

Fecal Coliform TMDL

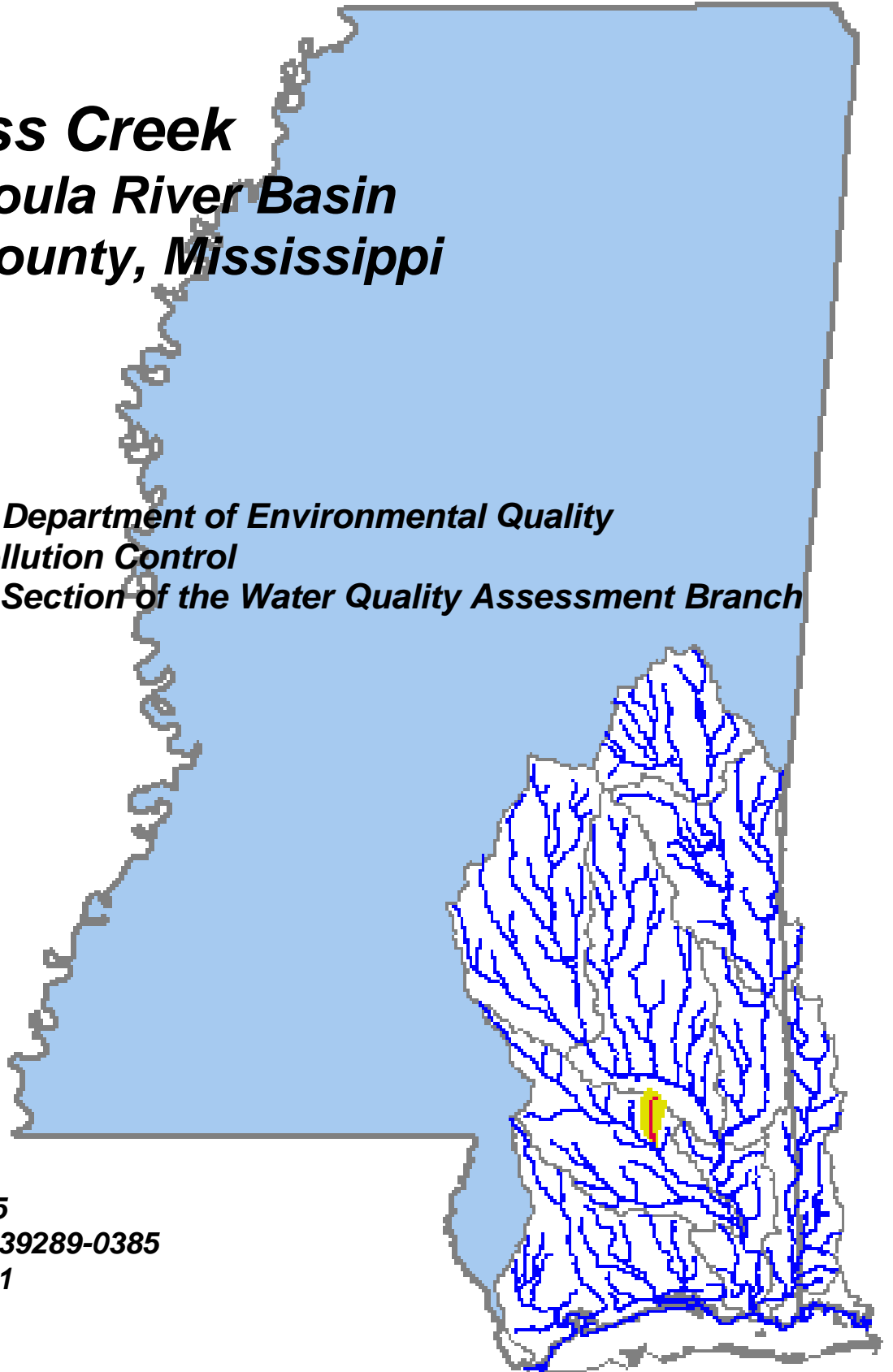
For

***Cypress Creek
Pascagoula River Basin
Perry County, Mississippi***

Prepared By

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Office of Pollution Control
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EXECUTIVE SUMMARY

Cypress Creek has been placed on the Mississippi 1998 Section 303(d) List of Waterbodies as an impaired waterbody segment, due to fecal coliform bacteria. The applicable state standard specifies that for the summer months, the maximum allowable level of fecal coliform shall not exceed a geometric mean of 200 per 100 ml, nor shall more than 10 percent of the samples examined during any month exceed a colony count of 400 per 100 ml. A review of the available monitoring data for the watershed indicates that there is a violation of the standard for the impaired waterbody.

Cypress Creek is a small creek - 15.2 miles in length - completely located in Perry County, Mississippi. The BASINS Nonpoint Source Model (NPSM) was selected as the modeling framework for performing the TMDL allocations for this study. Daily flow values from the USGS gage on Cypress Creek at Janice were used to calibrate the hydrologic flow for the watershed. The weather data used for this model were collected at Leakesville. The representative hydrologic period used for this TMDL was January 1, 1985, through December 31, 1995.

Fecal coliform loading from nonpoint sources in the watershed were calculated based upon wildlife populations; numbers of cattle, hogs, and chickens; information on livestock and manure management practices for the Pascagoula Basin; and urban development. The estimated fecal coliform production and accumulation rates due to nonpoint sources for the watershed were incorporated into the model. Also represented in the model were the nonpoint sources such as failing septic systems and cattle that have direct access to tributaries of the Cypress Creek. There are no NPDES Permitted discharges located in the watershed. Under existing conditions, output from the model indicates violation of the fecal coliform standard in the stream. After applying a load reduction scenario, there were no violations of the standard according to the model.

The scenario used to reduce the fecal coliform load involves a cooperative effort between all fecal coliform contributors in the Cypress Creek Watershed. First is the removal of 88% of the cattle's direct access to tributaries. This could be accomplished by fencing streams in cattle pastures. Education on best management practices is a vital part of achieving this goal. Second, a 50% reduction in the fecal coliform contribution from failing septic tanks is required. The model assumed there is a 40% failure rate of septic tanks in the drainage area. A reduction could be accomplished by education on best management practices for septic tank owners. Additionally, users of individual onsite wastewater treatment plants could be educated on the importance of disinfection of the effluent from their treatment plant.

The model accounted for seasonal variations in hydrology, climatic conditions, and watershed activities. The use of the continuous simulation model allowed for consideration of the seasonal aspects of rainfall and temperature patterns within the watershed. Calculation of the fecal coliform accumulation parameters and source contributions on a monthly basis accounted for seasonal variations in watershed activities such as livestock grazing and land application of manure.

