed Restoration and Protection Strategy Plans (WRAPS) that can work to meet both TMDL goals and protect public water supplies from sources of pollution. Regional public water supply planning is a program that will provide strategies to meet the long term public water supply needs in this basin using raw and finished water sources.

Protection of the three federal reservoirs in this basin is another aspect of source water protection. The State has made significant investments in acquiring storage space in Council Grove, Marion, and John Redmond reservoirs for municipal and industrial use. Reducing sedimentation into the lakes is a water quality as well as water quantity issue. Efforts such as streambank stabilization can help reduce sedimentation.

Wetland and riparian areas are a third focus of watershed protection and restoration. The primary approach to wetland and riparian area management in the basin focuses on providing technical and financial assistance to landowners to protect and restore these resources in priority watersheds through the implementation of best management practices. Wetland and riparian areas are transitional lands between aquatic and upland locations. Wetlands include areas with hydric soils where standing water or wet soil conditions predominate. Riparian areas include streamside and floodplain areas where the vegetation, soils, or topography are distinguishable from that on adjoining uplands. Healthy riparian areas are an important component to filtering out pollutants and sediment from the streams and lakes. Healthy riparian areas can also control bank erosion, provide habitat and slow surface water runoff that leads to flooding. A preliminary analysis of the Neosho basin indicates about 23 percent of the streams have cropland as the riparian land use. Wetlands provide unique wildlife habitat, and serve as flood water detentions. Wetlands and riparian areas also provide aesthetic value.

A state map setting out high priority areas identifies high priority TMDL areas and high priority biological value areas (Figure 4). Nearly all of the Neosho Basin is identified as a High Biological Priority. Areas that overlap both the TMDL priority, and the Biological priority would be targeted for state assistance. Source water protection for public water supply is an additional focus for prioritizing watershed restoration and protection activities.

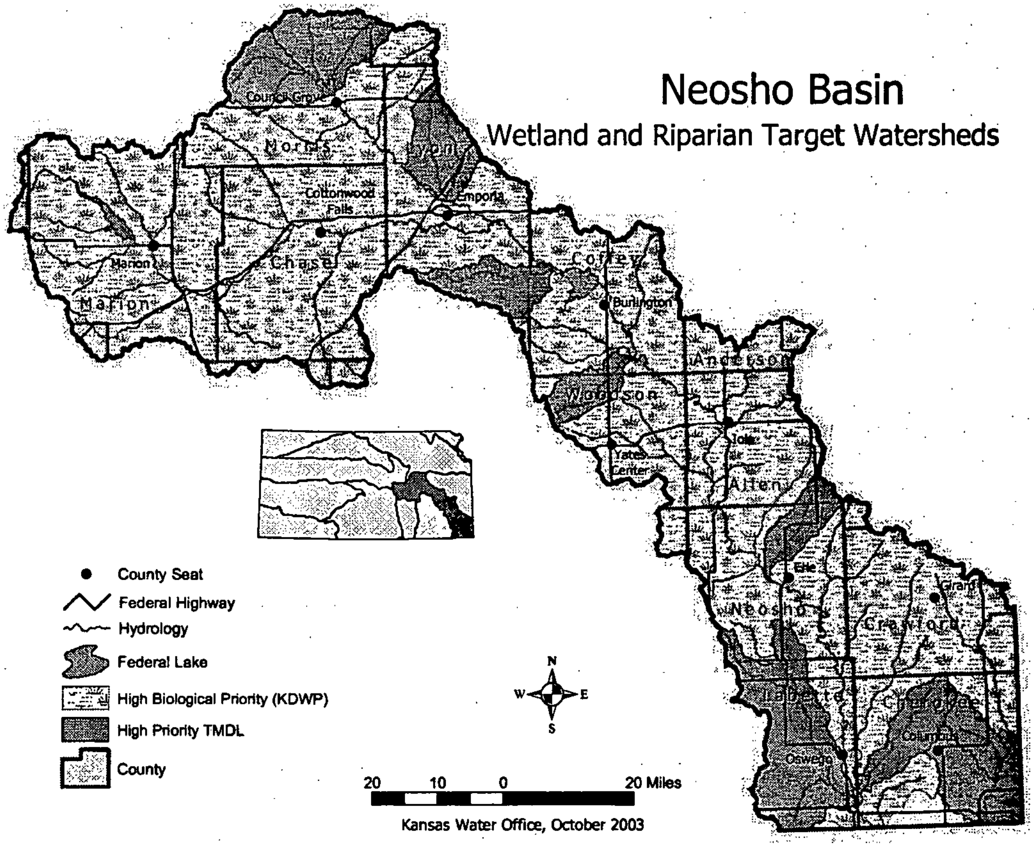


Figure 4

KANSAS WATER OFFICE OBJECTIVES:

- By 2010, reduce the average concentration of bacteria, biochemical oxygen demand, dissolved solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas lakes and streams.

- By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

- By 2010, maintain, enhance or restore priority wetlands and riparian areas.

RECOMMENDED ACTIONS:

1. Develop an inter-agency strategy to coordinate programs and activities for watershed restoration and protection. Key state agencies will be Kansas Department of Health and Environment, State Conservation Commission, Kansas Department of Wildlife and Parks, Kansas Department of Agriculture-Division of Water Resources and Kansas Water Office. Coordinate with other agencies and organizations as appropriate.

2. Focus state resources towards high priority watersheds, particularly those that include high priority TMDLs, high biological priority, and source water protection.

REFERENCES:

Kansas Water Authority, July 2003, *Kansas Water Plan, Fiscal Year 2005 Update,* Kansas Water Office, 257 p.

Kansas Water Authority, July 2001, *Kansas Water Plan, Fiscal Year 2003 Update, Neosho Basin Section*, Kansas Water Office.

Kansas Department of Health and Environment, August 2003, website: http://www.kdhe.state.ks.us/nps/index.html for Local Environmental Protection Program, and Source Water Assessments.

Kansas Water Office, 2003, draft *Kansas Priority Riparian and Wetlands Areas Implementation Plan.*

WATER MANAGEMENT CATEGORIES

The following issues are identified in the basin plan as items that require attention in addition to the basin priority issues, and are usually addressed by an individual agency's program. These issues are addressed within the following management categories:

- Water Conservation
- Public Water Supply
- Water Quality
- Flood Management
- Water Based Recreation

These categories also correspond to the Policy Section of the Kansas Water Plan and the Program Manual developed by the Kansas Water Office. These documents, respectively, contain new policy issues and the existing policy and statutory framework that relate to the management categories.

ISSUE: WATER CONSERVATION

There are 111 public water suppliers in the Neosho Basin. Seventy of them had water conservation plans as of December 2002. Thirteen public water suppliers reported 30 percent or more unaccounted for water at least once during the 1992 – 1997 assessment time period.

Objectives

1. By 2010, reduce the number of public water suppliers with excessive unaccounted for water by first targeting those with 30 percent or more unaccounted for water.

2. By 2015, all non-domestic points of diversion meeting predetermined criteria will be metered, gaged or otherwise measured under the authority of K.S.A. 82a-706c and K.S.A. 82a-1028(l). Criteria will include a minimal use requirement and priority area targeting.

3. By 2015, conservation plans will be required for water rights meeting the priority criteria under K.S.A. 82a-733 and it has been determined that such a plan would result in significant water management improvements.

Applicable Programs

The following programs relate to meeting the objectives in this category of resources management. For more information on the programs and associated policies, see the Programs Manual.

- **Kansas Department of Agriculture, Division of Water Resources: Water Appropriation Program**

- **Kansas Water Office: Water Conservation Program**

ISSUE: PUBLIC WATER SUPPLY

The primary approach to addressing public water supply issues in the basin focuses on ensuring that there are adequate supplies of surface and ground water within the basin to meet future water demands, reducing the number of public water supply systems that are vulnerable to drought, and ensuring that systems have the technical, financial and managerial capacity to meet future needs for water quality and quantity. A regional public water supply strategy will be developed for the basin to address these needs and provide program guidance to applicable state and federal programs.

An assessment completed in 2002 of long-term water supply availability for public water supply systems in the basin indicated that additional authorized quantities of water were needed for 34 public water supply systems to meet their projected 2040 demands (1998 data).

There are 111 public water suppliers in the Neosho Basin, 56 of which are rural water districts. The average municipal water use across the basin ranges from 60 to 239 gallons per capita per day, with a basin wide average of 107 gallons per capita per day (1999 data). Surface water is the primary water supply source in the basin. There are six public wholesale water supply districts in the basin. The Cottonwood/Neosho River Basin Assurance District is also active in the basin. The United States Corps of Engineers operate Council Grove, Marion and John Redmond reservoirs in coordination with the State to meet assurance district member's needs during periods of low flow.

Drought vulnerable public water suppliers are those suppliers most likely to first be impacted by drought due to basic source, distribution system or treatment capacity limitations; or that rely upon a single well as a sole source of water supply. Four public water suppliers in the Neosho Basin that were identified as drought vulnerable in 2000. Suppliers considered drought vulnerable as of June 2003 are summarized in Table 2 below.

Table 2
DROUGHT VULNERABLE PUBLIC WATER SUPPLIERS
(June 2003)

Name	Limitation Category
Cedar Point	Single Well Source
Chase RWD 01	Basic Source
Cherokee RWD 01	Distribution System
Cherokee RWD 04	Distribution System
Strong City	Basic Source

Capacity development is a process of public water supply systems to acquire and maintain adequate technical, financial and managerial (TFM) capabilities to provide safe drinking water. A survey was sent to community water systems to determine their TFM needs. The assessment of the Neosho basin indicated the systems listed below had high ranked TFM needs. The full report on capacity development can be found in the KDHE 2002 Report to the Governor, www.kdhe.state.ks.us/pws/capdev.html.

Facility Name	County	Population
Allen Co. RWD No. 11	Allen	54
Allen Co. RWD No. 15	Allen	135
Allen Co. RWD No. 3	Allen	32
City of Bartlett	Labette	124
City of Cedar Point	Chase	53
City of Chetopa	Labette	1,281
Coffey Co. RWD No. 2	Coffey	900
Coffey Co. RWD No. 2E	Coffey	905
City of Columbus	Cherokee	3,396
Green Acres Mobile Home Park	Lyon	300
City of Matfield Green	Chase	60
Neosho Co. RWD No. 3	Neosho	95

Objectives

1. By 2010, ensure that sufficient surface water storage is available to meet projected year 2040 public water supply needs for areas of Kansas with current or potential access to surface water storage.

2. By 2010, less than 5 percent of public water suppliers will be drought vulnerable.

3. By 2010, ensure that all public water suppliers have the technical, financial and managerial (TFM) capability to meet their needs and to meet Safe Drinking Water Act requirements.

Applicable Programs

The following programs relate to meeting the objectives in this category of resources management. For more information on the programs and associated policies, see the Programs Manual.

- **Kansas Department of Agriculture, Division of Water Resources: Water Appropriation Program**

- **Kansas Department of Health and Environment: Public Water Supply Program**

- **Kansas Water Office: State Water Planning Program**

- **Kansas Water Office: Water Conservation Program**

ISSUE: WATER QUALITY

Water quality is addressed through a comprehensive approach of restoration and protection through voluntary, incentive based, as well as regulatory programs. In this basin there are nine contamination sites for which the state has assumed responsibility. Ten counties have adopted state approved sanitary/environmental codes. Fifty-nine public water suppliers are conducting source water assessments. Sixteen conservation districts in the basin have local nonpoint source pollution management plans.

Objectives

1. By 2010, reduce the average concentration of bacteria, biochemical oxygen demand, dissolved solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas' lakes and streams.

2. By 2010, reduce the average concentration of dissolved solids, metals, nitrates, pesticides and volatile organic chemicals that adversely affect the water quality of Kansas ground water.

3. By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

Applicable Programs

The following programs relate to meeting the objectives in this category of resources management. For more information on the programs and associated policies, see the Programs Manual.

- **Kansas Corporation Commission: Conservation Division**

- **Kansas Department of Health and Environment: Environmental Remediation Program**

- **Kansas Department of Health and Environment: Environmental Protection Grant Program**

- **State Conservation Commission: Nonpoint Source Pollution Control and Water Resources Cost-Share Programs**

ISSUE: FLOOD MANAGEMENT

The primary approach to flood management in the basin focuses on floodplain management through community participation in the National Flood Insurance Program and reduction of rural flood damages through construction of watershed dams in organized watershed districts.

The basin has 41 communities (cities and counties) participating in the National Flood Insurance Program. One community has been suspended from the program and nine communities with identified flood hazard areas that do not participate. The communities shown in Table 3 have been identified by the Kansas Department of Agriculture, Division of Water Resources as priority communities in the basin for future floodplain mapping.

Priority watersheds for rural flood damage priorities were identified for the basin in 1986 by the United States Department of Agriculture, Natural Resources Conservation Service and are shown in Figure 5. Seventeen watershed districts have been organized in the basin.

The Kansas Water Office will be conducting an assessment of priority areas for flood damage reduction in FY 2003-2004 that will be used to target future program activities.

Table 3 PRIORITY COMMUNITIES FOR FLOODPLAIN MAPPING (January 2003)
Allen County
Anderson County
Cherokee County
Coffey County
Crawford County
Lyon County
Marion County
Neosho County

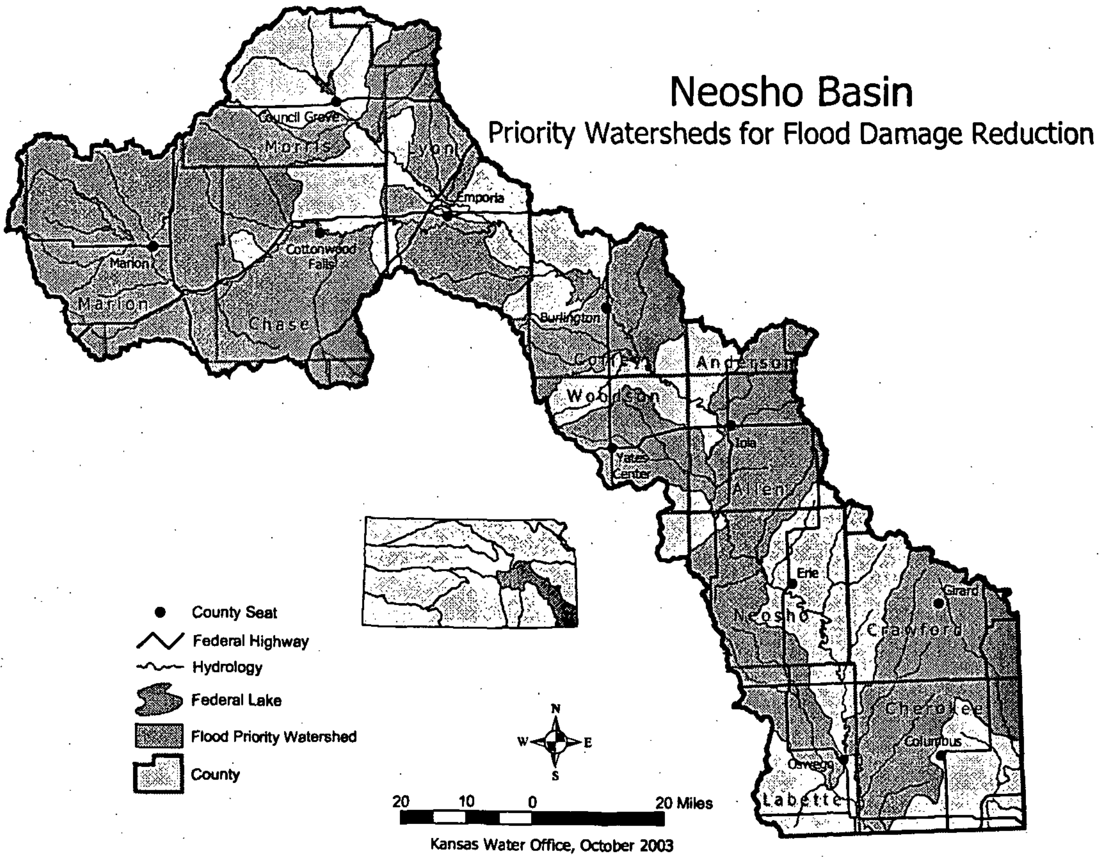


Figure 5

Objective

1. By 2010, reduce the vulnerability to damage from floods within identified priority communities or areas.

Applicable Programs

The following programs relate to meeting the objectives in this category of resources management. For more information on the programs and associated policies, see the Programs Manual.

- **Kansas Department of Agriculture, Division of Water Resources: Floodplain Management Program**
- **State Conservation Commission: State Assistance to Watershed Dam Construction Program**

ISSUE: WATER-BASED RECREATION

The state's rivers, streams and lakes represent a valuable recreational resource. Consideration of water-based recreation issues, problems and concerns are addressed in the Water-Based Recreation Policy Section. Even though the Neosho Basin has three large federal lakes that have recreation components there still is a demand for more water-based recreation facilities, particularly for fishing, hunting, hiking, motor boating, and water skiing. The Neosho River and its tributaries are not among the three rivers in the state considered open for public access.

Objective

1. By 2010, increase public recreational opportunities at Kansas lakes and streams.

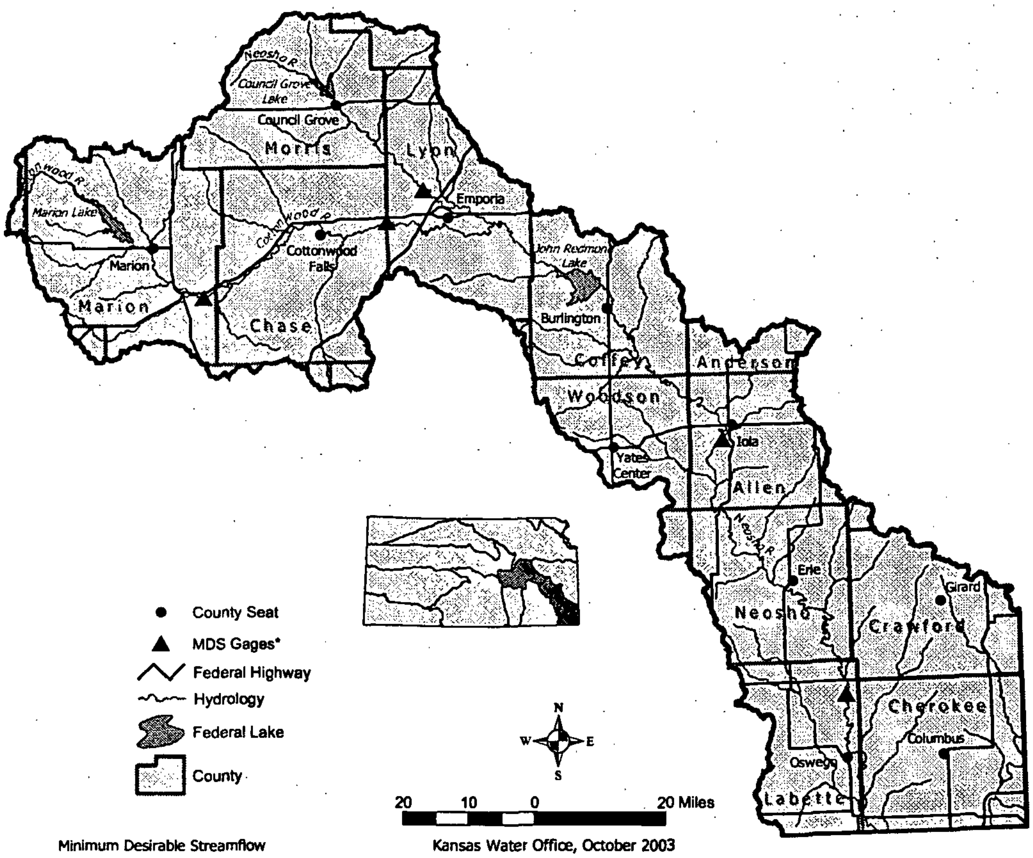
Applicable Program

The following program relates to meeting the objectives in this category of resources management. For more information on the programs and associated policies, see the Programs Manual.

- **Kansas Water Office: State Water Planning**

KANSAS WATER PLAN
NEOSHO BASIN SECTION

SUPPLEMENTAL ASSESSMENT AND DESCRIPTION OF CURRENT ACTIVITIES



LAST UPDATED: 12/24/2003

INTRODUCTION

The purpose of this document is to report the current activities and summarize assessment results for the priority and water management category issues in the Neosho Basin. This document will be updated periodically as new activities and studies are initiated.

BASIN PRIORITY ISSUES

Priority Issue: Management of Ozark Plateau Aquifer System and Spring River

The Ozark Plateau Aquifer system and the Spring River are water resources shared by Kansas, Missouri and Oklahoma which require increased interstate cooperation and management to meet current and long term growth demands, provide good quality water, and meet minimum desirable streamflow.

KANSAS WATER PLAN OBJECTIVES:

- By 2015, achieve sustainable yield management of Kansas surface and ground water sources outside of the Ogallala aquifer and areas specifically exempt by regulation. Sustainable yield management would be a goal that sets water management criteria to ensure long term trends in water use will move as close as possible to stable ground water levels and maintenance of sufficient streamflows.

- By 2010, ensure that all public water suppliers have the technical, financial and managerial capability to meet their needs and Safe Drinking Water Act requirements.

- By 2010, less than 5 percent of public water suppliers will be drought vulnerable.

Summary of Current Activities

In 2002, under the direction of the Natural Resources Subcabinet, a Water Issue Strategic Team (WIST), comprised of representatives from the state's natural resource agencies, was formed to identify the high-priority current issues they held in common.

In 2003, the WIST identified the Ozark Plateau Aquifer system and the Spring River as an issue in need of further coordination and study. As a result, an inter-agency working group was formed to specifically address this issue. The working group has developed a Water Issue Strategic Plan (WISP) that defines the issue, goals, objectives, strategies, and activities related to the issue.

The goals identified in the WISP include:

- Determine the affects of ground water development in Missouri on ground water inflows to Kansas and baseflow contribution to the Spring River, Shoal Creek and the Neosho River.
- Develop an administrative approach to water management of the water supply to protect existing uses and define limits on future development.
- Develop an interstate cooperative management forum between Kansas, Missouri and Oklahoma state agencies to address ground and surface water issues.
- Develop a public water supply regional plan for southeast Kansas for both short-term (within 10 years) demands and long term demands.

Several strategies and activities have been proposed to accomplish these goals. As the WISP is further developed and activities are initiated, additional information will be available in this supplemental assessment.

Research and Assessment

No additional research or analysis related to this issue is available at this time.

Priority Issue: Protecting and Enhancing Instream Flow

The Neosho River has been having increasingly frequent low flow problems. Low flows have caused aquatic life stress and more frequent administration of water rights. Low flows can also result in poorer quality water. The Neosho River from the USGS gages near Iola to Parsons will be evaluated, and management strategies developed to protect and enhance streamflow.

KANSAS WATER PLAN OBJECTIVES:

- By 2015, achieve sustainable yield management of Kansas surface and ground water sources outside of the Ogallala aquifer and areas specifically exempt by regulation.
- By 2015, meet minimum desirable streamflow at a frequency no less than the historical achievement for the individual sites at time of enactment.
- By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

Summary of Current Activities

In 2002, under the direction of the Natural Resources Subcabinet, a Water Issue Strategic Team (WIST), comprised of representatives from the state's natural resource agencies, was formed to identify the high-priority current issues they held in common.

In 2003, the WIST identified the protection and enhancement of instream flows as an issue in need of further coordination and study. As a result, an inter-agency working group was formed to specifically address this issue. The working group has developed a Water Issue Strategic Plan (WISP) that defines the issue, goals, objectives, strategies, and activities related to the issue.

The goals identified in the WISP include:

- Mitigate transit losses between endpoints of specified stream reaches to maintain dynamic stream hydraulics to efficiently route water through reaches.
- Maintain adequate baseflow and habitat along mainstem.
- Maintain adequate baseflow and habitat along tributaries.
- Test instream flow management techniques on the Neosho River between Iola and Parsons, the Verdigris River between Toronto Dam and Neodesha, and the Fall River between Fall River Dam and Neodesha.
- Identify and inventory reaches needing instream flow protection for subsequent strategy development in out-years.

Several strategies and activities have been proposed to accomplish these goals. As the WISP is further developed and activities are initiated, additional information will be available in this supplemental assessment.

Research and Assessment

In November 2003, the Kansas Geological Survey (KGS) provided the Kansas Water Office with an assessment report that reviews trends in mean annual streamflow that account for the influence of precipitation for selected USGS gaging stations from 1948 to 2001. A central premise to this assessment is that it associates the total precipitation that falls within the drainage areas of USGS gaging stations with the mean annual flow rates for each gaging station. This association is based on the potential that the total amount of precipitation would run off and flow past a gaging station. Influences from land use patterns, soil-infiltration rates, surface diversions, and a host of other parameters that affect runoff are not accounted for. This assessment simply establishes trends in mean annual flow that account for a measure of the variations in precipitation over time.

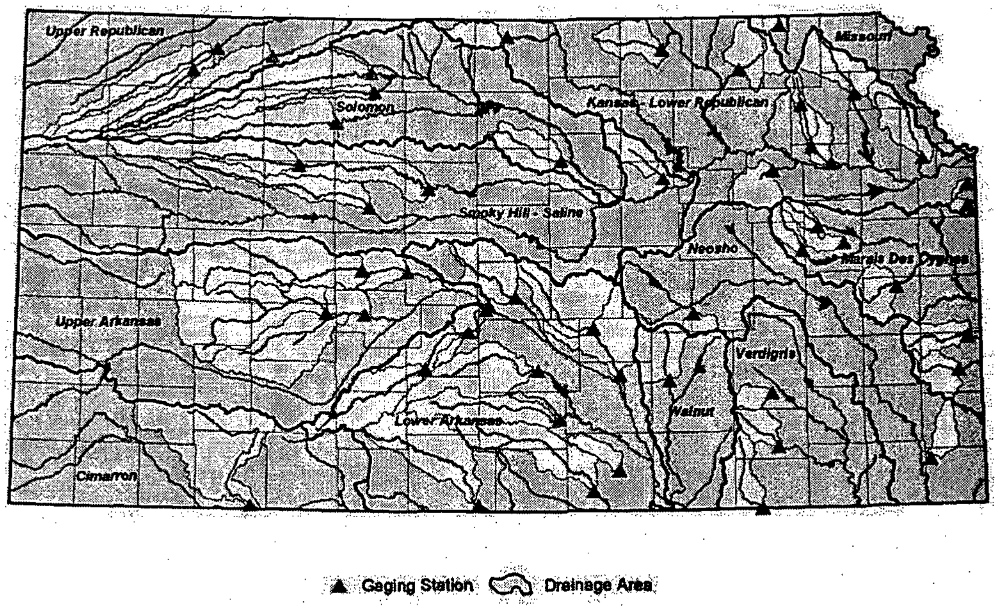
Mean annual streamflow values were obtained from the USGS via the National Water Information System (NWIS), located at http://waterdata.usgs.gov/nwis. The NWIS provides streamflow statistics for all USGS gaging stations in Kansas, including annual mean streamflow in cubic feet per second. To establish long-term trends in streamflow, only gaging stations that had at least 20 years of recently recorded streamflow values were selected, which limits the 310 gaging stations in Kansas that contain calculated mean flow values to 126 stations.

To associate the influence of precipitation with each gaging station, the drainage area for each station was identified from 14-Digit USGS Hydrologic Unit Basins (HUC14). The Natural Resources Conservation Service and USGS created the HUC14 basin delineations from 1:24,000 scale topographic maps. Each USGS gaging station was coded as to which HUC14 basin made up its drainage area.

Total monthly precipitation data was obtained from the National Climate Data Center (NCDC) at http://lwf.ncdc.noaa.gov/oa/ncdc.html. The number of stations in Kansas that contain usable monthly precipitation data varies from year to year and ranges from 188 to 301 stations with an average of 274 for the 1948 to 2001 time period. NCDC precipitation data became widely available in 1948, both in terms of a greater number of obtainable stations and their spatial distribution across the state.

Basing the gage selection requirements on stations that have at least 20 years of recently recoded streamflow, have the majority of their drainage areas lying completely within Kansas, and are not located below major surface water impoundments limits the usable USGS gaging stations to two stations in the Neosho Basin (Figure 1).

USGS Gaging Stations with at least 20 years of streamflow history, have the majority of their drainage area completely within the state, and are not located below a major surface water impoundment. State of Kansas, 2003



With the mean annual flow and annual precipitation that fell within the drainage area for each gaging station that fit the selection requirements identified, a statistical regression model was fit to the data to establish a trend in mean annual streamflow that accounts for variations in precipitation over time.

Of the two original gaging stations in the Neosho Basin that had at least 20 years of mean annual flow calculated, the majority of their drainage areas located within the boundaries of Kansas, and were not located below a major surface water impoundment, all the stations had a mean annual flow calculated every year from 1982 to 2001 and thus could be used to aggregate annual flow into a composite value for a 20-year period.

