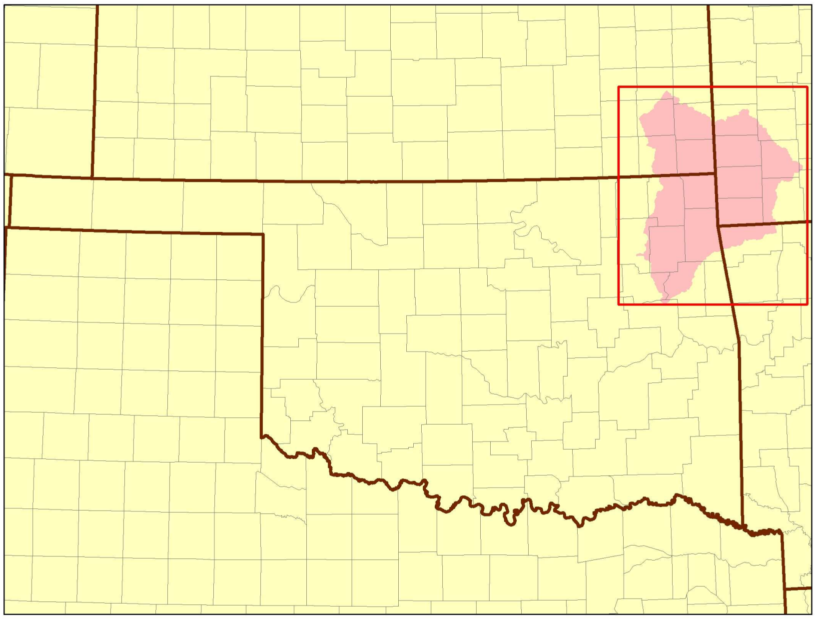
FINAL

BACTERIA TOTAL MAXIMUM DAILY LOADS FOR THE NEOSHO RIVER BASIN, OKLAHOMA (OK121600)



Prepared for:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

Prepared by:

PARSONS

JUNE 2008

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OKWBID

OK121600010060, OK121600010100, OK121600010440, OK121600030090, OK121600030160, OK121600030180, OK121600030190, OK121600030340, OK121600030440, OK121600030445, OK12600030510, OK121600040060, OK121600040130, OK121600040170, OK121600040200

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OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

Prepared by:

PARSONS

8000 Centre Park Drive, Suite 200
Austin, TX 78754

JUNE 2008

Oklahoma Department of Environmental Quality: FY07 106 Grant (CA# I-006400-05) Project 24 – Bacteria TMDL Development

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ACRONYMS AND ABBREVIATIONS

ASAE	American Society of Agricultural Engineers
BMP	best management practice
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cfu	Colony-forming unit
CPP	Continuing planning process
CWA	Clean Water Act
DMR	Discharge monitoring report
LA	Load allocation
LDC	Load duration curve
mg	Million gallons
mgd	Million gallons per day
mL	Milliliter
MOS	Margin of safety
MS4	Municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
O.S.	Oklahoma statutes
ODAFF	Oklahoma Department of Agriculture, Food and Forestry
ODEQ	Oklahoma Department of Environmental Quality
OPDES	Oklahoma Pollutant Discharge Elimination System
OSWD	Onsite wastewater disposal
OWRB	Oklahoma Water Resources Board
PBCR	Primary body contact recreation
PRG	Percent reduction goal
SSO	Sanitary sewer overflow
TMDL	Total maximum daily load
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WLA	Wasteload allocation
WQM	Water quality monitoring
WQS	Water quality standard
WWTP	Wastewater treatment plant

Executive Summary

This report documents the data and assessment used to establish TMDLs for the pathogen indicator bacteria fecal coliform, *Escherichia coli (E. coli),* or Enterococci for certain waterbodies in the Neosho River Basin. Elevated levels of pathogen indicator bacteria in aquatic environments indicate that a receiving water is contaminated with human or animal feces and that there is a potential health risk for individuals exposed to the water. Data assessment and TMDL calculations are conducted in accordance with requirements of Section 303(d) of the Clean Water Act (CWA), Water Quality Planning and Management Regulations (40 CFR Part 130), U.S. Environmental Protection Agency (USEPA) guidance, and Oklahoma Department of Environmental Quality (ODEQ) guidance and procedures. ODEQ is required to submit all TMDLs to USEPA for review and approval. Once the USEPA approves a TMDL, then the waterbody may be moved to Category 4a of a state's Integrated Water Quality Monitoring and Assessment Report, where it remains until compliance with water quality standards (WQS) is achieved (USEPA 2003).

The purpose of this report is to establish pollutant load allocations for indicator bacteria in impaired waterbodies, which is the first step toward restoring water quality and protecting public health. TMDLs determine the pollutant loading a waterbody can assimilate without exceeding the WQS for that pollutant. A TMDL consists of a wasteload allocation (WLA), load allocation (LA), and a margin of safety (MOS). The WLA is the fraction of the total pollutant load apportioned to point sources, and includes stormwater discharges regulated under the National Pollutant Discharge Elimination System (NPDES) as point sources. The LA is the fraction of the total pollutant load apportioned to nonpoint sources. The MOS is a percentage of the TMDL set aside to account for the uncertainty associated with natural process in aquatic systems, model assumptions, and data limitations.

This report does not stipulate specific control actions (regulatory controls) or management measures (voluntary best management practices) necessary to reduce bacteria loadings within each watershed. Watershed-specific control actions and management measures will be identified, selected, and implemented under a separate process.

E.1 Problem Identification and Water Quality Target

A decision was made to place specific waterbodies in this Study Area, listed in Table ES-1, on the ODEQ 2004 303(d) list because evidence of nonsupport of primary body contact recreation (PBCR) was observed.

Elevated levels of bacteria above the WQS for one or more of the bacterial indicators result in the requirement that a TMDL be developed. The TMDLs established in this report are a necessary step in the process to develop the bacteria loading controls needed to restore the primary body contact recreation use designated for each waterbody.

Table ES-1 Excerpt from the 2004 Integrated Report – Comprehensive Waterbody Assessment Category List

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK121600010060_00	Ranger Creek	10.52	5	2009	N
OK121600010100_00	Fourteenmile Creek	26.06	5	2009	N
OK121600010440_00	Crutchfield Branch	5	5	2018	N
OK121600030090_00	Drowning Creek	14.4	5	2009	N
OK121600030160_00	Horse Creek	18.69	5	2009	N
OK121600030180_00	Fly Creek	4.27	5	2009	N
OK121600030190_00	Little Horse Creek	6.46	5	2009	N
OK121600030340_00	Cave Springs Branch	12.85	5	2004	N
OK121600030440_00	Elk River	13.11	5	2005	N
OK121600030445_00	Honey Creek	9.73	5	2005	N
OK121600030510_00	Sycamore Creek	9.18	5	2009	N
OK121600040060_00	Tar Creek 139	12	5	2009	N
OK121600040130_00	Cow Creek	12.42	5	2009	N
OK121600040170_00	Fourmile Creek	7.1	5	2009	N
OK121600040200_00	Russell Creek	11.48	5	2009	N

N = Not Supporting; Source: 2004 Integrated Report, ODEQ 2004

For the data collected between 1997 and 2005, evidence of nonsupport of the PBCR use based only on fecal coliform concentrations was observed in five waterbodies: Horse Creek (OK121600030160), Fly Creek (OK121600030180), Cow Creek (OK121600040130), Fourmile Creek (OK121600040170), and Russell Creek (OK121600040200). Evidence of nonsupport of the PBCR use based only on Enterococci concentrations was observed in four waterbodies: Ranger Creek (OK121600010060), Elk Creek (OK121600030440), Sycamore Creek (OK121600030510), and Tar Creek 139 (OK121600040060). Evidence of nonsupport of the PBCR use based on both fecal coliform and Enterococci concentrations was observed in four waterbodies: Fourteenmile Creek (OK121600010100), Drowning Creek (OK121600030090), Little Horse Creek (OK121600030190) and Honey Creek (OK121600030445). Evidence of nonsupport of the PBCR use based on both *E. coli* and fecal coliform was observed in only one waterbody: Cave Branch Creek (OK121600030340). Lastly, evidence of nonsupport for all three bacteria indicators was observed in Crutchfield Branch (OK121600010440). Table ES-2 summarizes the waterbodies requiring TMDLs for not supporting PBCR.

Table ES-2 Waterbodies Requiring TMDLs for Not Supporting Primary Body Contact Recreation Use

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria		
			FC	ENT	*E. coli*
OK121600010060D	OK121600010060_00	Ranger Creek		X	
OK121600010100G	OK121600010100_00	Fourteenmile Creek	X	X	
OK121600010440-001SR	OK121600010440_00	Crutchfield Branch	X	X	X
OK121600030090G	OK121600030090_00	Drowning Creek	X	X	
OK121600030160G	OK121600030160_00	Horse Creek	X		
OK121600030180D	OK121600030180_00	Fly Creek	X		
OK121600030190A	OK121600030190_00	Little Horse Creek	X	X	
OK121600030340J	OK121600030340_00	Cave Springs Branch	X		X
OK121600030440-001AT	OK121600030440_00	Elk River		X	
OK121600030445-001AT	OK121600030445_00	Honey Creek	X	X	
OK121600030510D	OK121600030510_00	Sycamore Creek		X	
OK121600040060D	OK121600040060_00	Tar Creek 139		X	
OK121600040130G	OK121600040130_00	Cow Creek	X		
OK121600040170G	OK121600040170_00	Fourmile Creek	X		
OK121600040200G	OK121600040200_00	Russell Creek	X		

ENT = enterococci; FC = fecal coliform

The definition of PBCR is summarized by the following excerpt from Chapter 45 of the Oklahoma WQSs.

(a) Primary Body Contact Recreation involves direct body contact with the water where a possibility of ingestion exists. In these cases the water shall not contain chemical, physical or biological substances in concentrations that are irritating to skin or sense organs or are toxic or cause illness upon ingestion by human beings.

(b) In waters designated for Primary Body Contact Recreation...limits...shall apply only during the recreation period of May 1 to September 30. The criteria for Secondary Body Contact Recreation will apply during the remainder of the year.

To implement Oklahoma's WQS for PBCR, the Oklahoma Water Resources Board (OWRB) promulgated Chapter 46, *Implementation of Oklahoma's Water Quality Standards* (OWRB 2007). The excerpt below from Chapter 46: 785:46-15-6, stipulates how water quality data will be assessed to determine support of the PBCR use as well as how the water quality target for TMDLs will be defined for each bacterial indicator.

(a) Scope. The provisions of this Section shall be used to determine whether the subcategory of Primary Body Contact of the beneficial use of Recreation designated in OAC 785:45 for a waterbody is supported during the recreation season from May 1 through September 30 each year. Where data exist for multiple bacterial indicators on the same waterbody or waterbody segment, the determination of use support shall be based upon the use and application of all applicable tests and data.

(b) Screening levels:

(1) The screening level for fecal coliform shall be a density of 400 colonies per 100ml.

(2) The screening level for Escherichia coli shall be a density of 235 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 406 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(3) The screening level for enterococci shall be a density of 61 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 108 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(c) Fecal coliform:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is met and no greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section.

(2) The parameter of fecal coliform is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is not met, or greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(d) Escherichia coli (E. coli):

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to E. coli if the geometric mean of 126 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of E. coli is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to E. coli if the geometric mean of 126 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

(e) Enterococci:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to enterococci if the geometric mean of 33 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of enterococci is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to enterococci if the geometric mean of 33 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

Compliance with the Oklahoma WQS is based on meeting requirements for all three bacterial indicators. Where concurrent data exist for multiple bacterial indicators on the same waterbody or waterbody segment, each indicator group must demonstrate compliance with the numeric criteria prescribed (OWRB 2006).