1.0 INTRODUCTION

1.1 Background

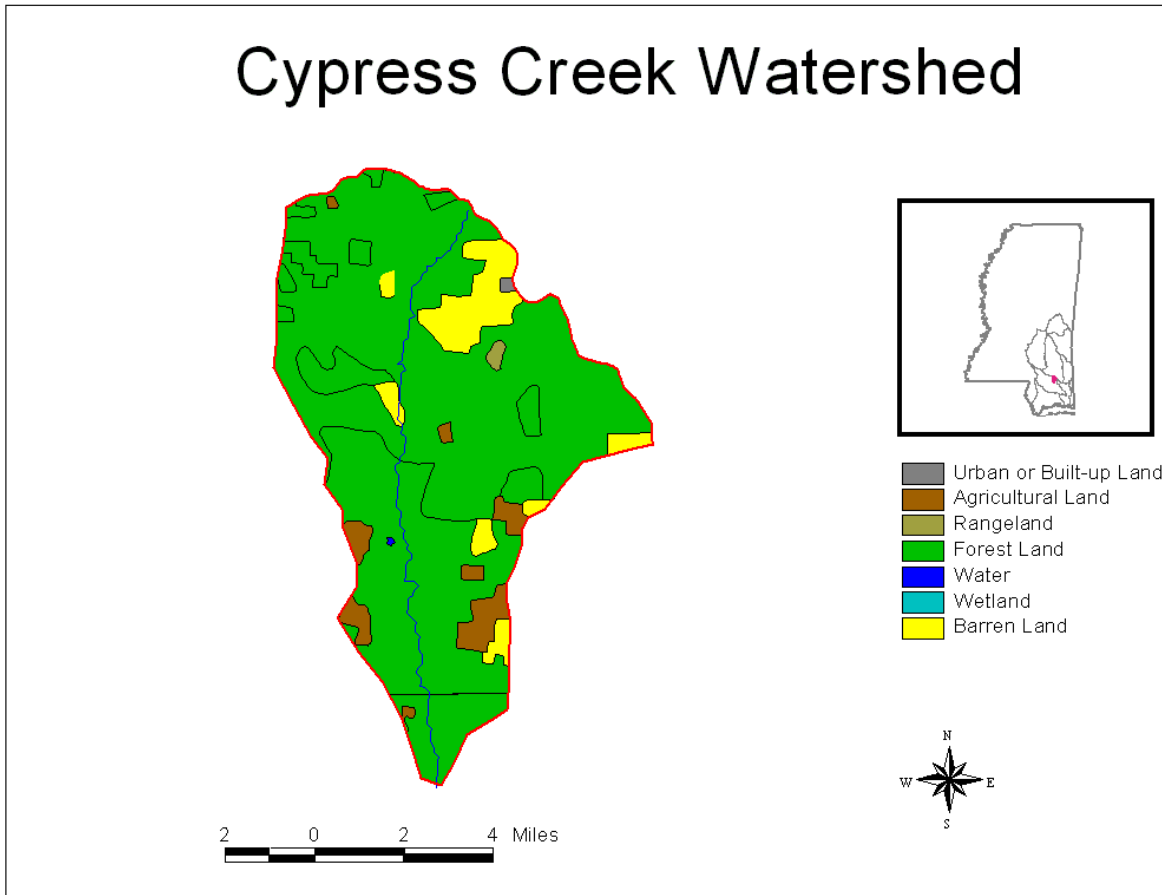
The identification of waterbodies not meeting their designated use and the development of total maximum daily loads (TMDLs) for those waterbodies are required by Section 303(d) of the Clean Water Act and the Environmental Protection Agency's (EPA) Water Quality Planning and Management Regulations (40 CFR part 130). The TMDL process is designed to restore and maintain the quality of those impaired waterbodies through the establishment of pollutant specific allowable loads. The pollutant of concern for this TMDL is fecal coliform. Fecal coliform bacteria are used as indicator organisms. They are readily identifiable and indicate the possible presence of other pathogenic organisms in the waterbody. The TMDL process can be used to establish water quality based controls to reduce pollution from both point and nonpoint sources, and restore and maintain the quality of water resources.

The Mississippi Department of Environmental Quality (MDEQ) has identified Cypress Creek as being impaired by fecal coliform bacteria for a length of 12 miles as reported in the Mississippi 1998 Section 303(d) List of Waterbodies. This segment is listed as impaired because sufficient monitoring data is available to show that there is an impairment in this segment. The impaired segment begins at the headwaters and extends to the confluence with Black Creek in southern Perry County. Cypress Creek is ranked 110th on the 1998 303(d) list.

The Cypress Creek Watershed is in the Pascagoula River Basin Hydrologic Unit Code (HUC) 03170007 in southeastern Mississippi. The drainage area of the monitored segment from the headwaters to the confluence with Black Creek is approximately 39,000 acres; and lies within Perry County. The watershed is rural in nature and includes the small towns of Janice and Oak Grove. It is located approximately 10 miles south of New Augusta between Janice and Oak Grove. It is completely located within the DeSoto National Forest. Forest is the dominant landuse within this watershed. Cypress Creek flows into Black Creek, thence into the Pascagoula River, thence into the Mississippi Sound. The land distribution is shown in Table 1.1.

Table 1.1 Land Distribution in acres for the Cypress Creek Watershed

Watershed	Urban	Forest	Wetlands	Pasture	Cropland	Barren	Total
Cypress Creek	0	35980	179	2582	209	205	39155
% of total	0%	91.9%	.5%	6.6%	.5%	.5%	100%