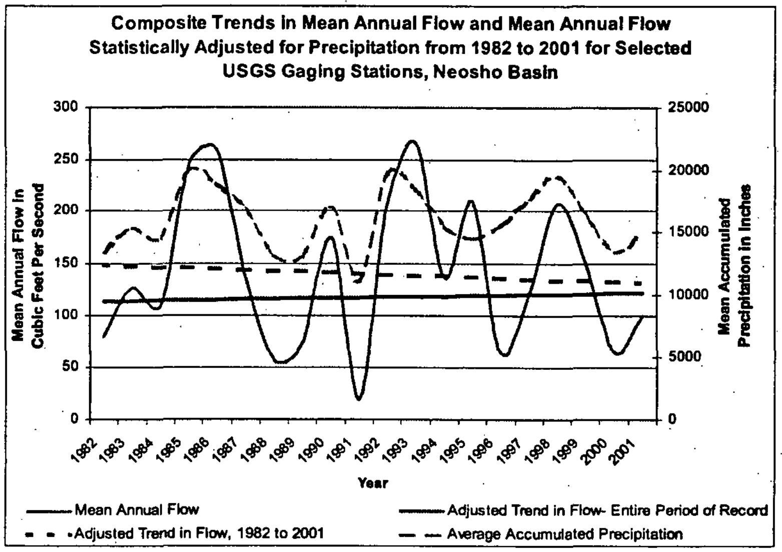
Based on these two stations, the overall average trend in streamflow that has been statistically adjusted for precipitation shows a fractional increase in flow based on the entire period of record for all the gages. However, none of the three gaging stations had statistically significant annual trends, based on the all available flow record, after factoring out variations in precipitation.

Calculating the trend in the adjusted streamflow rates using only records from 1982 to 2001 results in a slightly higher flow rate in terms of average annual cubic feet per second, but also has a fractional rise in flow over this time period. None of the stations had statistically significant annual trends for this time period.

The following charts show the individual trends in mean annual streamflow that have been statistically adjusted for variations in annual precipitation, and when possible, the composite trend for stations where a mean annual streamflow value was established for every year from 1982 to 2001.

Composite Trend: 2 stations are used in this aggregated trend

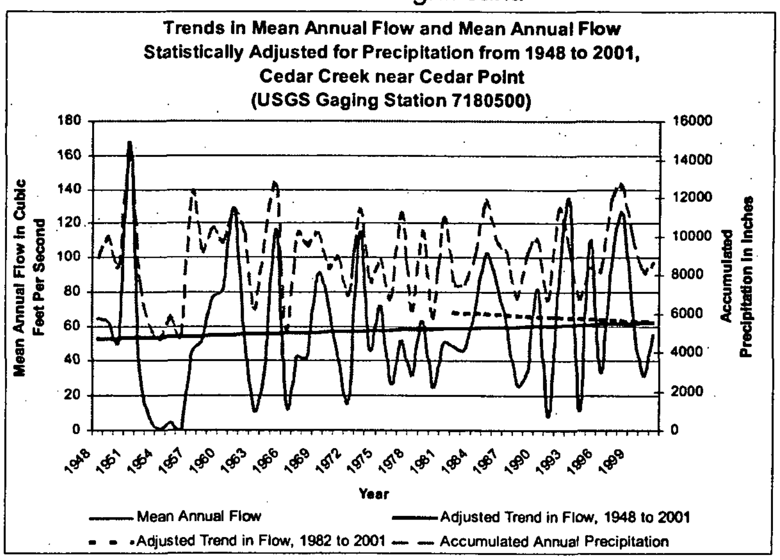
Average R-squared value:
Entire Period of Record = 0.70158, 1982 to 2001 = 0.66624
Probt Count:
Entire Period of Record = 0 out of 2 stations, 1982 to 2001 = 0



Station 7180500- CEDAR C NR CEDAR POINT, KS

Entire Period of Record
R-Squared = 0.64762
Probt = 0.374759514664763
Slope = 0.178738887774245
Change in Trend is not statistically significant.

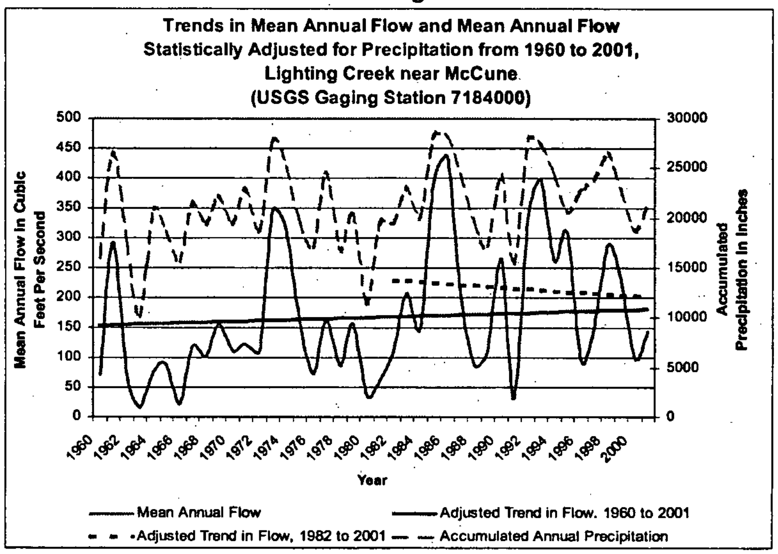
1982 to 2001 Time Period
R-Squared = 0.57736
Probt = 0.769263978779855
Slope = -0.293064204450504
Change in Trend is not statistically significant.



Station 7184000- LIGHTING C NR MCCUNE, KS

Entire Period of Record
R-Squared = 0.75553
Probt = 0.390521134805219
Slope = 0.661047858137962
Change in Trend is not statistically significant.

1982 to 2001 Time Period
R-Squared = 0.75512
Probt = 0.542829814676115
Slope = -1.46861398255896
Change in Trend is not statistically significant.



Priority Issue: Watershed Protection and Restoration

The protection and restoration of watersheds with impaired water quality and watersheds above public water supply reservoirs, is high priority in the Neosho Basin. Three main areas of focus are included in this effort: 1) Achievement of Total Maximum Daily Loads (TMDLs); 2) Source water protection; and 3) Restoration and protection of wetland and riparian areas.

KANSAS WATER OFFICE OBJECTIVES:

- By 2010, reduce the average concentration of bacteria, biochemical oxygen demand, dissolved solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas lakes and streams.

- By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

- By 2010, maintain, enhance or restore priority wetlands and riparian areas.

Summary of Current Activities

In 2002, under the direction of the Natural Resources Subcabinet, a Water Issue Strategic Team (WIST), comprised of representatives from the state's natural resource agencies, was formed to identify the high-priority current issues they held in common.

In 2003, the WIST identified the protection and restoration of watersheds as an issue in need of further coordination and study. As a result, an inter-agency working group was formed to specifically address this issue. The working group has developed a Water Issue Strategic Plan (WISP) that defines the issue, goals, objectives, strategies, and activities related to the issue.

The goals identified in the WISP include:

- Develop restoration and protection plans for existing and planned public water supplies (ground water and surface water).
- Provide state and federal programs support for implementation of local watershed restoration and protection plans.
- Ensure adequate local support for plan implementation.
- Develop plans to restore TMDL watersheds.
- Stabilize hydraulic/hydrologic function of watersheds (use comprehensive approach).
- Obtain public recognition of the importance of watershed protection (social marketing).

Several strategies and activities have been proposed to accomplish these goals. As the WISP is further developed and activities are initiated, additional information will be available in this supplemental assessment.

Research and Assessment

No additional research or analysis related to this issue is available at this time.

Issue: Water Conservation

KANSAS WATER PLAN OBJECTIVES:

- By 2010, reduce the number of public water suppliers with excessive unaccounted for water by first targeting those with 30 percent or more unaccounted for water.
- By 2015, all non-domestic points of diversion meeting predetermined criteria will be metered, gaged or otherwise measured under the authority of K.S.A. 82a-706c and K.S.A. 82a-1028(l). Criteria will include a minimal use requirement and priority area targeting.
- By 2015, conservation plans will be required for water rights meeting the priority criteria under K.S.A. 82a-733 and it has been determined that such a plan would result in significant water management improvements.

Summary of Current Activities

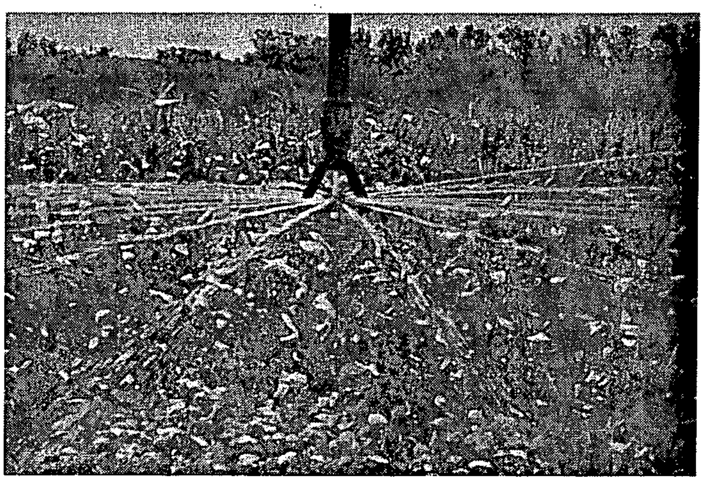
There are no current activities related to this issue to report at this time.

Research and Assessment

Each of the water management category issues have been assessed to provide baseline information to aid in targeting programs to areas of greatest need and to evaluate future progress in addressing the issues.

Irrigation

On September 22, 2000, the Kansas Department of Agriculture, Division of Water Resources adopted new county-based acre-foot per acre standards on reasonable quantities of water for irrigation use. The new county-based standards were established either on the net irrigation requirement for corn for an 80 percent chance rainfall event or a value equivalent to one standard deviation from the mean reported water use for a county, whichever is higher. These values are considered the maximum amount that can be authorized for a new irrigation water right permit. As such, it is expected that the



annual water use would typically be less than these values and only approach these maximum levels during dry climatic periods.

In accordance to the FY 2003 Kansas Water Plan, the newly adopted county-based standards were used as the benchmark for amounts considered reasonable for irrigation. It should be noted that water use in excess of the new county-based acre-foot per acre standards does not necessarily imply that an irrigator has exceeded the authorized quantity for water right or violated the Kansas Water Appropriation Act.

There are many reasons for high irrigation water use ranging from climatic factors to irrigated crop and soil types. The assessment attempts to measure potentially inefficient irrigation water usage and possibly target enhanced water conservation measures where appropriate.

This assessment used annual irrigation water use report data collected by the Kansas Department of Agriculture, Division of Water Resources.

There were three data parameters used in the irrigation assessment: 1) the total number of irrigation points of diversion that reported higher acre-foot per acre than the county-based acre-foot per acre standards, 2) the total amount of irrigation water reported used over the county-based acre-foot per acre standards, and 3) the number of irrigation water rights (which were grouped together based on how they overlap one another by either points of diversion or place of use) that appear to use water in excess of their respective authorized quantities.

A detailed description of the methodology and assessment can be viewed at the Kansas Water Office website: http://kwo.org.

Table 1. Number of Irrigation Points of Diversion Reporting Water Usage Over KDA-DWR County-Based AF/A Standards 1991-1997

1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
15	3	2	9	7	6	5	6	9	7

Table 2. Amount of Irrigation Water, in Acre-Feet, Reported Used Over the KDA-DWR County-Based AF/A Standards 1991-1997

1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
311	14	4	159	45	78	30	40	110	88

Table 3. Total Number of Water Right Groups that Appear to Have Used Water in Excess of Their Annual Authorized Quantity 1991-1997

1991	1992	1993	1994	1995	1996	1997	1998	1999	Average
17	2	2	6	6	4	2	6	8	6

Figure 1. Number of Irrigation Points of Diversion Reporting Water Usage Over KDA-DWR County Based AF/A Standards, 1991-1997.

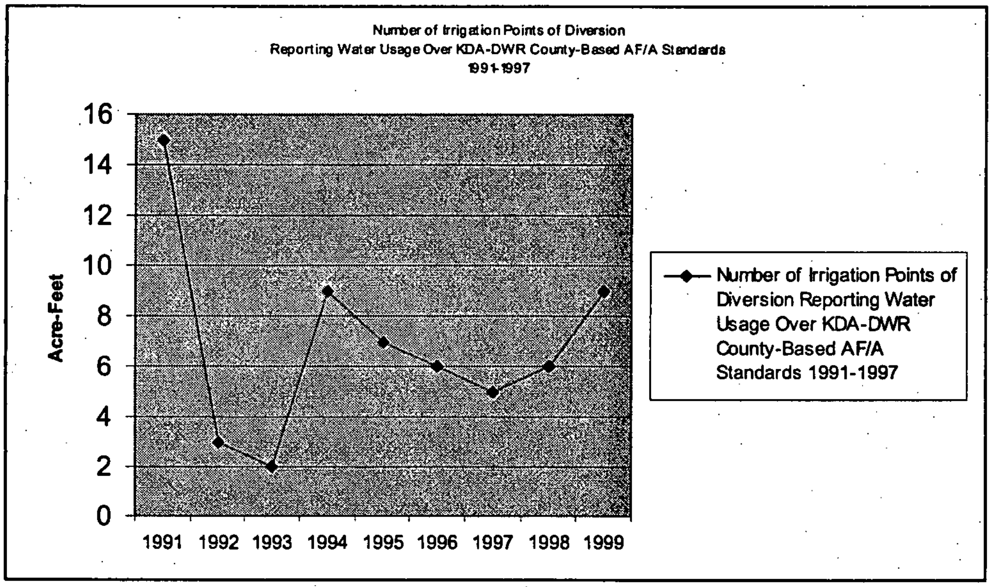


Figure 2. Amount of Irrigation Points of Diversion Reporting Water Usage Over KDA-DWR County Based AF/A Standards, 1991-1997.

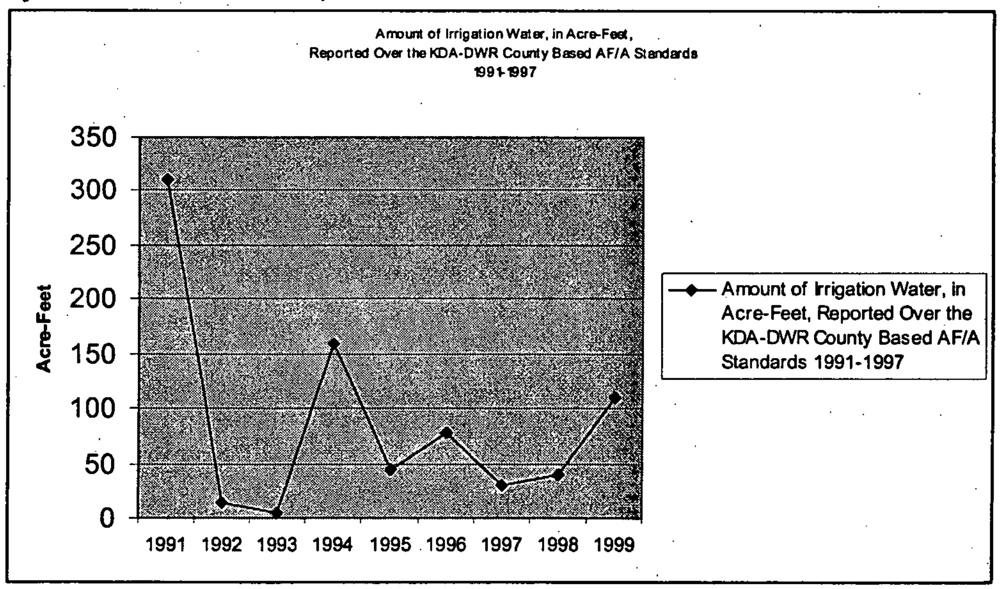
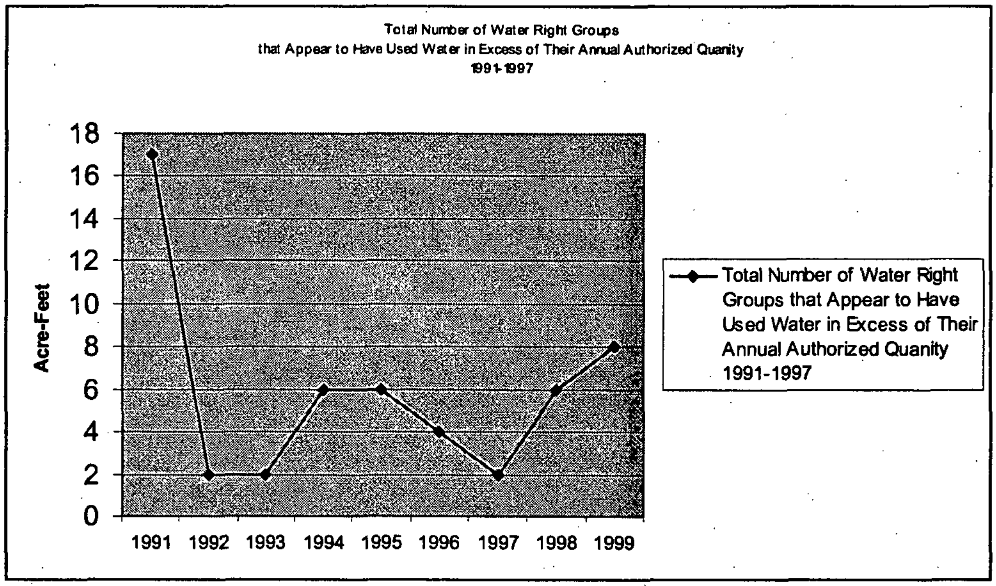


Figure 3. Total Number of Water Rights that Appear to Have Used Water in Excess of Their Actual Authorized Quantity, 1991-1997.



Municipal

Unaccounted for water is the amount of water that a public water supplier diverted under its water right or appropriation and/or purchased from other entities; minus the metered amounts that are sold to other public water suppliers; sold to large industrial, bulk, or livestock water users; sold to residential and commercial customers; or distributed as free water. A public water supplier may have a high percent of unaccounted for water, if it has: 1) inaccurately estimated the amount of water pumped or purchased due to not metering all water at the intake source or by using raw water or finished water meters that are inaccurate or improperly installed; 2) inaccurate customer meters; 3) bookkeeping errors; 4) non-metered uses such as water used in the treatment process, city buildings, churches, watering a golf course, etc.; or 5) water leaks.

The Kansas Water Office determined the percent and amount of unaccounted for water suppliers by using two data sets: 1) the annual municipal water use report data collected by the Kansas Department of Agriculture, Division of Water Resources; and 2) the Kansas Water Office Population and Demand Projections data. The time period used for this assessment was 1992-1997.

One data parameter used for this assessment was the number of public water suppliers with 30 percent or more unaccounted for water. The amount of unaccounted for water in excess of 15 percent of the total water pumped or purchased by public water suppliers was chosen as a second data parameter, in order to gain a better understanding of the amount of unaccounted for water that might be saved for beneficial use. A public water supplier cannot account for all water pumped. Since 15 percent was the average percent of unaccounted for water for Kansas public water suppliers in 1997, it is considered the reasonable standard for unaccounted for water.

The average amount of unaccounted for water in excess of 15 percent of total water use in the basin was 196,742,000 gallons.

Table 4. Number of Public Water Suppliers With 30 Percent or More Unaccounted for Water 1992-1997					
1992	1993	1994	1995	1996	1997
4	7	5	4	1	3

Table 5. Unaccounted for Water in Excess of 15 Percent of Total Water Use in Thousands of Gallons 1992-1997					
1992	1993	1994	1995	1996	1997
237,935	191,822	150,981	144,857	121,232	333,627

Issue: Public Water Supply

KANSAS WATER PLAN OBJECTIVES:

- By 2010, ensure that sufficient surface water storage is available to meet projected year 2040 public water supply needs for areas of Kansas with current or potential access to surface water storage.

- By 2010, less than 5 percent of public water suppliers will be drought vulnerable.

- By 2010, ensure that all public water suppliers have the technical, financial and managerial (TFM) capability to meet their needs and to meet Safe Drinking Water Act requirements.

Summary of Current Activities

There are no current activities related to this issue to report at this time.

Research and Assessment

No additional research or analysis related to this issue is available at this time.

Issue: Water Quality

KANSAS WATER PLAN OBJECTIVES:

- By 2010, reduce the average concentration of bacteria, biochemical oxygen demand, dissolved solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas' lakes and streams.
- By 2010, reduce the average concentration of dissolved solids, metals, nitrates, pesticides and volatile organic chemicals that adversely affect the water quality of Kansas ground water.
- By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

Summary of Current Activities

There are no current activities related to this issue to report at this time.

Research and Assessment

Ground Water Quality

Assessment of ground water quality in Kansas was completed using an initial data set used for analysis was from the Kansas Ground Water Quality Monitoring Network maintained by the Kansas Department of Health and Environment. This provided ambient ground water quality data covering the basin.

Kansas Ground Water Quality Monitoring Network wells were sampled on a 2-year rotation resulting in a maximum of five data sets per monitoring site during the 1990-2000 assessment periods. The constituents evaluated were chloride, sulfate, total dissolved solids (TDS), ammonia, arsenic, iron, lead manganese, nitrate (as nitrogen), selenium, and the pesticides atrazine, alachlor, and metachlor.

The Kansas Ground Water Monitoring Program was managed and operated by Kansas Department of Health and Environment from 1990 to 2001. Kansas Department of Health and Environment discontinued the ground water quality network in FY 2002 due to budget constraints. The primary objective of the monitoring program was to provide reliable information on ground water quality for use in identification of any temporal or spatial trends in aquifer chemistry. The monitoring network provided a reliable indication of ground water quality conditions within the Neosho Basin.

Ground Water quality is also monitored for specific projects or areas by state and local agencies including Kansas Department of Health and Environment, the Kansas Geological Survey, Kansas Corporation Commission, Kansas Department of Agriculture, and the ground water management districts.

Summary statistics resulting from the ambient ground water quality assessment are presented in Table 7. Table 8 reports the average concentrations using the average from each of the 16 wells over the period of study. Sixty-nine percent, 11 wells had an average of at least one parameter that exceeded the current relevant standard.

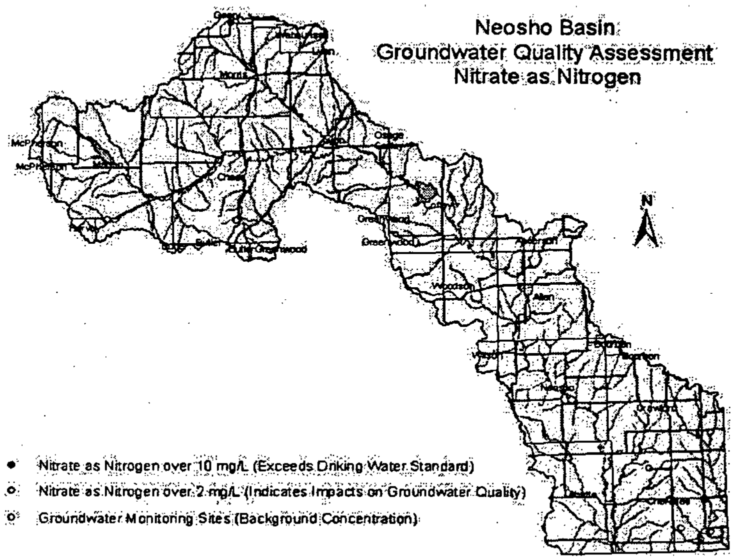
Table 7. Ambient Groundwater Quality Assessment Summary Neosho Basin							
Parameter	Number of Samples	Sample Average in mg/L	Maximum in mg/L	Standard in mg/L (Type)[1]	Samples Over Standard	Wells Over Standard	Percent Wells Over Standard At Least Once
Chloride	69	81	480	250 (SMCL)	4	1	6%
Sulfate	69	82	280	250 (SMCL)	1	0	0%
Total Dissolved Solids	69	513	1133	500 (SMCL)	43	10	63%
Arsenic	69	0.015	0.05	0.05 (MCL)	0	0	0%
Iron	69	0.458	9.49	0.3 (SMCL)	19	5	31%
Lead	61	0.012	0.05	0.015 (AL)	18	4	27%
Manganese	69	0.07	1.78	0.05 (SMCL)	11	3	19%
Selenium	61	0.012	0.05	0.05 (MCL)	0	0	0%
Ammonia	69	0.124	0.59	None	NA	NA	NA
Nitrate	68	1.79	15.6	10 (MCL)	3	1	6%

MG/L: milligrams per liter
MCL: maximum contaminant level. MCLs are the highest level of a contaminant that is allowed in drinking water.
SMCL: secondary maximum contaminant level. SMCL are non-enforceable guidelines regulating contaminants that may cause cosmetic or aesthetic effects in drinking water.
AL: Action level. Action levels are achieved by a treatment technique that requires systems to control the corrosiveness of their water..

Table 8. Ambient Groundwater Quality Assessment Average Well Concentrations				
Parameter	**Number of Wells**	**Average of Wells**	**Wells with Averages Over MCL or SMCL**	**Percent Wells with Average Over MCL or SMCL**
Chloride	16	78	1	6%
Sulfate	16	85	0	0%
Total Dissolved Solids	16	518	10	63%
Arsenic	16	0.015	0	0%
Iron	16	0.602	5	31%
Lead	15	0.012	4	27%
Manganese	16	0.150	3	19%
Selenium	15	0.011	0	0%
Ammonia	16	0.140	NA	NA
Nitrate	16	1.77	1	6%

Nitrate (reported as nitrate as nitrogen) concentration is the most common contaminant affecting the use of ground water for drinking water. Recent U.S. Geological Survey publications have lowered Kansas background (natural) concentrations to 2 mg/L. Concentrations above 2 mg/L indicate that nitrate from non-natural sources such as human or animal waste or fertilizers have entered the ground water. Approximately 25 percent, or 4 wells, are impacted from land surface activities (concentrations greater than 2 mg/L) in the Neosho Basin. Approximately 13 percent, or 2 wells, exceeded the drinking water standard for public water supply (10 mg/L). Figure 7 shows the distribution of wells with indicators of ground water quality above natural conditions in the basin.

Figure 7. Distribution of wells with indicators of ground water quality above natural conditions in the Neosho Basin.



Another indicator of impacts to ground water is the presence of human-made chemicals such as pesticides. Three commonly used pesticides, atrazine, alachlor, and metochlor were included in the ground water quality monitoring assessment. Seventy-one pesticide samples were taken in the Neosho Basin. Atrazine was detected two times in one well in the Neosho Basin. The highest concentration in the basin was 0.54 ug/L for atrazine.

Issue: Flood Management

KANSAS WATER PLAN OBJECTIVE:
▪ By 2010, reduce the vulnerability to damage from floods within identified priority communities or areas.

Summary of Current Activities

There are no current activities related to this issue to report at this time.

Research and Assessment

No additional research or analysis related to this issue is available at this time.

Issue: Water Based Recreation

KANSAS WATER PLAN OBJECTIVE:
• By 2010, increase public recreational opportunities at Kansas lakes and streams.

Summary of Current Activities

There are no current activities related to this issue to report at this time.

Research and Assessment

In October 2002, the Interdisciplinary Communication Research Institute at Wichita State University provided the Kansas Water Office with an assessment of the State Water Plan public recreational opportunities objective. The assessment provided a two-fold analysis of 1) the recreational opportunities currently available in Kansas; and 2) the level of public demand for recreation, which included an identification of priority activities for enhancement and perceptions of the quality and availability of recreational opportunities.

As of December 1999, there are 58 water based recreation opportunities in the Neosho Basin. Of the 58 opportunities, the majority were community lakes (29). Table 6 shows the number of water-based recreation opportunities in the basin by category and site location.

Table 6. Water Based Recreation Opportunities in the Neosho Basin, as of December 1999

Site Location	*Large Reservoirs*	*State Fishing Lakes*	*Community Lakes*	*River Access*	*Other*	*Total*
Category						
Total	3	6	29	18	2	58
Water Surface Acres	19,104	785	9,546		3,312	32,747
Hunting Acres	7,672	3,504	1,205		16,268	28,649
Boating	3	5	18	3		29
Camping	3	6	13	7		29
Fishing	3	6	29	18	1	57
Hiking Trails	1	1	4			6
Hunting	3	4	1		2	10
Picnic Sites	3	6	23	7		39
Swimming	3	4	8			15

PLANNING PURPOSE AND PROCESS

The *Kansas Water Plan* is the tool used in Kansas to address current water issues and to plan for future water quality and quantity needs. The State Water Resource Planning Act (K.S.A. 82a-901a) declares that "the state can best achieve the proper utilization and control of the water resources of the state through comprehensive planning which coordinates and provides guidance for the management, conservation and development of the state's water resources." The State of Kansas embarked upon comprehensive state water planning in the early 1980's when it created the Kansas Water Office and the Kansas Water Authority. The Kansas Water Office is the water planning agency for the state mandated under K.S.A. 82a-903 to formulate a state water plan. The Kansas Water Office is required to formulate the Plan, with input from other water-related agencies.

Within and a part of the Kansas Water Office is the Kansas Water Authority, which is comprised of 23 members as shown in the box below. The Kansas Water Authority annually reviews and approves the *Kansas Water* Plan. Eleven of the members are appointed by the Governor, one is appointed by the President of the Senate and one by the Speaker of the House. The agency representatives serve as *ex-officio* members (K.S.A. 74-2622).