As stipulated in the WQS, utilization of the geometric mean to determine compliance for any of the three indicator bacteria depends on the collection of five samples within a 30-day period. For most water quality monitoring (WQM) stations in Oklahoma there are insufficient data available to calculate the 30-day geometric mean since most water quality samples are collected once a month. As a result, waterbodies placed on the 303(d) list for not supporting the PBCR are the result of individual samples exceeding the instantaneous criteria or the long-term geometric mean of individual samples exceeding the geometric mean criteria for each respective bacterial indicator. Targeting the instantaneous criterion established for the primary contact recreation season (May 1st to September 30th) as the water quality goal for TMDLs corresponds to the basis for 303(d) listing and may be protective of the geometric mean criterion as well as the criteria for the secondary contact recreation season. However, both the instantaneous and geometric mean criteria for *E. coli* and Enterococci will be evaluated as water quality targets to ensure the most protective goal is established for each waterbody.

All TMDLs for fecal coliform must take into account that no more than 25 percent of the samples may exceed the instantaneous numeric criteria. For *E. coli* and Enterococci, no more than 10 percent of samples may exceed instantaneous criteria. Since the attainability of stream beneficial uses for *E. coli* and Enterococci is based on the compliance of either the instantaneous or a long-term geometric mean criterion, percent reductions goals will be calculated for both criteria. TMDLs will be based on the percent reduction required to meet either the instantaneous or the long-term geometric mean criterion, whichever is less.

E.2 Pollutant Source Assessment

A source assessment characterizes known and suspected sources of pollutant loading to impaired waterbodies. Sources within a watershed are categorized and quantified to the extent that information is available. Bacteria originate from warm-blooded animals; some plant life and sources may be point or nonpoint in nature.

There are no NPDES-permitted facilities of any type in the contributing watersheds of Fourteenmile Creek, Fly Creek, Little Horse Creek, Cow Creek, Fourmile Creek, and Russell Creek. Nine of the 15 watersheds in the Study Area OK121600010060_00 (Ranger Creek) OK121600010440_00 (Crutchfield Branch), OK121600030090_00 (Drowning Creek), OK121600030160_00 (Horse Creek), OK121600030340_00 (Cave Springs Branch), OK121600030440_00 (Elk River), OK121600030445_00 (Honey Creek), OK121600030510_00 (Sycamore Creek), and OK121600040060_00 (Tar Creek) have a continuous point source discharger.

There are no NPDES-permitted no-discharge facilities in the Study Area; however, it is possible the wastewater collection systems associated with WWTPs could be a source of bacteria loading. While not all sewer overflows are reported, ODEQ has some data on sanitary sewer overflows (SSO) available. There were 355 SSO occurrences, ranging from 1 gallon to 3,676,000 gallons, reported in the Study Area between January 1990 and January 2007. The City of Miami, Oklahoma, located in Tar Creek (OK121600040060_00), falls under requirements designated by USEPA for inclusion in the Phase II stormwater program. There are no NPDES-permitted concentrated animal feeding operations within the Study Area.

Since there are no NPDES-permitted facilities present in the Fourteenmile Creek, Fly Creek, Little Horse Creek, Cow Creek, Fourmile Creek, and Russell Creek watersheds, nonsupport of the PBCR use is caused entirely by nonpoint sources. In eight of the other nine watersheds, most point sources are relatively minor and for the most part tend to meet instream water quality criteria in their effluent, so nonpoint sources are considered to be the major origin of bacteria loading. Given the number of dischargers and the Municipal separate storm sewer system (MS4) area in the Tar Creek watershed, point source loading may be significant but is still likely to be less than the overall nonpoint source loading contribution. Table 3-13 in Section 3 of the Neosho River Basin Bacteria TMDL Report summarizes the suspected sources of bacteria loading in each impaired watershed.

Nonpoint source bacteria loading to the receiving streams of each waterbody emanate from a number of different sources including wildlife, various agricultural activities and domesticated animals, land application fields, urban runoff, failing onsite wastewater disposal (OSWD) systems, and domestic pets. The data analysis and the load duration curves (LDC) demonstrate that exceedances at the WQM stations are the result of a variety of nonpoint source loading occurring during a range of flow conditions. Low flow exceednaces are likely due to a combination of non-point sources, uncontrolled point sources and permit noncompliance.

E.3 Using Load Duration Curves to Develop TMDLs

The TMDL calculations presented in this report are derived from LDCs. LDCs facilitate rapid development of TMDLs and as a TMDL development tool, are effective in identifying whether impairments are associated with point or nonpoint sources.

Use of the LDC obviates the need to determine a design storm or selected flow recurrence interval with which to characterize the appropriate flow level for the assessment of critical conditions. For waterbodies impacted by both point and nonpoint sources, the "nonpoint source critical condition" would typically occur during high flows, when rainfall runoff would contribute the bulk of the pollutant load, while the "point source critical condition" would typically occur during low flows, when treatment plant effluents would dominate the base flow of the impaired water. However, Flow range is only a general indicator of the relative proportion of point/nonpoint contributions. It is not used in this report to quantify point source or nonpoint source contributions. Violations that occur during low flows may not be caused exclusively by point sources. Violations have been noted in some watersheds that contain no point sources. Research has show that bacteria loading in streams during low flow conditions may be due to direct deposit of cattle manure into streams and faulty septic tank/lateral field systems.

The basic steps to generating an LDC involve:

- obtaining daily flow data for the site of interest from the U.S. Geological Survey ;
- sorting the flow data and calculating flow exceedance percentiles for the time period and season of interest;
- obtaining the water quality data from the primary contact recreation season (May 1 through September 30);
- matching the water quality observations with the flow data from the same date;
- display a curve on a plot that represents the allowable load multiply the actual or estimated flow by the WQS for each respective indicator;
- multiplying the flow by the water quality parameter concentration to calculate daily loads; then
- plotting the flow exceedance percentiles and daily load observations in a load duration plot.

LDCs display the maximum allowable load over the complete range of flow conditions by a line using the calculation of flow multiplied by the water quality criterion. The TMDL can be expressed as a continuous function of flow, equal to the line, or as a discrete value derived from a specific flow condition.

E.4 TMDL Calculations

As indicated above, the bacteria TMDLs for the 303(d)-listed WQM stations covered in this report were derived using LDCs. A TMDL is expressed as the sum of all WLAs (point source loads), LAs (nonpoint source loads), and an appropriate MOS, which attempts to account for uncertainty concerning the relationship between effluent limitations and water quality.

This definition can be expressed by the following equation:

$$\boldsymbol{TMDL = \Sigma\ WLA + \Sigma\ LA + MOS}$$

For each waterbody the TMDLs presented in this report are expressed as a percent reduction across the full range of flow conditions (See Table ES-3). The difference between existing loading and the water quality target is used to calculate the loading reductions required. Percent reduction goals (PRG) are calculated for each WQM site and bacterial indicator species as the reductions in load required so that no more than 25 percent of the existing instantaneous fecal coliform observations and no more than 10 percent of the existing instantaneous *E. coli* or Enterococci observations would exceed the water quality target.

Table ES-3 presents the percent reductions necessary for each bacterial indicator causing nonsupport of the PBCR use in each waterbody of the Study Area. Attainment of WQS in response to TMDL implementation will be based on results measured at each of these WQM stations. Selection of the appropriate PRG for each waterbody in Table ES-3 is denoted by bold text. The TMDL PRG will be the lesser of that required to meet the geometric mean or instantaneous criteria for *E. coli* and Enterococci because WQSs are considered to be met if, 1) either the geometric mean of all data is less than the geometric mean criteria, or 2) no more than 10 percent of samples exceed the instantaneous criteria. Based on this table, the TMDL PRGs for Ranger Creek, Fourteenmile Creek, Crutchfield Branch, Drowning Creek, Little Horse Creek, Elk River, Honey Creek, Sycamore Creek and Tar Creek will be based on Enterococci; the TMDL PRGs for Horse Creek, Fly Creek, Cow Creek, Fourmile Creek and

Russell Creek will be based on fecal coliform; and the TMDL PRG for Cave Springs Branch will be based on *E. coli*. The PRGs range from 26 to 99 percent.

Table ES-3 TMDL Percent Reduction Goals Required to Meet Water Quality Standards for Impaired Waterbodies in the Neosho River Basin Study Area

Waterbody ID	WQM Station	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instant-aneous	Instant-aneous	Geo-mean	Instant-aneous	Geo-mean
OK121600010060_00	OK121600010060D	Ranger Creek				89%	**67%**
OK121600010100_00	OK121600010100G	Fourteenmile Creek				76%	**69%**
OK121600010440_00	OK121600010440-001SR	Crutchfield Branch	98.6%	97%	96%	99.7%	**99.4%**
OK121600030090_00	OK121600030090G	Drowning Creek	28%			56%	**47%**
OK121600030160_00	OK121600030160G	Horse Creek	**86%**				
OK121600030180_00	OK121600030180D	Fly Creek	**49%**				
OK121600030190_00	OK121600030190A	Little Horse Creek	49%			84%	**77%**
OK121600030340_00	OK121600030340J	Cave Springs Branch	47%	59%	**53%**		
OK121600030440_00	OK121600030440-001AT	Elk River				78%	52%
OK121600030445_00	OK121600030445-001AT	Honey Creek	28%			99%	**90%**
OK121600030510_00	OK121600030510D	Sycamore Creek				**3%**	26%
OK121600040060_00	OK121600040060D	Tar Creek				84%	**80%**
OK121600040130_00	OK121600040130G	Cow Creek	**60%**				
OK121600040170_00	OK121600040170G	Fourmile Creek	**55%**				
OK121600040200_00	OK121600040200G	Russell Creek	**49%**				

The TMDL, WLA, LA, and MOS vary with flow condition, and are calculated at every 5th flow interval percentile. For illustrative purposes, the TMDL, WLA, LA, and MOS are calculated for the median flow at each site in Table ES-4. The WLA component of each TMDL is the sum of all WLAs within the contributing watershed of each WQM station. The sum of the WLAs can be represented as a single line below the LDC. The WLA for MS4s is estimated based on the percentage of MS4 area which falls under the study watershed. The LDC and the simple equation of:

$$\textit{Average LA} = \textit{average TMDL} - \textit{MOS} - \sum \textit{WLA}$$

can provide an individual value for the LA in counts per day, which represents the area under the TMDL target line and above the WLA line. For MS4s the load reduction will be the same as the PRG established for the overall watershed. Where there are no continuous point sources the WLA is zero.

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs include an MOS. The MOS is a conservative measure incorporated into the TMDL equation that accounts for the uncertainty associated with calculating the allowable pollutant loading to ensure WQSs are attained. USEPA guidance allows for use of implicit or explicit expressions of the MOS, or both. When conservative assumptions are used in development of the TMDL, or conservative factors are used in the calculations, the MOS is implicit. When a specific percentage of the TMDL is set aside to account for uncertainty, then the MOS is considered explicit.

For the explicit MOS the water quality target was set at 10 percent lower than the water quality criterion for each pathogen which equates to 360 colony-forming units per 100 milliliter (cfu/100 mL), 365.4 cfu/100 mL, and 97.2/100 mL for fecal coliform, *E. coli*, and Enterococci, respectively. The net effect of the TMDL with MOS is that the assimilative capacity or allowable pollutant loading of each waterbody is slightly reduced. These TMDLs incorporate an explicit MOS by using a curve representing 90 percent of the TMDL as the average MOS. The MOS at any given percent flow exceedance, therefore, can be defined as the difference in loading between the TMDL and the TMDL with MOS. The use of instream bacteria concentrations to estimate existing loading is another conservative element utilized in these TMDLs that can be recognized as an implicit MOS. This conservative approach to establishing the MOS will ensure that both the 30-day geometric mean and instantaneous bacteria standards can be achieved and maintained.

E.5 Reasonable Assurance

As authorized by Section 402 of the CWA, ODEQ has delegation of the NPDES in Oklahoma, except for certain jurisdictional areas related to agriculture and the oil and gas industry retained by the Oklahoma Department of Agriculture and Oklahoma Corporation Commission, for which the USEPA has retained permitting authority. The NPDES program in Oklahoma is implemented via Title 252, Chapter 606 of the Oklahoma Pollution Discharge Elimination System (OPDES) Act, and in accordance with the agreement between ODEQ and USEPA relating to administration and enforcement of the delegated NPDES program. Implementation of WLAs for point sources is done through permits issued under the OPDES program.