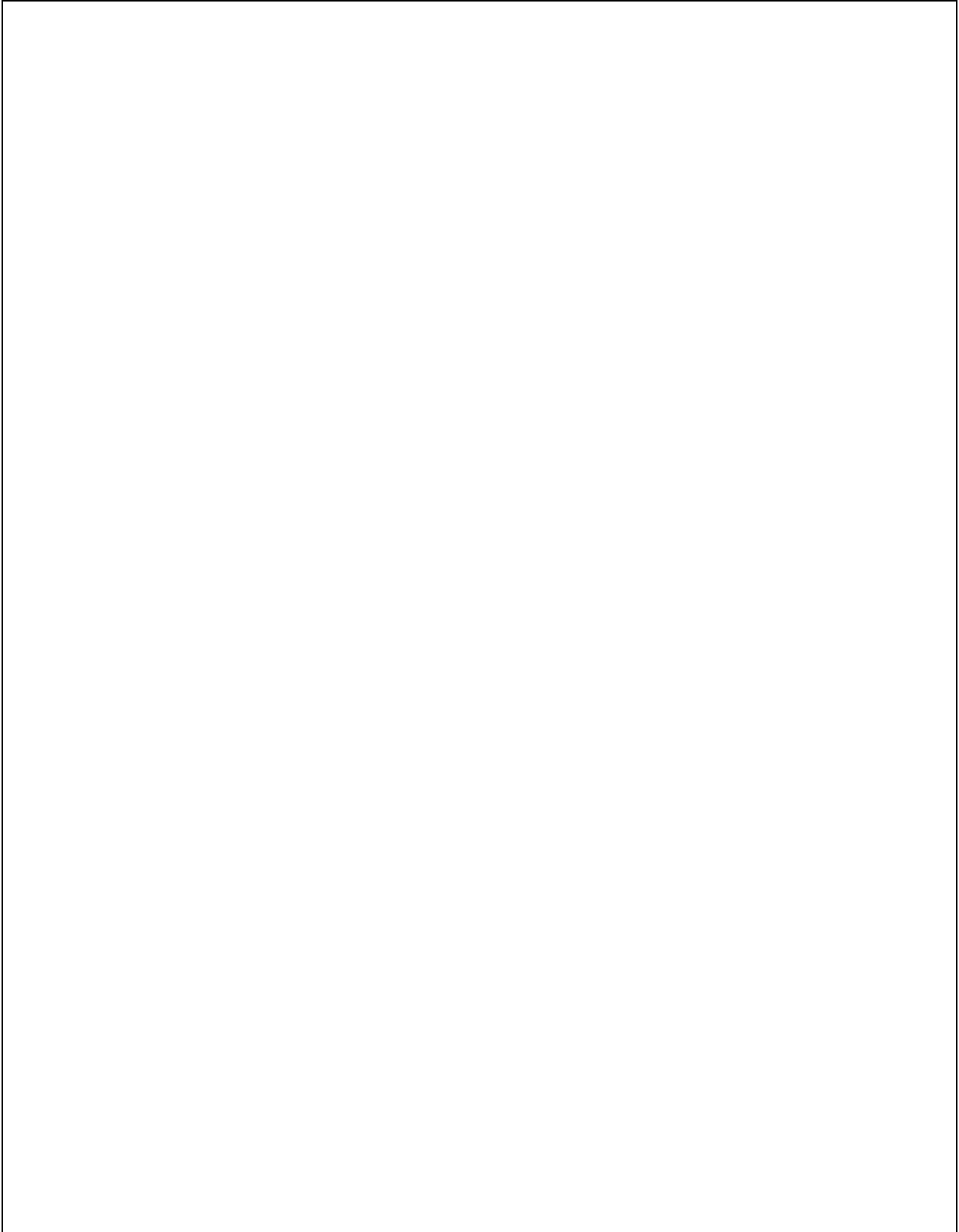


1.2 Applicable Waterbody Segment Use

Designated beneficial uses and water quality standards are established by the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* regulations. The designated uses for Cypress Creek as defined by the regulations are Secondary Contact Recreation and Fish and Wildlife Support. Secondary contact recreation is defined as incidental contact with the water, including wading and occasional swimming.

1.3 Applicable Waterbody Segment Standard

The water quality standard applicable to the use of the waterbody and the pollutant of concern is defined in the *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. The standard states that from May through October the fecal coliform colony counts shall not exceed a geometric mean of 200 per 100 ml, nor shall more than 10 percent of the samples examined during any month exceed a colony count of 400 per 100 ml. And that from November through April the fecal coliform colony counts shall not exceed a geometric mean of 2000 per 100 ml, nor shall more than 10 % of the samples examined during any month exceed a colony count of 4000 per 100ml. This water quality standard will be used as targeted endpoints to evaluate impairments and establish this TMDL.



The total number of animals in the 9 subwatersheds are as follows.

Fecal contributions from these animals are used to derive loading estimates for all landuses except for Built-up.

The number input for Poultry should be "Chickens Sold" from tbl_lstock2.dbf divided by 7.

Agricultural Animals

SUBSHED	BEEF COWS	SWINE (HOGS)	DAIRY COWS	POULTR Y	CATTLE	BEEF FOR RATIO	MILK FOR RATIO
Cypress Creek	544	26	0	61765	544	1	0
P2	#DIV/0!	0	#DIV/0!	0	0	0	0
P3	#DIV/0!	0	#DIV/0!	0	0	0	0
P4	#DIV/0!	0	#DIV/0!	0	0	0	0
P5	#DIV/0!	0	#DIV/0!	0	0	0	0
P6	#DIV/0!	0	#DIV/0!	0	0	0	0
P7	#DIV/0!	0	#DIV/0!	0	0	0	0
P8	#DIV/0!	0	#DIV/0!	0	0	0	0
P9	#DIV/0!	0	#DIV/0!	0	0	0	0
TOTAL	#DIV/0!	26	0	61765	544	1	0

Wildlife

The deer population is the only major wildlife source considered. The same deer density is assumed for all subwatersheds.

Deer/sq. mile 45
 Deer/acre 0.070312
 5

This sheet contains information relevant to land application of waste produced

by agricultural animals in the study area.

Application of hog manure, cattle manure, and poultry litter is considered.

The information is presented based on monthly variability of waste application.

It is assumed that cattle manure is applied to both Cropland and Pastureland using the same method.

Hog Manure Available for Wash-off

This is the percentage of manure applied by month.

	January	February	March	April	May	June	July	August	September	October	November	December
% of annual manure applied in month	0.05	0.05	0.05	0.14	0.14	0.08	0.08	0.08	0.12	0.12	0.05	0.04

The percent of manure available for runoff is dependent on the method of manure application. The percent available is computed below based on incorporation into soil. These are assumed values.

% available for runoff = (1 - % incorporated) + (% incorporated * 0.5)	0.6	% Applied to Cropland:	0.00	% Applied to Pastureland:	1.00
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The following is the resulting manure application based on the monthly percentage applied and incorporation into the soil.

Subwatershed	January	February	March	April	May	June	July	August	September	October	November	December
Cypress Creek	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024
P2	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024
P3	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024
P4	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024
P5	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024
P6	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024
P7	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024

P8	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024
P9	0.03	0.03	0.03	0.084	0.084	0.048	0.048	0.048	0.072	0.072	0.03	0.024

Cattle Manure Available for Wash-off

This is the percentage of manure applied by month.

	January	February	March	April	May	June	July	August	September	October	November	December
% of annual manure applied in month	0	0	0	0.2	0.2	0.0666	0.0667	0.0667	0.2	0.2	0	0

The percent of manure available for runoff is dependent on the method of manure application. The percent available is computed below based on incorporation into soil. These are assumed values.

% available for runoff = $(1 - \% \text{ incorporated}) + (\% \text{ incorporated} * 0.5)$

0.625	% Applied to Cropland:	0.00	% Applied to Pastureland:	1.00
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The following is the resulting manure application based on the monthly percentage applied and incorporation into the soil.

Subwatershed	January	February	March	April	May	June	July	August	September	October	November	December
Cypress Creek	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P2	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P3	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P4	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P5	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P6	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P7	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P8	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0
P9	0	0	0	0.125	0.125	0.041625	0.04169	0.04169	0.125	0.125	0	0

Poultry Litter Available for Wash-off

This is the percentage of manure applied by month.

	January	February	March	April	May	June	July	August	September	October	November	December	
% of annual manure applied in month	0	0	0	0.143	0.143	0.143	0.143	0.143	0.143	0.142	0	0	1

The percent of manure available for runoff is dependent on the method of manure application. The percent available is computed below based on incorporation into soil. These are assumed values.

% available for runoff = (1 - % incorporated) + (% incorporated * 0.33)	0.36	% Applied to Cropland:	0.00	% Applied to Pastureland:	1.00
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The following is the resulting manure application based on the monthly percentage applied and incorporation into the soil.

Subwatershed	January	February	March	April	May	June	July	August	September	October	November	December
Cypress Creek	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P2	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P3	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P4	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P5	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P6	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P7	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P8	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0
P9	0	0	0	0.05148	0.05148	0.05148	0.05148	0.05148	0.05148	0.05112	0	0

This sheet contains information relevant to cattle farming in the study area.

Dairy Cattle

Dairy cattle are assumed to be either kept in feedlots or allowed to graze (depending on the milking/feeding schedule, which is four hours per day). When grazing, a certain percentage is assumed to have direct access to streams.
 Dairy cattle waste is therefore either applied as manure to Cropland and Pastureland, contributed directly to Pastureland, or contributed directly to streams (referred to as Cattle in Streams).

Beef Cattle

Beef cattle are assumed to be either kept in feedlots or allowed to graze (depending on the season). When grazing, a certain percentage is assumed to have direct access to streams.
 Beef cattle waste is therefore either applied as manure to Cropland and Pastureland, contributed directly to Pastureland, or contributed directly to streams (referred to as Cattle in Streams).