Representative of the Governor
Director of the Kansas Water Office
Representative of Central Kansas Groundwater Management Districts
Representative of Western Kansas Groundwater Management Districts
Representative of Conservation and Environmental Issues
Secretary of the Kansas Department of Agriculture
Representative of the President of the Senate
Representative of State Association of Kansas Watersheds
Director of Division of Environment, Kansas Department of Health and Environment
Secretary of the Kansas Department of Wildlife and Parks
Director of the Agricultural Experiment Station KSU
Representative of Small Municipal Water Users
Representative of the Speaker of the House
Representative of Kansas Association of Conservation Districts
Chief Engineer of the Kansas Department of Agriculture, Division of Water Resources
Representative of Large Municipal Water Users
Representative of the General Public
Secretary of Kansas Department of Commerce and Housing
Representative of the General Public
Administrative Officer of State Conservation Commission
Representative of Industrial Water Users
Chairperson of Kansas Corporation Commission
State Geologist of Kansas Geological Survey

SCOPE

The *Kansas Water Plan* is based upon a comprehensive, watershed oriented approach to planning. A watershed is an area defined by a boundary within which all water ultimately drains into one body of water. The interconnections within the watershed that define the action of the hydrological cycle in that area must be considered in managing the water resources. The recharge areas where the surface conditions interact most readily with the water under the surface must be considered as part of the system defining the watershed. Some watersheds feature shallow aquifers that actively interact with flowing streams. Other watersheds have virtually no surface water and depth to freshwater aquifers may be hundreds of feet. In addition, the specific precipitation patterns, topography, soil types and land use patterns are features that make each watershed unique. This scope provides a framework for consideration of all water related issues.

GUIDING PRINCIPLES

The *Kansas Water Plan* is developed under the following guiding principles.

Comprehensive

Comprehensive planning provides guidance for a wide range of water management, conservation and development issues (K.S.A. 82a-901). The policy categories are organized as follows:

- Water Management
- Water Conservation
- Public Water Supply
- Water Quality
- Flood Management
- Wetland and Riparian Management
- Water-Based Recreation
- Data and Research
- Public Information and Education

Each of these categories is also addressed, where appropriate, for specific areas in the state.

K.S.A. 82a-903 directs that the *Kansas Water Plan* include sections corresponding with water planning areas as determined by the Kansas Water Office. In 1985 the Kansas Water Office adopted the 12 major river basins as those planning areas (Figure 1.) These were submitted to the Kansas legislature who then directed the agency to prepare basin plans as part of the *Kansas Water Plan* (1985 Session Laws of Kansas, Chapter 341.)

Coordination

Hundreds of public and private organizations and thousands of individuals share the responsibility to manage the state's water resources. No single organization, acting alone within the scope of its powers, can carry out programs to manage, conserve or develop the waters of the state. It is essential that organizations at all levels, local, state, federal and frequently other states, act in a coordinated fashion to achieve common objectives in water resource management.

The *Kansas Water Plan* is formulated and used for the general purpose of accomplishing the coordinated management, conservation and development of the water resources of the state. The Division of Water Resources of the Kansas Department of Agriculture, the State Geological Survey, Kansas Department of Health and Environment, Division of Environment, the Department of Wildlife and Parks, the State Conservation Commission and all other interested state agencies cooperate with the office in formulation of the *Kansas Water Plan* (K.S.A. 82a-903). Once formulated, the Plan then becomes a useful tool for coordinated efforts in planning, implementation and operation of programs and activities to address water issues in the state. Figure 2 depicts the concept of a management process that involves federal, state, and local entities. Each agency has a management process. K.S.A. 82a-931 contains a declaration of the state's intention to coordinate state planning with local and national planning. The *Kansas Water Plan* integrates those water resource management processes through identification of priority issues and priority areas.

Coordination with the public is also an important component. The need to seek public input in the planning process is set out in K.S.A. 82a-903 and states that: ". . . the Kansas Water Office and the Kansas Water Authority shall seek advice from the general public and from committees consisting of individuals with knowledge of and interest in water issues and in the water planning areas." Basin advisory committees were established in 1985 to meet that need. These committees are made up of volunteer citizens located within each of the 12 major river basins in the state. The committees meet at least quarterly in various locations throughout the basins. All meetings are publicized and the public is encouraged to attend. Each committee has 11 members representing water use categories of municipal, other public water suppliers, domestic, irrigation, industry and recreation, as well as at-large members.

Continuous

Continuous planning is the key to ensuring that the planning effort is an integral part of the state's water management process (Figure 3). Once the Plan is formulated, programs are implemented and operated for a period of time and ultimately the program outcomes are assessed. Information from operating experience and assessment of the condition of the state's water resources are used to modify and improve the Plan. Consequently, planning, by its nature, must be a continuous process, constantly adapting to new conditions and information. A plan set in concrete is an obstacle to effective management instead of a useful tool.

PURPOSE OF THE *KANSAS WATER PLAN*

The *Kansas Water Plan* is used to coordinate management, conservation and development of the water resources of the state. Objectives for the *Kansas Water Plan* were developed in 1998 and provide a focus for this coordinated effort. The Objectives are articulated in the section "*Kansas Water Plan Objectives*".

Purpose of Policy Sections

The purpose of the policy sections is to give an overview of the water resource category, such as water quality, and the state's involvement with the issues related to that category. Current policy in each category is defined by the body of adopted law and program operations in accordance with appropriations made by the legislature and governor. Each policy section describes the statutory framework, objectives of the water plan for the category, and current programs and activities for the water resource management category. The sections also contain a summary of the resource conditions of the state, and the management concepts used to address the issues. New and emerging issues are included where applicable, and options to address those issues are discussed. New issues to be included in the Policy Section would be those that need new or amendatory legislation or new or significantly revised programs.

Purpose of Basin Sections

The purpose of the basin sections is to make recommendations for the operation of state programs that can assist in addressing priority issues and in meeting the *Kansas Water Plan* objectives in the basin. Basin advisory committees were formed in 1985 to represent the 12 major river basins of the state in the planning process. The emphasis of the planning effort in each basin is:

1. Identification of priority issues;

2. Identification of state programs that can address the issues; and

3. Development of guidelines to the agencies for the operation of state programs that can assist in addressing priority issues in the basin and in meeting *Kansas Water Plan* objectives.

Purpose of Future Issues

Issues that are identified through the planning process that are not currently addressed are captured in this category. These may be identified in either policy or basin sections. Each year the Kansas Water Authority reviews these items to determine if those issues should be considered for evaluation under the water planning process based on the following criteria:

- Involve the need for development of new policy as opposed to implementation of existing policy.
- Are not suitably addressed through existing programs or policies.
- Present a central need for policy definition as opposed to funding requirements.
- Are closely tied to some beneficial use of water.

KANSAS WATER PLANNING PROCESS

The key to coordinated, comprehensive and continuous planning is the annual state water planning process which emphasizes public participation through basin advisory committees, public meetings and public hearings (Figure 3). This process applies to the revision of *Kansas Water Plan* policy and basin sections. The annual state water planning process in Kansas is coordinated with numerous local, state and federal agencies, special interest groups and the public.

July: Generally, policy or basin issues to be addressed in a given planning cycle are identified at the July Kansas Water Authority meeting. The Kansas Water Authority directs the Kansas Water Office and the agencies to begin development of the background information on potential policy or program initiatives.
July–October: Background information is prepared and preliminary recommendations are identified. This is done with input from the basin advisory committees and others with specific expertise in water issues under study, sometimes in the form of technical advisory committees.
October: The background information is reviewed with the Kansas Water Authority. If the Kansas Water Authority determines the issue is ready for further development, they direct the Kansas Water Office to develop a preliminary draft. Also during this time period, the basin advisory committees provide input at their meetings. Changes to the basin plan sections are recommended by the basin advisory committees at their October meetings. Input from other individuals, organizations and agencies may also be considered.
January: A preliminary draft of the annual update of the *Kansas Water Plan* is presented to the Kansas Water Authority. At that time, the Kansas Water Authority determines if the draft is ready for public review, as is, or with changes. The Kansas Water Authority does not take a position on the draft, only that it is ready for public scrutiny.
March: Public meetings are held to solicit public comment on the draft. The basin advisory committees and the Kansas Water Office jointly host these meetings.
April: The input received at the public meetings is summarized and recommendations on necessary revisions are presented to the Kansas Water Authority. The Kansas Water Authority may direct that a working draft be prepared with necessary changes and released for comment at public hearings. Again, no specific position on the part of the Kansas Water Authority is taken, only that the draft is ready for continued review and input by the public.
May–June: Public hearings on the working draft are held, with a minimum of one in the western part of the state and one in the eastern part of the state. The basin advisory committees also meet in June and make recommendations on the development of the final draft of the Plan.
July: Giving due consideration to the comments received at the hearings, a final draft of the *Kansas Water Plan* is prepared by the Kansas Water Office and presented to the Kansas Water Authority for consideration of approval. After being approved, the Plan is submitted to the Governor and Legislature by the Kansas Water Office.

There is flexibility built into the planning process, so that issues may be identified and planning initiated at times other than July, and the process may be extended beyond one year in the case of particularly complex issues. There is also flexibility in having additional meetings, such as additional basin advisory committee meetings or with specific stakeholder groups, as appropriate to the specific issue under review.

Implementation of the *Kansas Water Plan*

Implementation of the *Kansas Water Plan* is accomplished in part by the passage of necessary legislation and through funding of specific programs or projects. Creation of the State Water Plan Fund in 1989 provided a dedicated source of revenue for implementation of the *Kansas Water Plan*. The Plan serves as guidance to the agencies for preparation of budgets to implement the *Kansas Water Plan*. Following submission of agency budgets in September, the Kansas Water Authority reviews the agencies' requests and prepares recommendations to the Governor and Legislature on actions necessary to implement the Plan, including legislation, coordination and appropriations from the State Water Plan Fund (K.S.A. 74-2622(d)).

PRODUCTS OF THE MANAGEMENT PROCESS

Each step of the management process depicted in Figure 4 results in a document that either summarizes or provides guidance in the other steps in the process. Those products are:

Planning - The *Kansas Water Plan*: This document provides recommendations on projects and programs for the management, conservation and development of the water resources of the state. The document is prepared by the Kansas Water Office, in cooperation with water related agencies, requires pubic participation through public hearings and is approved by the Kansas Water Authority.

Implementation - Kansas Water Authority Report to Governor and Legislature: This document is required by statute to be provided annually to the Governor and Legislature by December 1. This document provides recommendations to the Governor and Legislature on expenditures from the State Water Plan Fund and priorities for implementation of the *Kansas Water Plan.*

Operate - State and Federal Water Programs: This publication (also known as the Redbook), prepared by the Kansas Water Office, contains a description and contact information for all water related programs in Kansas.

Operate - *Kansas Water Plan* Status Report: This report provides specifics on activities that have been taken in response to the guidelines contained in the *Kansas Water Plan*. This report is prepared using information submitted by all water related state agencies. The main focus is on programs that are funded with State Water Plan Funds; however, some other activities are included.

Evaluate - Kansas Water Resource Condition 2002: This report is a summary of assessment information completed by the Kansas Water Office that describes what is known about the condition of the water resources in Kansas from each *Kansas Water Plan* policy section perspective. The information contained in this report should tell the reader if progress is being made and where and to what extent problems remain. Ultimately, assessment information will provide a basis on which to develop future policy and program guidance under the water planning process.

FUTURE ISSUE

There is a need to increase funding for implementation of the state water plan. All options for increasing funding should be explored. A clear identification of what is needed and why, and a documentation of accomplishments of the funds currently received should also be developed.

KANSAS WATER PLAN 2010 & 2015 OBJECTIVES

The Kansas Water Authority approved the 2010 Objectives in October 1998. These objectives will be used as guidance for:

- Assessing the condition of the water resources of Kansas.
- Developing measurable objectives for each of the 12 river basins in Kansas.
- Incorporating site specific information for implementing targeted programs in each basin.

The *Kansas Water Plan* 2010 Objectives are listed below:

1. By 2010, ensure that sufficient surface water storage is available to meet projected year 2040 public water supply needs for areas of Kansas with current or potential access to surface water storage.

2. By 2010, less than five percent of public water suppliers will be drought vulnerable.

3. By 2010, ensure that all public water suppliers have the technical, financial and managerial (TFM) capability to meet their needs and Safe Drinking Water Act requirements.

4. By 2010, reduce the number of public water suppliers with excessive "unaccounted for" water by first targeting those with 30 percent or more "unaccounted for" water.

5. By 2010, reduce the number of irrigation points of diversion for which the acre feet per acre (AF/A) water use exceeds an amount considered reasonable for the area (amounts typically considered reasonable are 1.0 AF/A in eastern Kansas, 1.5 AF/A in central Kansas, 2.0 AF/A in western Kansas) and those that overpumped the amount authorized by their water rights.

6. By 2015, all non-domestic points of diversion meeting predetermined criteria will be metered, gaged or otherwise measured under the authority of K.S.A. 82a-706c and K.S.A. 82a-1028(l). Criteria will include a minimal use requirement and priority area targeting.

7. By 2015, conservation plan will be required for water rights meeting the priority criteria under K.S.A. 82a-733 and it has been determined that such a plan would result in significant water management improvements.

8. By 2010, reduce water level decline rates within the Ogallala Aquifer and implement enhanced water management in targeted areas.

9. By 2015, achieve sustainable yield management of Kansas surface and ground water sources, outside of the Ogallala aquifer and areas specifically exempt by regulation. Sustainable yield management would be a goal that sets water management criteria to ensure long term trends in water use will move as close as possible to stable ground water levels and maintenance of sufficient stream flows.

10. By 2015, meet minimum desirable streamflow at a frequency no less than the historical achievement for the individual sites at time of enactment.

11. By 2010, reduce the average concentration of bacteria, biochemical oxygen demand, dissolved solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas lakes and streams.

12. By 2010, reduce the average concentration of dissolved solids, metals, nitrates, pesticides and volatile organic chemicals that adversely affect the water quality of Kansas ground water.

13. By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

14. By 2010, reduce the vulnerability to damage from floods within identified priority communities or areas.

15. By 2010, maintain, enhance or restore priority wetlands and riparian areas.

16. By 2010, increase public recreational opportunities at Kansas lakes and streams.

17. By 2010, target data collection, research projects, and data sharing activities to address specific water resource issues as identified in the Kansas water planning process and to support and guide state water resource program operations.

18. By 2010, Kansas Water Office public information activities should be directed at ensuring the public is aware of the *Kansas Water Plan* and knows where and how to obtain current and reliable information on the status of water resources in Kansas.

19. By 2010, provide educational activities to ensure that Kansans increase their knowledge and understanding of the State's water resources to enable them to make better personal and public decisions on water conservation, development and management.

WATER MANAGEMENT

INTRODUCTION

State policy regarding water management is guided by the Water Appropriation Act, which states that water in the State of Kansas is dedicated to the use of the people of the State, with the State charged to manage that resource. As such, surface and ground water can be appropriated, which allows for the beneficial use of that water, without waste, if that use does not cause impairment of an existing, more senior water right and does not unreasonably affect the public interest. A water right does not constitute ownership of such water. The date of priority of a water right, and not the type of use, determines the right to divert and use water at any time when supply is not sufficient to satisfy all water rights.

Overall, Kansas' water resources are mature in development. Efficient management and expanded conservation are necessary to assure an adequate supply of water for the future, as development of new water is limited. Most of the significant sources of ground water are fully appropriated and are being closed to new appropriation. In addition, the majority of the State's streams are also fully appropriated, at least during the irrigation season from July 1 to September 30. Only the Kansas, Missouri, Big Blue and Spring Rivers are still open to new appropriations for those months. It is foreseeable that many streams will eventually become fully appropriated year round.

Sustainable yield management, a concept that has been discussed for a number of years, became part of the fiscal year 2004 *Kansas Water Plan*. It is the goal of sustainable yield management to set criteria for development and use of water within a defined hydrologic system that ensures long term stability. It allows for reasonable short term ground water level and stream flow variation that does not exceed the system's natural ability to recover during wet periods, and protects against degradation of the environment.

Enforcement of current law and regulations are important and necessary. When possible, the State prefers to use voluntary, incentive based programs and education to increase conservation and reduce water consumption in areas of competition. Public input, both through the state water planning process which directs state programs and actions, and by local water users within Groundwater Management Districts which develop district management plans, are critical in developing workable solutions.

Management of Kansas' ground and surface water fits into six categories:

1) The Ogallala-High Plains aquifer;
2) Ground water outside of the Ogallala-High Plains aquifer;
3) River-Reservoir management;
4) Stream reaches with established Minimum Desirable Streamflow;
5) Streams outside of Minimum Desirable Streamflow protected areas;
6) Interstate water management.

1) The Ogallala-High Plains aquifer

The High Plains aquifer, composed of several hydraulically connected aquifer units of which the largest is the Ogallala, is the primary source of water in western Kansas. See Figure 1 below. The High Plains aquifer has been intensely developed with large volume pumping, mostly for irrigation, leading to significant ground water declines. The Ogallala portion of the High Plains aquifer (Ogallala-High Plains aquifer) is characterized by low recharge, and higher declines. The expected "usable life" of the aquifer, when the aquifer is no longer able to support the high rates of pumping, varies widely due to differences in amount of saturated thickness, hydraulic conductivity, withdrawals and other variables. There have been a number of programs and activities implemented through the *Kansas Water Plan* to help conserve the ground water resources. The High Plains aquifer has had a significant reduction in the rate of decline over the past thirty years, due to efforts made at the individual, Groundwater Management District, State, and Federal levels. Even with the improvements, though, the aquifer is still declining.

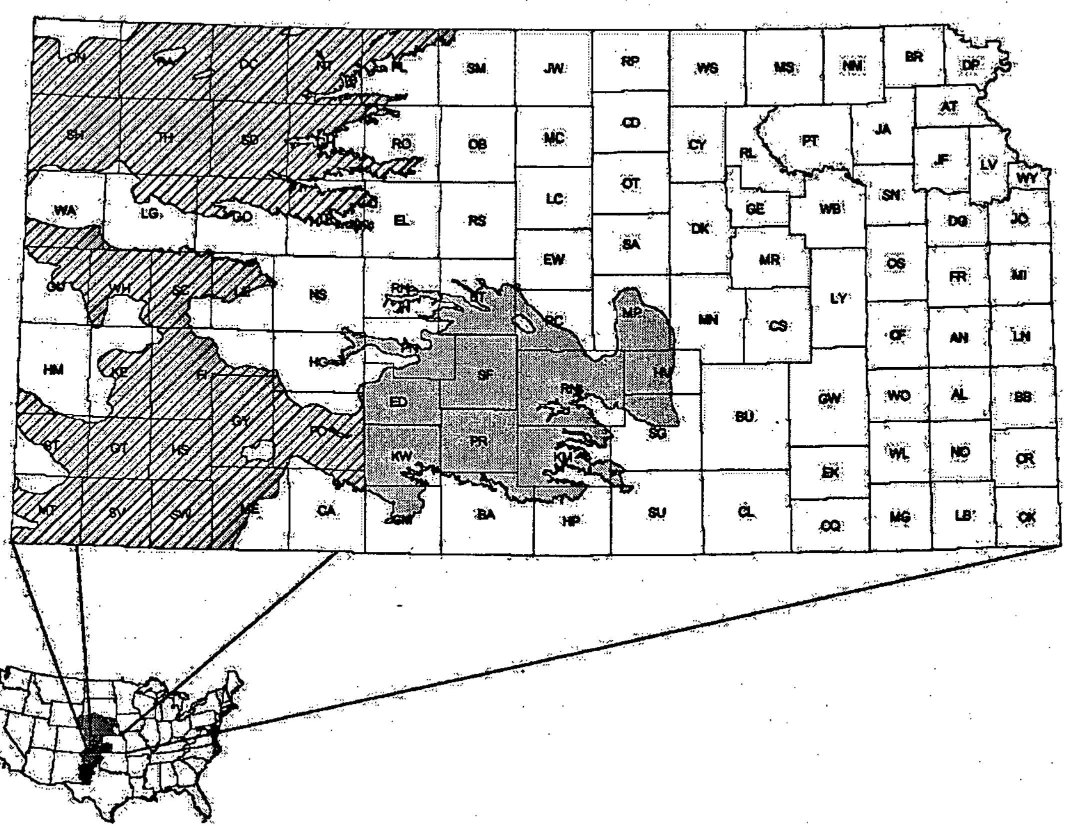


Figure 1: Outline of High Plains aquifer, a multi-state regional system composed of several hydraulically connected units. The largest unit is the Ogallala, which is in western Kansas. The High Plains aquifer in south central Kansas contains the Equus beds and Great Bend Prairie units.

The key management approach for the Ogallala is to delineate the Ogallala-High Plains aquifer into aquifer subunits to allow management decisions in areas of similar aquifer characteristics. The Groundwater Management Districts and the Division of Water Resources are to delineate the aquifer subunits in their areas. A water use goal will be established for each subunit to extend and conserve the life of the Ogallala-High Plains aquifer. The Groundwater Management Districts and the Division of Water Resources are to report progress on implementing these recommendations to the Kansas Water Authority in July 2004, and every two years thereafter. The first project report was given in July 2003.

At some point the specific subunits would be managed to sustain the aquifer. This point may be based on the estimated usable life of the aquifer, the minimum saturated thickness needed to support large volume pumping, the estimated recharge, or other criteria determined appropriate for the subunit. Programs, research, and activities are being developed and/or coordinated through the *Kansas Water Plan* to implement the recommendations in the Ogallala Aquifer Management Advisory Committee report, and extend the time the aquifer can support irrigation and other uses. The long term management approach will use the legal framework of the Kansas Water Appropriation Act and Groundwater Management Act to manage and administer the aquifer. Public input will be sought on proposed new management strategies through the state water planning process. Voluntary, incentive-based approaches to reduce total water use are preferred over regulatory solutions, where possible. The State recognizes the importance of providing current, accessible information on the aquifer conditions to all water users.

Until high priority aquifer subunits are defined, a priority ground water decline area map will be used to guide state and federal efforts to areas in need of water conservation. It can be found in the background information on this website for water conservation.

The State Conservation Commission Water Resources Cost Share Program, Kansas State University Mobile Irrigation Lab, and the USDA Natural Resources Conservation Service EQIP Ground and Surface Water Conservation programs are important to help producers install more efficient irrigation systems and more efficiently use those systems, or assist in their conversion to dryland production.

2) Ground water outside of the Ogallala-High Plains aquifer

The management focus on ground water outside of the Ogallala-High Plains aquifer is to achieve sustainable yield management by 2015. Ground water use is extensively developed in the Equus beds and Great Bend Prairie units of the High Plains aquifer. More limited aquifers spread across the state.

Equus Beds Groundwater Management District No. 2 and the Big Bend Groundwater Management District No. 5 cover the majority of the High Plains aquifer outside of the Ogallala. Big Bend Groundwater Management District No. 5 is closed by regulation of the Chief Engineer (K.A.R. 5-25-4c) to new appropriation except for applications for small uses of less than 15 acre-feet. Equus Beds Groundwater Management District No. 2 reviews and makes recommendations on applications for new appropriation based on a safe yield regulation (K.A.R. 5-22-7). This regulation compares the annual recharge of a local area to the amount of water that has been appropriated.

The majority of ground water outside of the High Plains aquifer is alluvial ground water. Kansas manages surface and alluvial groundwater on a conjunctive use basis. A portion of the natural recharge that reaches the alluvial aquifer contributes to streamflow through baseflow. Some stream baseflow is protected through regulation and a percentage of the recharge is not available for appropriation. There is concern that many surface and alluvial ground water systems have been over appropriated. The amount of water that has been appropriated, the amount of baseflow contribution from alluvial and other aquifers, and potential corrective actions will be reviewed by an instream flow technical advisory committee which is described in the "new issues" subsection.

In many areas, sustainable yield management is already attained. When a senior water right is impaired, the owner can ask the Chief Engineer to provide relief by curtailing junior water right withdrawals. Another option to meet water needs are special management plans based on voluntary strategies to reduce water use in a subbasin. The Rattlesnake Creek subbasin is implementing a special management plan. Designation of an Intensive Groundwater Use Control Area (IGUCA) is another option that allows for flexible solutions, but when adopted has the force and function of law. An example is the Wet Walnut IGUCA which includes reduced water appropriations by all the water right holders that are junior to the impaired Cheyenne Bottoms water right, where those reductions help relieve the impairment. The solution utilized in the Wet Walnut does not cut any water right holder off completely, although the amount of reduction is weighted based on seniority.

The remaining aquifers outside the High Plains are bedrock or deep confined or semi-confined aquifers. The Dakota aquifer is one important resource through southwest to north central Kansas. Another aquifer of note is the Ozark Plateau aquifer in southeast Kansas. This aquifer has experienced declines in water level in recent years due to intense development in southwest Missouri. The Kansas Water Office has begun discussion with neighboring states on this aquifer and will be evaluating management options.

3) River-reservoir management

Reservoirs are used, in part, to provide dependable water supplies in streams with highly variable flow. There are 24 federally constructed reservoirs within Kansas. The 1958 Federal Water Supply Act made storage in federal reservoirs available to state and local governments if the local entities agreed to repay the cost of construction of the water supply storage. The State of Kansas agreed to repay these costs in a number of federal reservoirs. Currently, the state owns storage in 14 U.S. Army Corps of Engineers and U.S. Department of Interior Bureau of Reclamation reservoirs.

In 1985, the State of Kansas and the Corps of Engineers entered into a memorandum of agreement. That agreement allowed the state to purchase additional storage in certain federal reservoirs. In return, the state agreed to obtain water reservation rights for water quality storage, and protect water quality releases from diversion by water right holders. In addition, the state agreed to develop the water assurance program and operate the reservoirs as systems for the benefit of all users.

Three water assurance districts have been formed along the Kansas, Marais des Cygnes, and Neosho rivers. Operations agreements under these assurance districts insure that there is both water for municipal and industrial water users and water for instream flow. These operations agreements were updated in 2001 and 2002.

In 1989, the State of Kansas and the Corps of Engineers entered into a memorandum of understanding regarding the Verdigris River Basin. This agreement insures that certain releases will be made to meet target flows for multiple uses.

Operation of Kanopolis and Wilson Lakes insure that there are minimum releases to meet water quality and aquatic life needs in the stream.

These agreements and memorandums of understanding insure that the reservoir-river systems are operated in a sustainable manner.

Management of rivers and associated federal reservoirs is becoming increasingly complex, as more limitations and demands are placed on the river-reservoir systems. To assist with decision making, hydrologic computer modeling is planned or is underway for several river–reservoir systems: Neosho, Marais des Cygnes, Verdigris and Kansas River systems.

4) Stream reaches with established Minimum Desirable Streamflow

Minimum desirable streamflows (MDS) protect flow for instream uses relative to fish, wildlife, water quality, general aesthetics and downstream domestic and senior water rights. In developing the MDS, a compromise was made between instream protection (fish and water quality), water availability and future economic development. The Water Appropriation Act was amended in 1984 to protect waters necessary to preserve and maintain streamflows at or above the minimum desired levels. Although not a water right in itself, the Chief Engineer is to withhold from appropriation that amount of water needed to maintain minimum desirable streamflow (K.S.A. 82a-703(b)). Minimum desirable streamflows established before July 1, 1990 have a priority date of April 12, 1984. There are MDS established at 33 sites on 23 streams, monitored at U.S. Geological Survey gaging stations (see Figure 2). The purpose of MDS is to protect flow from depleted conditions as a result of extensive water appropriation. During severely dry conditions, MDS might not be achieved. There are two methods to enhance low flow to meet MDS. For streams located below reservoirs that contain state owned storage, releases can be made to supplement low flow, including flows for spring fish spawns if water is held in the flood pool. The second method of meeting MDS is administration of water rights "junior" to the April 12, 1984 priority date. When the flow has been below statutory MDS for seven consecutive days, the Chief Engineer will determine if other conditions have been met and, if necessary, initiate administration of any water rights granted after April 12, 1984 (K.A.R. 5-15-1). There have been no new minimum desirable streamflows established since 1989.

Minimum Desirable Streamflow (MDS) Gages

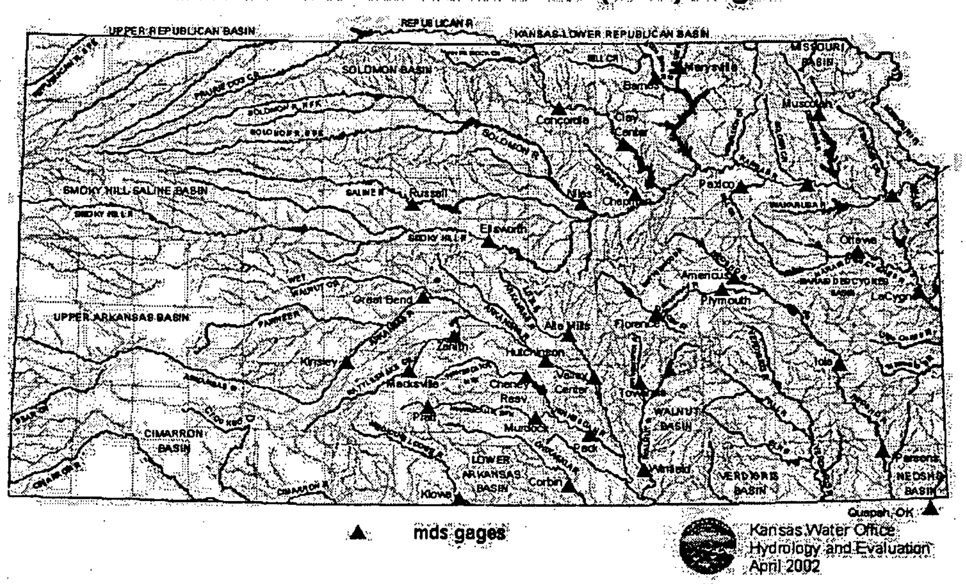


Figure 2

5) Streams outside of Minimum Desirable Streamflow protected areas

Most of Kansas stream reaches lie outside of minimum desirable streamflow protection. The stream itself may have flow conditions that are too unreliable to establish a minimum desirable streamflow. In all our streams, Kansas' has a long term goal of "preserving, maintaining or enhancing baseflow for instream water uses relative to water quality, fish, wildlife, aquatic life, recreation, general aesthetics and domestic uses and for the protection of existing waters rights" (K.S.A. 82a-928(i)).