Table ES-4 TMDL Summaries Examples

Waterbody ID	WQM Station	Waterbody Name	Indicator Bacteria Species	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
OK121600010060_00	OK121600010060D	Ranger Creek	EN	1.89E+09	0	0	1.70E+09	1.89E+08
OK121600010100_00	OK121600010100G	Fourteenmile Creek	EN	4.76E+10	0	0	4.28E+10	4.76E+09
OK121600010440_00	OK121600010440-001SR	Crutchfield Branch	EN	1.35E+10	6.25E+08	0	1.15E+10	1.35E+09
OK121600030090_00	OK121600030090G	Drowning Creek	EN	1.06E+10	1.37E+09	0	8.18E+09	1.06E+09
OK121600030160_00	OK121600030160G	Horse Creek	FC	1.41E+10	1.06E+09	0	1.17E+10	1.41E+09
OK121600030180_00	OK121600030180D	Fly Creek	FC	3.43E+09	0	0	3.08E+09	3.43E+08
OK121600030190_00	OK121600030190A	Little Horse Creek	EN	1.69E+09	0	0	1.52E+09	1.69E+08
OK121600030340_00	OK121600030340J	Cave Springs Branch	EC	2.58E+10	0	0	1.37E+10	2.58E+09
OK121600030440_00	OK121600030440-001AT	Elk River	EN	7.16E+11	0	0	6.35E+11	7.16E+10
OK121600030445_00	OK121600030445-001AT	Honey Creek	EN	3.7E+10	0	0	3.31E+10	3.7E+09
OK121600030510_00	OK121600030510D	Sycamore Creek	EN	3.52E+10	0	0	3.17E+10	3.52E+09
OK121600040060_00	OK121600040060D	Tar Creek	EN	1.32E+10	6.87E+08	1.32E+09	9.88E+09	1.32E+09
OK121600040130_00	OK121600040130G	Cow Creek	FC	9.79E+09	0	0	8.81E+09	9.79E+08
OK121600040170_00	OK121600040170G	Fourmile Creek	FC	9.72E+09	0	0	8.75E+09	9.72E+08
OK121600040200_00	OK121600040200G	Russell Creek	FC	1.22E+10	0	0	1.10E+10	1.22E+09

† Derived for illustrative purposes at the median flow value
* WLA calculations for facilities outside of Oklahoma are not enforceable

SECTION 1
INTRODUCTION

1.1 TMDL Program Background

Section 303(d) of the Clean Water Act (CWA) and U.S. Environmental Protection Agency (USEPA) Water Quality Planning and Management Regulations (40 Code of Federal Regulations [CFR] Part 130) require states to develop total maximum daily loads (TMDL) for waterbodies not meeting designated uses where technology-based controls are in place. TMDLs establish the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so states can implement water quality-based controls to reduce pollution from point and nonpoint sources and restore and maintain water quality (USEPA 1991).

This report documents the data and assessment used to establish TMDLs for the pathogen indicator bacteria fecal coliform, *Escherichia coli (E. coli)*, or Enterococci for certain waterbodies in the Neosho River Basin. Elevated levels of pathogen indicator bacteria in aquatic environments indicate that a receiving water is contaminated with human or animal feces and that there is a potential health risk for individuals exposed to the water. Data assessment and TMDL calculations are conducted in accordance with requirements of Section 303(d) of the CWA, Water Quality Planning and Management Regulations (40 CFR Part 130), USEPA guidance, and Oklahoma Department of Environmental Quality (ODEQ) guidance and procedures. ODEQ is required to submit all TMDLs to USEPA for review and approval. Once the USEPA approves a TMDL, then the waterbody may be moved to Category 4a of a state's Integrated Water Quality Monitoring and Assessment Report, where it remains until compliance with water quality standards (WQS) is achieved (USEPA 2003).

The purpose of this TMDL report is to establish pollutant load allocations for indicator bacteria in impaired waterbodies, which is the first step toward restoring water quality and protecting public health. TMDLs determine the pollutant loading a waterbody can assimilate without exceeding the WQS for that pollutant. TMDLs also establish the pollutant load allocation necessary to meet the WQS established for a waterbody based on the relationship between pollutant sources and in-stream water quality conditions. A TMDL consists of a wasteload allocation (WLA), load allocation (LA), and a margin of safety (MOS). The WLA is the fraction of the total pollutant load apportioned to point sources, and includes stormwater discharges regulated under the National Pollutant Discharge Elimination System (NPDES) as point sources. The LA is the fraction of the total pollutant load apportioned to nonpoint sources. The MOS is a percentage of the TMDL set aside to account for the uncertainty associated with natural process in aquatic systems, model assumptions, and data limitations.

This report does not stipulate specific control actions (regulatory controls) or management measures (voluntary best management practices) necessary to reduce bacteria loadings within each watershed. Watershed-specific control actions and management measures will be identified, selected, and implemented under a separate process involving stakeholders who live and work in the watersheds, tribes, and local, state, and federal government agencies.

This TMDL report focuses on 15 waterbodies that ODEQ placed in Category 5 of the 2004 Integrated Report [303(d) list] for nonsupport of primary body contact recreation (PBCR):

- Ranger Creek (OK121600010060_00),
- Fourteenmile Creek (OK121600010100_00),
- Crutchfield Branch (OK121600010440_00),
- Drowning Creek (OK121600030090_00),
- Horse Creek (OK121600030160_00),
- Fly Creek (OK121600030180_00),
- Little Horse Creek (OK121600030190_00),
- Cave Springs Branch (OK121600030340_00),
- Elk River (OK121600030440_00),
- Honey Creek (OK121600030445_00),
- Sycamore Creek (OK12600030510_00),
- Tar Creek (OK121600040060_00),
- Cow Creek (OK121600040130_00),
- Fourmile Creek (OK121600040170_00), and
- Russell Creek (OK121600040200_00).

Figure 1-1a and Figure 1-1b are location maps showing the impaired segments of these Oklahoma waterbodies and their contributing watersheds. This map also displays the locations of the water quality monitoring (WQM) stations used as the basis for placement of these waterbodies on the Oklahoma 303(d) list. These waterbodies and their surrounding watersheds are hereinafter referred to as the Study Area.

Elevated levels of bacteria above the WQS result in the requirement that a TMDL be developed. The TMDLs established in this report are a necessary step in the process to develop the bacteria loading controls needed to restore the contact recreation use designated for each waterbody. Table 1-1 provides a description of the locations of the WQM stations on the 303(d)-listed waterbodies.

Table 1-1 Water Quality Monitoring Stations used for 2004 303(d) Listing Decision

Waterbody Name	Waterbody ID	WQM Station	WQM Station Location Descriptions
Ranger Creek	OK121600010060_00	OK121600010060D	Ranger Creek
Fourteenmile Creek	OK121600010100_00	OK121600010100G	Fourteenmile Creek
Crutchfield Branch	OK121600010440_00	OK121600010440-001SR	Crutchfield Branch, off U.S. 412
Drowning Creek	OK121600030090_00	OK121600030090G	Drowning Creek
Horse Creek	OK121600030160_00	OK121600030160G	Horse Creek
Fly Creek	OK121600030180_00	OK121600030180D	Fly Creek
Little Horse Creek	OK121600030190_00	OK121600030190A	Little Horse Creek
Cave Springs Branch	OK121600030340_00	OK121600030340J	Cave Springs Branch site 2 near South West City, MO
Elk River	OK121600030440_00	OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO
Honey Creek	OK121600030445_00	OK121600030445-001AT	Honey Creek, off SH 25, Grove

Waterbody Name	Waterbody ID	WQM Station	WQM Station Location Descriptions
Sycamore Creek	OK121600030510_00	OK121600030510D	Sycamore Creek
Tar Creek 139	OK121600040060_00	OK121600040060D	Tar Creek at Miami, OK
Cow Creek	OK121600040130_00	OK121600040130G	Cow Creek
Fourmile Creek	OK121600040170_00	OK121600040170G	Fourmile Creek
Russell Creek	OK121600040200_00	OK121600040200G	Russell Creek

1.2 Watershed Description

General. The watersheds in the Neosho River Basin addressed in these TMDLs are located in northeastern Oklahoma. The majority of the 15 waterbodies included in this report are located in Craig, Ottawa, Delaware, Mayes, and Cherokee Counties. The headwaters of Fourmile Creek (OK121600040170) and Tar Creek (OK121600040060) originate in Cherokee County, Kansas. 32.4, 12.3 and 69.8 percent of the Fourmile Creek, Tar Creek, and Russell Creek watersheds, respectively, fall within the State of Kansas.

The headwaters of Sycamore Creek (OK12600030510_00) originate in Newton County, Missouri and 50.7 percent of its contributing watershed falls within the State of Missouri. The headwaters of Elk River (OK121600030440_00) and Honey Creek (OK121600030445_00), originate in, McDonald County, Missouri. 79.7 percent of the Elk River's contributing watershed is located in Missouri and 12.8 percent of its contributing watershed is located in the State of Arkansas.

Drowning Creek (OK121600030090_00), Horse Creek (OK121600030160_00), Fly Creek (OK121600030180_00), Elk River (OK121600030440_00), Honey Creek (OK121600030445_00), and Sycamore Creek (OK12600030510_00) are all tributaries that drain directly into Lake-o-the-Cherokees, Oklahoma.

Russell Creek watershed and the western portion of the Cow Creek watershed are part of the Central Irregular Plains ecoregion, while all other watersheds lie within the Ozark Highlands ecoregion. Russell Creek (OK121600040200), Fourmile Creek (OK121600040170), Tar Creek (OK121600040060) and Cow Creek (OK121600040130) are in the Northern Shelf Areas geologic province, while all other waterbodies fall within the Ozark Uplift geologic province. Table 1-2, derived from the 2000 U.S. Census, demonstrates that for the most part, with the exception of Tar Creek, these watersheds within Oklahoma are sparsely populated (U.S. Census Bureau 2000).

Table 1-2 County Population and Density

County Name	Population (2000 Census)	Population Density (per square mile)
Craig	14,950	20
Ottawa	33,194	70
Mayes	37,077	50
Delaware	38,369	58
Cherokee, OK	42,521	57

Climate. Table 1-3 summarizes the average annual precipitation for each WQM station. Average annual precipitation values among the WQM stations in this portion of Oklahoma ranges between 44.1 and 47.0 inches (Oklahoma Climate Survey 2005).

Table 1-3 Average Annual Precipitation by Watershed

Neosho River Precipitation Summary		
Waterbody Name	**Waterbody ID**	**Average Annual (Inches)**
Ranger Creek	OK121600010060_00	46.3
Fourteenmile Creek	OK121600010100_00	47.0
Crutchfield Branch	OK121600010440_00	44.7
Drowning Creek	OK121600030090_00	46.2
Horse Creek	OK121600030160_00	44.7
Fly Creek	OK121600030180_00	44.7
Little Horse Creek	OK121600030190_00	44.8
Cave Springs Branch	OK121600030340_00	45.6
Elk River	OK121600030440_00	45.3
Honey Creek	OK121600030445_00	46.1
Sycamore Creek	OK121600030510_00	44.4
Tar Creek 139	OK121600040060_00	45.4
Cow Creek	OK121600040130_00	44.8
Fourmile Creek	OK121600040170_00	44.9
Russell Creek	OK121600040200_00	44.1

Land Use. Tables 1-4a and 1-4b summarize the acreages and the corresponding percentages of the land use categories for the contributing watershed associated with each respective Oklahoma waterbody. The land use/land cover data were derived from the U.S. Geological Survey (USGS) 2001 National Land Cover Dataset (USGS 2007). The land use categories are displayed in Figures 1-2a and 1-2b.

The combination of pasture/hay and cultivated crops, totaling 87, 70, 87, and 77 percent, respectively, are the primary land use categories in Little Horse Creek, Horse Creek, Cow Creek, and Russell Creek. For Ranger Creek, Fourteenmile Creek, Crutchfield Branch, Drowning Creek, Honey Creek, Cave Springs Branch, Fly Creek, and Sycamore Creek, the primary land use category is pasture/hay and the second largest land use category is deciduous forest. For Elk River the primary land use category is deciduous forest and the second largest land use category is pasture/hay. For Tar Creek and Fourmile Creek the primary land use category is cultivated crops and the second largest land use category is pasture/hay.