	Beef Cattle Grazing		Dairy Cattle Grazing		Assumed Cattle Access to Streams	
Month	Percentage of Time not Confined (0.0 or 1.0)		Percentage of Time not Confined (0.0 or 1.0)		Percentage of Time (0.0 to 1.0)	
January		1.00		0.84		0.02
February		1.00		0.84		0.02
March		1.00		0.84		0.02
April		1.00		0.84		0.02
May		1.00		0.84		0.02
June		1.00		0.84		0.02
July		1.00		0.84		0.02
August		1.00		0.84		0.02
September		1.00		0.84		0.02
October		1.00		0.84		0.02

November	1.00	0.84	0.02
December	1.00	0.84	0.02

Month	Total Beef Cattle Grazing Days	Total Dairy Cattle Grazing Days
January	31	26.04
February	28	23.52
March	31	26.04
April	30	25.2
May	31	26.04
June	30	25.2
July	31	26.04
August	31	26.04
September	30	25.2
October	31	26.04
November	30	25.2
December	31	26.04
Total Grazing Days:	365	306.6

These data accessed from the following references are used in the remaining worksheets.

From ASAE

Animal	Total Manure prod (lb./day per 1,000 lb. animal)	Typical Animal Mass (lb.)	Manure prod per animal (lb./day)	Fecal Coliform (#/day E10 per 1,000 lb. animal)	Fecal Coliform (#/day)	Manure prod (lb./yr.)	Fecal Coliform (#/day)
Beef cow	40	794	32	13	1.03E+11	11587	5.71E+10
Dairy cow	86	1411	121	7.2	1.02E+11	44290	1.83E+11
Hog	84	134	11	8	1.08E+10	4123	1.08E+10
Sheep	40	60	2	20	1.19E+10	869	1.19E+10
Chicken	64	4	0	3.4	1.35E+08	93	1.35E+08
Broiler	85	2	0	3.4	6.75E+07	62	6.75E+07
Turkey	47	15	1	0.62	9.29E+07	257	9.29E+07
Duck	110	3	0	81	2.50E+09	124	2.50E+09

**From Metcalf
& Eddy**

**Estimated Fecal Coliform
Production Rates by Animal**

Animal	#/day	Reference
Cow	5.40E+09	Metcalf & Eddy, pg. 101 1991
Hog	8.90E+09	Metcalf & Eddy, 1991
Sheep	1.80E+10	Metcalf & Eddy, 1991
Chicken	2.40E+08	Metcalf & Eddy, 1991
Turkey	1.30E+08	Metcalf & Eddy,

Duck	1.10E+10	1991 Metcalf & Eddy, 1991
Deer	5.00E+08	BPJ
Geese	4.90E+10	LIRPB, 1982

**From: Horner,
1992**

**Fecal Coliform Loading Rates by
Landuse**

	Median #/ha-y	#/acre/day
Road	1.80E+08	2.00E+05
Commercial	5.60E+09	6.21E+06
Single family low density	9.30E+09	1.03E+07
Single family high density	1.50E+10	1.66E+07
Multifamily residential	2.10E+10	2.33E+07

This sheet contains information related to the contribution of failing septic systems to streams.

The direct contribution of fecal coliform from septics to a stream can be represented as a point source in the model. Required input for point sources in NPSM are loading rate (#/hr) and flow (cfs).

The following assumptions are made for septic contributions.

People: 1102
 Estimated # septics: 394
 Avg. # people served per septic: 2.8 people/septic
 Assume a failure rate for septics in the watershed: 40 %

Therefore the number of failing septics in the watershed is: 157.429

Assume failing septics are distributed evenly across watershed based on land area. Therefore, density of failing septics is: 0.00406 septic/acre

Assume the average FC concentration reaching the stream (from septic overcharge) is: 1.00E+0 #/100 ml (Horsely & Whitten, 1996)
 Assume a typical septic overcharge flow rate of: 4 gal/day/person (Horsely & Whitten, 1996)

SEPTICS AS A POINT SOURCE

Total area (acres)	# failing septics	Tot. # people served	Septic flow (gal/day)	Septic flow (mL/hr)	FC rate (#/hr)	Septic flow (cfs)
Subwatershed						

Fecal Coliform TMDL for Cypress Creek, Mississippi

Cypress Creek	38771	157	440.8	30856	4866248.333	4.87E+08	4.78E-02
P2	0	0	0	0	0	0.00E+00	0.00E+00
P3	0	0	0	0	0	0.00E+00	0.00E+00
P4	0	0	0	0	0	0.00E+00	0.00E+00
P5	0	0	0	0	0	0.00E+00	0.00E+00
P6	0	0	0	0	0	0.00E+00	0.00E+00
P7	0	0	0	0	0	0.00E+00	0.00E+00
P8	0	0	0	0	0	0.00E+00	0.00E+00
P9	0	0	0	0	0	0.00E+00	0.00E+00
Total:	38771						

POINT SOURCES FOR EACH SUBWATERSHED (Point Sources/Loads)

Cattle in Streams, monthly averages

	Flow (cfs)	Fecal (#/hr)
Cypress Creek	7.69E-06	2.94E+08
P2	#DIV/0!	#DIV/0!
P3	#DIV/0!	#DIV/0!
P4	#DIV/0!	#DIV/0!
P5	#DIV/0!	#DIV/0!
P6	#DIV/0!	#DIV/0!
P7	#DIV/0!	#DIV/0!
P8	#DIV/0!	#DIV/0!
P9	#DIV/0!	#DIV/0!

Septic Tanks

	Flow (cfs)	Fecal (#/hr)
Cypress Creek	2.39E-02	2.43E+08
P2	0.00E+00	0.00E+00
P3	0.00E+00	0.00E+00
P4	0.00E+00	0.00E+00
P5	0.00E+00	0.00E+00
P6	0.00E+00	0.00E+00
P7	0.00E+00	0.00E+00
P8	0.00E+00	0.00E+00
P9	0.00E+00	0.00E+00

LANDUSE AREAS (Just to us as a check)

SUBSHE D	CROPLA ND	FOREST	URBAN	PASTURELA ND	TOTAL
Cypress Creek	209	35980	0	2582	38771
P2	0	0	0	0	0
P3	0	0	0	0	0
P4	0	0	0	0	0
P5	0	0	0	0	0
P6	0	0	0	0	0
P7	0	0	0	0	0
P8	0	0	0	0	0
P9	0	0	0	0	0
TOTAL	209	35980	0	2582	38771

**SCENARIO
S**

Source	% Reduced
Cattle Access	88
Septic Failure	50
Runoff	0

PASTURELAND AND CROPLAND – ACCUM (Data Editor\PERLND\PQAL\Monthly Input\MON-ACCUM)

Monthly Input - ACCUM

	Cypress Creek		P2		P3		P4		P5	
	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland
January	1.19E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
February	1.19E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
March	1.19E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
April	2.27E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
May	2.24E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
June	2.22E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
July	2.19E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
August	2.19E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
September	2.26E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
October	2.21E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
November	1.19E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
December	1.18E+09	3.52E+07	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	P6		P7		P8		P9	
	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland
January	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
February	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
March	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
April	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
May	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
June	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
July	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
August	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
September	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
October	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
November	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
December	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