A number of Kansas streams have had a progressive reduction in median flow over the past four decades. The Cimarron, Upper Arkansas and Smoky Hill-Saline basins have had serious reductions in flow, where the dropping aquifer water table has resulted in reduced baseflow and land conservation measures have reduced runoff from rain and snowmelt. The streams in eastern Kansas have also had reduced flow, as streams become fully appropriated.

6) Interstate water management

Interstate water management applies to all surface and ground water that flows across the state border. Water compacts provide a legal arrangement between states to equitably divide and apportion the water supply of a river or river basin. Kansas is a member of the Republican River Compact, the Blue River Compact, and two Arkansas River Compacts, one with Colorado and one with Oklahoma.

Kansas has undertaken litigation in recent years on both the Arkansas River Compact with Colorado and the Republican River Compact with Nebraska. The purpose of these lawsuits was to force adherence to the compact provisions and provide adequate and sustainable water supplies to Kansas. The U.S. Supreme Court ruled in favor of the State of Kansas on the Arkansas River litigation and the Republican River lawsuit was recently settled out of court. These two actions should ensure that the Kansas receives its entitlement under the compacts.

The State of Kansas is a member of the Missouri River Basin Association, an association of eight states which cover the majority of the Missouri River drainage area. The association has been working with the U.S. Army Corps of Engineers and Native American Indian tribes for the past decade to develop a management plan for the Missouri River that meets all river needs for the foreseeable future.

Management of the High Plains aquifer is a multi-state concern, particularly along state borders. Extending under eight states, the High Plains aquifer is the primary source of irrigation water in the High Plains region. Information sharing on the aquifer between states is occurring in the High Plains sub-committee of the Western States Water Council, represented by state water agency personnel; in the High Plains Geological Survey coalition on the hydrogeology; and through the Ogallala Aquifer Institute that promotes education on this important resource.

There are concerns on the declining water levels in the Ozark Plateau aquifer system in southeast Kansas. The Kansas Water Office, Kansas Department of Agriculture Division of Water Resources, and Kansas Department of Health and Environment are sharing information with water agencies in Missouri and Oklahoma on the water systems in the Ozark Plateau region.

OBJECTIVES

- By 2010, reduce water level decline rates within the Ogallala aquifer and implement enhanced water management in targeted areas.

- By 2015, achieve sustainable yield management of Kansas surface and ground water sources, outside of the Ogallala-High Plains aquifer and areas specifically exempt by regulation. Sustainable yield management would be a goal that sets water management criteria to ensure long term trends in water use will move as close as possible to stable ground water levels and maintenance of sufficient streamflows.

- By 2015, meet minimum desirable streamflow at a frequency no less than the historical achievement for the individual sites at the time of enactment.

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STATUTORY FRAMEWORK

Kansas statutes and associated rules and regulations provide the framework upon which the water management activities of the State are conducted. Key statutes include:

- It is a goal of the State to have sound management, both public and private, of atmospheric, surface and ground water supplies of the State (K.S.A. 82-927).

- The Kansas Water Office shall formulate on a continuing basis a State Water Plan for the management, conservation and development of the water resources of the State (K.S.A. 82a-903) to meet the long-range goals and policies of the State as defined in K.S.A.82a-927 and 928.

- Water in the State of Kansas is dedicated to the use of the people of the State, subject to the control and regulation of the State (K.S.A. 82a-702).

- Water rights are administered through the Kansas Water Appropriation Act (K.S.A. 82a-730), which is based on the Doctrine of Prior Appropriation.

- The Chief Engineer, Department of Agriculture, Division of Water Resources, has the regulatory authority to ascertain whether a proposed use will prejudicially and unreasonably affect the public interest (K.S.A. 82a-711).

- The Chief Engineer is to consider established minimum desirable streamflow requirements, safe yield and the recharge rate for a water supply, and all other matters pertaining to the determination of granting a new water right (K.S.A. 82a-711).

- It is the policy of the State to preserve the basic water use doctrine and allow local water users to determine their own destiny with respect to ground water management as long as it does not conflict with the laws and policies of the State, through the Groundwater Management Districts (K.S.A. 82a-1020).

- State law provides for designation of special use areas, called "intensive groundwater use control areas" to address defined groundwater problems (K.S.A. 82a-1036).

- State law provides for the voluntary retirement of water rights through the Water Right Purchase Program, administered by the State Conservation Commission (K.S.A. 2-1915).

- Flexibility in redistribution and annual use of individual water right appropriations is provided by law through the Kansas Water Banking Act and the five year "flex account" term permits, both of which have a conservation element (K.S.A. 2001 Supp. 82a-761 *et seq.*).

- The Water Transfers Act (K.S.A. 82a-1501) requires a hearing panel to determine if applications for water transfers of at least 2,000 acre-feet to be transferred a distance of 35 miles or greater from the point of diversion, are in the best interest of the State.

- The Kansas Water Authority shall review plans for development, management or use of waters of the State by any State or local agency (K.S.A. 74-2622 (2)).

The Chief Engineer is to represent the State of Kansas on four interstate compacts pertaining to the apportionment of waters in rivers which flow through Kansas and one or more other states (K.S.A. 82a-518; 82a-420; 82a-528; 82a-529), and to serve as the Kansas director to the Missouri River Basin Association.

WATER MANAGEMENT PROGRAMS

Attorney General Water Litigation Fund finances a position dedicated to monitoring and enforcement of Colorado's compliance with the Arkansas River Compact. It is recommended this position be funded through the Interstate Water Litigation Fund (K.S.A. 82a-1802(c) (2)).

Kansas Department of Agriculture Division of Water Resources Water Appropriation Program has six components:

- Processing applications to appropriate water;
- Processing applications for changes to existing water rights;
- Processing applications for water transfers;
- Issuing certificates of appropriation; inventorying and monitoring water use reports;
- Administration and enforcement of water rights and minimum desirable streamflows including protection of reservoir storage releases.

Kansas Department of Agriculture, Division of Water Resources Water Banking Program A water bank, a not-for-profit corporation, may provide an alternative for individuals to obtain water in areas where new water development is closed, and promote water conservation. A water bank may be a surface or a ground water bank. A water right or portion of that right, deposited in a bank may be leased for use if it will be used within the bank boundaries and in the same hydrologic unit from which the water deposit was made.

A bankable water right may also be placed in a safe deposit account for future use, minus a conservation component, for up to five years. The bank is to have a conservation component and ensure that the net consumption of water will not increase. Water right deposits are subject to terms and conditions by the Chief Engineer.

Kansas Department of Agriculture, Division of Water Resources Subbasin Water Resource Management Program develops and helps implement subbasin specific water management strategies to reduce demand for limited water resources. The program gets input from the regulated community and general public to develop a management plan for consideration by the Chief Engineer. The water management plan would incorporate strategies other than strict water right administration.

Kansas Department of Agriculture, Division of Water Resources Interstate Water Issues Program provides support to the Chief Engineer and the Attorney General's office on compliance issues related to interstate compacts. There is a settlement agreed to between Kansas, Colorado and Nebraska in the Republican River Compact, although it must still be approved by the U.S. Supreme Court. The settlement of the Arkansas River Compact litigation with Colorado is in the final stages. The program provides the Chief Engineer support for protecting Kansas' interests under interstate compacts and other interstate water matters.

Kansas Department of Agriculture, Division of Water Resources Technical Services Program provides administrative and technical support to the Chief Engineer and the other programs within the Division of Water Resources. Major issues include geographic information systems (GIS), intensive groundwater use control areas (IGUCAs), flowmeter specifications, and water assurance districts.

Kansas Geological Survey Ogallala-High Plains Aquifer Studies gain additional information on the extent and characteristics of the High Plains aquifer to better meet Kansans' future water needs. Recent studies have been on the a) best estimates of aquifer recharge, including the range of values spatially; b) potential relationship between saturated thickness and well yield; c) relationship between ground water levels, estimated usable life of the aquifer; d) climatic variations; and e) appropriate scale of use and precision of data sets.

State Conservation Commission Water Rights Purchase Program allows the state to buy and retire water rights from willing sellers in targeted areas, in order to restore streamflow or recharge aquifers in need of recovery. The program provides a cost-share to local entities to purchase a water right. The water right would then be held in the custodial care of the State.

Kansas State University Kansas Water Resources Institute, and Water Conservation and Management Programs supports studies that provide improved understanding on the relationship of hydrology and economics, improved production in a low-water environment and decision support systems for farmers.

Kansas Water Office State Water Planning Program is responsible for the formulation of the *Kansas Water Plan* through the coordinated, continuous and comprehensive water planning process. This program also provides the interstate and federal coordination on water issues, as well as planning and implementation assistance on special water-related topics.

Kansas Water Office Assessment and Evaluation collects and analyzes water data.

Kansas Water Office Reservoir Operations/Management assures the state owned storage in federal reservoirs is properly managed.

Kansas Water Office Water Assurance Program established in 1986, the Water Assurance Program allows coordinated operation of state-owned or controlled water supply storage space in federal lakes to satisfy downstream municipal and industrial water rights during drought conditions. Water right holders in this program are assured to receive water during times of low flow, as releases are made for water delivery. This program was developed to meet the needs of municipal and industrial water users whose needs could not be economically or otherwise met by the Water Marketing Program.

Kansas Water Office Water Marketing Program is to meet present and anticipated municipal and industrial water needs through purchase of water storage in federal reservoirs. The water contained in that storage is sold to water supply users, in the best interest of the State. Water supply contracts began under this program in 1974. In 2002, a contract was signed for storage space in the Kanopolis Reservoir. Sixty-four percent of the storage under contract with the Corps of Engineers is committed to municipal and industrial customers. The State pays for the annual operation, maintenance and repair costs incurred by the Corps for the portion of the storage space which the state has called into service.

Kansas Water Office Information and Education Program is a priority of the Water Resource Education Program has been supporting the Ogallala Aquifer Institute through start-up contracts. The Ogallala Aquifer Institute is a not-for-profit education "hub" to promote the historical, cultural, economic and environmental importance of the High Plains aquifer through multi-disciplinary education. Located in Garden City, the Ogallala Aquifer Institute has a board of directors representing each of the eight High Plains aquifer states.

WATER CONSERVATION

INTRODUCTION

Kansas water resource development is moving toward more efficient management and conservation to assure adequate water in the future. Water conservation is considered to be any beneficial reduction in water use or in water losses.

State policy regarding water conservation is guided by the principle that the privilege to use water carries with it the responsibility to use water wisely. Water conservation policy is also shaped by a philosophy of "sharing the shortage" among those using a water source before regulation will be imposed and by the desire to meet drought or other emergency conditions in a proactive manner.

Water conservation is essential for the effective management of water resources in Kansas and to insure that a sufficient supply of water is available for the beneficial uses of the people of the State. It is a tool to help meet the demands society places on a finite resource, water.

The need for water may be met by a combination of supply and demand management. Water conservation provides the means through which demand management is accomplished. Kansas has approached water conservation through a combination of education, planning, technical assistance, financial assistance and regulation. The emphasis has been on incentive-based programs that inform individual water users about the cost-savings that can be realized through water conservation.

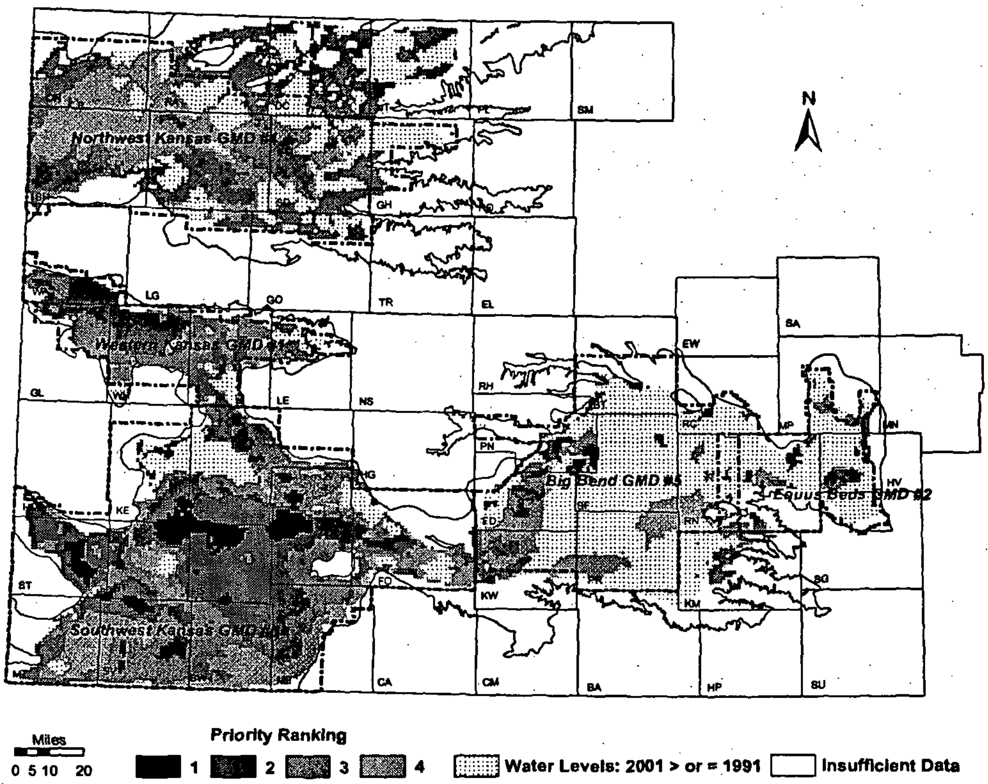
The Kansas Department of Agriculture, Division of Water Resources and the Kansas Water Office have cooperatively required and reviewed water conservation plans for municipal, irrigation, and industrial users. Free assistance is provided to irrigation and municipal water users who are required to adopt and implement conservation plans. This has resulted in roughly 500 public water suppliers with water conservation plans developed and implemented. In addition, 1,245 active water rights as of June 2003 have irrigation conservation plans approved by the Kansas Department of Agriculture's Division of Water Resources. Irrigation guidelines will be revised in cooperation with the USDA Natural Resources Conservation Service so that state and federal guidelines will be consistent.

Conservation efforts work toward a reduction in water use, so efforts are potentially most effective where use is the highest. It is important to recognize that some water reduction practices, such as converting from flood irrigation systems to sprinklers, may change the dynamics of the hydrologic system in multiple ways, including reduction in the amount of ground water recharge. Critical areas to conserve are where the estimated usable life is short and ground water use is high.

Since water conservation is a management tool, it is directly related to two other policy sections of the *Kansas Water Plan.* These sections are Public Water Supply and Water Management.

Until aquifer subunits are defined in the Ogallala-High Plains aquifer, the map in Figure 1 (priority ground water decline areas) will be used to target management and conservation efforts in western Kansas. Figure 1 indicates the relative need for management and conservation through a priority ranking of 1-4, with 1 being the areas with a shorter estimated usable lifetime for the aquifer to support 400 gpm well yields, and having a history of higher ground water usage. The map was generated by overlaying the estimated usable life of the High Plains aquifer with the average, annual reported ground water use. The estimated usable lifetime of the Ogallala-High Plains aquifer is based on ground water decline trends from 1991 – 2001 and the estimated minimum saturated thickness necessary to support 400 gallons per minute pumping for 90 days (see Figure 13 in Kansas Geological Survey Open-File Report 2002-25D). The second database is the density of annual reported ground water use, averaged over the years 1990 – 2000, within a 5 mile radius area (see Figure 15b in Open-File Report 2002-25D). The combination of both conditions, estimated usable lifetime and the density of reported annual ground water use, defined the priority zones. Areas with insufficient data and water levels for 2001 greater or equal to those in 1991 are also indicated in Figure 1. (For additional information on the estimated usable life and distribution of water use, see the Kansas Geological Survey on-line report, "Exploring Relationships Between Water Table Elevations, Reported Water Use, and Aquifer Lifetime as Parameters for Consideration in Aquifer Subunit Delineations" www.kgs.ukans.edu/HighPlains/OHP/2002_25D.pdf).

Priority Ground Water Decline Areas



Ground water decline map created by scoring two databases as follows:

<u>Estimated Usable Lifetime</u>
1 point: Already exhausted and areas under 50 years
2 points: 50 to 100 years
3 points: 100 to 250 years
4 points: greater than 250 years

<u>Density of ground water use</u>
1 point: greater than 300 acre feet
2 points: 200 to 300 AF
3 points: 100 to 200 AF
4 points: 0 to 100 AF

<u>Priority Rank based on an area's total score from the two databases</u>
Rank 1: Any combination that adds to 2 or 3 points
Rank 2: Any combination that adds to 4 or 5 points
Rank 3: Any combination that adds to 6 or 7 points

Figure 1

KANSAS WATER PLAN OBJECTIVES AND RESOURCE CONDITIONS

- By 2010, reduce the number of public water suppliers with excessive "unaccounted for" water by first targeting those with 30 percent or more "unaccounted for" water.

- By 2010, reduce the number of irrigation points of diversion for which the amount of water applied in acre-feet per acre (AF/A) exceeds an amount considered reasonable for the area (amounts typically considered reasonable are 1.0 AF/A in eastern Kansas, 1.5 AF/A in central Kansas, and 2.0 AF/A in western Kansas) and those that overpump the amount authorized by their water rights.

- By 2015, all non-domestic points of diversion meeting predetermined criteria will be metered, gaged or otherwise measured under the authority of K.S.A. 82a-706c and K.S.A. 82a-1028(l). Criteria will include a minimal use requirement and priority area targeting.

- By 2015, conservation plans will be required for water rights meeting the priority criteria under K.S.A. 82a-733 and it has been determined that such a plan would result in significant water management improvements.

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STATUTORY FRAMEWORK

- K.S.A. 74-2608 directs the Kansas Water Office to develop and maintain guidelines for water conservation plans and practices.

- Water use conservation plans are required for anyone: 1) purchasing water from the State Water Marketing Program (K.S.A. 82a-1311a); 2) participating in the Water Assurance District Program (K.S.A. 82a-1348); 3) sponsoring or purchasing the public water supply portion of a Multipurpose Small Lakes Program project (K.S.A. 82a-1608); 4) transferring water under the Water Transfers Act (K.S.A. 82a-1502); or 5) applying for a loan from the State Revolving Fund (K.S.A. 65-163g).

- By state law, the Kansas Water Office shall formulate a comprehensive *Kansas Water Plan* for the management, conservation and development of the water resources of the State. The plan shall specify standards for operation and management of projects, programs and facilities as necessary or desirable to accomplish the policies, goals and objectives of the *Kansas Water Plan*. (K.S.A. 82a-903 *et seq.*)

- Statutory goals related to water conservation are: the prevention of the waste of the water supplies of the State and the protection of the public interest through the conservation of the water resources of the State in a technologically and economically feasible manner (K.S.A. 82a - 927(e)(i)); and the policy to achieve these goals through the encouragement of the use of agricultural soil and water conservation practices and structures to control erosion and to effectively utilize precipitation and run off (K.S.A. 82a-928(r)).

- State agencies that make loans, grants, or cost-share funds available for water-related projects may require, prior to approval of funding, the development and approval of a water conservation plan (K.S.A 82a-733 (d)(e)).

- The Chief Engineer may require water right owners to adopt and implement a water conservation plan. Priority should be given to criteria set out in K.S.A. 82a-733. These are: 1) users that share a common drought vulnerable source; 2) users whose use is significantly higher than their peers, and 3) users who apply for state administered grants, loans or cost share moneys for water related projects. The Chief Engineer may delegate authority to implement and enforce provisions of K.S.A. 82a-733 to a groundwater management district to carry out provisions of the statute within the district (K.S.A. 82a-733(h)).

- The Chief Engineer may require and enforce conservation measures for domestic users and may delegate this authority to municipalities that have approved conservation plans so they can require compliance of private well owners within the city limits (K.S.A. 82a-733(i)).

- The Kansas Water Office personnel shall provide technical assistance to water users who are required to adopt and implement conservation plans (K.S.A. 82a-733(c)).

- When the Governor declares a State of Drought, actions contained within the Drought/Emergency Contingency portions of approved conservation plans and state facilities plans are triggered (K.S.A. 48-924(e)).

- All water right holders are required to file an annual water use report to the Kansas Department of Agriculture, Division of Water Resources (K.S.A. 82a-732).

- The Chief Engineer has full authority to require meters or other measuring devices (K.S.A. 82a-706c). Meters are required on all new or replacement diversion points.

- Groundwater Management Districts have the power to install or require the installation of meters, gauges, or other measuring devices and read or require water users to read and report those readings as may be necessary to determine the quantity of water withdrawn (92a1028(l)).

- K.S.A. 82a-1801 provides for the disbursement of funds recovered by the State in the litigation against Colorado to resolve disputes under the Arkansas River Compact. The cost to the Attorney General of conducting the lawsuit will first be credited to the Interstate Litigation Fund. Of the amount remaining, two thirds will be credited for use in the area in the Upper Arkansas Basin directly impacted by the provisions of the Arkansas River Compact. The remaining one third will be credited to the State Water Plan Fund for water conservation projects.

- The Kansas Weather Modification Act (K.S.A. 82a-1401 *et seq.*), gives authority to the Kansas Water Authority, and the Director of the Kansas Water Office as chief administrative officer, to issue licenses for persons engaged in weather modification activities, to issue permits for weather modification programs or projects, to enter into contracts for weather modification activities, and to use funds to encourage research or to contract for and support local efforts in weather modification activities.

WATER CONSERVATION PROGRAMS

Kansas Department of Agriculture, Division of Water Resources Water Appropriation Program has six components:

- Processing applications to appropriate water;
- Processing applications for changes to existing water rights;
- Processing applications for water transfers;
- Issuing certificates of appropriation;
- Inventorying and monitoring water use reports;
- Administration and enforcement of water rights and minimum desirable streamflows including protection of reservoir storage releases.

The Chief Engineer has authority to require conservation plans and meters of any water right holder. Effective water management can only be achieved if accurate information regarding amounts of water diverted for use is available.

State Conservation Commission Water Resources Cost-Share Program provides State cost-share assistance to landowners for the establishment of enduring water conservation practices to protect and improve the quantity and quality of Kansas' water resources.

Kansas State University, Research and Extension Water Conservation and Management Programs aim to conserve and protect natural resources while maintaining the economic competitiveness and profitability of agriculture. The current focus is irrigation management plus soil and water conservation under non-irrigated conditions. The Kansas Water Office contracted with Kansas State University to provide technical assistance to irrigators. Kansas State University has developed a Mobile Irrigation Laboratory, funded from State Water Plan funds, to educate irrigators on management techniques to improve water use efficiency.

Kansas Water Office Water Conservation Program provides, directly or indirectly, technical assistance for water users who are required to adopt and implement water conservation plans. Assistance is provided to other priority water users by the Kansas Water Office, Kansas State University, local groundwater management districts and by the Kansas Rural Water Association.

Kansas Water Office Weather Modification Program is responsible for issuing weather modification project permits and for licensing of individuals conducting weather modification activities in Kansas. Cost-share assistance is provided for local program operation. Currently, weather modification activities aimed at hail suppression are conducted in 14 southwest Kansas counties.

Kansas Water Office State Water Planning Program is responsible for the formulation of the State Water Plan through the coordinated, continuous and comprehensive water planning process. This program also provides interstate and federal coordination on water issues as well as planning and implementation assistance on special water related topics.

Kansas Water Office, Water Conservation, Water Conservation Projects Fund was established by K.S.A. 82a-1801 and K.S.A. 82a-1803. The program has not actually yet been established.

PUBLIC WATER SUPPLY

INTRODUCTION

Under Kansas law (K.S.A. 65-162a) a public water supply system is defined as "...a system for the provision to the public of piped water for human consumption, if such system has at least ten (10) service connections or regularly serves an average of at least twenty-five (25) individuals daily at least sixty (60) days out of the year. Such term includes any source, treatment, storage or distribution facilities under control of the operator of the system and used primarily in connection with the system and any source treatment, storage or distribution facilities not under such control but which are used in connection with such system."

Kansas has about 1,100 public water supply systems. Public water supply systems are typically managed by a public entity, such as a municipality or a rural water district, but may also be managed privately. The governing bodies of public water supply systems bear primary responsibility for providing an adequate supply of high quality drinking water to the public.

In eastern Kansas, the primary source of water is surface water: rivers, federal reservoirs, multipurpose small lakes and municipal lakes. In western Kansas, the primary source is ground water drawn from wells that reach into the water bearing aquifers. While 68 percent of the State's public water systems rely upon ground water sources, these systems serve only 29 percent of the population. In 2000, average gallon per capita usage for public water suppliers ranged from a high of 306 in western Kansas to a low of 95 in eastern Kansas. Per capita averages increased approximately 19 percent from 1999 to 2000 in western Kansas, while in eastern Kansas per capita average increased by only two percent over the same period.

Most Kansas public water suppliers have their own source of raw water. Such sources include wells in alluvial or deeper aquifers, streams and rivers, springs or municipal lakes. Several suppliers use lakes developed through the Kansas Multipurpose Small Lakes Program.

Use of these sources requires a water right from the Kansas Department of Agriculture, Division of Water Resources. The maximum annual authorized quantity of water that can be diverted is established by the water right. Other sources of raw water include the Kansas Water Marketing Program and direct purchase of water in federal reservoirs from the federal government.

Under the Kansas Water Marketing Program, the State of Kansas has bought water supply storage in 12 federal reservoirs. Water from this storage space may be bought from the state for municipal or industrial use. Many public water suppliers also buy finished water at wholesale from another supplier, either as a sole source of supply or to supplement their own source(s).

Kansas' goal is to insure that all federal and state drinking water quality standards are met and capacity development goals are achieved by public water suppliers. Regulation of public water supply systems is accomplished through the Kansas Department of Health and Environment's Public Water Supply Program. The Department administers all requirements of the Federal Safe Drinking Water Act with statutory authority identified in K.S.A. 65-171m. Technical and financial assistance is also provided through a variety of government programs administered by state and federal agencies.

The Kansas Department of Health and Environment Drinking Water Program indicates that in 2000, the overall compliance rate with monitoring or Maximum Contaminant Levels for Kansas public water supply systems was 85 percent. A total of 165 systems incurred at least one violation of a drinking water regulation. This means that 957 of the 1,098 systems operating had no violations in 2000. Ninety-one percent of the Kansas population was served by water systems in compliance with federal and state drinking water regulations. Only nine percent, or 223,589 people, were affected by water systems that had monitoring or Maximum Contaminant Level violations.

Although Kansas has a good record of compliance with drinking water standards, public water suppliers still face many challenges. The state has two financial assistance programs available for public water supply projects. The Drinking Water State Revolving Loan Fund, administered by the Kansas Department of Health and Environment, has provided $122 million in low interest loans since 1998 to public water suppliers to help them meet their increasing responsibilities under the Safe Drinking Water Act. In 2001, the Kansas Department of Commerce and Housing provided a total of $4,044,515 in Community Development Block Grant Program grants to utilities with low and moderate-income customers for water supply projects.

The Safe Drinking Water Act as amended in 1996 makes capacity development an important strategy in preventing public water supplier problems. Capacity development involves helping public water suppliers improve their finances, management, infrastructure and operations so they can provide safe drinking water consistently, reliably and cost-effectively. Capacity has three components: technical, financial and managerial, each of which must be adequate for a public water supplier to achieve overall capacity (capability). *Technical capacity* refers to the physical infrastructure of the water system, including source water adequacy, infrastructure adequacy (wells and/or water intakes, treatment, storage and distribution), and the ability of system personnel to implement requisite technical knowledge. *Financial capacity* refers to the financial resources of the water system including revenue sufficiency, credit worthiness and fiscal controls. *Managerial capacity* considers the management structure of the public water supplier including ownership accountability, staffing and organization and effective linkages.

Another provision of the 1996 amendments to the Safe Drinking Water Act requires each state to develop a Source Water Assessment Program. Additionally, each state is required to develop a source water assessment for each public water supply system that treats and distributes raw source water. An assessment includes the delineation of the source water assessment area, an inventory of potential contaminant sources, susceptibility analysis, and public information. Source water assessments in Kansas are being done in partnership with the affected public water suppliers.

Drought can severely challenge a public water supplier through depletion of the raw water supply and greatly increased customer water demand. Even if the raw water supply remains adequate, problems due to limited treatment capacity or limited distribution system capacity may be encountered. The Kansas Water Office has developed guidelines for development of municipal water conservation plans that contain a drought/emergency contingency component. A key element is identification of triggers for imposing voluntary or mandatory water use restrictions. Approximately 80 drought vulnerable public water suppliers have state approved water conservation plans. Forty-four public water suppliers are known to have imposed water use restrictions at some time in 2002. Water conservation is also an effective mechanism for reducing long-term demand by reducing waste and lowering the amount of water used on a per capita basis. The Water Conservation Policy Section addresses public water suppliers with excessive unaccounted for water.

The State encourages the development of regional public water supply systems. Regionalization of public water supply service in Kansas usually involves formation of a public wholesale water supply district. Wholesale water supply districts are commonly comprised of several member municipalities or rural water districts that may rely upon the water provided by the wholesale district to supplement their own water supply sources or to provide their entire water supply. Wholesale districts provide the advantages of economies of scale that commonly are not available to their individual members.