There are seven cities located in the Tar Creek watershed: Treece, Picher, Cardin, Quapaw, Commerce, North Miami, and Miami. The four cities located in the Elk River watershed are Goodman, Noel, Gravette, and Sulphur Springs. Afton is located in Horse Creek watershed and South West City is located in Honey Creek watershed. The only city located in Drowning Creek watershed is Jay, and the only city within the Crutchfield Branch watershed is Locust Grove. There are no urban areas within Cow Creek, Russell Creek, Fourmile Creek, Little Horse Creek, Fly Creek, Sycamore Creek, Fourteenmile Creek, Cave Springs Branch, or Ranger Creek watersheds. Low, medium, and high intensity developed land account for less than 7 percent of the land use in each watershed, with the exception of the Tar Creek watershed, which accounts for 14.2 percent of the land use.

Table 1-4a Land Use Summaries by Watershed

Landuse Category	WQM Station							
	Ranger Creek	Fourteen-mile Creek	Crutchfield Branch	Drowning Creek	Honey Creek	Cave Springs Branch	Fly Creek	Little Horse Creek
Waterbody ID	OK121600010060_00	OK121600010100_00	OK121600010440_00	OK121600030090_00	OK121600030160_00	OK121600030180_00	OK121600030190_00	OK121600030340_00
Percent of Open Water	1.2	0.1	0.1	0.3	0.0	0.1	1.5	0.7
Percent of Developed, Open Space	4.6	4.1	8.2	4.5	4.0	4.5	6.2	5.9
Percent of Developed, Low Intensity	0.1	0.0	4.2	1.3	0.3	0.3	0.4	2.4
Percent of Developed, Medium Intensity	0.0	0.0	1.4	0.4	0.0	0.1	0.0	0.3
Percent of Developed, High Intensity	0.0	0.0	0.3	0.2	0.0	0.2	0.0	0.0
Percent of Barren Land (Rock/Sand/ Clay)	0.0	0.0	0.0	0.1	0.0	0.4	0.0	0.0
Percent of Deciduous Forest	41.8	33.4	22.5	43.0	28.0	14.1	21.7	2.8
Percent of Evergreen Forest	0.2	0.4	0.1	0.0	0.0	0.1	0.0	0.0
Percent of Mixed Forest	0.3	0.1	0.1	0.0	0.0	0.1	0.0	0.0
Percent of Shrub/Scrub	0.8	0.2	0.0	0.0	0.0	0.0	0.0	0.2
Percent of Grassland/Herbaceous	3.6	1.4	2.7	1.3	0.3	0.1	10.6	0.9
Percent of Pasture/Hay	46.8	59.9	60.1	49.0	66.8	79.7	48.1	75.5
Percent of Cultivated Crops	0.1	0.0	0.0	0.0	0.1	0.1	11.4	11.2
Percent of Woody Wetlands	0.3	0.3	0.3	0.0	0.2	0.0	0.1	0.2
Percent of Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Landuse Category	WQM Station							
	Ranger Creek	Fourteen-mile Creek	Crutchfield Branch	Drowning Creek	Honey Creek	Cave Springs Branch	Fly Creek	Little Horse Creek
Waterbody ID	OK121600010060_00	OK121600010100_00	OK121600010440_00	OK121600030090_00	OK121600030160_00	OK121600030180_00	OK121600030190_00	OK121600030340_00
Acres Open Water (percent of total)	169	36	12	77	9	13	103	80
Acres Developed, Open Space	634	1,869	779	1,116	1,396	406	416	729
Acres[a] Developed, Low Intensity	12	16	401	316	96	31	27	295
Acres Developed, Medium Intensity	0	2	134	93	14	8	0	35
Acres Developed, High Intensity	0	0	27	38	10	17	0	0
Acres Barren Land (Rock/Sand/Clay)	0	6	4	13	11	32	0	0
Acres Deciduous Forest	5,759	15,194	2,140	10,729	9,667	1,260	1,453	338
Acres Evergreen Forest	34	163	13	6	4	8	0	0
Acres Mixed Forest	46	26	6	4	14	13	0	0
Acres Shrub/Scrub	116	101	0	1	0	4	2	19
Acres Grassland/Herbaceous	489	641	255	317	117	9	709	113
Acres Pasture/Hay	6,448	27,210	5,720	12,225	23,069	7,109	3,217	9,276
Acres Cultivated Crops	18	17	0	0	39	13	763	1,378
Acres Woody Wetlands	41	152	24	10	64	2	5	22
Acres Emergent Herbaceous Wetlands	0	0	0	0	0	0	0	3
Total (Acres)	**13,766**	**45,432**	**9,515**	**24,944**	**34,510**	**8,925**	**6,695**	**12,288**

Table 1-4b Land Use Summaries by Watershed

Landuse Category	WQM Station						
	Horse Creek	Sycamore Creek	Tar Creek	Cow Creek	Russell Creek	Fourmile Creek	Elk River
Waterbody ID	OK121600030440_00	OK121600030445_00	OK121600030510_00	OK121600040060_00	OK121600040130_00	OK121600040170_00	OK121600040200_00
Percent of Open Water	2.8	0.9	1.1	0.8	0.3	0.2	0.4
Percent of Developed, Open Space	7.3	4.2	6.4	4.7	4.0	4.0	4.7
Percent of Developed, Low Intensity	2.2	0.4	9.5	0.7	0.1	0.3	0.7
Percent of Developed, Medium Intensity	0.2	0.0	3.4	0.0	0.0	0.0	0.2
Percent of Developed, High Intensity	0.0	0.0	1.3	0.0	0.0	0.0	0.1
Percent of Barren Land (Rock/Sand/Clay)	0.0	0.0	5.0	0.0	0.0	0.3	0.1
Percent of Deciduous Forest	14.0	37.5	3.8	3.9	8.6	8.9	49.4
Percent of Evergreen Forest	0.0	0.2	0.0	0.0	0.0	0.0	0.4
Percent of Mixed Forest	0.0	0.0	0.0	0.0	0.2	0.0	0.1
Percent of Shrub/Scrub	0.0	0.1	0.0	0.4	0.0	0.0	0.1
Percent of Grassland/Herbaceous	2.8	0.9	0.3	0.2	9.1	1.4	2.1
Percent of Pasture/Hay	54.5	55.5	25.9	78.2	64.0	33.0	40.9
Percent of Cultivated Crops	15.7	0.5	40.6	8.5	13.2	50.5	0.2
Percent of Woody Wetlands	0.3	0.1	2.4	2.6	0.5	1.3	0.5
Percent of Emergent Herbaceous Wetlands	0.1	0.0	0.2	0.0	0.0	0.0	0.0
Acres Open Water (percent of total)	718	318	372	153	80	39	639
Acres Developed, Open Space	1,877	1,520	2,248	894	953	765	7,730

Landuse Category	WQM Station						
	Horse Creek	Sycamore Creek	Tar Creek	Cow Creek	Russell Creek	Fourmile Creek	Elk River
Waterbody ID	OK121600030440_00	OK121600030445_00	OK121600030510_00	OK121600040060_00	OK121600040130_00	OK121600040170_00	OK121600040200_00
Acresa Developed, Low Intensity	574	137	3,337	134	23	61	1,157
Acres Developed, Medium Intensity	63	10	1,196	2	0	3	387
Acres Developed, High Intensity	7	1	449	0	0	0	171
Acres Barren Land (Rock/Sand/Clay)	10	0	1,738	0	0	58	244
Acres Deciduous Forest	3,585	13,656	1,329	746	2,072	1,704	80,537
Acres Evergreen Forest	0	57	2	0	7	0	677
Acres Mixed Forest	0	3	0	4	46	0	127
Acres Shrub/Scrub	6	28	9	68	0	1	94
Acres Grassland/Herbaceous	726	312	108	34	2,173	274	3,389
Acres Pasture/Hay	13,993	20,203	9,068	15,022	15,344	6,284	66,599
Acres Cultivated Crops	4,026	165	14,189	1,636	3,168	9,611	399
Acres Woody Wetlands	73	23	837	502	120	244	859
Acres Emergent Herbaceous Wetlands	20	0	72	7	1	1	8
Total (Acres)	**25,677**	**36,433**	**34,954**	**19,202**	**23,987**	**19,045**	**163,019**

Figure 1-1a Watersheds Not Supporting Primary Body Contact Recreation Use within the Study Area

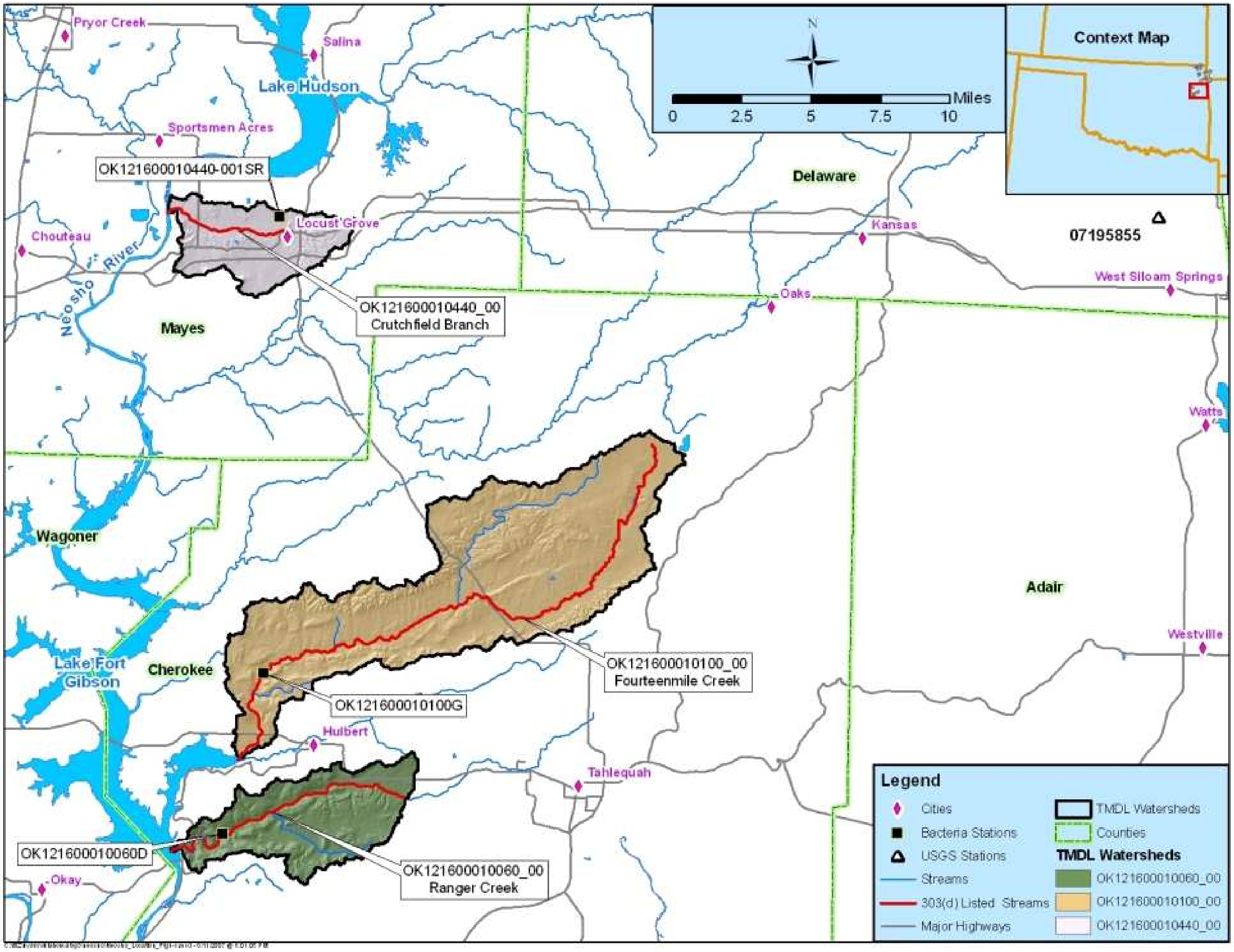


Figure 1-1b Watersheds Not Supporting Primary Body Contact Recreation Use within the Study Area