PASTURELAND AND CROPLAND – SQOLIM (Data Editor\PERLND\PQAL\Monthly Input\MON-SQOLIM)

Monthly Input - SQOLIM

	Cypress Creek		P2		P3		P4		P5	
	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland
January	4.75E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
February	4.77E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
March	4.75E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
April	9.09E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
May	8.94E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
June	8.90E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
July	8.76E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
August	8.76E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
September	9.02E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
October	8.85E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
November	4.76E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
December	4.72E+09	1.41E+08	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

	P6		P7		P8		P9	
	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland	Pastureland	Cropland
January	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
February	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
March	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
April	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
May	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
June	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
July	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
August	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
September	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
October	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
November	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
December	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

**URBAN AND FOREST - ACQOP & SQOLIM (Data
Editor\PERLND\PQAL\QUAL-INPUT\ACQOP & SQOLIM)**

**ACQOP for all
months**

	Urban	Forest
Cypress Creek	0.00E+00	3.52E+07
P2	0.00E+00	0.00E+00
P3	0.00E+00	0.00E+00
P4	0.00E+00	0.00E+00
P5	0.00E+00	0.00E+00
P6	0.00E+00	0.00E+00
P7	0.00E+00	0.00E+00
P8	0.00E+00	0.00E+00
P9	0.00E+00	0.00E+00

SQOLIM for all months

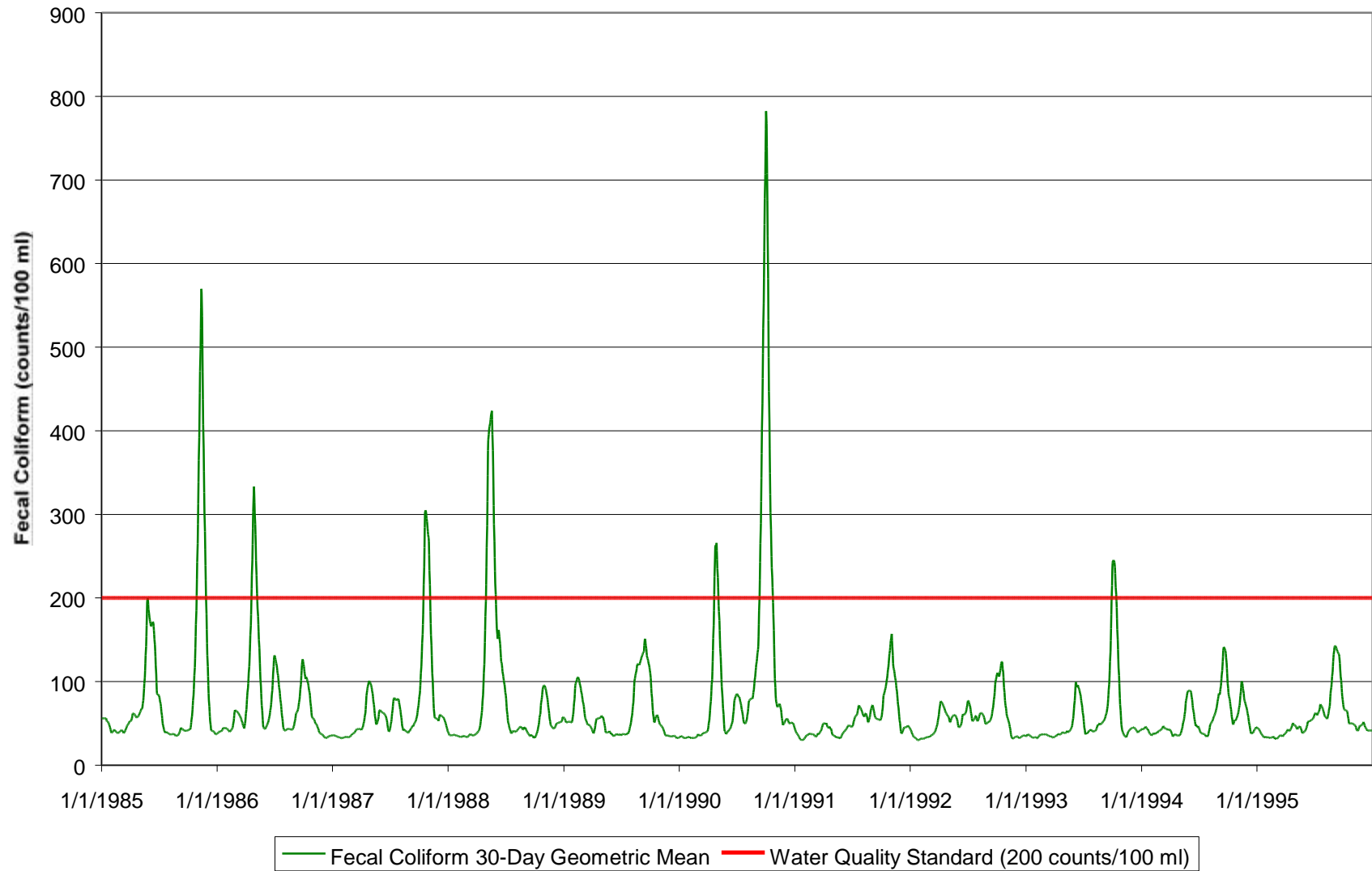
	Urban	Forest
Cypress Creek	0.00E+00	1.41E+08
P2	0.00E+00	0.00E+00
P3	0.00E+00	0.00E+00
P4	0.00E+00	0.00E+00
P5	0.00E+00	0.00E+00
P6	0.00E+00	0.00E+00
P7	0.00E+00	0.00E+00
P8	0.00E+00	0.00E+00
P9	0.00E+00	0.00E+00