Wholesale districts generally use a reliable water supply source such as a Kansas Water Marketing Program contract from a federal lake or a multipurpose small lake and have a newer water treatment plant that can readily be upgraded to meet more stringent Safe Drinking Water Act requirements as they become effective.

Regionalization is a key state strategy for ensuring that small systems attain and maintain technical, financial and managerial capacity. Regionalization is further encouraged by Kansas statute. K.S.A. 65-163(g) (2) states that the Secretary of the Kansas Department of Health and Environment shall, "in consultation with the Kansas water office, encourage regional cooperative public water supply projects in accordance with the public water supply regionalization strategy of the state water plan;..." In addition, the development of regional systems provides a mechanism for the efficient distribution of raw and finished water supplies for municipal use from existing state-owned storage in federal lakes, multipurpose small lakes or other supply sources. Priority for state funding should encourage water supply planning and construction projects that are cost-effective.

Twenty-three public wholesale water supply districts have been organized in Kansas, to date. Not all of these districts are actively delivering water. Several have been organized recently and have not yet had the time to develop the infrastructure to deliver water. Others were formally organized but never became operational.

KANSAS WATER PLAN OBJECTIVES

- By 2010, ensure that sufficient surface water storage is available to meet projected year 2040 public water supply needs for areas of Kansas with current or potential access to surface water storage.

- By 2010, less than five percent of public water suppliers will be drought vulnerable.

- By 2010, ensure that all public water suppliers have the technical, financial and managerial capability to meet their needs and to meet Safe Drinking Water Act requirements.

STATUTORY FRAMEWORK

- Long-range goals of the State related to public water supply are "the development, to meet the anticipated future needs of the people of the state, of sufficient supplies of water for beneficial purposes" (K.S.A. 82a-927(a)) and "the efficient, economic distribution of the water supplies of the state (K.S.A. 82a-927(g))."

- The development of adequate water storage to meet, as nearly as practicable, present and anticipated water uses through planning and construction of multipurpose reservoirs and through the acquisition from the federal government of storage in federal reservoirs and by agreements with the federal government regarding the use of storage (K.S.A. 82a-928(f)).

- The design of municipal water systems to provide an adequate water supply to meet the needs during a drought having a two percent chance of occurrence (K.S.A. 82a-928(q)).

- The achievement of the primary drinking water standards promulgated by the Secretary of Health and Environment pursuant to K.S.A. 65-171m, and amendments thereto (K.S.A. 82a-928(h)).

- The provision of financial and technical assistance to public corporations concerned with management, conservation and development of water resources (K.S.A. 82a-928(m)).

- The encouragement of local initiative in the planning, implementation, funding and operation of local water programs to the extent that the same are supportive of state water programs (K.S.A. 82a-928(p)).

- The Kansas Department of Health and Environment has authority under Kansas law (K.S.A. 65-163) to regulate public water supply systems through permitting, investigations, and regulations.

PUBLIC WATER SUPPLY PROGRAMS

Kansas Department of Agriculture, Division of Water Resources Water Appropriation Program provides for the processing, administration and enforcement of water rights.

Kansas Department of Health and Environment Public Water Supply Program provides regulatory oversight and technical assistance to public water suppliers to assure safe potable drinking water to Kansas residents. The agency is responsible for implementation of the State's Capacity Development Strategy.

Kansas Department of Health and Environment Drinking Water State Revolving Loan Fund Program provides low interest loans to public water supply systems for infrastructure projects to help achieve or maintain compliance with Safe Drinking Water Act requirements.

Kansas Water Office State Water Planning Program coordinates the development the *Kansas Water Plan*.

Kansas Water Office Water Conservation Program provides technical assistance to public water suppliers to develop water conservation plans and address high unaccounted for water and other problems.

Community Development Block Grant Program Administered by the Kansas Department of Commerce provides grants for water and sewer infrastructure projects. Project applicants are required to discuss proposed projects with an interagency committee of funding agencies including the Kansas Department of Commerce, Kansas Department of Health and Environment and USDA Rural Development. Water project applications are reviewed by Kansas Department of Health and Environment and Kansas Water Office for input prior to selection of projects for funding. Ten water projects were funded during 2001. The Kansas Department of Commerce encourages water supply utilities receiving Community Development Block Grants to have an approved Water Conservation Plan.

Kansas Water Office Assurance Program allows coordinated operation of state-owned or controlled water supply storage space in federal lakes to satisfy downstream municipal and industrial water rights during drought conditions. Three water assurance districts are operational in the Kansas-Lower Republican, Marais des Cygnes and Neosho river basins.

Kansas Water Office Water Marketing Program provides for present and future municipal and industrial water supply needs through the purchase of water supply storage in federal reservoirs. Water is supplied to municipal and industrial water supply users through long-term purchase contracts. The State of Kansas owns water supply storage in 12 federal reservoirs available for this program. Regional public water supply strategies will be used to direct future decisions regarding water marketing contracts.

State Conservation Commission Multipurpose Small Lakes Program provides for the addition of storage space for public water supply and/or recreation in the construction of a planned flood control structure. The Kansas Water Office reviews all projects for future public water supply needs. Ten multipurpose small lakes that have been constructed include public water supply storage. Another is scheduled for construction. Future program activities will be directed to projects consistent with regional public water supply strategies.

USDA Rural Development Water Loan and Grant Program provides financial assistance to state agencies for water and sewer projects in rural areas and towns up to 10,000 people. During the 2001 Fiscal Year, 21 communities received loan and grant assistance totaling $19,504,500.

U.S. Army Corps of Engineers Planning Assistance to States Program provides planning assistance to state agencies for water resource planning. The program has been used to provide assistance to the Kansas Water Office in developing regional public water supply strategies through the State Water Planning Process.

Multi-Agency Project Proposal Reviews The Kansas Water Office coordinates with the United States Department of Agriculture Rural Development, the Kansas Department of Health and Environment, and the Kansas Department of Commerce to review and comment on proposed water projects for consistency with the *Kansas Water Plan* and prioritization for funding. The development of regional public water supply strategies will be used to further coordinate government program activities regarding public water supply projects.

Kansas Water Plan

Water Quality Policy and Institutional Framework

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Kansas Water Plan

Water Quality Policy and Institutional Framework

The *Kansas Water Plan* is the cornerstone of a four-step process (planning, plan implementation, operation and evaluation) through which the State of Kansas manages its water resources. Through this process, state priorities are established and recommendations are made regarding program operations, funding and statutory change, if needed. Water Quality is one of nine management categories addressed in the *Kansas Water Plan*.

The purpose of this *Kansas Water Plan* Section is to describe the policy and institutional framework through which water quality protection and restoration is addressed in Kansas and to provide an overview of progress towards meeting established goals and objectives.

River basin sections of the *Kansas Water Plan* provide additional detail about priority basin issues, including water quality. Twelve major river basins, covering the entire state, are used for planning purposes.

Overview

In a broad sense, substances contributing to water pollution come from either point or non-point sources. Point sources of pollution are those that can be tied to a specific point of discharge, such as a factory, wastewater treatment plant, paved areas or large livestock feeding operation. Non-point pollutant sources generally involve contaminants carried overland in storm runoff from large land areas such as agricultural fields.

Governments at all levels; federal, state and local, as well as individual citizens play an important role in collectively ensuring that water quality goals are achieved and maintained.

Clean Water Act

The federal Clean Water Act provides the framework for management of water quality in the nation's surface waters. Initially enacted in 1948 as the Federal Water Pollution Control Act, the Clean Water Act, as it has come to be known, was significantly expanded and strengthened in 1972, amended in 1977 and reauthorized in 1987. Two fundamental goals of the Clean Water Act are to: 1) eliminate the discharge of pollutants into the nation's waters, and 2) achieve water quality standards such that all waters are fishable and swimmable. No such umbrella federal legislation exists for ground water.

Initially, the Clean Water Act focused on point sources of pollution. The primary management tool was discharge permits issued by the states as part of the National Pollutant Discharge Elimination System. Section 319 of the 1987 reauthorization added a focus on non-point pollutant sources.

State-established surface water quality standards, approved by the U.S. Environmental Protection Agency (EPA) are perhaps the keystone of the Clean Water Act. States are required to submit an assessment of surface water quality conditions to the EPA every two years. A list of impaired waters not meeting water quality standards must also be submitted every two years for EPA approval. Total Maximum Daily Loads must be developed for waters that are chronically impaired.

Other federal legislation of significance to water quality includes the Resource Conservation and Recovery Act of 1976, the associated Comprehensive Environmental Response, Compensation and Liability Act (Superfund) of 1980, and the Superfund Amendments and Reauthorization Act of 1986. These acts address solid and hazardous wastes and storage tanks.

The 1996 amendments to the federal Safe Drinking Water Act, while focused on finished drinking water at the tap, also called for source water assessments of public water systems treating raw water. These assessments identify potential sources of drinking water contaminants.

Kansas Actions

Kansas compliance with Clean Water Act provisions has allowed the EPA to grant "primacy" to Kansas for Clean Water Act administration and enforcement in the state. The Kansas Department of Health and Environment oversees administration of the Clean Water Act, although other state agencies play important roles. This compliance includes enactment of state statutes and administrative regulations consistent with federal policy and the various assessment and reporting requirements involved.

Primacy for administration and enforcement of the Safe Drinking Water Act and other federal water quality legislation has also been granted to Kansas by the EPA. The Kansas Corporation Commission has authority to regulate and remediate oil and gas activities that may have impact on water quality (K.S.A. Chapter 55).

Kansas has also: 1.) established an extensive surface water quality monitoring program; 2.) developed numerous Total Maximum Daily Loads to restore impaired waters; 3.) implemented an innovative Watershed Restoration and Protection Strategy (WRAPS); and 4.) developed a nutrient reduction plan.

Watershed Approach

The nature of a watershed such as its geology, topography, land use and land cover all influence the quality of water within the watershed and at points downstream. Contaminant levels in a stream or lake usually represent the combined impact of all such upstream inputs. Because of this, Kansas uses a locally driven, watershed based approach to water quality management where possible. A primary goal of this approach is to achieve properly functioning watersheds through the implementation of WRAPS projects or other means.

Kansas Water Plan Goals, Policies and Objectives

The Water Resources Planning Act (K.S.A. 82a-901 *et seq.*) provides the statutory authorization for addressing water quality management in the *Kansas Water Plan*. This Act established long-range goals for the management, conservation and development of the waters of the state, including:

- o Protection and the improvement of the quality of the water supplies of the state; and
- o Prevention of the pollution of the water supplies of the state.

Policies for achieving these goals as stated in the Water Resources Planning Act include:

- o Identification of minimum desirable streamflows to preserve, maintain or enhance baseflows for in-stream water uses including water quality;

- Maintenance of the surface waters of the state within the water quality standards adopted by the secretary of health and environment;
- Protection of the quality of the ground waters of the state;
- Provision of financial and technical assistance to public corporations concerned with water resources;
- Encouragement of local initiative; and
- Encouragement of the use of agricultural soil and water conservation practices to control erosion.

***Kansas Water Plan* 2010 Objectives**

In October 1998, the Kansas Water Authority approved objectives for the year 2010 as part of the *Kansas Water Plan*. Additional objectives for the year 2015 have also been approved.

These objectives provide established targets for quantifying progress in implementing the *Kansas Water Plan*. Three 2010 Objectives address water quality protection and restoration as follows:

- By 2010, reduce the average concentration of bacteria, biochemical oxygen demand, dissolved solids, metals, nutrients, pesticides and sediment that adversely affect the water quality of Kansas lakes and streams.

- By 2010, reduce the average concentration of dissolved solids, metals, nitrates, pesticides and volatile organic chemicals that adversely affect the quality of Kansas ground water.

- By 2010, ensure that water quality conditions are maintained at a level equal to or better than year 2000 conditions.

While an assessment of each of these objectives was conducted, assessment of water quality monitoring data collected by the Kansas Department of Health and Environment as required by the Clean Water Act is now considered to provide a better basis upon which to identify trends and target funding and program assistance to areas of greatest need.

Surface Water Quality: Clean Water Act Compliance

Water Quality Standards

Section 303 of the Clean Water Act requires the state to set surface water quality standards for waters within their jurisdictions. Water quality standards define uses for water bodies and identify specific water quality criteria for achieving those uses. These standards also contain antidegradation policies designed to protect improvements in water quality and existing high quality waters.

Once surface water quality standards have been adopted by the states and approved by the U.S. Environmental Protection Agency (EPA), they are used in determining National Pollutant Discharge Elimination System permit limits, water body impairment status and Total Maximum Daily Load endpoints.

Water quality standards consist of three basic elements:

- Designated uses that describe the existing and/or potential uses of a waterbody or segments thereof;
- Water quality criteria (typically allowable numeric pollutant concentrations) necessary to protect the designated uses or uses of the waterbody; and
- An antidegradation policy to maintain and protect existing water quality.

Other policies and provisions explaining how the standards are to be implemented etc. may also be part of water quality standards.

Kansas Surface Water Quality Standards - All Kansas surface waters have been determined to be either classified, meaning they are subject to meeting Kansas Surface Water Quality Standards (K.A.R. 28-16-28b *et seq.*), or unclassified. The designated uses of classified surface waters are listed in the Kansas Surface Water Register and adopted by reference in K.A.R. 28-16-28d. These designated use categories are:

- Aquatic Life Use (special, expected or restricted);
- Contact Recreational Use (five subcategories);
- Domestic Water Supply Use;
- Food Procurement Use;
- Ground Water Recharge;
- Industrial Water Supply Use;
- Irrigation Use; and
- Livestock Watering Use.

If a designated use for a specific water body is contested, a Use Attainability Analysis may be conducted. Guidance has been developed by Kansas Department of Health and Environment (KDHE) for conducting such analyses. In compliance with Substitute for Senate Bill 204 (K.S.A. 82a-2004b), enacted in 2001, KDHE is to make public a list of currently classified stream segments for which:

- Use attainability analyses for designated uses other than recreational use have been completed;
- Use other than recreational use has been determined not attainable; and
- Use attainability analyses for designated uses other than recreational use have not been completed.

Water Quality Monitoring and Assessment

The Kansas Department of Health and Environment (KDHE) monitors water quality conditions in streams and publicly owned lakes and wetlands throughout Kansas. KDHE also tracks contaminant levels in fish tissue, monitors the quality of effluent discharged from selected wastewater treatment facilities, and conducts special investigations, often in cooperation with other state or federal agencies.

These surface water quality monitoring programs or networks are operated by KDHE:

KDHE: Stream Chemistry Monitoring Program
KDHE: Stream Biological Monitoring Program
KDHE: Lake and Wetland Monitoring Program
KDHE: Fish Tissue Monitoring Program
KDHE: Compliance Monitoring Program.

In addition to these KDHE programs, the Kansas Department of Wildlife and Parks (KDWP) surveys fish and macro-invertebrate populations in streams which may serve as good surrogate indicators of water quality:

KDWP: Stream Assessment and Monitoring Program.

Among the uses of the information collected from the KDHE monitoring programs are the following two products that the Clean Water Act requires the states to submit to the EPA.

<u>Section 305(b) Report</u> – A biennial assessment of the state's surface water quality is required by the Clean Water Act. The 2006 Kansas Water Quality Assessment, also known as the 305(b) Report, considers four years of stream chemistry monitoring data (2002-2005), five years of stream biological monitoring data (2000-2004), six years of lake and wetland monitoring data (2000-2005), and three years of fish tissue contaminant data (2002-2004). Collectively, this information allows water quality assessment of 18,493 miles of streams and 245,227 acres of publicly owned (or publicly accessible) lakes and wetlands. This represents approximately 60 percent of the state's classified stream mileage and 95 percent of the state's classified lake and wetland acreage.

Monitoring data indicates that 53 percent of the state's assessed stream mileage fully supports all designated uses; 7 percent is fully supported but threatened for at least one use; and 39 percent is impaired for one or more uses. Approximately 15 percent of assessed lake acreage fully supports all uses, while 76 percent is impaired for one or more designated uses. Sixteen percent of wetland acres either fully support all uses or lack sufficient data for evaluation; the remaining 84 percent are impaired for one or more uses.

The major causes of non-support for streams, in order of prevalence, are organic enrichment, high salinity, elevated pH, and elevated E. coli bacteria concentrations. Major causes for lakes ad wetlands include elevated nutrient levels, eutrophication, siltation, high turbidity, and taste and odor problems.

Approximately 61 percent of the state's assessed lake acreage has exhibited no change in trophic condition in recent years. Another 28 percent of the assessed acreage has experienced a measurable increase in trophic state, while 4 percent has exhibited some improvement in trophic condition.

Section 303(d) List – If monitoring indicates that a river segment or other water body is consistently violating water quality standards, the water body is deemed water quality impaired. Water bodies not meeting water quality standards for their designated use(s) are identified on the 303(d) List. Section 303(d) of the Clean Water Act requires states to identify those waters that fail to meet surface water quality standards and submit a list of such waters to the EPA every two years. Information from the KDHE water quality monitoring networks is used in this identification. The 303(d) List is used to identify those waters targeted for the development of total maximum daily loads.

The 2004 Kansas Section 303(d) List of Impaired Waters was approved by the EPA in December 2005. This list contains 1,639 water quality limited stream segments. Of these segments, 877 are newly listed in 2004; 127 segments originally listed in 1998 are carried-over to 2004; and 635 segments originally listed in 2002 are carried over to 2004.

Other Assessment Information – In the late 1990s the EPA and the U.S. Department of Agriculture-Natural Resources Conservation Service (NRCS) lead the development of a Clean Water Action Plan for enhancing implementation of the Clean Water Act. This plan called for conducting unified watershed assessments as part of implementing watershed restoration action strategies.

A Kansas Unified Watershed Assessment project was facilitated by KDHE and the NRCS in 1998. Water quality monitoring data and other natural resource condition information were used in the assessment. Unified Watershed Assessments were a key part of the federal Clean Water Action Plan which also included watershed restoration action strategies. These strategies were a predecessor to the current watershed restoration and protection strategies (WRAPS).

Of 92 HUC-8 level watersheds examined in Kansas, 71 were classified as in need of restoration (Category I). Nine watersheds were classified as needing protection (Category II).

Watershed Condition Reports prepared by KDHE provide residents with additional information with which to assess conditions within their watershed. A joint effort is being initiated by the NRCS and KDHE to conduct Rapid Watershed Assessments that will include estimates of conservation needs within the watershed.

National Pollutant Discharge Elimination System

As authorized by the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge directly into waters of the United States. Point sources include any discernable, confined and discrete conveyance such as a pipe or ditch. Confined Animal Feeding Operations (CAFOs) are also included.

An NPDES permit is a license for a facility to discharge a specific amount of a pollutant into a waterbody under certain conditions to protect human health and the integrity of aquatic life. The Kansas Department of Health and Environment (KDHE) is the U.S. Environmental Protection Agency (EPA) delegated permitting authority for NPDES permits in Kansas. Permits are issued for a specific period of time not to exceed five years.

Municipal – The Municipal Programs Section of KDHE regulates discharge from municipal waste treatment facilities. Municipal wastewater treatment infrastructure plays an important role in meeting established water quality goals. Replacement and routine maintenance of this infrastructure can present a significant financial challenge for communities. Construction grants were available until the early 1990's under the Clean Water Act and were administered by

KDHE. The grants provided 50 to 75 percent of eligible project costs. The Clean Water Act Amendments of 1987 phased-out the Construction Grants Program and replaced it with a revolving loan program to assist municipalities in the construction of wastewater collection and treatment systems by providing low interest loans. The State Revolving Loan Program is administered by KDHE and has been in-place since the early 1990's.

Industrial - The Industrial Programs Section of KDHE administers regulatory permitting programs for the handling, treatment and disposal of industrial wastewater and the pretreatment of industrial wastes directed to municipal wastewater collection and treatment systems subject to federal Clean Water Act provisions or Kansas surface water quality standards.

Stormwater – The Clean Water Act amendments of 1987 required the EPA to adopt regulations to require NPDES permits of stormwater dischargers. The Kansas Municipal Stormwater Program has designated 39 entities within five urbanized areas and 19 municipalities outside of these urbanized areas as regulated municipal separate storm sewer systems requiring individual stormwater NPDES permits. In addition, two general permits have been developed; one for small municipal separate storm sewer systems in urbanized areas and the other for small systems outside urbanized areas. Urbanized areas include Wichita; Topeka; Lawrence, St.Joseph, MO-KS and Kansas City, MO-KS.

The Industrial Programs Section manages permits for stormwater discharges associated with construction and industrial activities.

Confined Animal Feeding Operations - In Kansas, the Livestock Waste Management Section of KDHE's Bureau of Water administers Kansas laws regarding livestock waste. All CAFOs with an animal unit capacity of 300 or more must register with KDHE. Any facility with an animal unit capacity of 1,000 or more must obtain a Livestock Waste Management Permit. Additionally, any facility that represents a significant water pollution potential must register with KDHE.

Total Maximum Daily Loads

The Clean Water Act requires states to conduct Total Maximum Daily Load (TMDL) studies and develop TMDLs for water bodies identified on the state's List of Impaired Waters (Section 303(d) List). TMDLs are quantitative objectives and strategies needed to achieve the state's surface water quality standards. The process of developing TMDLs determines:

- The pollutants causing water quality impairments;
- The degree to which applicable water quality standards are not achieved;
- The levels of reduction in pollutant loading needed to achieve the standards;
- Corrective actions to be implemented in the watershed that affect the water quality of the impaired waterbody;
- Monitoring and evaluation strategies to assess the impact of the corrective actions; and
- Provision for future revision of TMDLs based on evaluations.

In 1995, a complaint was filed against the U.S. Environmental Protection Agency (EPA), compelling it to enforce Section 303(d) of the Clean Water Act by establishing TMDLs in Kansas. The State intervened in the litigation and a settlement was reached; the court decree approving the settlement was made on April 13, 1998. The Court Decree included a schedule for TMDLs to be developed and submitted in each of the state's 12 major river basins by 2006.

The Kansas Department of Health and Environment (KDHE) Watershed Planning Section is responsible for development of TMDLs:

KDHE: Total Maximum Daily Load Program.

The initial round of TMDL submissions will be completed by June 30, 2006, with submission of TMDLs for the Lower Arkansas and Upper Republican basins. Following this initial submission, Kansas intends to rotate through the river basins, revising TMDLs as needed. This revision cycle started with the Kansas-Lower Republican Basin in 2005.

Implementation of high priority TMDLs is included in each *Kansas Water Plan* basin section as a basin priority issue. Mechanisms existing under state authority to manage pollutant loadings, particularly those of a non-point nature are described below.

Critical Water Quality Management Areas - KDHE has authority to establish Critical Water Quality Management Areas (CWQMAs) (K.A.R. 28-16-70) under the authority of K.S.A. 65-171a and 171d, and K.S.A. 65-3301 *et seq.* Watersheds may be designated as a CWQMA because of pollutant sources that may cause damage to resources of the state; public nuisance or health hazards; destruction of fishery habitat; excessive deposition of sediment; additional risk to threatened or endangered species; or violation of water quality standards. Pollutant sources within a CWQMA are evaluated and a management plan is developed.

Pesticide Management Areas - The Kansas Department of Agriculture has authority (K.S.A.2-2472) to develop Pesticide Management Areas (PMAs) when notified by the EPA or KDHE that a pesticide that poses a serious threat to the public health, safety and welfare or to the natural resources of the state. A technical advisory committee is used in establishing the PMA boundaries and in developing a management plan.

Sanitation Zones - K.S.A. 65-187 gives the secretary of health and environment authority to adopt rules and regulations designating and establishing Sanitation Zones to regulate and control development of areas around certain water impoundments to prevent pollution, assure sound and economical development and maintain healthy and sanitary conditions.

Source Water Protection Planning – The Safe Drinking Water Act requires KDHE to provide assistance and coordinate the completion of public water system source water assessments as described elsewhere in this *Kansas Water Plan* Section. While the Safe Drinking Water Act does not require source water protection plans to be developed, KDHE encourages public water supplies and their surrounding communities, on a voluntary basis, to use the source water assessments as the foundation for future protection planning efforts.

Surface Water Quality: Other Plans, Programs and Strategies

While not necessarily tied directly to compliance with the Clean Water Act, the following plans, programs or strategies enhance achievement of its goals. Also, while primarily addressing surface water quality, these items may address ground water quality as well.

Surface Water Nutrient Reduction Plan

Nutrients including phosphorus and nitrogen are one of the greatest impediments to achieving improved quality of surface waters in Kansas. Additionally, nutrients exported beyond Kansas contribute to water quality problems elsewhere, such as development of a "dead zone" within the Gulf of Mexico where many bottom-dwelling organisms have been killed or forced to move.

The U.S. Environmental Protection Agency has requested that all states develop plans to establish water quality criteria for nutrients in surface waters. Kansas has focused on nutrient reduction rather than nutrient criteria as proposed in the Kansas Surface Water Nutrient Reduction Plan. Reduction targets have proven to be effective elsewhere in the United States, notably in Connecticut and North Carolina.

As indicated in the Nutrient Reduction Plan, approximately 51,000 tons of total nitrogen and 7,700 tons of total phosphorus are exported from Kansas annually. Point source contributions to this export are 18 percent for total nitrogen and 25 percent for total phosphorus. While small, these point source contributions are significant. Analysis indicates that discharges from the relatively small number of large wastewater treatment facilities are responsible for the vast majority of the point source contribution.

An overall target of a 30 percent reduction in the total export of both total phosphorus and total nitrogen from Kansas is proposed. The 30 percent overall reduction in total nitrogen export is expected to be accomplished by a 55 percent reduction in contributions from point sources combined with a 24 percent reduction from non-point sources. For the 30 percent reduction in total phosphorus exports, component reductions from point and non-point sources are projected to be 55 percent and 22 percent, respectively.

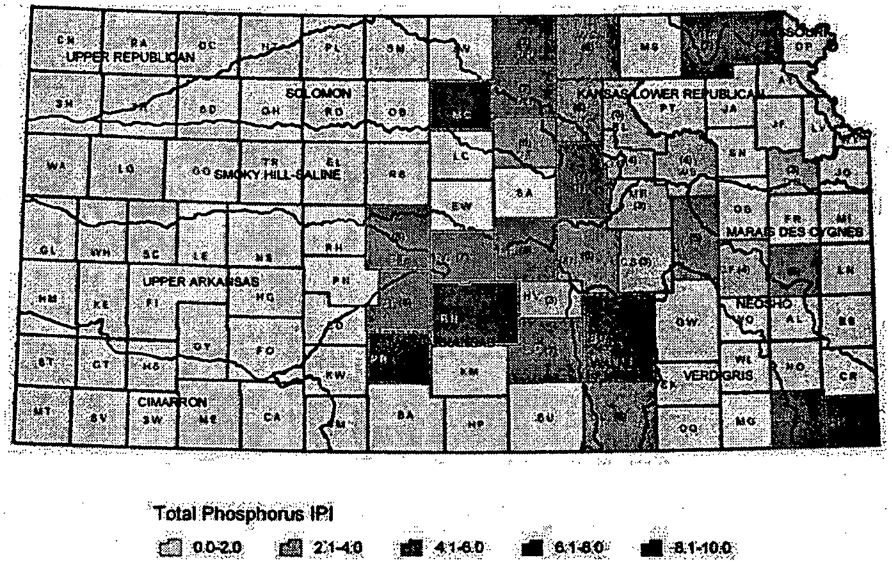
Percentage reductions needed to achieve this overall 30 percent export target will vary by river basin. Figures 1 and 2 show a county-level improvement potential index for total phosphorus in surface waters and total nitrogen in surface waters, respectively. This index was devised to screen counties based on the relative potential improvement that could be expected from implementation of non-point source best management practices. Higher index values indicate a greater potential for improvement.

The proposed Kansas approach emphasizes specific controls for large sewage treatment plants along with targeted practices for controlling non-point nutrient sources.

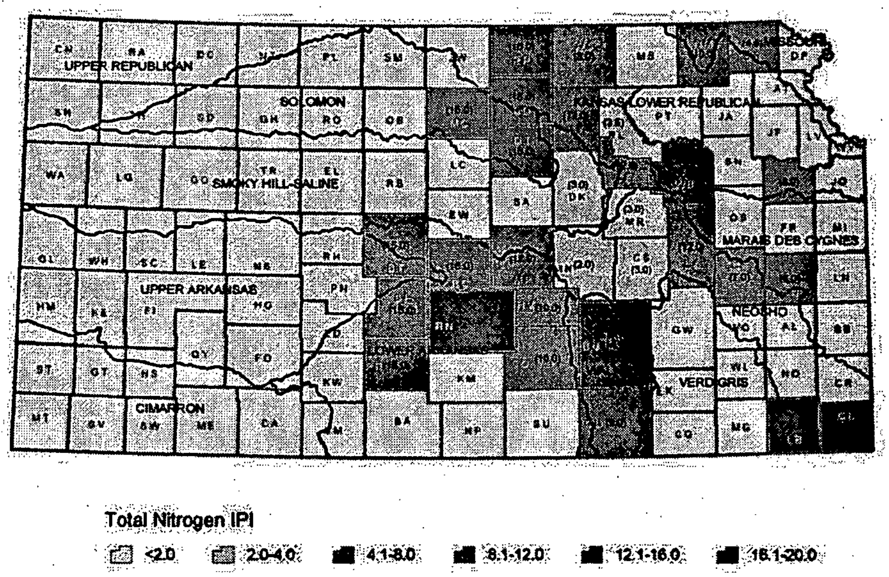
Specific actions necessary to meet the 30 percent reduction target are expected to be developed through Watershed Restoration and Protection Strategies and establishment of high priority Total Maximum Daily Loads. The policy infrastructure for both approaches is in place.