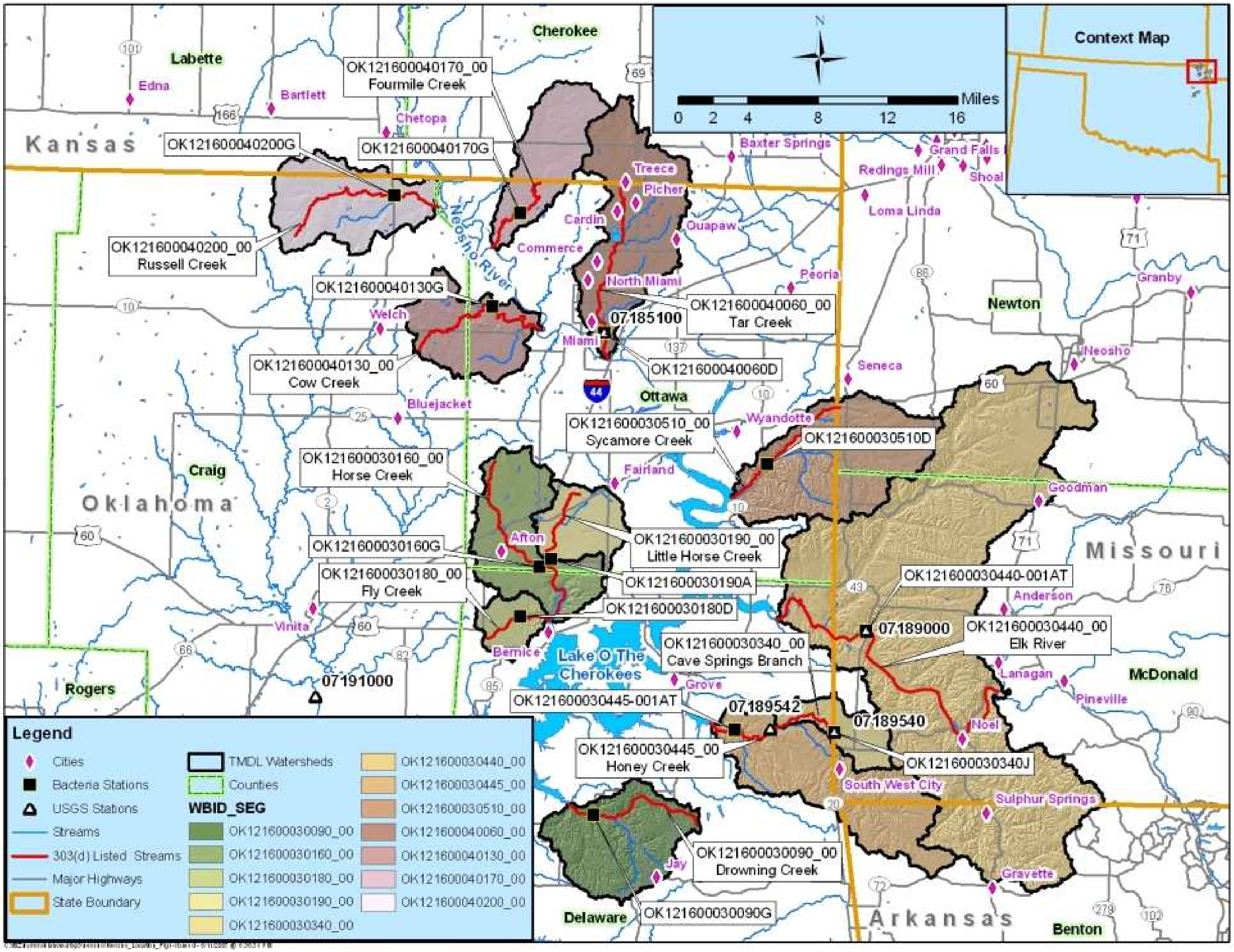


Figure 1-2a Land Use Map byWatershed

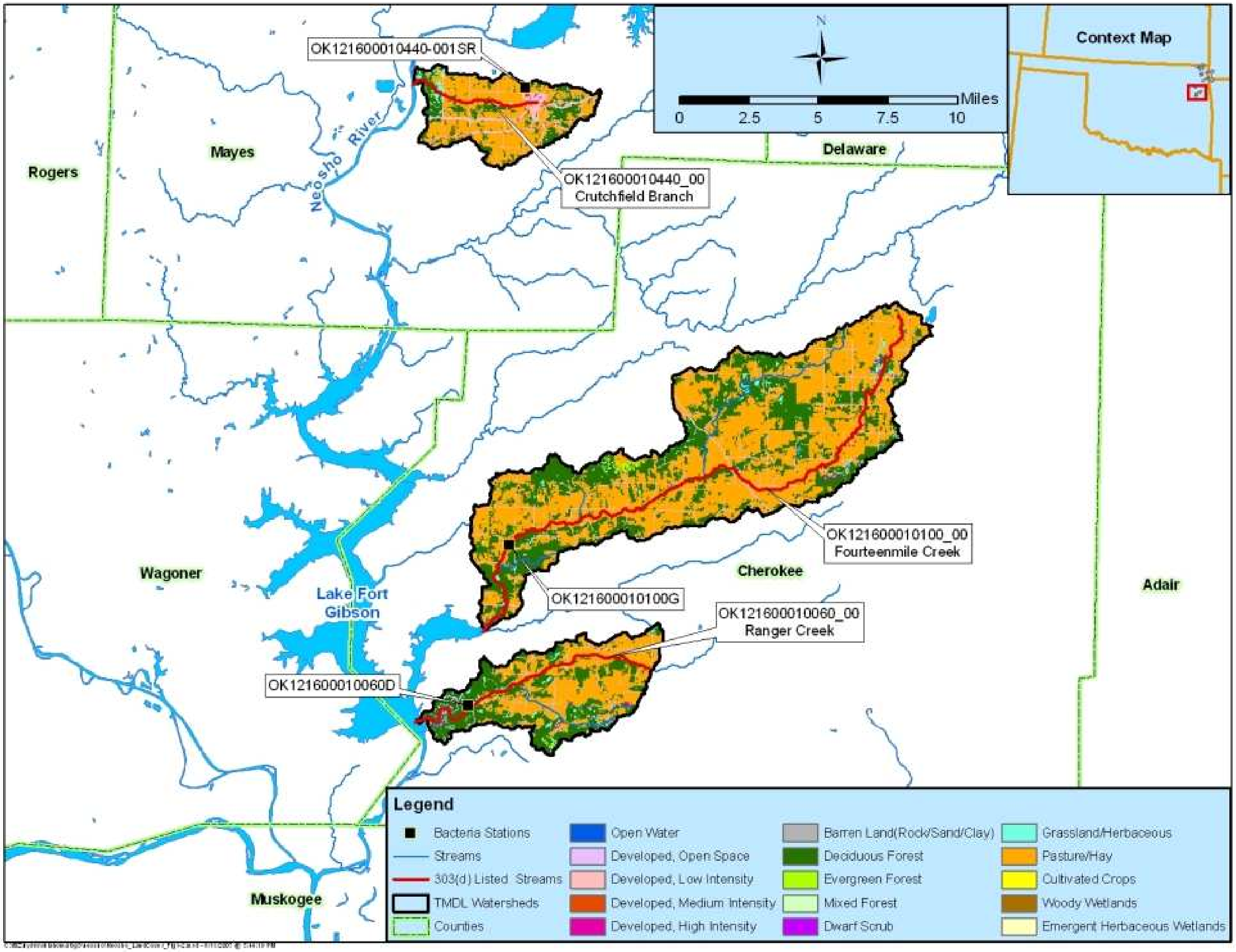
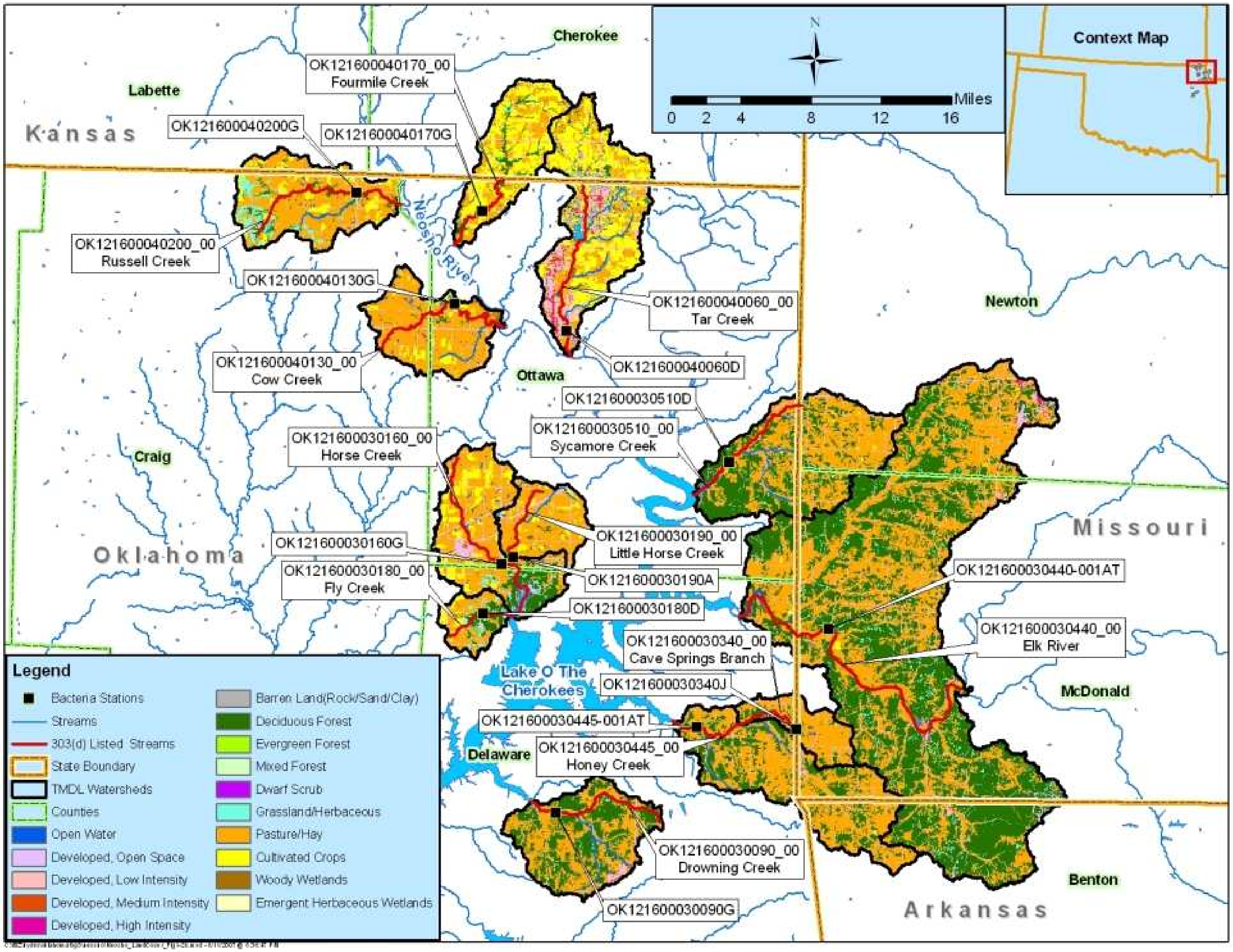


Figure 1-2b Land Use Map byWatershed



SECTION 2
PROBLEM IDENTIFICATION AND WATER QUALITY TARGET

2.1 Oklahoma Water Quality Standards

Title 785 of the Oklahoma Administrative Code authorizes the Oklahoma Water Resources Board (OWRB) to promulgate Oklahoma's water quality standards (OWRB 2006). The OWRB has statutory authority and responsibility concerning establishment of state water quality standards, as provided under 82 Oklahoma Statute [O.S.], §1085.30. This statute authorizes the OWRB to promulgate rules …*which establish classifications of uses of waters of the state, criteria to maintain and protect such classifications, and other standards or policies pertaining to the quality of such waters.* [O.S. 82:1085:30(A)]. Beneficial uses are designated for all waters of the state. Such uses are protected through restrictions imposed by the antidegradation policy statement, narrative water quality criteria, and numerical criteria (OWRB 2006). The beneficial uses designated for Ranger Creek (OK121600010060), Fourteenmile Creek (OK121600010100), Crutchfield Branch (OK121600010440), Drowning Creek (OK121600030090), Horse Creek (OK121600030160), Fly Creek (OK121600030180), Little Horse Creek (OK121600030190), Cave Springs Branch (OK121600030340), Elk River (OK121600030440), Honey Creek (OK121600030445), Sycamore Creek (OK121600030510), Tar Creek (OK121600040060), Cow Creek (OK121600040130), Fourmile Creek (OK121600040170), and Russell Creek (OK121600040200) in this TMDL include PBCR, public/private water supply, warm water aquatic community, industrial and municipal process and cooling water, agricultural water supply, emergency water supply, habitat limited aquatic community, high quality water, fish consumption, cool water aquatic community and aesthetics. The TMDLs in this report only address the PBCR-designated use. Table 2 1, an excerpt from Appendix B of the 2004 Integrated Report (ODEQ 2004), summarizes the PBCR use attainment status for the waterbodies of the Study Area and targeted TMDL date. The priority for targeting TMDL development and implementation is derived from the chronological order of the dates listed in the TMDL Date column of Table 2-1. The TMDLs established in this report are a necessary step in the process to restore the PBCR use designation for each waterbody.