APPENDIX B

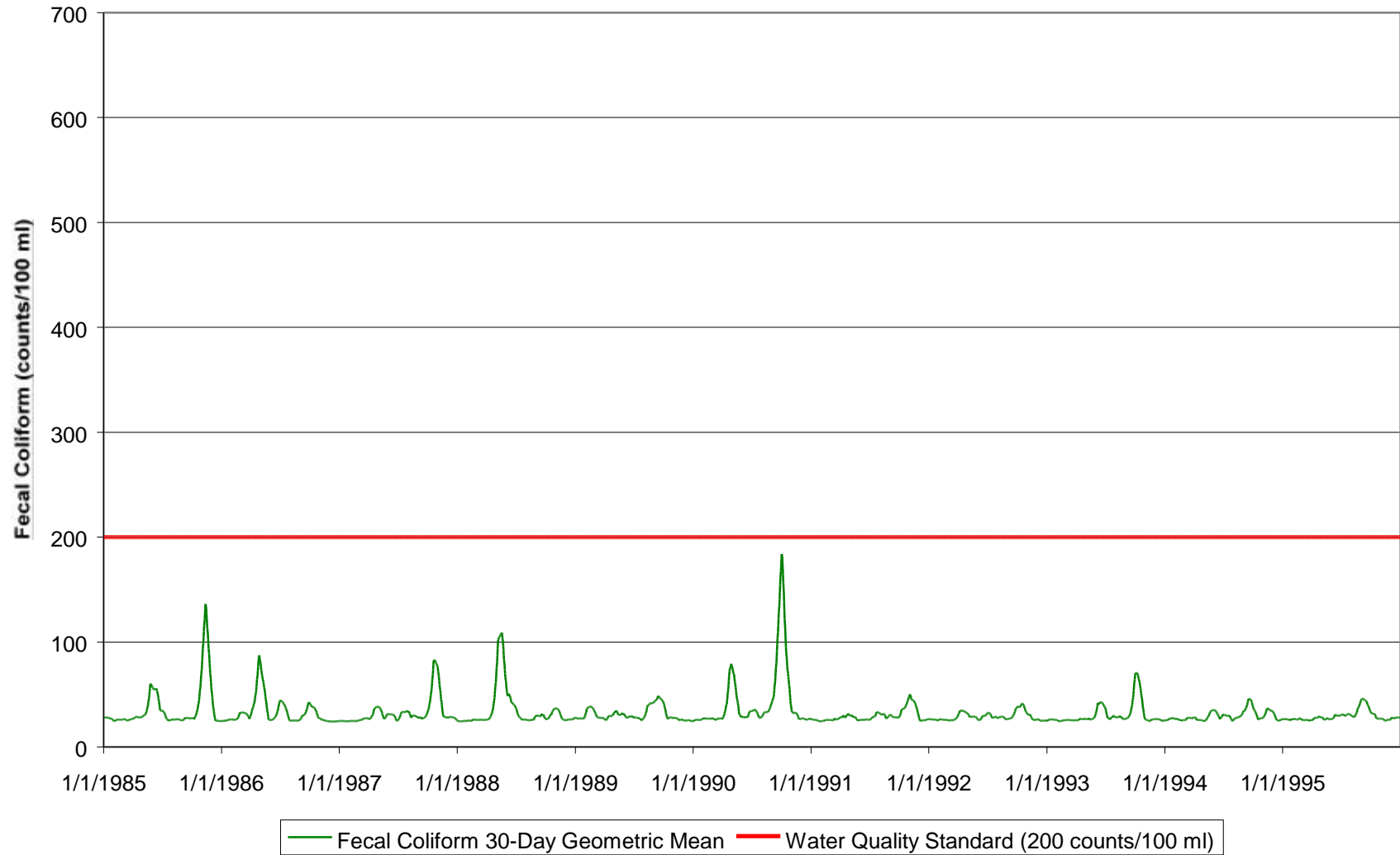
This appendix contains printouts of the various model run results. All graphs represent an 11-year time period, from January 1, 1985, to December 31, 1995. Graph B-1 shows the 30-day geometric mean for fecal coliform concentrations in counts per 100 ml in the impaired section of Cypress Creek. The graphs contain a reference line at 200 counts per 100 ml. Graph B-1 represents the existing conditions in Cypress Creek. Graph B-2 represents the conditions in Cypress Creek after the reduction scenario has been applied. Graphs B-1 and B-2 are shown with the same scale for comparison purposes.

Graph B-3 through B-5 shows the modeled flow, in cubic feet per second compared to the actual USGS gage readings from Cypress Creek near Janice. The graphs each represent one year of flow model output and data.

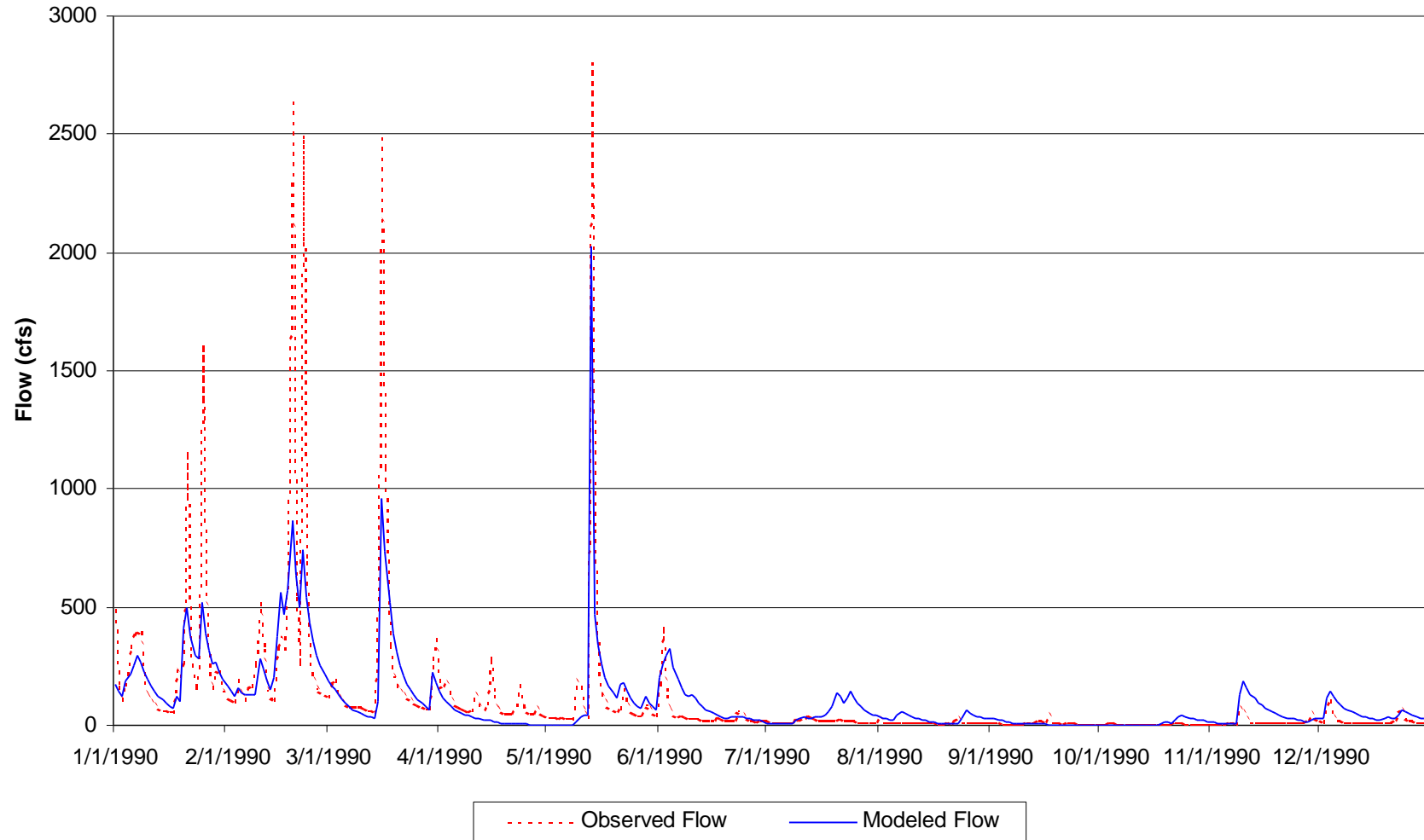
Graph B-1 Modeled Fecal Coliform Concentrations Under Existing Conditions