Figures 1 and 2

Improvement Potential Index (IPI) for Total Phosphorus in Surface Waters



Improvement Potential Index (IPI) for Total Nitrogen in Surface Waters



Kansas Watershed Restoration and Protection Strategy

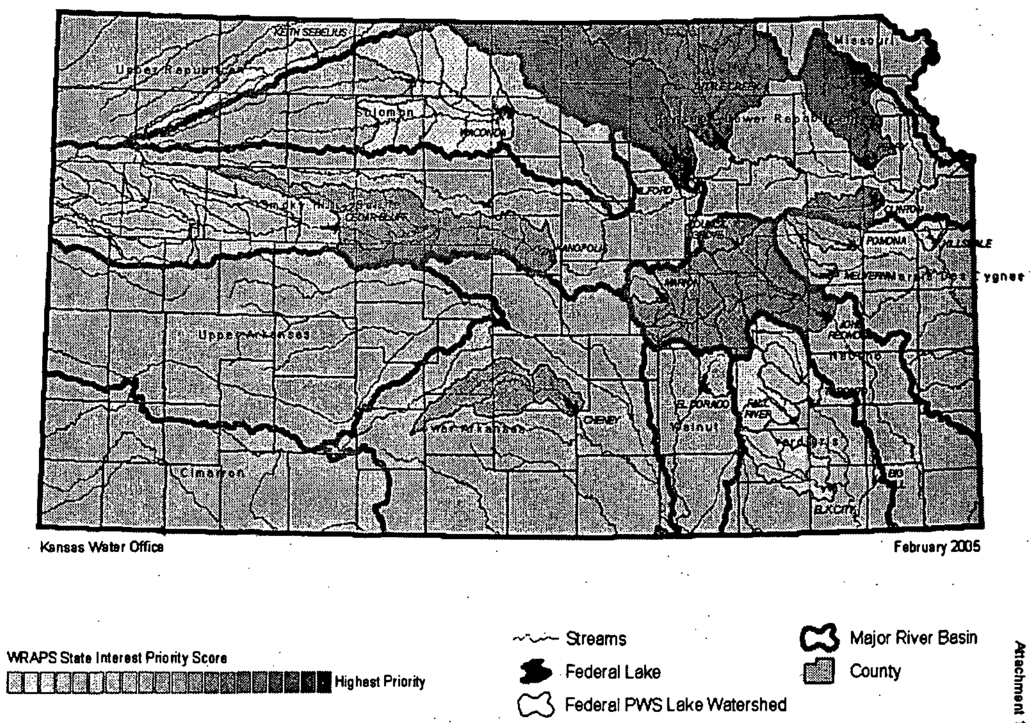
A Kansas Watershed Restoration and Protection Strategy (KS-WRAPS) was adopted in 2004 through a KS-WRAPS Memorandum of Agreement among member agencies of the Governor's Natural Resources Sub-cabinet. This effort was initiated as a component of the *Kansas Water Plan* Projects Initiative of the Kansas Water Authority. The strategy provides the general program framework and guidance for development and implementation of individual watershed restoration and protection strategies (WRAPS) in priority watersheds. Watersheds above federal reservoirs that provide public water supply benefits are identified as areas of significant state interest for WRAPS development and implementation (See Figure 3). As of April 2006, WRAPS projects were underway or proposed for each of these 20 priority federal reservoir watersheds. Implementation of WRAPS is also encouraged in Unified Watershed Assessment Category I and II watersheds.

Each local WRAPS project provides a planning and management framework that engages stakeholders in a process to:

- o Identify watershed restoration and protection needs.
- o Establish watershed management goals.
- o Create a cost-effective action plan to achieve goals.
- o Implement the action plan.

Figure 3

Watersheds of Federal Reservoirs in Kansas Serving Public Water Supply Needs



Attachment 1

A local stakeholder leadership team oversees each WRAPS project. Clean Water Act-Section 319 grants and the State Water Plan Fund provide funding to local sponsors for WRAPS development, assessment, planning and implementation projects to supplement other available funding sources. Projects are funded on a priority basis considering state and local interests and project history.

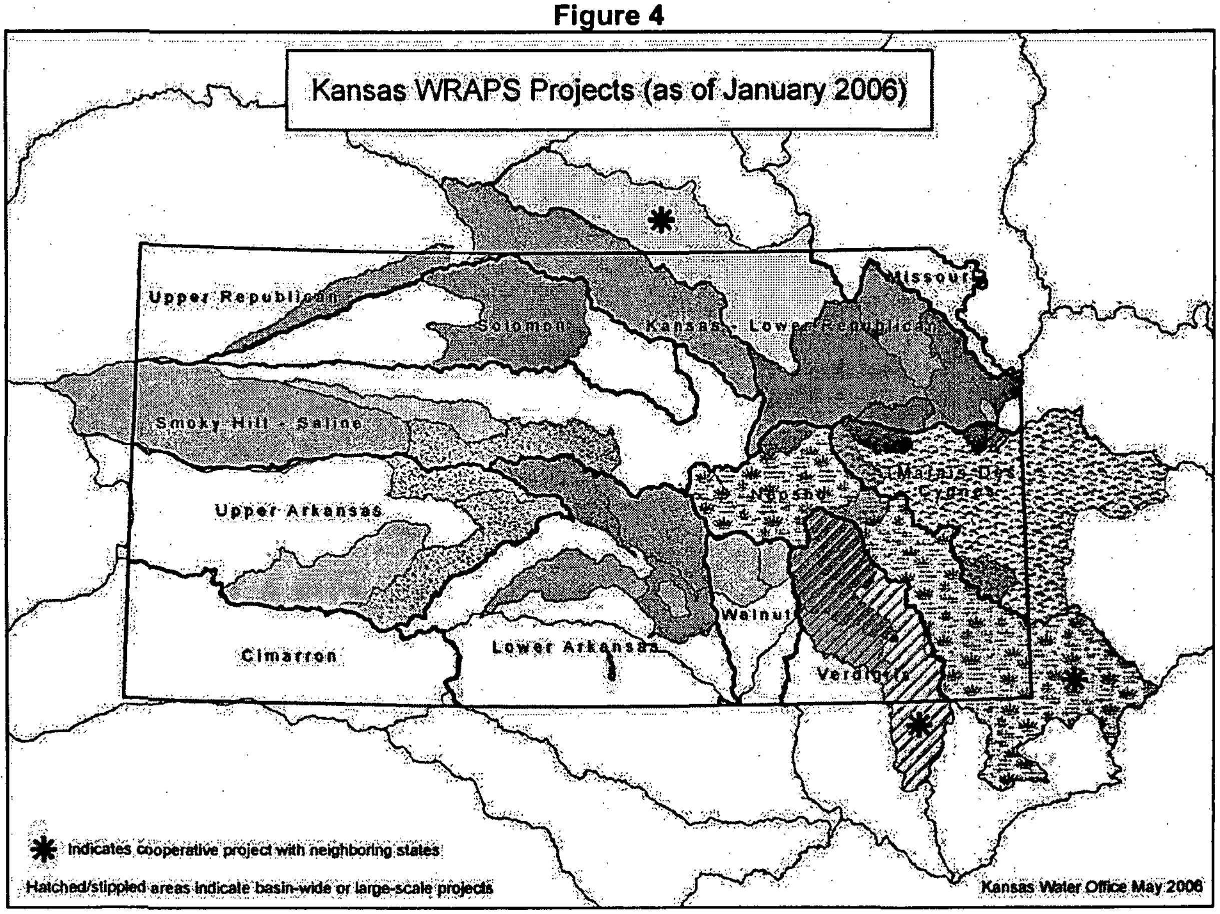
In State Fiscal Year (SFY) 2006, a total of $2.0 million was appropriated for WRAPS projects. This includes $800,000 from the State Water Plan Fund and $1.2 million from federal Clean Water Act-Section 319 grants. An additional $800,000 has been requested from the State Water Plan Fund for SFY 2007 which would again be paired with $1.2 million in federal funding. Projects may receive funding from either source or a combination of both. The Kansas

Department of Health and Environment administers the project grants in consultation with an interagency WRAPS Work Group.

WRAPS projects can address multiple water and related natural resource issues within a watershed such as water quality, source water protection, flooding and stormwater runoff, wildlife habitat, wetland and riparian area management and outdoor recreation. These projects may also contribute to energy conservation through implementation of practices resulting in reduced use of farm machinery, such as no-till or reduced tillage farming and conversion of cropland to permanent vegetative cover.

As of January 2006, there were 45 WRAPS-related projects located throughout Kansas as shown in Figure 4.

Figure 4



Wetland and Riparian Area Protection – Wetland and riparian areas are important elements of a properly functioning watershed. Benefits derived from riparian or streamside areas include erosion and sediment control, timber production, wildlife habitat, water quality protection, recreation and aesthetic values. Wetlands in Kansas provide unique wildlife habitat, floodwater detention, ground water recharge, and water quality benefits.

The primary policy of the state regarding wetland and riparian area management is to facilitate the protection of these areas from conversion or channel modifications and to stabilize streams which have been adversely affected by channel modification activities. Alterations to stream channels are regulated under state and federal laws. In addition, federal regulations protect some wetland areas from being filled in, and require compensatory mitigation for unavoidable losses. There are no state regulations that protect wetland or riparian areas. However, the state promotes the restoration and enhancement of these areas to maintain or maximize environmental benefits.

Wetland and riparian area management is a key strategy in implementing Total Maximum Daily Loads and in addressing high priority biological areas. Development and implementation of Watershed Restoration and Protection Strategies is expected to enhance this effort and result in pro-active protection activities.

A Kansas Wetlands and Riparian Areas Protection and Restoration Implementation Plan was completed by the Kansas Water Office and the Kansas Alliance for Wetlands and Streams in 2003 utilizing a grant from the U.S. Environmental Protection Agency.

Please see the *Kansas Water Plan* Wetland and Riparian Management Section for a full description of the policies and institutional framework upon which wetland and riparian area restoration and protection efforts are undertaken.

Kansas Source Water Assessment

The Safe Drinking Water Act originally enacted by Congress in 1972, was amended in 1986 and 1996. Originally, the Safe Drinking Water Act focused primarily on treatment as the means of providing safe drinking water at the tap. The U.S. Environmental Protection Agency (EPA) was authorized to set national primary standards for drinking water. The EPA has designated the Kansas Department of Health and Environment (KDHE) as having primary responsibility for administering and enforcing the Safe Drinking Water Act in Kansas.

The 1996 amendments broadened the scope of the Safe Drinking Water Act, recognizing source water protection, operator training, funding for water system improvements and public information as important components of safe drinking water. Please see the *Kansas Water Plan* Public Water Supply Section for a full description of the policies and institutional framework upon which public water systems are managed.

The Safe Drinking Water Act requires each state to develop a Source Water Assessment Program. Wellhead protection is included. Additionally, states are required to develop a source water assessment for each public water system that treats raw source water.

KDHE has completed source water assessments for all 763 Kansas public water systems required to have them. As indicated in Kansas Source Water Assessment (January 2004), 54 percent of the 677 systems utilizing a groundwater source received a low susceptibility analysis score; 45 percent were scored moderate and one percent high. Fifty-one percent of surface water systems received low susceptibility scores, with 43 percent scoring moderate and six percent high. Communities are being encouraged by KDHE to use these assessments as the foundation for development of a local source water protection plan.

Spillage of solvents, pesticides and other chemicals; illegal dumping of wastes: abandoned industrial facilities and landfills; leaking storage tanks, oil and gas exploration and production; and surface mining are each examples of potential source water contamination sources.

Non-Point Source Pollution Control Programs

Federal Programs - Federal programs play a significant role in addressing non-point source pollution concerns in Kansas. Implementation of these programs may also result in fuel savings resulting from reduced use of machinery.

The U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) has several programs that address water quality related issues. The Conservation Reserve Program (CRP) is a voluntary program that provides annual rental payments to agricultural producers to safeguard environmentally sensitive lands by planting long-term, resource conserving vegetation to control soil erosion improve water quality and enhance wildlife habitat. Program signups are held periodically. A continuous signup provision of the CRP provides funding for installing vegetative buffers and other practices to protect rivers and streams and other environmentally sensitive areas.

As of January 2006, over 3 million acres were enrolled in the CRP in Kansas with approximately 72,000 acres enrolled in the continuous CRP. Contracts period vary from 10-15 years.

The NRCS Environmental Quality Incentive Program (EQIP) provides technical and financial assistance to eligible farmers and ranchers to address soil, water, air and related natural resource concerns on their agricultural land. State water quality priority areas, such as high priority Total Maximum Daily Load watersheds, source water assessment areas and federal multipurpose reservoirs are considered in the evaluation criteria for ranking and funding EQIP applications. A current status of EQIP projects in Kansas is available on the Kansas NRCS website.

The NRCS Conservation Security Program provides financial incentives for producers who meet established standards for conservation and environmental management on their operations. The program is administered on a priority HUC-8 watershed basis. Ten priority watersheds have been approved in Kansas as of January 2006.

The U.S. Environmental Protection Agency Section 319 Grant Program is administered through the Kansas Department of Health and Environment (KDHE). Local projects funded through this program are designed to eliminate or minimize non-point source pollution through the use of locally-driven management strategies and programs.

The U.S. Geological Survey is involved with a variety of water quality monitoring and assessment projects that assist cooperators in addressing water quality related issues.

State Programs - The State Conservation Commission (SCC) has several programs that provide cost-share assistance to agricultural producers and other landowners for implementing best management practices that enhance water quality, reduce soil erosion and protect or restore riparian and wetland resources. These programs may also conserve energy resources through reduced use of fuel. These programs are funded through the State Water Plan Fund and address priorities established in the *Kansas Water Plan*. SCC programs are administered through county conservation districts, located in each of the State's 105 counties.

The SCC Non-point Source Pollution Control Program provides funding through conservation districts that have developed and adopted a Local Non-point Source Pollution Management Plan. Currently, 104 counties have adopted plans. The SCC Kansas Water Quality Buffer Initiative provides per acre rental payments supplementing federal rental payments received through the continuous CRP to install vegetative buffers along rivers and streams in priority watersheds to improve water quality. Buffer coordinators have been employed in a number of counties to facilitate landowner enrollment in this program.

The KDHE Watershed Management Section administers the EPA Section 319 Grant Program which provides funding for a variety of water quality and watershed related projects. The Local Environmental Protection Program (LEPP) provides funding to local units of government for adoption and implementation of county environmental codes. A current status map showing counties participating in the LEPP is available on the KDHE website.

University affiliated programs play an important role in water quality restoration and protection. The Kansas State University Research and Extension Program encompasses a variety of water quality related research projects as well as supporting watershed assessment and planning activities through county extension agents and watershed specialists. The Kansas Biological Survey and the Kansas Geological Survey at the University of Kansas are also engaged in water quality related research and watershed assessment and management projects.

The Kansas Department of Agriculture administers programs relating to the use and regulation of pesticides and fertilizers.

Local Programs - Local governing bodies, agencies and organizations play a vital role in addressing non-point source pollution issues at the community level. Although ownership of water in Kansas is held as a public trust, decisions on land use and land management that can directly impact the quality and quantity of water resources are typically made by local agencies or individuals. Thus successful efforts to restore or protect our waters rely heavily on local actions and initiatives. Most of the state's water quality programs ultimately involve local entities for implementation of on-the-ground projects.

Conservation districts administer a number of natural resource programs addressing water quality, soil erosion, wildlife habitat and other resource concerns. The SCC provides cost-share funding to landowners for implementation of best management practices through local conservation district programs. Conservation districts also work closely with the NRCS to implement Farm Bill programs and their offices are generally co-located. All 105 counties in Kansas are served by conservation districts.

Watershed districts prepare plans and implement projects that address rural flooding, sedimentation, and related resource concerns. Historically, construction of watershed dams has been the primary mechanism utilized with cost-share assistance for planning and construction received through state and federal programs. In recent years, with decreased funding and increased regulatory requirements for dam construction, watershed districts have been exploring additional options to address these concerns and related issues. Also, many existing small dams are aging and funding for rehabilitation or upgrades is needed. Please see the *Kansas Water Plan* Small Dam Safety and Rehabilitation Section for more information and policy recommendations regarding dam hazard class changes and funding for dam repairs and upgrades.

Resource Conservation and Development Councils (RC&D), supported by the NRCS, improve the capability of local leaders in designated RC&D areas to plan and carry-out projects for resource conservation and community development. Program objectives focus on enhancing the quality-of-life through regional cooperation with the goal to attain and maintain economic viability that is compatible with natural resource conservation and a quality environment. Councils have a role in administering regional grant projects such as Watershed Restoration and Protection Strategy projects that cross political boundaries. Kansas has 10 authorized RC&D areas (map), with authorization of two areas pending and an additional area forming.

City and County governments have numerous authorities to address local land use planning and management issues, including water quality protection and restoration. Comprehensive land use planning and zoning authorities provide the foundation for addressing many of these issues. Effective watershed management ultimately requires that natural resource restoration and protection measures be incorporated into community land use plans and policies. National Pollutant Discharge Elimination System (q.v.) permitting programs for municipal wastewater treatment plants and urban stormwater management are also implemented through local governments.

Environmental and Conservation Organizations are actively involved in promoting water resource protection and restoration efforts through a variety of activities including information and education, stakeholder organization and on-the-ground projects. In some instances, these organizations serve as sponsors for local WRAPS projects.

Ground Water Quality: Overview

As indicated previously, no umbrella federal ground water quality legislation comparable to the Clean Water Act has been enacted. Emphasis at both the federal and state levels has been on regulation of solid and hazardous waste disposal, storage tanks, and remediation of previously contaminated sites. Much of this emphasis has its roots in concerns about drinking water quality and enhances attainment of federal Safe Drinking Water Act goals.

State initiatives related to ground water quality include a Governor's Executive Order covering the Equus Beds Aquifer and identification of sensitive areas for wastewater lagoons. Executive Order 00-04, made by Governor Graves on March 15, 2000, ordered the Secretary of the Kansas Department of Health and Environment to identify all known sources of existing and potential pollution in the Equus Beds Aquifer of south central Kansas. An on-going public reporting of such pollution was also ordered and may be viewed through the Equus Beds Information Resource web site.

Regulations adopted by the Kansas Department of Health and Environment in 2004 (K.A.R. 28-16-160 through K.A.R. 28-16-174) cover municipal, commercial and industrial wastewater lagoon requirements. Sensitive groundwater areas have been delineated in regard to implementing these regulations.

While the following certainly may have surface water implications, ground water aspects tend to take precedence in Kansas.

Resource Conservation and Recovery Act and Related Federal Statutes

The federal Resource Conservation and Recovery Act (RCRA) was enacted in 1976 to ensure that the huge volume of municipal and industrial solid waste generated nationwide were managed properly. Four goals were set by RCRA including protection of human health and the environment from the hazards posed by waste disposal. Three interrelated programs were established to meet these goals:

- *Solid Waste Program*
- Hazardous Waste Program
- Underground Storage Tank Program

Although RCRA created the framework for proper management of solid waste, it does not address the problems of hazardous waste found at inactive or abandoned sites or those resulting from spills that require emergency response. These problems are addressed by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly called Superfund, which was enacted in 1980. CERCLA was amended by the Superfund Amendments and Reauthorization Act (SARA) in 1986.

Kansas Compliance and Implementation - As with most federal environmental legislation, RCRA and CERCLA encourage the states to develop their own waste management programs that meet federal standards in lieu of direct implementation of the federal program by the U. S. Environmental Protection Agency. The Kansas Environmental Response Act (K.S.A. 65-3452 *et seq.*) of 1988 provides authority and guidance for implementation of CERCLA in this state.

Federal and state law requires reporting of accidental spillage of any materials that may pollute water, air or soil. An exception (K.A.R. 82-3-603) is made for very minor spills and escapes occurring at oil and gas exploration and production sites. Cleanup of these spills is required.

The Kansas Department of Health and Environment's Bureau of Environmental Remediation (BER) is charged with responding to environmental emergencies and with managing environmental contamination through pollution source control, containment or remedial action. The BER is responsible for assessment and remediation of contaminated sites, with the exception of those related to oil and gas activities which are the responsibility of the Kansas Corporation Commission (KCC).

Ground Water Quality Monitoring

The Kansas Ground Water Monitoring Program was managed and operated by the Kansas Department of Health and Environment from 1990 through 2001. However, the ground water quality network was discontinued in fiscal year 2002 due to budget cuts. The 1990-2001 data includes 1,736 analyses from a maximum of 200 wells used for public water supply, rural/domestic water supply, irrigation, livestock watering, industrial water supply, ground water monitoring, or a combination of these uses that were sampled for inorganic chemistry, pesticides, volatile organic compounds, radionuclide and radon samples.

The primary objective of this monitoring program was to provide reliable information on ground water quality for use in the identification of any temporal and spatial trends in aquifer chemistry associated with alterations in land use patterns, advances in land treatment methods and other resource management practices, changes in ground water availability or withdrawal rates, and regional climatic variations.

Ground water quality is also monitored for specific projects or areas by state and local agencies including the Kansas Department of Health and Environment, Kansas Geological Survey; Kansas Corporation Commission; Kansas Department of Agriculture and the groundwater management districts.

Remediation of Contaminated Sites

State agency responsibility for contaminated site remediation depends upon the source of the contamination. Where contamination is related to oil or gas production at the production site, the Kansas Corporation Commission is responsible; otherwise, remediation is the responsibility of the Kansas Department of Health and Environment.

Remediation involves the assessment, investigation, cleanup and monitoring of contaminated sites. Once reported, potentially contaminated sites are inspected to assess the immediate and long-term health and environmental risks. If the site poses an immediate risk, emergency response actions are taken. If the site is determined to pose a treat to human life or the environment, an investigation is conducted to characterize the magnitude and extent of contamination and to evaluate whether remediation may be needed.

Remediation of a site may require removal (excavation of soil, drum removal), on-site clean up, off-site treatment or containment of contaminants. Where human health is threatened, alternate drinking water supplies may be provided.

The Kansas Department of Health and Environment (KDHE) encourages those responsible for the contamination to work cooperatively to achieve an appropriate cleanup. However, at so-called orphan sites a responsible party can't be identified, or is unable or unwilling to participate in remedial actions. The State Water Plan Contamination Remediation Program was developed specifically to provide a means of addressing such sites which, for whatever reason, fall outside the scope of other programs. Funding is provided through the State Water Plan Fund. The following link provides additional information.

KDHE: State Water Plan Remediation Program

Contamination sites in the State Water Plan Contamination Remediation Program are prioritized based upon health risk to identify those sites requiring immediate attention. The majority of sites are being addressed in response to ground water impacts that have affected public and/or private drinking water wells.

As of December 31, 2005, there were 84 sites in the State Water Plan Contamination Remediation Program. Site summaries for all sites currently being managed through this program are available. Information regarding all contaminated sites managed by KDHE, regardless of program, is available in the Identified Sites List.

Oil and Gas Related Sites - Abandoned oil and gas wells present a significant public safety and water contamination potential unless properly plugged. The Abandoned Oil and Gas Well / Site Remediation Program of the Kansas Corporation Commission (KCC) uses monies from the Abandoned Oil and Gas Well / Site Remediation Fund established in 1996 to plug abandoned wells and remediate surface and ground water contamination related to oil and gas activities. An annual revenue transfer from the State Water Plan Fund helps provide funding. A map showing the location of all abandoned oil and gas wells plugged since 1996 is available. The following link provides additional information.

KCC: Abandoned Oil and Gas Well / Site Remediation Program

Kansas Water Plan Basin Sections

Priority basin issues related to water quality have been identified in eight *Kansas Water Plan* basin sections. These issues include High Priority Total Maximum Daily Loads (TMDLs) and Watershed Protection and Restoration which incorporates achievement of TMDLs, development of source water protection plans and restoration and protection of wetland and riparian areas.

Following are links to these priority basin issues identified in the basin sections:

Kansas-Lower Republican
Lower Arkansas
Upper Arkansas
Marais des Cygnes
Missouri
Neosho
Verdigris
Walnut

Selected References

1. The Kansas Water Plan Fiscal Year 2005 Update; Final Draft. *Water Quality Policy Section.* Released by the Kansas Water Authority, July 2003.

2. Kansas WRAPS Work Group. *Kansas Watershed Restoration and Protection Strategy.* Adopted by the Governor's Natural Resources Sub-Cabinet, May 2004 and endorsed by the Kansas Water Authority, June 2004.

3. Kansas Department of Health and Environment, Bureau of Water. *Surface Water Nutrient Reduction Plan.* December 29, 2004.

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WATER QUALITY PROGRAMS

Kansas Department of Health and Environment Water Quality Monitoring and Assessment (Formerly TMDL Program and Use Attainability Analysis) is responsible for identifying and determining the nature and extent of water quality conditions in Kansas, developing and recommending appropriate corrective action, and evaluating the effectiveness of these actions. Activities of the program include operating a monitoring network, compilation of data, the analysis interpretation of that data, use attainability analyses, and development of TMDLs for surface waters that do not meet water quality standards.

Kansas Department of Health and Environment Environmental Remediation Program is responsible for environmental emergencies and investigation and long-term cleanup of contaminated areas. The Bureau investigates suspected contamination sites to determine if contamination exists; evaluates the potential threat to public health and the environment from contaminated sites; and maintains the contaminated site list used to establish priorities for cleanup. The Bureau responds to petroleum and chemical spills and is responsible for coordination of cleanup at spill sites; provides oversight of cleanup by private parties at contaminated sites; administration of the Federal Superfund Program in Kansas; and administration of the Storage Tank Program for above and underground tanks.

Kansas Department of Health and Environment Watershed Management (Formerly Nonpoint Source Pollution Technical Assistance Program) The mission of the Watershed Management Program is to achieve widespread use of nonpoint source pollution control measures. This will result in reduction of pollution caused by nonpoint sources. Principal funding is provided via federal Section 319-nonpoint source pollution control grants and the *Kansas Water Plan* funds. Funds support: 1) Kansas Department of Health and Environment staff and operations; 2) demonstration projects; 3) special investigations; 4) grants to local governments to develop and implement local environmental protection plans; 5) technical assistance; 6) technology transfer; and 7) information and education. Technical assistance is provided to public and private sector organizations in identifying nonpoint source caused water pollution problems and preparation of a corrective action plan. Nonpoint source pollution control plans prepared by county conservation districts and others are reviewed to assure consistency with Kansas nonpoint source pollution control principles and practices. The program also directs the Source Water Assessment Program required by the Federal Safe Drinking Water Act.

Kansas Department of Health and Environment Environmental Protection Grant Program allows local entities to receive a grant for development of an environmental protection plan to implement the environmental protection strategy of the *Kansas Water Plan*. An environmental protection plan covers the sanitary code, subdivision water and wastewater plan, solid waste management plan, hazardous waste management plan, public water supply protection plan and nonpoint source pollution control plan.

Kansas Department of Health and Environment Water Pollution Control Program protects health and the environment through control of sources of water pollution. This includes permitting of wastewater treatment and facilities and storm water systems.

Kansas Corporation Commission Conservation Division The Abandoned Oil and Gas Well/Site Remediation Fund, created during the 1996 legislative session, provided for the plugging of abandoned wells and the remediation of contamination sites related to oil and gas activities thorough July 1, 2002. Senate Bill 321, passed during the 2001 legislative session, extends this fund for seven more years to July 1, 2009. The Kansas Corporation Commission utilizes this funding for the plugging of the State's orphaned oil and gas wells and the remediation of contamination sites. Since FY 1997 approximately 3,400 abandoned wells have been plugged with about 8,639 wells on the inventory for plugging at the end of FY 2002. There is a site priority ranking system that allows the program to focus resources on contamination sites that pose the greatest risk to human health and the environment. At the close of 2002, 97 contamination sites have been awarded and are currently in remediation or monitoring. The Soil Stabilization Program assists in stabilizing soil with high salinity and reducing siltation, which may affect water quality.

State Conservation Commission Nonpoint Source Pollution Control Program provides state financial assistance for nonpoint pollution control projects for the protection or restoration of surface and ground water quality. The program is administered at the local level by the county conservation districts. Counties must have a State Conservation Commission approved local nonpoint source plan for landowners in county to be eligible for funds. State Conservation Commission conducts a needs inventory in high priority TMDL watersheds to determine practices that are needed to address the impairments of fecal coliform, dissolved oxygen, eutrophication and nutrients and pesticides. Based on the needs inventory, a proportion of the nonpoint source program allocation is dedicated specifically to practices to address those impairments in high priority watersheds. The counties also receive a base level of funding that is used to fund other priorities identified in the local nonpoint source management plans.

State Conservation Commission Water Resources Cost Share Program provides state cost-share assistance to landowners for the establishment of enduring water conservation practices to protect and improve the quality and quantity of Kansas water resources. These practices, which are not generally a part of normal farming operations, are in the public interest and contribute to the protection and enhancement of water resources. The program is administered at the local level by the 105 county conservation districts.

State Conservation Commission Buffer Initiative compliments the Federal Conservation Reserve Program continuous sign-up provisions by offering additional financial incentives to landowners installing grass filter strips or riparian forest buffers. Though benefits accrue for other purposes, the program is targeted for water quality restoration purposes. The initiative is available only in high priority TMDL watersheds.