Table 2-1 Excerpt from the 2004 Integrated Report – Comprehensive Waterbody Assessment Category List

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK121600010060_00	Ranger Creek	10.52	5	2009	N
OK121600010100_00	Fourteenmile Creek	26.06	5	2009	N
OK121600010440_00	Crutchfield Branch	5	5	2018	N
OK121600030090_00	Drowning Creek	14.4	5	2009	N
OK121600030160_00	Horse Creek	18.69	5	2009	N

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK121600030180_00	Fly Creek	4.27	5	2009	N
OK121600030190_00	Little Horse Creek	6.46	5	2009	N
OK121600030340_00	Cave Springs Branch	12.85	5	2004	N
OK121600030440_00	Elk River	13.11	5	2005	N
OK121600030445_00	Honey Creek	9.73	5	2005	N
OK121600030510_00	Sycamore Creek	9.18	5	2009	N
OK121600040060_00	Tar Creek 139	12	5	2009	N
OK121600040130_00	Cow Creek	12.42	5	2009	N
OK121600040170_00	Fourmile Creek	7.1	5	2009	N
OK121600040200_00	Russell Creek	11.48	5	2009	N

N = Not Supporting; Source: 2004 Integrated Report, ODEQ 2004

The definition of PBCR is summarized by the following excerpt from Chapter 45 of the Oklahoma WQSs.

(a) Primary Body Contact Recreation involves direct body contact with the water where a possibility of ingestion exists. In these cases the water shall not contain chemical, physical or biological substances in concentrations that are irritating to skin or sense organs or are toxic or cause illness upon ingestion by human beings.

(b) In waters designated for Primary Body Contact Recreation...limits...shall apply only during the recreation period of May 1 to September 30. The criteria for Secondary Body Contact Recreation will apply during the remainder of the year.

To implement Oklahoma's WQS for PBCR, OWRB promulgated Chapter 46, *Implementation of Oklahoma's Water Quality Standards* (OWRB 2007). The excerpt below from Chapter 46: 785:46-15-6, stipulates how water quality data will be assessed to determine support of the PBCR use as well as how the water quality target for TMDLs will be defined for each bacteria indicator.

(a) Scope. The provisions of this Section shall be used to determine whether the subcategory of Primary Body Contact of the beneficial use of Recreation designated in OAC 785:45 for a waterbody is supported during the recreation season from May 1 through September 30 each year. Where data exist for multiple bacterial indicators on the same waterbody or waterbody segment, the determination of use support shall be based upon the use and application of all applicable tests and data.

(b) Screening levels.

(1) The screening level for fecal coliform shall be a density of 400 colonies per 100ml.

(2) The screening level for Escherichia coli shall be a density of 235 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 406 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(3) The screening level for enterococci shall be a density of 61 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 108 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(c) Fecal coliform:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is met and no greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section.

(2) The parameter of fecal coliform is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is not met, or greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(d) Escherichia coli (E. coli):

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to E. coli if the geometric mean of 126 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of E. coli is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to E. coli if the geometric mean of 126 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

(e) Enterococci:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to enterococci if the geometric mean of 33 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of enterococci is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to enterococci if the geometric mean of 33 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

Compliance with the Oklahoma WQS is based on meeting requirements for all three bacteria indicators. Where concurrent data exist for multiple bacterial indicators on the same waterbody or waterbody segment, each indicator group must demonstrate compliance with the numeric criteria prescribed (OWRB 2006).

As stipulated in the WQS, utilization of the geometric mean to determine compliance for any of the three indicator bacteria depends on the collection of five samples within a 30-day period. For most WQM stations in Oklahoma there are insufficient data available to calculate the 30-day geometric mean since most water quality samples are collected once a month. As a result, waterbodies placed on the 303(d) list for not supporting the PBCR are the result of individual samples exceeding the instantaneous criteria or the long-term geometric mean of individual samples exceeding the geometric mean criteria for each respective bacteria indicator. Targeting the instantaneous criterion established for the primary contact recreation season (May 1st to September 30th) as the water quality goal for TMDLs corresponds to the basis for 303(d) listing and may be protective of the geometric mean criterion as well as the criteria for the secondary contact recreation season. However, both the instantaneous and geometric mean criteria for *E. coli* and Enterococci will be evaluated as water quality targets to ensure the most protective goal is established for each waterbody.

The specific data assessment method for listing indicator bacteria based on instantaneous or single sample criterion is detailed in Oklahoma's 2004 Integrated Report. As stated in the report, a minimum of 10 samples collected between May 1st and September 30th (during the primary recreation season) is required to list a segment for *E. coli* and Enterococci.

A sample quantity exception exists for fecal coliform that allows waterbodies to be listed for nonsupport of PBCR if there are less than 10 samples. The assessment method states that if there are less than 10 samples and the existing sample set already assures a nonsupport determination, then the waterbody should be listed for TMDL development. This condition is true in any case where the small sample set demonstrates that at least three out of six samples exceed the single sample fecal coliform criterion. In this case if four more samples were available to meet minimum of 10 samples, this would still translate to >25 percent exceedance or nonsupport of PBCR (*i.e.,* three out of 10 samples = 33 percent exceedance). For *E. coli* and Enterococci, the 10-sample minimum was used, without exception, in attainment determination.

2.2 Problem Identification

Table 2-2 summarizes water quality data collected during the primary contact recreation season from the WQM stations between 1997 and 2006 for each indicator bacteria. The 1999 to 2003 subset of these data collected during the primary contact recreation season were used to support the decision to place specific waterbodies within the Study Area on the ODEQ 2004 303(d) list (ODEQ 2004). Water quality data from the primary and secondary contact recreation seasons are provided in Appendix A. For the data collected between 1997 and 2005, evidence of nonsupport of the PBCR use based only on fecal coliform concentrations was observed in five waterbodies: Horse Creek (OK121600030160), Fly Creek (OK121600030180), Cow Creek (OK121600040130), Fourmile Creek (OK121600040170), and Russell Creek (OK121600040200). Evidence of nonsupport of the PBCR use based only on Enterococci concentrations was observed in four waterbodies: Ranger Creek (OK121600010060), Elk Creek (OK121600030440), Sycamore Creek (OK121600030510), and Tar Creek 139 (OK121600040060). Evidence of nonsupport of the PBCR use based on both fecal coliform and Enterococci concentrations was observed in four waterbodies: Fourteenmile Creek (OK121600010100), Drowning Creek (OK121600030090), Little Horse Creek (OK121600030190), and Honey Creek (OK121600030445). Evidence of nonsupport of the PBCR use based on both *E. coli* and fecal coliform was observed in only one waterbody: Cave Branch Creek (OK121600030340). Lastly, evidence of nonsupport for all three bacteria indicators was observed in Crutchfield Branch (OK121600010440). Table 2-3 summarizes the waterbodies requiring TMDLs for not supporting PBCR.

2.3 Water Quality Target

The Code of Federal Regulations (40 CFR §130.7(c)(1)) states that, "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards." For the WQM stations requiring TMDLs in this report, defining the water quality target is somewhat complicated by the use of three different bacteria indicators with three different numeric criterion for determining attainment of PBCR use as defined in the Oklahoma WQSs. As previously stated, because available bacteria data were collected on an approximate monthly basis (see Appendix A) instead of at least five samples over a 30–day period, data for these TMDLs are analyzed and presented in relation to the instantaneous criteria for fecal coliform and both the instantaneous and a long-term geometric mean for both *E. coli* and Enterococci.

All TMDLs for fecal coliform must take into account that no more than 25 percent of the samples may exceed the instantaneous numeric criteria. For *E. coli* and Enterococci, no more than 10 percent of samples may exceed instantaneous criteria. Since the attainability of stream beneficial uses for *E. coli* and Enterococci is based on the compliance of either the instantaneous or a long-term geometric mean criterion, percent reductions goals will be calculated for both criteria. TMDLs will be based on the percent reduction required to meet either the instantaneous or long-term geometric mean criterion, whichever is less.

The water quality target for each waterbody will also incorporate an explicit 10 percent MOS. For example, if fecal coliform is utilized to establish the TMDL, then the water quality target is 360 organisms per 100 milliliters (mL), 10 percent lower than the instantaneous water quality criteria (400/100 mL). For *E. coli* the instantaneous water quality target is 365 organisms/100 mL, which is 10 percent lower than the criterion value (406/100 mL), and the geometric mean water quality target is 113 organisms/100 mL, which is 10 percent lower than the criterion value (126/100 mL). For Enterococci the instantaneous water quality target is 97/100 mL, which is 10 percent lower than the criterion value (108/100 mL) and the geometric mean water quality target is 30 organisms/100 mL, which is 10 percent lower than the criterion value (33/100 mL).

Each water quality target will be used to determine the allowable bacteria load which is derived by using the actual or estimated flow record multiplied by the instream criteria minus a 10 percent MOS. The line drawn through the allowable load data points is the water quality target which represents the maximum load for any given flow that still satisfies the WQS.