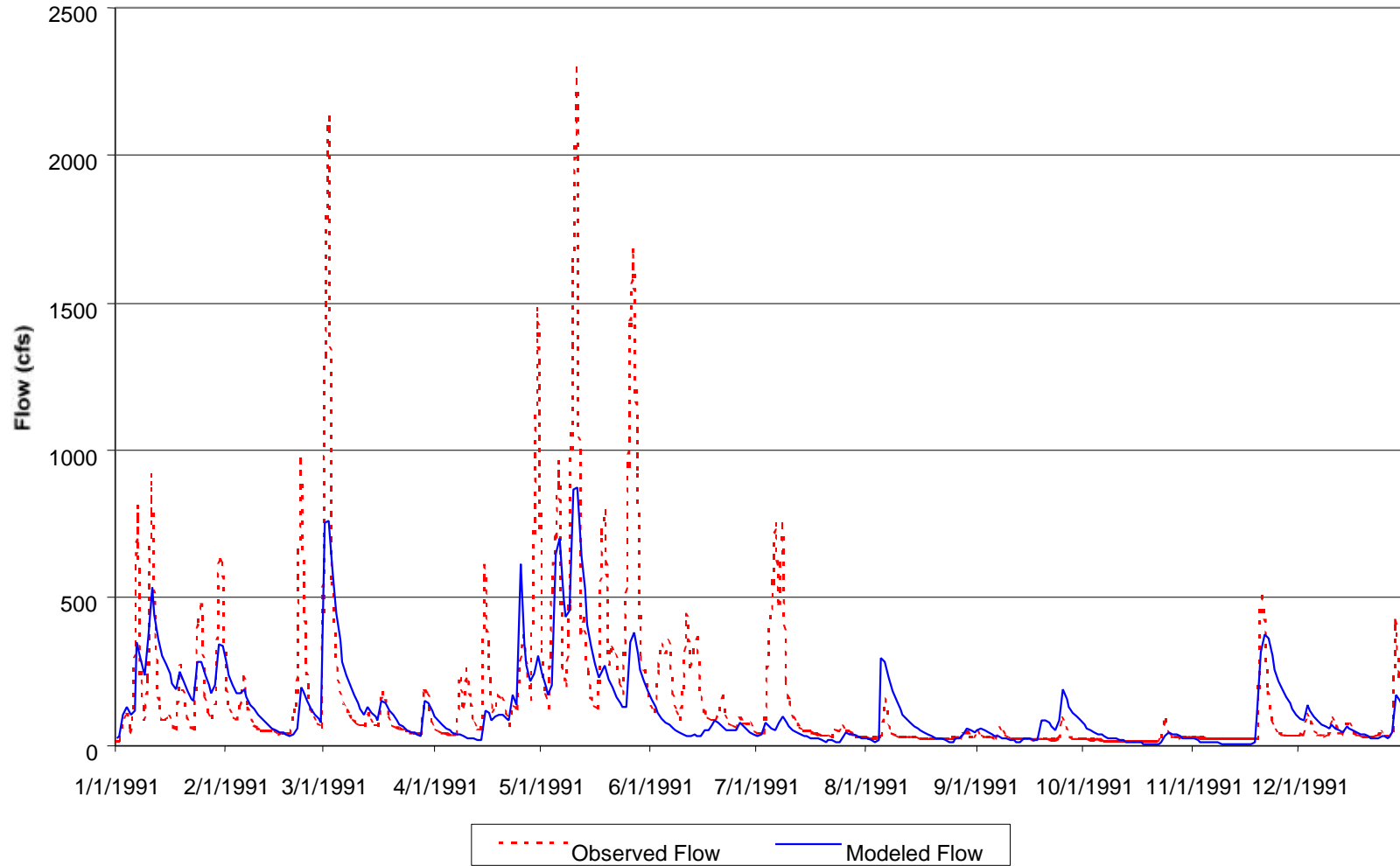
Graph B-2 Modeled Fecal Coliform Concentrations After Application of Reduction Scenario



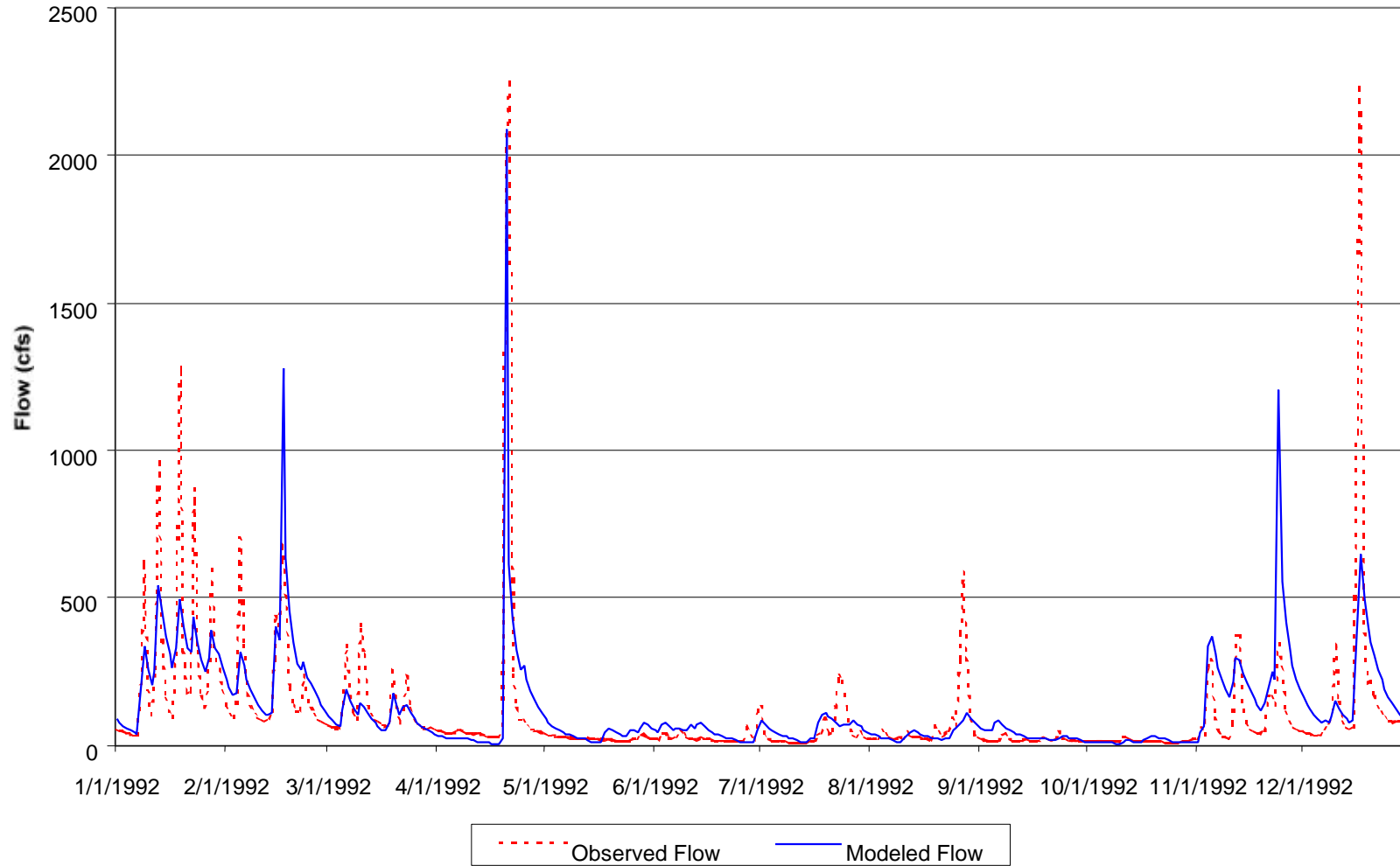
**Graph B-3 Daily Flow Comparison between USGS Gage 02479155
and Reach 03170007005 for 01/01/90 - 12/31/90**



**Graph B-4 Daily Flow Comparison between USGS Gage 02479155
and Reach 03170007005 for 01/01/91 - 12/31/91**



**Graph B-5 Daily Flow Comparison between USGS Gage 02479155
and Reach 03170007005 for 01/01/92 - 12/31/92**



REFERENCES

Horner, 1992. Water Quality Criteria/Pollutant Loading Estimation/Treatment Effectiveness Estimation. In R.W. Beck and Associates. Covington Master Drainage Plan. King County Surface Water Management Division, Seattle, WA.