Kansas Department of Wildlife and Parks Stream Monitoring (Biological Monitoring) assesses aquatic biological resources to develop a biological baseline of data and an Index of Biotic Integrity. The program is focused on obtaining baseline aquatic data in basins where the TMDLs have been established. It will provide a tool to assess the relative success of addressing surface water quality impairments. The program was initiated in the Neosho Basin and the Kansas-Lower Republican Basin. Biological monitoring within a basin consists of three years of sampling 40 to 45 sites throughout the basin, of which approximately 30 sites remain as long-term monitoring locations. Stream survey crews measure a variety of biological and physical parameters.

Kansas State University Water Quality Program Kansas State Research and Extension has comprehensive statewide research and extension programs in water quality, especially nonpoint source pollution prevention in agriculture. Educational program needs and goals are developed at the county level by local citizens. Educational programs are delivered by state and area-based specialists and county extension agents. The goal of these programs is to minimize the impact of agriculture on water quality and protect the environment while maintaining the economic competitiveness and profitability of agriculture. Programs and expertise exist in areas such as best management practices for pesticides and fertilizers, domestic drinking water, well plugging, grazing land management, conservation tillage, crop residue management, cropping systems, urban pollution problems, and soil, crop, and livestock management. On-farm demonstrations, field days, publications, newsletter, news releases, and public meetings are utilized in the delivery of the educational programs. Research programs are carried out on the main campus and at the Northwest Kansas Research and Extension Center, Colby; the Agricultural Research Center, Hays; the Southwest Kansas Research and Extension Center, Garden City; the Southeast Agricultural Research Center, Parsons; and several experiment fields around the state.

Kansas Water Office State Water Planning Program coordinates the development of the *Kansas Water Plan*.

Kansas Department of Wildlife and Parks, Environmental Services is responsible for reviewing publicly funded and state and federally permitted development projects to determine impacts to wildlife habitats and public recreation lands. The section also is responsible for preparing permits issued by the Kansas Department of Wildlife and Parks for projects impacting threatened and endangered species. Projects reviewed may include utility company inquiries, Kansas Department of Health and Environment solid and hazardous waste proposals, reviewing 404 notices, (U.S. Army Corps of Engineers), Water Projects Environmental Coordination Act reviews (Kansas Department of Agriculture), National Pollution Distribution Elimination System permits and 401 certification proposals (Kansas Department of Heath and Environment) and Environmental Protection Agency construction grant proposals. Environmental Services personnel investigate new methods of impact modeling, track threatened or endangered species distributions, and review state and federal environmental legislation.

Kansas Department of Agriculture Pesticide and Fertilizer Program oversees the registration and use of agricultural chemicals in the State. The Program has components that work to control nonpoint source pollution and improve water quality.

State Conservation Commission Riparian and Wetland Program developed out of the *Kansas Water Plan* and implemented by the conservation districts to address the conservation and management of riparian areas and wetlands. Financial assistance is provided to implement practices such as tree plantings, riparian fencing, wetland enhancement and other innovative bio-engineering practices. Over 40 demonstration projects have been completed.

Kansas State University Kansas Local Government Water Quality Planning and Management has a resource publication and guide for local governments to develop surface and ground water protection programs that are best suited to their communities. This non-technical guide is targeted to the needs of local elected officials, their technical advisors, and citizens who are concerned about water quality and interested in making recommendations for its protection.

Kansas Forest Service Forest Stewardship Program emphasizes the preparation of detailed comprehensive management plans that include recommendations for timber harvest, stand improvement, water quality, wildlife, soil erosion, recreation and tree planting. Kansas Forest Services has opted to focus the Forest Stewardship efforts in riparian forest management and windbreak establishment.

FLOOD MANAGEMENT

INTRODUCTION

Flooding is a natural and recurring event associated with rivers and streams, which has resulted over time in the formation of natural floodplains. Floodplains are valley lands along the course of a stream that may be inundated with water during a flood. In the 20^{th} century, major flooding occurred on the Kansas River in 1903, 1951 and 1993. Flooding of the Arkansas River (1965), the Marmaton River (1986, 1998) and the Walnut River (1998) are other examples of major floods. Disastrous flash flooding occurred in the Kansas City metropolitan area in 1977 and 1998.

Structural and non-structural measures can be used to manage floods and reduce flood damages. Structural measures involve the construction of flood control projects such as levees, dams and channel modifications. Non-structural measures include regulation of land use in the floodplain, acquisition and removal of flood prone structures, restoration or protection of wetland areas, flood insurance, flood warning systems, and public information and education programs.

Flood mitigation in the mid-20^{th} century concentrated on structural prevention methods. A total of 24 large federal reservoirs have been constructed in Kansas by the Corps of Engineers and the Bureau of Reclamation. Additional federal funding for watershed dams has been provided by the Natural Resources Conservation Service. The primary purpose of these reservoirs is flood control. Federally funded levees also provide structural flood protection in some areas.

In 1976, the Kansas Legislature authorized appropriation of state funds for cost-share assistance to build detention dams and/or grade stabilization structures within watershed districts. The State Conservation Commission has provided funding for watershed dams annually since 1978. Watershed works of improvement eligible for state cost-share assistance must be included in a state approved watershed general plan. Such plans have traditionally focused on structural flood control measures. Typically, the local sponsor is a watershed district, but other local entities such as drainage districts or cities can also sponsor plans. The state also provides funding for multipurpose small lakes that provide flood control and other benefits. Some cities and drainage districts have constructed levees with local and federal funds to control flood waters.

Encroachment of urban and agricultural development onto floodplains has resulted in the potential for flood damage. The potential for future flood damages may be reduced significantly by preventing inappropriate development from occurring in flood prone areas. Local governments may accomplish floodplain management through their land use planning and zoning authority to protect the public health, safety and welfare. Additional nonstructural flood mitigation measures include forecast and warning systems, flood proofing and evacuation, and riparian and wetland protection or restoration. Multi-objective management of flood prone areas can provide significant benefits for recreation, water quality and wildlife habitat while reducing the risk of future flood damages. Incorporating nonstructural measures into watershed plans could further enhance the reduction of damages from floods while also providing other benefits.

Homeowners, renters and business owners in communities participating in the National Flood Insurance Program may purchase federally-backed flood insurance. Communities (counties or cities) must adopt and enforce floodplain management ordinances to be eligible to participate in the National Flood Insurance Program. These regulations apply to the one percent annual chance flood, commonly referred to as a 100-year flood, or a flood of a magnitude that occurs only once in 100 years. Program requirements represent a minimum level of floodplain management. Communities can implement enhanced local programs to more effectively manage their floodplains and further reduce the potential for future flood damages.

KANSAS WATER PLAN OBJECTIVE

- By 2010, reduce the vulnerability to damage from floods within identified priority communities or areas.

At least one Kansas stream experiences severe flooding during an average year. Although flooding is generally confined to an area of less than 2,500 square miles, several severe floods have affected much larger areas. Three Presidential Flood Disaster Declarations have been made in Kansas in recent years. In 1993, 57 counties were declared disaster areas (FEMA, 1993). Two flood disaster declarations, for separate flood events, were made in the autumn of 1998. The first designated 12 counties, while the second designated 15 counties (FEMA, 1998). Two counties, Douglas and Franklin, were designated in both 1998 declarations. According to the U.S. Army Corps of Engineers estimates, the Great Flood of 1993 resulted in nearly $286 million in flood related damages in Kansas.

In 1986, the former U.S. Department of Agriculture, Soil Conservation Service (now Natural Resources Conservation Service) identified priority watersheds for rural flood damage reduction at the request of the Kansas Water Office. Priority watersheds were identified using historical flood damage information, the percentage of the watershed occupied by floodplain lands and the potential for construction of additional watershed floodwater retention structures. These watersheds are shown in Figure 1 and have been used in the *Kansas Water Plan* to target financial assistance for implementation of watershed projects.

Kansas Water Plan
Priority Watersheds for Flood Damage Reduction

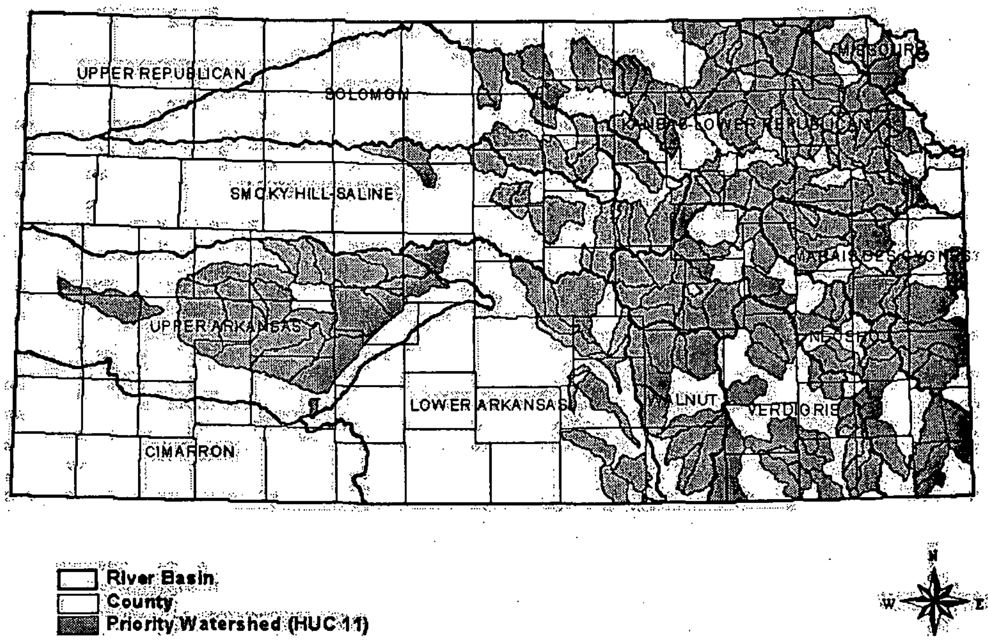

Figure 1

There are presently more than 90 organized watershed districts that cover about 22 percent of the state's land area (Secretary of State, 2003). About 60 of these districts have active general plans. Figure 2 shows watershed districts organized as of 1993. Four additional districts have subsequently been organized in northeast and north central Kansas. Watershed districts in Kansas must file with the Secretary of State's office and receive a certificate of incorporation. The formation of new districts must also be approved by the Chief Engineer.

There are 356 communities in Kansas with identified special flood hazard areas, of which 94 do not participate in the National Flood Insurance Program. Another 14 are suspended for some form of non-compliance. Flood insurance is available to nearly 95 percent of Kansans living within identified flood hazard areas, but fewer than 15 percent of flood hazard area residents are actually covered by flood insurance.

Information on community status in the NFIP can be obtained from the Kansas Department of Agriculture, Division of Water Resources or online at www.accesskansas.org/kda/dwr/WS/nfip.htm.

Floodplain maps are a major component of administering a local floodplain management program. New or updated maps are needed in many Kansas communities. The Division of Water Resources provides limited state mapping assistance to local communities and coordinates with the federal government on floodplain mapping priorities. A list of current priority communities for floodplain mapping is shown in Table 1.

Watershed Districts

(As of 1993)

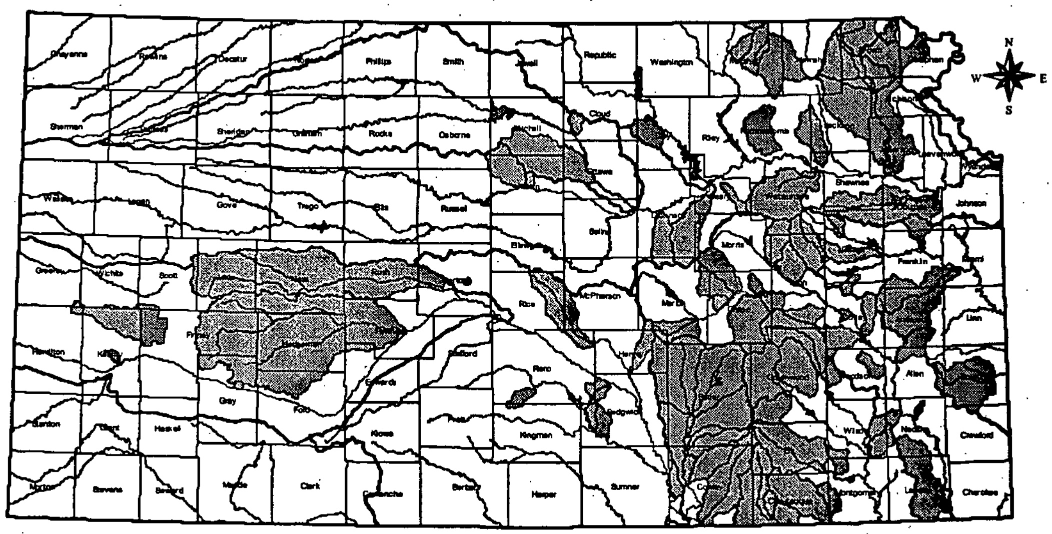

Figure 2

Table 1 Kansas Floodplain Mapping Priorities As of January 2003 (Source: Kansas Department of Agriculture, Division of Water Resources)		
Counties to be Mapped or Remapped		Counties to have Existing Information Digitized
Wabaunsee	**McPherson**	**Butler**
Lyon	**Nemaha**	**Douglas**
Saline	**Neosho**	**Hamilton**
Seward	**Brown**	**Jackson**
Sumner	**Marshall**	**Johnson**
Montgomery	**Franklin**	
Crawford	**Osage**	
Barton	**Anderson**	
Bourbon	**Allen**	
Cherokee	**Coffey**	
Marion	**Ottawa**	
Ellis	**Rice**	

STATUTORY FRAMEWORK

Since 1957, the State has developed extensive statutory authority for addressing flood problems, issues, and concerns. The pertinent statutes include:

- K.S.A. 24-101 *et seq.* provides authorization and requirements for the organization and operation of drainage districts and levee projects.

- K.S.A. 24-126, 12-766 to 12-768 governs the placement of a fill or levee in the floodplain; authorizes the establishment of floodplain zones and adoption of floodplain regulations subject to state approval, and address other floodplain requirements of the National Flood Insurance Program.

- The Stream Obstructions Act (K.S.A. 82a-301 *et seq.*) provides state authority for review and approval of proposed projects to change the course, current, or cross section of any stream in the state.

- The Watershed District Act (Article 12, of K.S.A. 24-1201 *et seq.*) establishes watershed districts to construct, operate and maintain "works of improvement" on streams to assist in managing floodwater, erosion and sediment damages that occur in the watersheds of rivers and streams in Kansas.

Statutory authority for addressing flood management issues in the *Kansas Water Plan* is contained in the State Water Resource Planning Act (K.S.A. 82a-901 *et seq.*). This Act establishes as a long-range goal "the reduction of damaging floods and of losses resulting from floods" (K.S.A. 82a-927(b)). Policies for achieving this goal include the use of non-structural methods, including floodplain regulation, and structural measures; the design of proposed levees, dikes and storage structures; provision of financial and technical assistance; and the encouragement of local initiative (K.S.A. 82a-928(a)-(e), (m)(p)).

FLOOD MANAGEMENT PROGRAMS

Kansas Department of Agriculture, Division of Water Resources Floodplain Management Program coordinates on a local, state and federal basis flood management in Kansas. Operations include implementation of the National Flood Insurance Program, approval of local floodplain regulations, and flood mapping assistance.

State Conservation Commission State Assistance to Watershed Dam Construction provides cost-share assistance to watershed districts and other special purpose districts for the implementation of structural and nonstructural practices that reduce flood damages.

State Conservation Commission Multipurpose Small Lakes Program provides cost-share funding for multipurpose structures involving flood control and other benefits such as public water supply and/or recreation.

Kansas Water Office State Water Planning Program coordinates the development of the *Kansas Water Plan* and provides planning and implementation assistance for special water-related topics.

Adjutant General's Office Division of Emergency Management prepared an updated Kansas Hazard Mitigation Strategy, in coordination with the State Hazard Mitigation Team after the two declared flood disasters in 1998. The Strategy identifies several implementation tasks related to flooding that are consistent with the 2010 *Kansas Water Plan* Objective. After the 1993 and 1998 Presidential disaster declarations, the Adjutant General's Department, Division of Emergency Management made hazard mitigation grants available to communities for priority projects including:

1) acquisition of residential properties within identified floodplains;
2) protection of critical public facilities;
3) minor structural projects to improve local drainage.

The Federal Emergency Management Agency has approved acquisition of 311 properties in 20 communities at a total federal cost of approximately $11.3 million. In addition, three wastewater treatment plant protection projects (Olathe, Fort Scott and Leavenworth) totaling $3.4 million and $1,127,237 for floodplain mapping by the Kansas Department of Agriculture, Division of Water Resources were approved.

Kansas Department of Agriculture, Division of Water Resources Stream Obstruction Program regulates any project that changes the course, current or cross section of a stream. The Division is conducting an evaluation of the concept of a watershed based approach to project permitting. This evaluation was mandated in Senate Bill 436 of the 2002 Legislature. A report was completed and presented to the 2003 Legislature. Additional evaluation of this approach is being conducted by the Division in selected study areas.

Kansas Department of Commerce and Housing Flood Mitigation Assistance Program provides funding to NFIP-member communities for development of flood mitigation plans and implementation of flood mitigation projects, such as property acquisition/relocation, elevation of residential structures, culverts, detention/retention ponds, floodgates, and the flood proofing of non-residential structures. The program has awarded $113,390 in planning and project grants to Kansas communities in FY 2003.

For information about the hazard mitigation programs of the State of Kansas, please refer to the *Hazard Mitigation Resource Guide*, available from the Kansas Department of Commerce & Housing or at www.kansascommerce.com by going to 'Grants/Flood Mitigation Assistance Program/Documents & Forms.

WETLAND & RIPARIAN MANAGEMENT

INTRODUCTION

Concerns for the protection, restoration or enhancement of wetland and riparian areas have increased in response to greater public understanding of their ecological and economic value. Wetland and riparian areas are transitional lands between aquatic and upland locations. Wetlands include areas with hydric soils where standing water or wet soil conditions predominate. Riparian areas include streamside and floodplain areas where the vegetation, soils, or topography are distinguishable from that on adjoining uplands. Benefits derived from riparian areas include erosion and sediment control, timber production, wildlife habitat, water quality protection, recreation, and aesthetic values. Wetlands in Kansas provide unique wildlife habitat, floodwater detention, ground water recharge, and water quality benefits.

Estimates by the U.S. Fish and Wildlife Service indicate that Kansas has lost more than 400,000 acres or nearly one-half of its wetlands since the 1780s. The vast majority of these were shallow and often ephemeral wetlands drained for agricultural use since 1950. Loss of riparian areas to channel modifications and streamside clearing has also been extensive in many parts of the state although estimates of these losses are not readily available.

The primary policy of the state regarding wetland and riparian management is to facilitate the protection of these areas from conversion or channel modifications, and to stabilize streams which have been adversely affected by channel modification activities. Conversion of wetland or riparian areas from their natural state to agricultural or development uses poses a difficult management problem. There are some federal regulations protecting some wetland areas from being filled in, or that may require mitigation. There are no state regulations on wetlands, although there is a Conservation Easement Act in the Kansas statutes that would allow for state purchase of managed easements from a land owner willing to sell.(K.S.A. 32-807 and K.S.A. 58-3810 *et seq.*). This Act has never been used.

The state also promotes the restoration and enhancement of riparian and wetland areas to maintain or maximize the environmental benefits mentioned above. This is a key strategy in addressing the state's water quality restoration needs as part of implementing Total Maximum Daily Loads in high priority areas (see Water Quality Policy Section), and in addressing identified high priority biological areas. High priority areas were identified and mapped in the State Wetland and Riparian Implementation Plan (See map Figure 1).

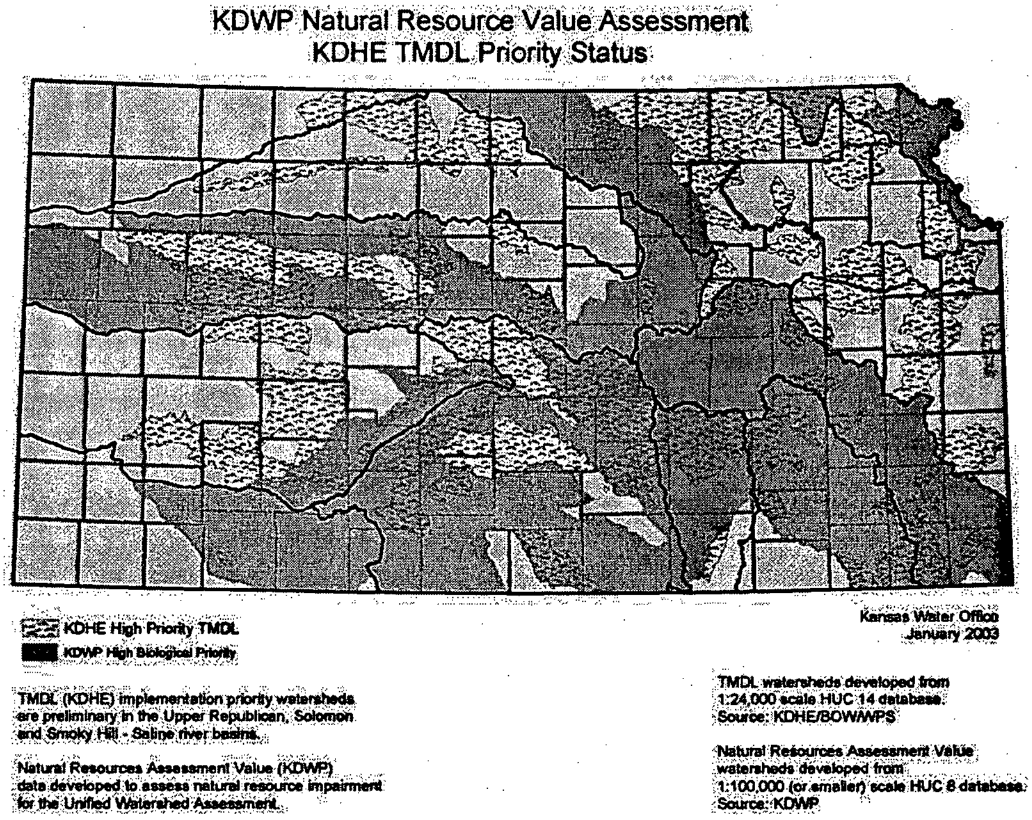

Figure 1

OBJECTIVES

- By 2010, maintain, enhance or restore priority wetlands and riparian areas.

STATUTORY FRAMEWORK

Statutory authority for addressing wetland and riparian management issues in the *Kansas Water Plan* is contained in the State Water Resource Planning Act (K. S. A. 82a-901 *et seq.*). This Act establishes as long-range goals "the reduction of damaging floods and the losses resulting from floods, the prevention of the pollution of the water supplies of the state, and the sound coordination of the development of the water resources of the state with the development of the other resources of the state." Statutory policies for achieving these goals include:

- The utilization of nonstructural methods, including floodplain regulation, and structural measures for the reduction of flood damage (K.S.A 82a-928 (a)).

- The identification of minimum desirable streamflows to preserve, maintain or enhance baseflows for in-stream water uses relative to water quality, fish, wildlife, aquatic life, recreation, general aesthetics, domestic uses, and for the protection of existing water rights (K.S.A. 82a-928 (i)).

- The maintenance of the surface waters of the state within the water quality standards adopted by the Secretary of Health and Environment as provided by K.S.A. 65-164 to 65-171t, inclusive, and amendments thereto (K.S.A. 82a-928 (j)).

- The provision of financial and technical assistance to public corporations concerned with management, conservation, and development of water resources (K.S.A. 82a-928 (m)).

- The encouragement of local initiative in the planning, implementation, funding, and operation of local water programs to the extent that the same are supportive of state water programs (K.S.A. 82a-928 (p)).

- The Kansas Forest Service is directed to carry on an assistance program with forest landowners and operation in the practice of forestry, including the growing, harvesting and marketing of forest products and in the management of forests for other multiple benefits such as water quality, streambank stabilization, erosion control, wildlife and recreation (K.S.A. 76-425(i)).

- The Kansas Forest Service shall cooperate with other agencies and organizations in conducting forestry related programs, including riparian and wetland protection and nonpoint source pollution control (K.S.A. 76-425(k)).

- The Kansas Forest Service shall cooperate with and assist the U.S.D.A. Cooperative Extension Service and other appropriate agencies in conducting educational programs and demonstrations in forest management, forestation, reforestation and other forestry related programs (K.S.A. 76-925(p)).

- The Kansas Forest Service shall promote and carry out the intent and purposes of this act and of the provisions of all federal acts for state cooperation in watershed management and urban and community tree planting management and care; and to enter into cooperative agreements with federal and state agencies and such agency's subdivisions for any or all of such purposes (K.S.A. 76-425(f)).

- The statutory guidance for State Conservation Commission programs providing potential technical and/or financial benefits for riparian and wetland management are found in K.S.A. 2-1915, as amended.

- The statutory guidance to the Kansas Department of Wildlife and Parks to administer a Conservation Easement Program in which landowners could voluntarily enroll eligible high priority wetland and riparian areas or donate easements is found in K.S.A. 32-807 and K.S.A. 58-3810 *et seq.*

- The Statutory guidance for Kansas Department of Health and Environment involvement in riparian and wetland management related issues is found in the TMDL development and implementation activities (K.S.A. 65-165 *et seq.*) and in the nonpoint source pollution control measures including grants for development of local protection plans, technical assistance, and demo projects (K.S.A. 75-5657).

- The Environmental Coordination Act which regulates channel change activities is under the statutory authority of the Kansas Department of Agriculture, Division of Water Resources (K.S.A. 82a-325-327).

WETLAND AND RIPARIAN APPLICABLE PROGRAMS

Several state, local and federal programs are available to carry out the public education, planning, technical assistance and regulatory compliance of implementation of a wetland and riparian management effort. They include:

Kansas Forest Service Forest Stewardship, and Conservation Tree Planting Programs work cooperatively with the Kansas Department of Wildlife and Parks and State Conservation Commission to implement riparian forestry programs in priority areas.

State Conservation Commission Riparian and Wetland Protection Program offers cost-share money via the county conservation districts to implement best management practices to better conserve and manage riparian and wetland areas. Recognition of riparian areas, tree plantings, wetland enhancement, streambank stabilization and soil bioengineering practices are utilized and encouraged where appropriate.

Kansas Water Office State Water Planning Program pursues funding, both state federal to develop and implement wetland and riparian protection and restoration plans. The Kansas Water Office Planning Unit coordinates the efforts of the various state water-related agencies' riparian and wetland programs. Efforts are focused on rivers, streams, lakes and wetlands targeted in the *Kansas Water Plan* for protection, maintenance and re-establishment.

Kansas Department of Wildlife and Parks Wildlife Habitat Improvement Program provides technical advice and planning assistance to develop and improve habitat on private land.

Kansas Department of Wildlife and Parks, State Parks and Wildlife Planning and Development Program includes planning and development of state parks, wildlife areas, and state fishing lake facilities on lands under control of the Kansas Department of Wildlife and Parks. The objective of the program is to develop Kansas Department of Wildlife and Parks lands in a coordinated manner for day use, camping, boating, fishing, hunting, and a broad spectrum of recreational pursuits in a manner compatible with natural resource management.

WATER-BASED RECREATION

INTRODUCTION

Kansans believe that the state's rivers, streams, and lakes represent a valuable recreational resource.

Canoeing and other float-type activities have become increasingly popular in Kansas. Public recreation use is encouraged on the state's three navigable rivers, the Missouri, Kansas, and Arkansas. Title to the bed and banks belong to the state on these rivers and thus public use of the water for recreation is allowed. However, access and associated facilities to allow use of the river is limited. Water-based recreational opportunities also exist at the state's federal reservoirs and state fishing lakes. However, limited facilities reduce potential recreational lake use in Kansas. The Kansas Department of Wildlife and Parks presently maintains park facilities at 25 large reservoirs, 48 state fishing lakes and 84 river access points which attempt to address the ever increasing state recreational needs such as fishing, boating, camping, etc. In addition, there are 198 community lakes and other recreational sites statewide.

Increasing the public's access to, and enjoyment of, the state's lakes, rivers and streams, and recognizing the associated economic, social, and quality of life benefits to be derived from fishing, boating and other water-related recreational activities is an objective of the *Kansas Water Plan*. The key policy issue identified in recent surveys conducted by the Kansas Water Office and Kansas Department of Wildlife and Parks is the fact that for years demand for water-based recreation has far exceeded present availability.

KANSAS WATER PLAN OBJECTIVE

- By 2010, increase public recreational opportunities at Kansas lakes and streams.

STATUTORY FRAMEWORK

Since 1955, the state has developed extensive statutory authority to protect, and provide and improve outdoor recreation and the natural resources of the state. These key mandatory water-based recreation considerations are found at K.S.A. 82a-907(a)(b)(d)(i)(m)(n).

- It shall be the policy of the state of Kansas to protect, provide and improve outdoor recreation and natural resources in this state and to plan and provide for the wise management and use of the state's natural resources, thus contributing to and benefiting the public's health and its cultural, recreational and economic life (K.S.A. 32-702).

- Outdoor water-based recreation has long been an important consideration in the management of the state's water resources as recognized in the State Water

Resource Planning Act (K.S.A. 82a-901 *et seq*). This Act provides guidance in formulating the state water plan and sets out a number of water based-recreation related considerations that the Kansas Water Office must consider.

- Day use, camping, boating, fishing and other recreational opportunities are developed through Kansas Department of Wildlife and Parks. Facilities are in place and managed at small fishing lakes, and major irrigation, flood control and water supply reservoirs by Kansas Department of Wildlife and Parks (K.S.A. 32-807; K.S.A. 32-837).