Table 2-2 Summary of Indicator Bacteria Samples from Primary Contact Recreation Season, 1997-2006

Waterbody ID	Waterbody Name	Indicator Bacteria	Single Sample Water Quality Criterion (#/100ml)	Geometric Mean Concentration (count/100ml)	Number of Samples	Number of Samples Exceeding Single Sample Criterion	% of Samples Exceeding Single Sample Criterion	Reason for Listing Change
OK121600010060_00	Ranger Creek	FC	400	1510	1	1	100%	
		EC	406	84	8	3	38%	Delist: Low Sample Count
		ENT	108	91	11	4	36%	
OK121600010100_00	Fourteenmile Creek	FC	400	130	9	3	33%	List: >25%
		EC	406	84	10	2	20%	Delist: < 126 Geo Mean
		ENT	108	86	20	10	50%	
OK121600010440_00	Crutchfield Branch, off US 412, Locust Grove	FC	400	4588	11	10	91%	
		EC	406	2670	10	9	90%	
		ENT	108	5166	10	10	100%	
OK121600010440_00	Crutchfield Branch, off US 82, Locust Grove	FC	400	2482	8	7	88%	
		EC	406	1154	8	6	75%	
		ENT	108	1534	8	8	100%	
OK121600030090_00	Drowning Creek	FC	400	174	11	3	27%	List: >25%
		EC	406	35	10	1	10%	Delist: < 126 Geo Mean
		ENT	108	47	10	2	20%	
OK121600030160_00	Horse Creek	FC	400	454	9	5	56%	
		EC	406	393	2	1	50%	Delist: Low Sample Count
		ENT	108	16000	1	1	100%	
OK121600030180_00	Fly Creek	FC	400	220	9	3	33%	
		EC	406	60	2	0	0%	
		ENT	108	470	1	1	100%	
OK121600030190_00	Little Horse Creek	FC	400	231	11	4	36%	
		EC	406	33	10	2	20%	Delist: < 126 Geo Mean
		ENT	108	134	13	7	54%	
OK121600030340_00	Cave Springs Branch Site 2 near South West City, MO	FC	400	350	46	21	46%	
		EC	406	243	41	12	29%	

Waterbody ID	Waterbody Name	Indicator Bacteria	Single Sample Water Quality Criterion (#/100ml)	Geometric Mean Concentration (count/100ml)	Number of Samples	Number of Samples Exceeding Single Sample Criterion	% of Samples Exceeding Single Sample Criterion	Reason for Listing Change
OK121600030440_00	Elk River at SH 43 near Tiff City, MO	FC	400	40	59	4	7%	
		EC	406	22	59	2	3%	
		ENT	108	62	26	7	27%	
OK121600030445_00	Honey Creek, off SH 25, Grove	FC	400	238	11	6	55%	List: >25%
		EC	406	89	11	1	9%	
		ENT	108	293	11	9	82%	
OK121600030510_00	Sycamore Creek	FC	400	850	1	1	100%	
		EC	406	30	8	1	13%	Delist: Low Sample Count
		ENT	108	40	11	1	9%	
OK121600030560_00	Lost Creek	FC	400	143	8	1	13%	
		EC	406	96	2	0	0%	Delist: Low Sample Count
		ENT	108	40	1	0	0%	
OK121600040060_00	Tar Creek at Miami, OK	FC	400	600	1	1	100%	
		EC	406	366	8	3	38%	
		ENT	108	151	13	7	54%	
OK121600040130_00	Cow Creek	FC	400	180	9	3	33%	
OK121600040170_00	Fourmile Creek	FC	400	239	9	3	33%	
		EC	406	27	2	0	0%	
		ENT	108	90	1	0	0%	
OK121600040200_00	Russell Creek	FC	400	281	10	3	30%	
		EC	406	87	2	0	0%	
		ENT	108	550	1	1	100%	

EC = *E. coli*; ENT = enterococci; FC = fecal coliform
Highlighted bacteria indicators require TMDL

Table 2-3 Waterbodies Requiring TMDLs for Not Supporting Primary Contact Recreation Use

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria		
			FC	ENT	*E. coli*
OK121600010060D	OK121600010060_00	Ranger Creek		X	
OK121600010100G	OK121600010100_00	Fourteenmile Creek	X	X	
OK121600010440-001SR	OK121600010440_00	Crutchfield Branch	X	X	X
OK121600030090G	OK121600030090_00	Drowning Creek	X	X	
OK121600030160G	OK121600030160_00	Horse Creek	X		
OK121600030180D	OK121600030180_00	Fly Creek	X		
OK121600030190A	OK121600030190_00	Little Horse Creek	X	X	
OK121600030340J	OK121600030340_00	Cave Springs Branch	X		X
OK121600030440-001AT	OK121600030440_00	Elk River		X	
OK121600030445-001AT	OK121600030445_00	Honey Creek	X	X	
OK121600030510D	OK121600030510_00	Sycamore Creek		X	
OK121600040060D	OK121600040060_00	Tar Creek 139		X	
OK121600040130G	OK121600040130_00	Cow Creek	X		
OK121600040170G	OK121600040170_00	Fourmile Creek	X		
OK121600040200G	OK121600040200_00	Russell Creek	X		

ENT = enterococci; FC = fecal coliform

SECTION 3
POLLUTANT SOURCE ASSESSMENT

A source assessment characterizes known and suspected sources of pollutant loading to impaired waterbodies. Sources within a watershed are categorized and quantified to the extent that information is available. Bacteria originate from warm-blooded animals; some plant life and sources may be point or nonpoint in nature.

Point sources are permitted through the NPDES program. NPDES-permitted facilities that discharge treated wastewater are required to monitor for one of the three bacteria indicators (fecal coliform, *E coli*, or Enterococci) in accordance with its permit. Nonpoint sources are diffuse sources that typically cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources may involve land activities that contribute bacteria to surface water as a result of rainfall runoff. For the TMDLs in this report, all sources of pollutant loading not regulated by NPDES are considered nonpoint sources. The following discussion describes what is known regarding point and nonpoint sources of bacteria in the impaired watersheds. Where information was available on point and nonpoint sources of bacteria originating in portions of the impaired watersheds located in Kansas, Missouri, or Arkansas, data were provided and summarized as part of each category. These data were provided to demonstrate that some of the bacteria loading outside of Oklahoma's jurisdiction may contribute to nonsupport of the PBCR use in Oklahoma. It is recognized that Oklahoma has no enforcement authority over bacteria sources originating beyond the Oklahoma state boundary.

3.1 NPDES-Permitted Facilities

Under 40CFR, §122.2, a point source is described as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Certain NPDES-permitted municipal plants are classified as no-discharge facilities. NPDES-permitted facilities classified as point sources that may contribute bacteria loading include:

- NPDES municipal wastewater treatment plants (WWTP);
- NPDES municipal no-discharge WWTP;
- NPDES municipal separate storm sewer discharge (MS4); and
- NPDES Concentrated Animal Feeding Operation (CAFO).

Continuous point source discharges such as WWTPs, could result in discharge of elevated concentrations of fecal coliform bacteria if the disinfection unit is not properly maintained, is of poor design, or if flow rates are above the disinfection capacity. While the no-discharge facilities do not discharge wastewater directly to a waterbody, it is possible that the collection systems associated with each facility may be a source of bacteria loading to surface waters. Stormwater runoff from MS4 areas, which is now regulated under the USEPA NPDES Program, can also contain high fecal coliform bacteria concentrations. There are two urbanized areas designated as MS4s within this Study Area; however, one of these is located in Missouri and only 0.2% MS4 area falls under the study watershed, so it is not addressed in this report. CAFOs are recognized by USEPA as significant sources of pollution, and may have the potential to cause serious impacts to water quality if not properly managed.

There are no NPDES-permitted facilities of any type in the contributing watersheds of Fourteenmile Creek, Fly Creek, Little Horse Creek, Cow Creek, Fourmile Creek, and Russell Creek.

Nine of the 15 watersheds in the Study Area, including Ranger Creek (OK121600010060_00), Crutchfield Branch (OK121600010440_00), Drowning Creek (OK121600030090_00), Horse Creek (OK121600030160_00), Cave Springs Branch (OK121600030340_00), Elk River (OK121600030440_00), Honey Creek (OK121600030445_00), Sycamore Creek (OK121600030510_00), and Tar Creek (OK121600040060_00) have a continuous point source discharger.

3.1.1 Continuous Point Source Discharges

The location of the NPDES-permitted facility which discharges wastewater to surface waters addressed in these TMDLs are shown in Figure 3-1 and is listed in Table 3-1. For the purposes of the pollutant sources assessment only facility types identified in Table 3-1 as Sewerage Systems, Poultry Slaughtering and Processing, and Mobile Home Sites are assumed to contribute bacteria loads within the watersheds of the impaired waterbodies. For some continuous point source discharge facilities the permitted design flow was not available and therefore is not provided in Table 3-1.

Table 3-1 Point Source Discharges in the Study Area

NPDES Permit No.	Name	Receiving Water	Facility Type	County Name	Design Flow (mgd)	Active/ Inactive	Facility ID
OK0022772	Locust Grove Public Works Authority	OK121600010440_00 Crutchfield Branch	Sewerage Systems	Mayes	0.50	Active	S21620
OK0031976	Jay Utilities Authority	OK121600030090_00 Drowning Creek	Sewerage Systems	Delaware	1.10	Active	S21614
OK0020656	Afton Public Works Authority	OK121600030160_00 Horse Creek	Sewerage Systems	Ottawa	0.14	Active	S21613
OK0020320	City of Commerce	OK121600040060_00 Tar Creek	Sewerage Systems	Ottawa	0.32	Active	S21605
OK0032263	City of Picher	OK121600040060_00 Tar Creek	Sewerage Systems	Ottawa	0.18	Active	S21603
OK0038962	Cardin Special Utilities	OK121600040060_00 Tar Creek	Sewerage Systems	Ottawa	0.05	Active	S21604
OK0033359	Cherokee Co Rural Water Dst	OK121600010060_00 Ranger Creek	Sewerage Systems	Cherokee	N/A	N/A	
YCRCLA349	Tar Creek	OK121600040060_00 Tar Creek	Services, Nec	Ottawa	N/A	N/A	
OK0031810	City of Miami	OK121600040060_00 Tar Creek	Sewerage Systems	Ottawa	N/A		

NPDES Permit No.	Name	Receiving Water	Facility Type	County Name	Design Flow (mgd)	Active/ Inactive	Facility ID
Arkansas Facilities							
AR0036480	City of Sulphur Springs	OK121600030440_00 Elk River	Sewerage Systems	Benton	0.10		
AR0046639	Benton County Stone Co., Inc.	OK121600030440_00 Elk River	Crushed And Broken Limestone	Benton	N/A		
Missouri Facilities							
MO0036773	Simmons Foods, Inc.	OK121600030340_00 Cave Springs Branch	Poultry Slaughtering & Process	McDonald	2.0		
MOG490392	N/A	OK121600030340_00 Cave Springs Branch	N/A	N/A	N/A		
MOG490654	N/A	OK121600030340_00 Cave Springs Branch	N/A	N/A	N/A		
MO0002500	Tyson Food, Inc	OK121600030440_00 Elk River	Poultry Slaughtering & Process	McDonald	2.482		
MO0039926	Neosho, Crowder WWTP	OK121600030440_00 Elk River	Sewerage Systems	Newton	3.0		
MO0054721	Noel WWTP	OK121600030440_00 Elk River	Sewerage Systems	McDonald	0.5		
MO0112101	Talbot Ind,inc - Plant #2	OK121600030440_00 Elk River	Wire Springs	Newton	0.402		
MO0112534	Goodman WWTP	OK121600030440_00 Elk River	Sewerage Systems	McDonald	0.130		
MO0116505	Park Place Neosho WWTP	OK121600030440_00 Elk River	Oper of Res Mobile Home Sites	Newton	0.007		
MO0123986	Quail Meadows Mobile Home Park	OK121600030440_00 Elk River	Oper of Res Mobile Home Sites	Newton	0.004		
MO0130176	Micronics, LLC	OK121600030440_00 Elk River	Nitrogen Fertilizers	McDonald	1.20		
MOG350044	Corp Barbara Chamberlain	OK121600030440_00 Elk River	Petroleum Bulk Stations & Term	McDonald	N/A		
MOG350158	MFA Bulk Plant-Neosho	OK121600030440_00 Elk River	Petroleum Bulk Stations & Term	Newton	N/A		

NPDES Permit No.	Name	Receiving Water	Facility Type	County Name	Design Flow (mgd)	Active/ Inactive	Facility ID
MOG490319	Neosho Quarry	OK121600030440_00 Elk River	Crushed and Broken Limestone	Newton	N/A		
MOG490714	N & M Concrete	OK121600030440_00 Elk River	Concrete Prod Exc Blck & Brick	Newton	N/A		
MOG490725	Neosho Concrete Products	OK121600030440_00 Elk River	Crushed and Broken Limestone	Newton	N/A		
MOR109K75	Lane Estates	OK121600030440_00 Elk River	Heavy Construction, Nec	Newton	N/A		
MOR109M95	Prairie View Mobile Home	OK121600030440_00 Elk River	Heavy Construction, Nec	Newton	N/A		
MOR22A099	William Sarratt	OK121600030440_00 Elk River	Wood Preserving	McDonald	N/A		
MOR22C018	Marco Group Inc	OK121600030440_00 Elk River	Wood Preserving	Newton	N/A		
MOR22C026	La-Z-Boy Midwest	OK121600030440_00 Elk River	Wood Preserving	Newton	N/A		
MOR23A063	Praxair, Inc.	OK121600030440_00 Elk River	Medicinal Chem/ Botanical Prod	Newton	N/A		
MOR23A077	BASF Neosho Plant	OK121600030440_00 Elk River	Medicinal Chem/ Botanical Prod	Newton	N/A		
MOR240446	Howard Johnsons Enterprises Inc	OK121600030440_00 Elk River	Farm Supplies	Newton	N/A		
MOR60A098	Larry Bennett	OK121600030440_00 Elk River	Motor Vehicle Parts, Used	McDonald	N/A		
MOR60A222	Poore Truck Salvage Inc.	OK121600030440_00 Elk River	Motor Vehicle Parts, Used	Newton	N/A		
MOR80C108	Ngmo-Emp, National Guard	OK121600030440_00 Elk River	Trucking Terminal Facilities	Newton	N/A		
MOR80F021	Neosho Memorial Airport	OK121600030440_00 Elk River	Airports, Flying Fields, and Airport Ter	Newton	N/A		
MO0036765	South West City WWTP	OK121600030445_00 Honey Creek	Sewerage Systems	McDonald	0.140		
MOR22A011	Woodward Pallet & Lumber	OK121600030510_00 Sycamore Creek	Wood Preserving	Newton	N/A		