Horsley & Whitten, Inc. 1996. Identification and Evaluation of Nutrient Bacterial Loadings to Maquoit Bay, Brunswick, and Freeport, Maine. Casco Bay Estuary Project.

Metcalf and Eddy. 1991. *Wastewater Engineering: Treatment, Disposal, Reuse*. 3rd Edition. McGraw-Hill, Inc., New York.

MDEQ. 1994. *Wastewater Regulations for National Pollutant Discharge Elimination System (NPDES) Permits, Underground Injection Control (UIC) Permits, State Permits, Water Quality Based Effluent Limitations and Water Quality Certification*. Office of Pollution Control.

MDEQ. 1995. *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Costal Waters*. Office of Pollution Control.

MDEQ. 1998. *Mississippi List of Waterbodies, Pursuant to Section 303(d) of the Clean Water Act*. Office of Pollution Control.

USEPA. 1998. *Better Assessment Science Integrating Point and Nonpoint Sources, BASINS, Version 2.0 User's Manual*. U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

DEFINITIONS

Ambient stations: a network of fixed monitoring stations established for systematic water quality sampling at regular intervals, and for uniform parametric coverage over a long-term period.

Assimilative capacity: the capacity of a body of water or soil-plant system to receive wastewater effluents or sludge without violating the provisions of the State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters and Water Quality regulations.

Background: the condition of waters in the absence of man-induced alterations based on the best scientific information available to MDEQ. The establishment of natural background for an altered waterbody may be based upon a similar, unaltered or least impaired, waterbody or on historical pre-alteration data.

Calibrated model: a model in which reaction rates and inputs are significantly based on actual measurements using data from surveys on the receiving waterbody.

Critical Condition: hydrologic and atmospheric conditions in which the pollutants causing impairment of a waterbody have their greatest potential for adverse effects.

Daily discharge: the "discharge of a pollutant" measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in units of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the day. For pollutants with limitations expressed in other units of measurement, the "daily average" is calculated as the average.

Designated Use: use specified in water quality standards for each waterbody or segment regardless of actual attainment.

Discharge monitoring report: report of effluent characteristics submitted by a NPDES Permitted facility.

Effluent standards and limitations: all State or Federal effluent standards and limitations on quantities, rates, and concentrations of chemical, physical, biological, and other constituents to which a waste or wastewater discharge may be subject under the Federal Act or the State law. This includes, but is not limited to, effluent limitations, standards of performance, toxic effluent standards and prohibitions, pretreatment standards, and schedules of compliance.

Effluent: treated wastewater flowing out of the treatment facilities.

Fecal coliform bacteria: a group of bacteria that normally live within the intestines of mammals, including humans. Fecal coliform bacteria are used as an indicator of the presence of pathogenic organisms in natural water.

Geometric mean: the n th root of the product of n numbers. A 30-day geometric mean is the 30th root of the product of 30 numbers.

Impaired Waterbody: any waterbody that does not attain water quality standards due to an individual pollutant, multiple pollutants, pollution, or an unknown cause of impairment.

Load allocation (LA): the portion of a receiving water's loading capacity attributed to or assigned to nonpoint sources (NPS) or background sources of a pollutant.

Loading: the total amount of pollutants entering a stream from one or multiple sources.

Nonpoint Source: pollution that is in runoff from the land. Rainfall, snowmelt, and other water that does not evaporate becomes surface runoff and either drains into surface waters or soaks into the soil and finds its way into groundwater. This surface water may contain pollutants that come from land use activities such as agriculture; construction; silviculture; surface mining; disposal of wastewater; hydrologic modifications; and urban development.

NPDES permit: an individual or general permit issued by the Mississippi Environmental Quality Permit Board pursuant to regulations adopted by the Mississippi Commission on Environmental Quality under Mississippi Code Annotated (as amended) §§ 49-17-17 and 49-17-29 for discharges into State waters.

Point Source: pollution loads discharged at a specific location from pipes, outfalls, and conveyance channels from either wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream.

Pollution: contamination, or other alteration of the physical, chemical, or biological properties, of any waters of the State, including change in temperature, taste, color, turbidity, or odor of the waters, or such discharge of any liquid, gaseous, solid, radioactive, or other substance, or leak into any waters of the State, unless in compliance with a valid permit issued by the Permit Board.

Publicly Owned Treatment Works (POTW): a waste treatment facility owned and/or operated by a public body or a privately owned treatment works which accepts discharges which would otherwise be subject to Federal Pretreatment Requirements.

Total Maximum Daily Load or TMDL: the calculated maximum permissible pollutant loading to a waterbody at which water quality standards can be maintained.

Regression Coefficient: an expression of the functional relationship between two correlated variables that is often empirically determined from data, and is used to predict values of one variable when given values of the other variable.

Waste: sewage, industrial wastes, oil field wastes, and all other liquid, gaseous, solid, radioactive, or other substances which may pollute or tend to pollute any waters of the State.

Wasteload allocation (WLA): the portion of a receiving water's loading capacity attributed to or assigned to point sources of a pollutant.

Water Quality Standards: the criteria and requirements set forth in *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters*. Water quality standards are standards composed of designated present and future most beneficial uses (classification of waters), the numerical and narrative criteria applied to the specific water uses or classification, and the Mississippi antidegradation policy.

Water quality criteria: elements of State water quality standards, expressed as constituent concentrations, levels, or narrative statements, representing a quality of water that supports the present and future most beneficial uses.

Waters of the State: all waters within the jurisdiction of this State, including all streams, lakes, ponds, wetlands, impounding reservoirs, marshes, watercourses, waterways, wells, springs, irrigation systems, drainage systems, and all other bodies or accumulations of water, surface and underground, natural or artificial, situated wholly or partly within or bordering upon the State, and such coastal waters as are within the jurisdiction of the State, except lakes, ponds, or other surface waters which are wholly landlocked and privately owned, and which are not regulated under the Federal Clean Water Act (33 U.S.C.1251 et seq.).

Watershed: the area of land draining into a stream at a given location.

ABBREVIATIONS

7Q10.....	Seven-Day Average Low Stream Flow with a Ten-Year Occurrence Period
BASINS	Better Assessment Science Integrating Point and Nonpoint Sources
BMP	Best Management Practice
CWA	Clean Water Act
DMR	Discharge Monitoring Report
EPA.....	Environmental Protection Agency
GIS	Geographic Information System
HUC	Hydrologic Unit Code
LA	Load Allocation
MARIS.....	State of Mississippi Automated Information System
MDEQ.....	Mississippi Department of Environmental Quality
MOS	Margin of Safety
NRCS	National Resource Conservation Service
NPDES.....	National Pollution Discharge Elimination System
NPSM.....	Nonpoint Source Model
RF3.....	Reach File 3
USGS	United States Geological Survey
WLA	Waste Load Allocation