- Assistance is provided to communities to enhance fisheries and associated recreational opportunities through the Community Lakes Assistance Program (K.S.A. 32-807, K.S.A. 32-829).

- Recreation features at multipurpose small lakes are developed via State Conservation Commission (K.S.A. 82a-1602; K.S.A. 82a-1603(k)).

WATER BASED RECREATION PROGRAMS

State Conservation Commission Multipurpose Small Lakes Program was developed out of the *Kansas Water Plan* to provide cost-share assistance to a government entity for construction or renovation of a dam for flood control and water supply and/or recreational purposes.

Kansas Water Office State Water Planning Program develops a comprehensive *Kansas Water Plan* that sets out guidance and recommendations to water-related agencies on how to best address identified issues of statewide importance. The *Kansas Water Plan* also identifies local water-based recreation issues in the Basin Plan sections.

Kansas Department of Wildlife and Parks Planning and Developing Programs develops Kansas Department of Wildlife and Parks managed lands in a coordinated manner for day use, camping, boating, fishing, hunting and other recreational pursuits in a manner compatible with natural resource management.

Kansas Department of Wildlife and Parks Stream Access Program provides a systematic approach to implementing general access to navigable streams. This is intended to expand access to water-based recreation opportunities consistent with regional needs. Sites would be identified and prioritized, with development tied to available funds.

Kansas Department of Wildlife and Parks Land and Water Conservation Fund Program uses off-shore drilling tax revenues to finance land acquisition and recreation programs. It was enacted to preserve, develop and assure access to outdoor recreation resources and for all streams and provides matching grants through state and local units of government. To be eligible for funding states must develop a 5-year State Comprehensive Outdoor Recreation Plan, or "SCORP". (For example, these monies could possibly be used to address water based projects such as the multipurpose recreation center at Lake Meade in the Upper Arkansas, and hiking and biking and equestrian trails in all basins.)

Kansas Department of Wildlife and Parks Community Lakes Assistance Program provides communities which control and/or operate public lakes with technical and financial assistance to enhance fisheries and associated recreational activities.

Kansas Department of Wildlife and Parks Motor Boat Access Program was developed to provide technical assistance and cost-share monies to enhance water based recreation activities by developing motor boat access at the state's recreational lake facilities upon request of a local sponsor.

Kansas Department of Wildlife and Parks Wildlife Habitat Improvement Program (WHIP) is designed to improve and develop wildlife habitat on private lands with little or no landowner expense or sacrifice of agricultural production. Landowners receiving grants for habitat re-establishment are under no obligation to provide public access. The program provides good technical training to landowners on sound management of riparian and wetland areas.

Kansas Department of Wildlife and Parks Fishing Impoundments and Stream Habitat (FISH) Program allows walk in fishing on private property with the landowner's permission and with the landowner receiving annual payments of $40 per acre and $500 - $1,000 per stream mile, as per negotiated agreement with Kansas Department of Wildlife and Parks. Current Activities – Now in its fourth year, the program has enrolled over 1,300 acres of ponds and over 80 miles of streams. It features more than 130 sites in 48 counties.

DATA AND RESEARCH

INTRODUCTION

Accurate and timely data is crucial to both planning and management of water resources in Kansas. It is a policy of the State that all State agencies with responsibilities affecting water resources shall carry on basic data collection, research and analyses concerning matters relating to the water resources (K.S.A. 82a-941). The Kansas Water Office has a mandate to collect and compile information pertaining to a wide range of water issues and, in so doing, collect and compile information from other agencies, instrumentalities and political subdivisions of the State and the federal governments (K.S.A. 74-2608).

Basic analysis and research is coordinated through the water planning process and the Kansas Water Authority. All state agencies with water resource responsibilities target data collection and analysis on high priority water resource issues and in support of the 2010 objectives.

Geospatial data, as available from each water resource related agency, is shared through the Geographic Information Systems Policy Board and the Data Access and Support Center. The Geographic Information Systems Policy Board was initiated in 1989. Administrative support for the Geographic Information Systems Policy Board is contained within the Department of Administration. The Data Access and Support Center is located at and partially supported by the Kansas Geological Survey.

Research is primarily carried out at the Kansas Board of Regents' universities and by federal agencies. Statutory guidance indicates that it is the responsibility of the Kansas Water Office to coordinate and guide data collection and research toward issues of importance within the *Kansas Water Plan.*

The State develops and supports research, through the Kansas Water Research Institute, on high priority water resource issues and objectives of the state, as identified through the state water planning process. The Kansas Water Research Institute fosters the dissemination and application of research results, and facilitates effective communication among water resource professionals in Kansas.

Programs are designed to a level of completeness and accuracy to support planning and management of the State's water resources.

KANSAS WATER PLAN OBJECTIVES

- By 2010, target data collection, research projects, and data sharing activities to address specific water resource issues as identified in the Kansas water planning process and to support and guide state water resource program operations.

STATUTORY FRAMEWORK

- It is a policy of the state that all state agencies with responsibilities affecting water resources of the state shall carry on basic data collection, research and analyses concerning matters relating to the water resources of the state (K.S.A. 82a-941).
- It is a policy of the state that the Kansas Water Office review and coordinate financial assistance for research that may be provided by federal or state agencies to public corporations concerned with management, conservation and development of water resources to prevent duplication of effort (K.S.A. 82a-928(n)).
- The Kansas Water Office has a mandate to collect and compile information pertaining to a wide range of water issues and, in so doing, collect and compile information obtainable from other agencies, instrumentalities and political subdivisions of the state and the federal government (K.S.A. 74-2608).

DATA AND RESEARCH APPLICABLE PROGRAMS

Kansas Department of Agriculture Division of Water Resources Water Appropriation Program (Water Use) Owners of water rights, except for domestic water right users, are required to file an annual water use report with the Division of Water Resources. The Division of Water Resources, in cooperation with the Kansas Water Office and the U.S. Geological Survey inventories and monitors water use reports and produces publications on water use.

Kansas Biological Survey Kansas Applied Remote Sensing Program research focuses on enhancing the manner in which remote sensing and Geographic Information Systems technologies are used for natural resource management, environmental assessment, landscape ecology, and agriculture. Work at Kansas Applied Remote Sensing promotes broad-scale application of remote sensing and Geographic Information Systems in decision-making, policy formulation, and planning.

Kansas Geological Survey High Plains Aquifer Evaluation - The High Plains aquifer in south-central and western Kansas is the water source for domestic, municipal, and industrial supplies over large areas and key economic and population centers, and is the resource critical for producing much of the income annually generated from irrigated crops. The ground water of the High Plains aquifer is threatened by depletion due to extensive water right development in western Kansas, and by water quality deterioration in some areas. The Kansas Geological Survey, in cooperation with the Kansas Water Office and the Kansas Department of Agriculture, is providing technical information supporting recommendations of the Governor and the *Kansas Water Plan*.

Kansas Geological Survey Surface Water Ground Water Interactions An understanding of interactions between surface and ground waters is critical to state and local agencies for water rights administration and management strategies related to such issues as minimum desirable streamflows. The *Kansas Water Plan* includes water planning and management strategies for each basin related to stream-aquifer interactions.

Kansas Department of Health and Environment Water Quality Monitoring and Assessment is responsible for collecting water quality samples for Kansas streams and lakes. Activities include: 1) identifying and determining the nature and extent of water quality conditions in Kansas and suitability of water resources for drinking water supplies, aquatic life support, recreation, industrial and agricultural uses and ground water recharge; 2) developing and recommending appropriate corrective actions to correct identified water quality and water pollution problems; and 3) evaluating the effectiveness of implemented pollution control and water quality management measures intended to solve water quality and pollution problems.

Kansas State University Weather Station Program collects and disseminates climate data from certain weather stations in Kansas.

Kansas State University Kansas Water Research Institute funds water-related research projects with federal funding.

Kansas Water Office Assessment and Evaluation Program The *Kansas Water Plan* 2010 and 2015 Objectives provide a means to quantify the condition of water resources in the state through the assessment of each objective. The assessments will provide valuable information to planners and program managers to target funding and efforts to meet the 2010 and 2015 Objectives. Each completed assessment will be summarized in assessment notebooks for the state and by basin, and published on the Internet at www.kwo.org.

Geographic Information Systems Policy Board and Data Access and Support Center Kansas Geographic Information System Initiative The Geographic Information System Policy Board coordinates database development with State Water Plan funds. The Data Access and Support Center is the state repository and clearinghouse for geospatial water related data, and provides Internet access to those datasets.

U.S. Geological Survey Cooperative Program for Data Collection of Surface Water (Stream Gaging Program) monitors streamflow on 77 streams and water levels at six lakes, with funding from the *Kansas Water Plan* Fund and other cooperators.

PUBLIC INFORMATION AND EDUCATION

INTRODUCTION

Information and education are keys to all *Kansas Water Plan* policies. To make prudent water resource decisions, the state's decision makers and all individuals need to have an awareness, understanding and appreciation that will lead to action on the state's water resources. Knowledge and critical thinking skills developed and enhanced through various facets of the ongoing information and education programs of the *Kansas Water Plan* help fulfill those objectives.

Public information and education, while related, have different objectives. Public information provides timely and topical facts about specific issues or problems by means of news releases, informational brochures, journals, bulletins and videos and the Kansas Water Office web page. Public education is more process oriented with the goal of enhancing critical thinking, problem solving and decision making skills.

KANSAS WATER PLAN OBJECTIVES

- By 2010, *Kansas Water Plan* public information activities should be directed at ensuring the public is aware of water resource management policies and activities, including the *Kansas Water Plan* and knows where and how to obtain current reliable information on the status of water resources in Kansas.

- By 2010, provide educational activities to ensure that Kansans increase their knowledge and understanding of the State's water resources, to enable them to make better personal and public decisions on water conservation, development and management.

STATUTORY FRAMEWORK

- K.S.A. 82a-903 says, "The Kansas Water Office and Kansas Water Authority shall seek advice from the general public and from committees consisting of individuals with knowledge of and interest in water issues in the water planning areas."

- K.S.A. 82a-905. Sets out public hearing and public notice requirements for review of the *Kansas Water Plan* or any section or amendments thereto.

- K.S.A. 74-2608, the authorizing legislation for the Kansas Water Office, states that it shall "Collect and compile information pertaining to the climate, water and soil as related to the usage of water for agricultural, industrial and municipal purposes and the availability of water supplies in the several watersheds of the state, and in so doing, the office shall collect and compile the information obtainable from other agencies, instrumentalities of the state, political subdivisions of the state and federal government." The duty to disseminate such information is inherent in the responsibility to collect and compile it.

PUBLIC INFORMATION & EDUCATION PROGRAMS

Two principal audiences have been identified for water resource information, the general public and the water resource constituency. The former represents all water users. The latter includes elected local, state and federal officials; water resource professionals; natural resource, environmental and agricultural groups; and citizen representatives who serve on various water resource boards, including the state's basin advisory committees and the Kansas Water Authority.

Kansas Association of Conservation and Environmental Education (KACEE) provides the coordination of various educational programs and is the group directly responsible for Project WET (Water Education for Teachers) in Kansas.

The Kansas Environmental Leadership Program (KELP) provides leadership and environmental training to adults interested in water. The training includes participation in applied leadership projects that allow them to put into practice what they've learned.

Kansas Geological Survey Annual Field Conference is conducted each year. The Survey each year conducts a field conference that focuses on natural resource issues for legislators, state agency heads and other decision makers.

The Ogallala Aquifer Institute is a not-for-profit educational hub supported by State Water Plan Fund dollars that promotes the historical, cultural, economic and environmental importance of the High Plains Aquifer through multi-disciplinary education and information projects. Its objective is to increase understanding at all levels on the hydrology, conservation practices and overall importance of the High Plains aquifer.

Kansas Water Office Public Information and Education Program provides information on topical issues to the public and the media.

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Haines Daniel E

From: Waters, Ryan [ryanw@wp.state.ks.us]
Sent: Thursday, January 25, 2007 11:00 AM
To: Haines Daniel E
Subject: KDWP Neosho River info

Dan,

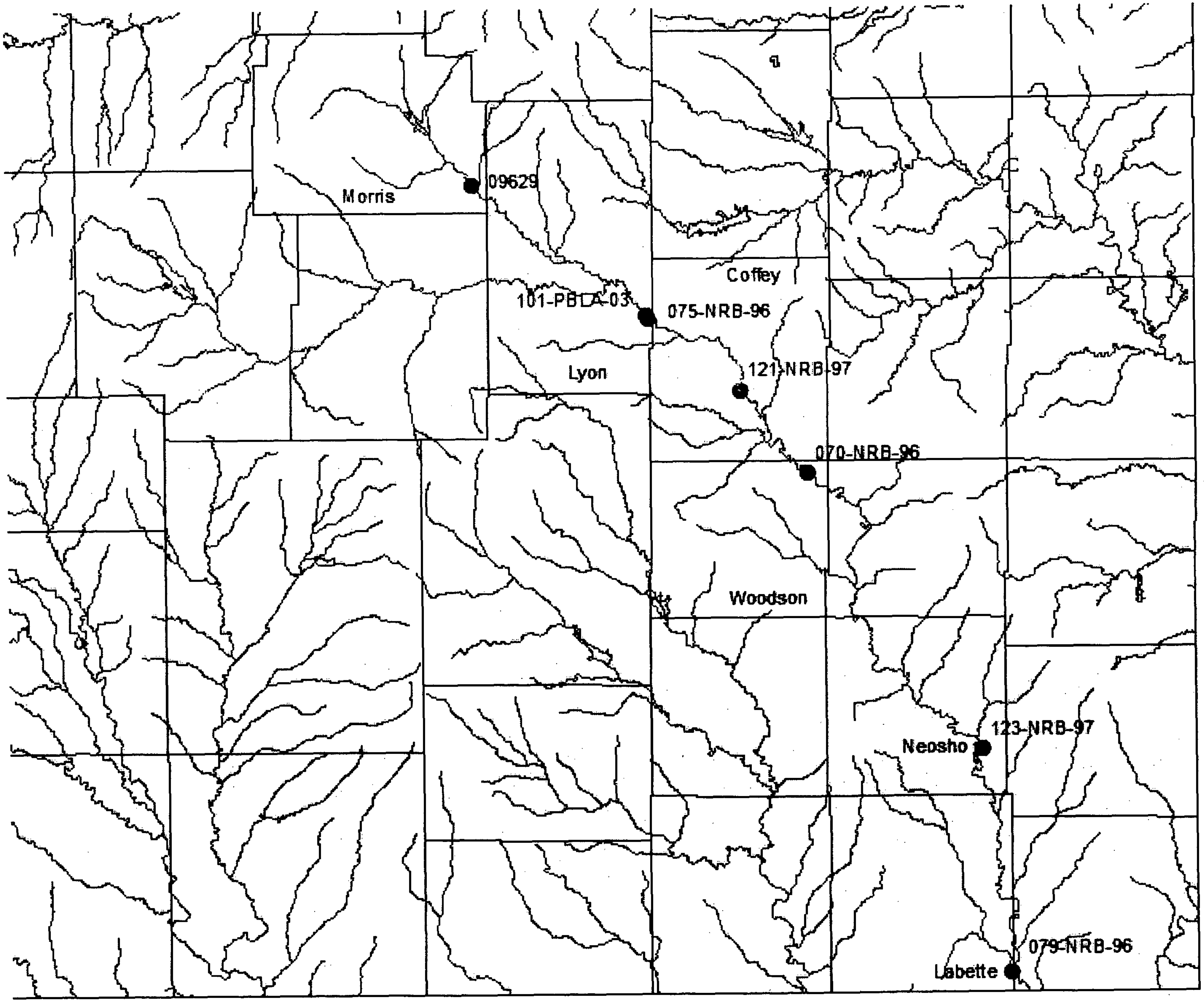
Here are some Neosho River information KDWP has collected over the last 12 years. Click on the tabs at the bottom of the EXCEL sheet to view the different sites.

If you are interested in a particular watershed in your area, click on the address:
http://www.kdwp.state.ks.us/news/other_services/stream_assessment_and_monitoring_program/sub_watershed_report

and view a watershed report summary based off our surveys.

Let me know if you have any questions.

Ryan Waters, Stream Fisheries Biologist
Environmental Services Section
Kansas Dept. Wildlife & Parks
Pratt, KS 67124
PH# 620-672-0738
Fax# 620-672-2972



Morris
09629
Coffey
101-PBLA-03
075-NRB-96
Lyon
121-NRB-97
070-NRB-96
Woodson
123-NRB-97
Neosho
079-NRB-96
Labette

FISH COMMUNITY

121-NRB-97	Neosho River	black buffalo	2
		bluntnose minnow	4
		bullhead minnow	14
		carmine shiner	1
		central stoneroller	1
		channel catfish	532
		flathead catfish	11
		freshwater drum	18
		ghost shiner	116
		gizzard shad	27
		green sunfish	8
		largemouth bass	1
		longear sunfish	2
		Neosho madtom	25
		orangethroat darter	3
		Ozark logperch	3
		red shiner	1470
		shortnose gar	2
		slenderhead darter	19
		slim minnow	2
		smallmouth buffalo	1
		spotted bass	1
		stonecat	9
		suckermouth minnow	15
		western mosquitofish	16
		white bass	2
		white crappie	1
		bluegill	18
		bluntnose minnow	57
		brook silverside	7
		bullhead minnow	40
		central stoneroller	17
		channel catfish	77
		fantail darter	1
		freshwater drum	4
		ghost shiner	24
		gizzard shad	39
		golden redhorse	1
		gravel chub	16
		green sunfish	21
		largemouth bass	3
		longnose gar	1
		Neosho madtom	19
		orangespotted sunfish	21
		red shiner	123
		redfin shiner	1
		slenderhead darter	16
		slim minnow	2
		stonecat	4
		suckermouth minnow	19
		western mosquitofish	225
		white bass	1
		white crappie	4

WATER CHEMISTRY

Site#	Stream	Date	Celcuis	Conductanc	Turbidity	TDS	Salinity	Oxygen	pH	Alkalinity	Chlorides	Ammonia	Nitrates	Phosphorus
121-NRB-97	Neosho River	12-Aug-97	25	419.5	14.5			7.45	8.245					

FRESHWATER MUSSEL COMMUNITY

Site#	Stream	Common Name	Live	Recent	Weathered
121-NRB-97	Neosho River	black sandshell	No	No	Yes
		bleufer	No	Yes	Yes
		butterfly	No	Yes	Yes
		creeper	No	No	Yes
		fawnsfoot	No	No	Yes
		fluted shell	No	No	Yes
		fragile papershell	No	Yes	Yes
		mapleleaf	No	No	Yes
		monkeyface	No	Yes	Yes
		Neosho mucket	No	No	Yes
		Ouachita kidneyshell	No	No	Yes
		pimpleback	No	Yes	Yes
		pistolgrip	Yes	Yes	Yes
		plain pocketbook	No	Yes	Yes
		pondmussel	No	Yes	Yes
		rabbitsfoot	No	No	Yes
		round pigtoe	No	No	Yes
		spike	No	Yes	Yes
		threeridge	No	No	Yes
		Wabash pigtoe	No	No	Yes
		washboard	Yes	Yes	No
		white heelsplitter	No	Yes	No
		yellow sandshell	No	No	Yes

FISH COMMUNITY

9629	Neosho River	bluntnose minnow	16
		bullhead minnow	4
		central stoneroller	12
		ghost shiner	4
		green sunfish	1
		largemouth bass	1
		longear sunfish	1
		orangespotted sunfish	22
		orangethroat darter	1
		red shiner	55
		redfin shiner	15
		slenderhead darter	1
		white crappie	13

WATER CHEMISTRY

Site#	Stream	Date	Celcuis	Conductanc	Turbidity	TDS	Salinity	Oxygen	pH	Alkalinity	Chlorides	Ammonia	Nitrates	Phosphorus
09629	Neosho River	09-Aug-95	28	450	93	230		5.7	7.74					

FRESHWATER MUSSEL COMMUNITY

NOT RECORDED

FISH COMMUNITY

101-PBLA-03	Neosho River	black buffalo	56
		bluegill	1
		bluntface shiner	1
		bluntnose minnow	3
		brook silverside	1
		bullhead minnow	4
		cardinal shiner	1
		carmine shiner	1
		central stoneroller	1
		channel catfish	173
		common carp	9
		flathead catfish	17
		freshwater drum	120
		ghost shiner	137
		gizzard shad	4
		largemouth bass	3
		longnose gar	3
		Neosho madtom	1
		Ozark logperch	15
		red shiner	362
		river carpsucker	6
		shortnose gar	1
		slenderhead darter	8
		smallmouth buffalo	120
		stonecat	8
		suckermouth minnow	8
		western mosquitofish	2
		white bass	8
		wiper (palmetto bass)	2

WATER CHEMSITRY

Site#	Stream	Date	Celcuis	Conductanc	Turbidity	TDS	Salinity	Oxygen	pH	Alkalinity	Chlorides	Ammonia	Nitrates	Phosphorus
101-PBLA-03	Neosho River	28-Jul-03	26	781	28	380	0.4	4.2	8.4	221	16	0.05	3.7	0.38

FRESHWATER MUSSEL COMMUNITY

Site#	Stream	Common Name	Live	Recent	Weathered
101-PBLA-03	Neosho River	bleufer	No	Yes	Yes
		deertoe	No	No	Yes
		fawnsfoot	Yes	Yes	No
		fragile papershell	Yes	Yes	Yes
		mapleleaf	No	Yes	Yes
		monkeyface	No	No	Yes
		Neosho mucket	No	No	Yes
		Ouachita kidneyshell	No	No	Yes
		pimpleback	No	No	Yes
		pink papershell	No	Yes	Yes
		pistolgrip	No	Yes	Yes
		plain pocketbook	No	No	Yes
		round pigtoe	No	No	Yes
		spike	No	No	Yes
		threehorn wartyback	Yes	Yes	Yes
		threeridge	No	No	Yes
		Wabash pigtoe	No	Yes	Yes
		white heelsplitter	No	No	Yes
		yellow sandshell	No	Yes	Yes

FISH COMMUNITY

075-NRB-96	Neosho River	bluegill	22
		bluntnose minnow	1
		bullhead minnow	13
		cardinal shiner	1
		central stoneroller	7
		channel catfish	166
		common carp	1
		flathead catfish	10
		freshwater drum	48
		gizzard shad	38
		golden redhorse	1
		green sunfish	25
		largemouth bass	2
		longnose gar	4
		mimic shiner	2
		Neosho madtom	4
		orangespotted sunfish	16
		orangethroat darter	1
		Ozark logperch	10
		red shiner	183
		river carpsucker	1
		shortnose gar	2
		slenderhead darter	6
		smallmouth buffalo	1
		spotted sucker	1
		stonecat	14
		suckermouth minnow	52
		western mosquitofish	84
		white bass	8
		white crappie	4

WATER CHEMISTRY

Site#	Stream	Date	Celcuis	Conductanc	Turbidity	TDS	Salinity	Oxygen	pH	Alkalinity	Chlorides	Ammonia	Nitrates	Phosphorus
075-NRB-96	Neosho River	30-Jul-96	26	546.5	29			7.9	8.365					

FRESHWATER MUSSEL COMMUNITY

Site#	Stream	Common Name	Live	Recent	Weathered
075-NRB-96	Neosho River	bleufer	Yes	Yes	Yes
		fawnsfoot	No	Yes	Yes
		fragile papershell	No	Yes	Yes
		mapleleaf	No	No	Yes
		Ouachita kidneyshell	No	No	Yes
		pimpleback	No	Yes	Yes
		pistolgrip	No	Yes	Yes
		spike	No	No	Yes
		threehorn wartyback	No	Yes	Yes
		threeridge	No	No	Yes

FISH COMMUNITY

Site#	Stream	Common Name	Number
070-NRB-96	Neosho River	black buffalo	2
		bluntnose minnow	3
		buffalo (unidentified)	27
		bullhead minnow	14
		central stoneroller	5
		channel catfish	8
		common carp	5
		flathead catfish	16
		freckled madtom	1
		freshwater drum	15
		gizzard shad	41
		green sunfish	1
		largemouth bass	2
		longnose gar	3
		red shiner	43
		redfin shiner	3
		river carpsucker	2
		shad (unidentified)	1
		slenderhead darter	15
		suckermouth minnow	26
		walleye	1
		western mosquitofish	23
		white bass	2
		white crappie	10

WATER CHEMISTRY

Site#	Stream	Date	Celcuis	Conductance	Turbidity	TDS	Salinity	Oxygen	pH	Alkalinity	Chlorides	Ammonia	Nitrates	Phosphorus
070-NRB-96	Neosho River	18-Jul-96	28	435.5	15.5			7.7	8.455					

FRESHWATER MUSSEL COMMUNITY

Site#	Stream	Common Name	Live	Recent	Weathered
070-NRB-96	Neosho River	Asian clam	No	No	Yes
		bleufer	No	Yes	Yes
		fragile papershell	No	Yes	Yes
		giant floater	No	Yes	Yes
		mapleleaf	Yes	Yes	Yes
		monkeyface	Yes	Yes	No
		Neosho mucket	No	No	Yes
		pimpleback	No	Yes	Yes
		pink papershell	No	Yes	Yes
		pistolgrip	No	Yes	No
		plain pocketbook	No	No	Yes
		pondmussel	No	No	Yes
		round pigtoe	No	No	Yes
		threehorn wartyback	Yes	Yes	Yes
		threeridge	Yes	Yes	Yes
		Wabash pigtoe	Yes	Yes	Yes
		wartyback	Yes	Yes	No
		white heelsplitter	No	Yes	Yes
		yellow sandshell	No	No	Yes

FISH COMMUNITY

Site#	Stream	Common Name	Number
123-NRB-97	Neosho River	bluegill	18
		bluntnose minnow	57
		brook silverside	7
		bullhead minnow	40
		central stoneroller	17
		channel catfish	77
		fantail darter	1
		freshwater drum	4
		ghost shiner	24
		gizzard shad	39
		golden redhorse	1
		gravel chub	16
		green sunfish	21
		largemouth bass	3
		longnose gar	1
		Neosho madtom	19
		orangespotted sunfish	21
		red shiner	123
		redfin shiner	1
		slenderhead darter	16
		slim minnow	2
		stonecat	4
		suckermouth minnow	19
		western mosquitofish	225
		white bass	1
		white crappie	4

WATER CHEMISTRY

Site#	Stream	Date	Celcuis	Conductanc	Turbidity	TDS	Salinity	Oxygen	pH	Alkalinity	Chlorides	Ammonia	Nitrates	Phosphorus
123-NRB-97	Neosho River	14-Aug-97	25	433	31.5			7.85	8.37					

FRESHWATER MUSSELS

Site#	Stream	Common Name	Live	Recent	Weathered
123-NRB-97	Neosho River	Asian clam	No	Yes	No
		bleufer	No	Yes	Yes
		fragile papershell	No	Yes	Yes
		mapleleaf	No	No	Yes
		monkeyface	No	Yes	Yes
		pimpleback	No	Yes	Yes
		pink papershell	No	Yes	Yes
		plain pocketbook	No	No	Yes
		rabbitsfoot	No	No	Yes
		round pigtoe	No	No	Yes
		threehorn wartyback	No	Yes	No
		threeridge	No	Yes	Yes

FISH COMMUNITY

079-NRB-96	Neosho River	black buffalo	2
		blue sucker	3
		bluegill	8
		bluntface shiner	1
		bluntnose minnow	1
		brook silverside	6
		buffalo (unidentified)	2
		bullhead minnow	20
		central stoneroller	1
		channel catfish	215
		common carp	5
		emerald shiner	17
		flathead catfish	25
		freckled madtom	1
		freshwater drum	10
		gizzard shad	9
		gravel chub	3
		inland silverside	6
		largemouth bass	5
		longnose gar	3
		mimic shiner	1
		Neosho madtom	5
		orangespotted sunfish	1
		Ozark logperch	1
		red shiner	518
		river carpsucker	1
		river darter	1
		slenderhead darter	24
		slenderhead darter X logperch	1
		stonecat	66
		suckermouth minnow	15
		western mosquitofish	5
		white bass	10
		white crappie	3

WATER CHEMISTRY

Site#	Stream	Date	Celcuis	Conductanc	Turbidity	TDS	Salinity	Oxygen	pH	Alkalinity	Chlorides	Ammonia	Nitrates	Phosphorus
079-NRB-96	Neosho River	06-Aug-96	26	305	14.5			6.55	7.86					

FRESHWATER MUSSEL COMMUNITY

Site#	Stream	Common Name	Live	Recent	Weathered
079-NRB-96	Neosho River	Asian clam	No	Yes	Yes
		bleufer	Yes	Yes	Yes
		butterfly	No	No	Yes
		fragile papershell	Yes	Yes	Yes
		giant floater	No	Yes	No
		mapleleaf	Yes	Yes	Yes
		monkeyface	Yes	Yes	Yes
		Neosho mucket	No	No	Yes
		pimpleback	No	Yes	Yes
		pink papershell	No	No	Yes
		pistolgrip	Yes	Yes	Yes
		plain pocketbook	No	Yes	Yes
		rabbitsfoot	No	No	Yes
		round pigtoe	No	No	Yes
		spike	No	No	Yes
		threehorn wartyback	Yes	Yes	Yes
		threeridge	Yes	Yes	Yes
		Wabash pigtoe	No	Yes	Yes
		white heelsplitter	No	No	Yes
		yellow sandshell	No	Yes	Yes