NPDES Permit No.	Name	Receiving Water	Facility Type	County Name	Design Flow (mgd)	Active/ Inactive	Facility ID
Kansas Facilities							
KS0081698	City of Treece	OK121600040060_00 Tar Creek	Sewerage Systems	Cherokee	0.0286		

N/A = not available

Discharge Monitoring Reports (DMR) were used to determine the number of fecal coliform analyses performed from 1998 through 2007, the maximum concentration during this period, the number of violations occurring when the monthly geometric mean concentration exceeded 200 colony forming units (cfu)/100 mL, and the number of violations when a daily maximum concentration exceeded 400 cfu/100 mL. DMR data for fecal coliform were only available for the Locust Grove Public Works Authority, Jay Utilities Authority, Afton Public Works Authority, the City of Sulphur Springs, Tyson Food, Inc., South West City Wastewater Treatment Plant (WWTP), Simmons Foods, Inc., Neosho-Crowder WWTP, Noel WWTP, Goodman WWTP, and Quail Meadows Mobile Home Park (see Appendix B). These data indicate that there are no geometric mean violations occurring at the Neosho-Crowder WWTP, Noel WWTP, Locust Grove Public Works Authority, and Goodman WWTP. However, over the 10-year period, Jay Utilities Authority WWTP discharged violated geometric mean permit limits for fecal coliform 5 percent of the time, Afton Public Works Authority WWTP 4 percent of the time, both Tyson Food, Inc. and South West City WWTP violated permit limits 8 percent of the time, and both Quail Meadows Mobile Home Park and Sulphur Springs violated permit limits 1 percent of the time.

Figure 3-1a Locations of NPDES-Permitted Facilities and Poultry Operations in the Study Area

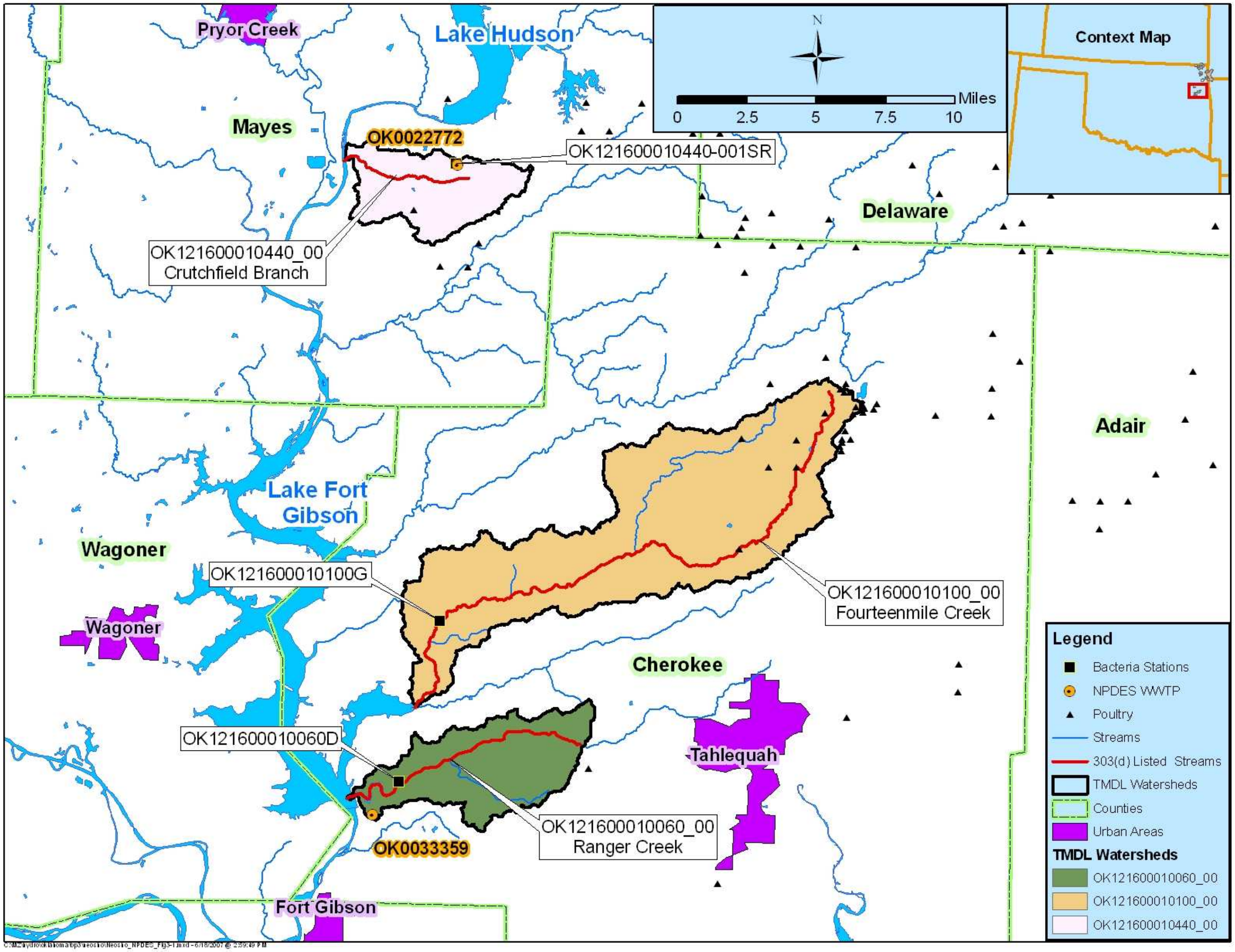
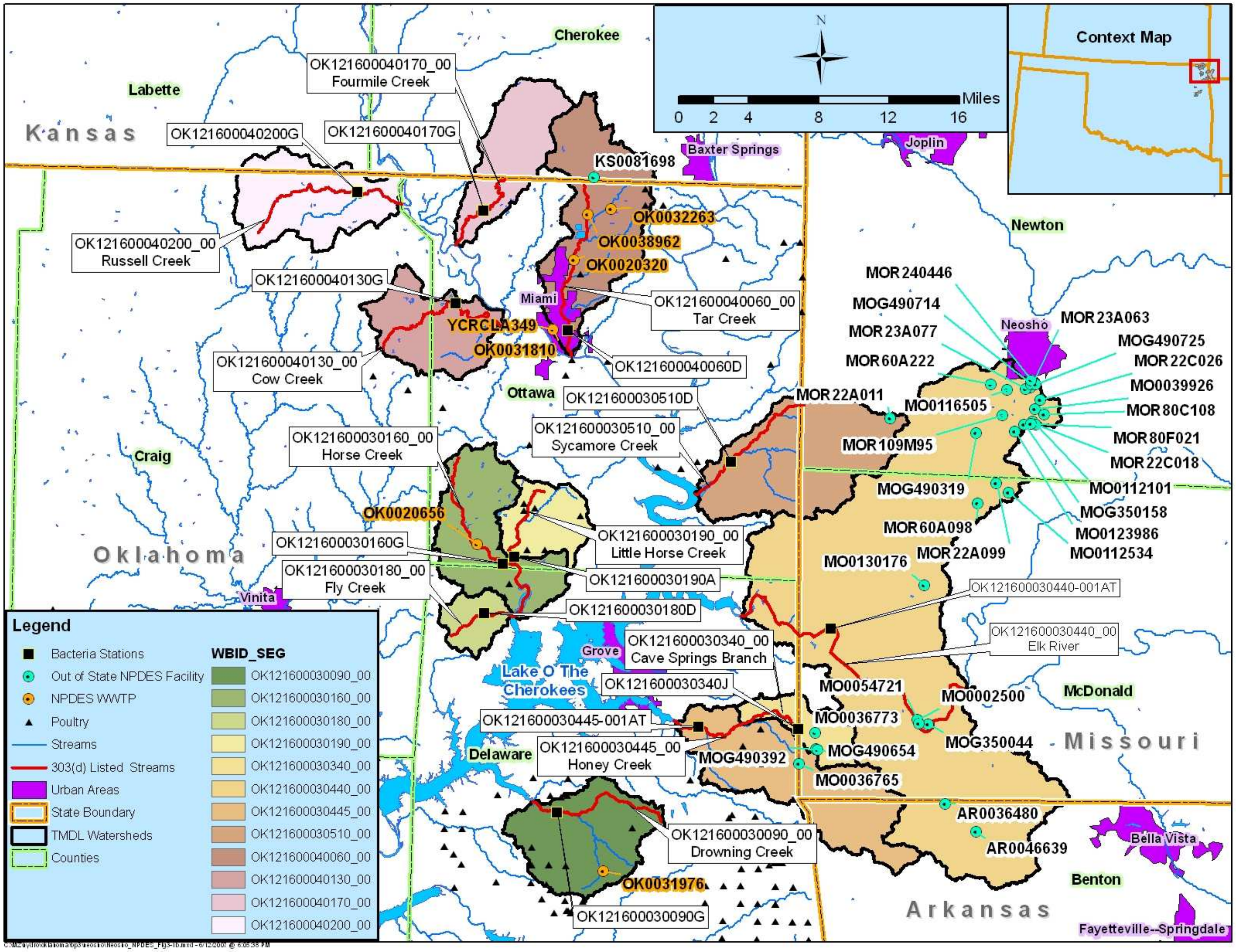


Figure 3-1b Locations of NPDES-Permitted Facilities and Oklahoma Poultry Operations in the Study Area



3.1.2 NPDES No-Discharge Facilities and SSOs

There are no NPDES-permitted no-discharge facilities in the Study Area. For the purposes of these TMDLs, no-discharge facilities do not contribute bacteria loading to the Neosho River and its tributaries. However, it is possible the wastewater collection systems associated with those WWTPs could be a source of bacteria loading, or that discharges may occur during large rainfall events that exceed the systems' storage capacities.

Sanitary sewer overflows (SSO) from wastewater collection systems, although infrequent, can be a major source of fecal coliform loading to streams. SSOs have existed since the introduction of separate sanitary sewers, and most are caused by blockage of sewer pipes by grease, tree roots, and other debris that clog sewer lines, by sewer line breaks and leaks, cross connections with storm sewers, and inflow and infiltration of groundwater into sanitary sewers. SSOs are permit violations that must be addressed by the responsible NPDES permittee. The reporting of SSOs has been strongly encouraged by USEPA, primarily through enforcement and fines. While not all sewer overflows are reported, ODEQ has some data on SSOs available. There were 355 SSO occurrences, ranging from 1 gallon to 3,676,000 gallons, reported for certain watersheds within the Study Area between January 1990 and January 2007 which are summarized in Table 3-2. Additional data on each individual SSO event are provided in Appendix B. No data were summarized for SSOs that may have occurred in portions of the Study Area located in Kansas, Missouri, or Arkansas. Given the significant number of occurrences and the size of overflows reported, bacteria from SSOs have been a significant source of bacteria loading in the past in the Horse Creek, Drowning Creek, Crutchfield Branch, and Tar Creek watersheds. Since data on out of state SSOs was not available, it is impossible to assess the significance of SSOs in Cave Springs, Honey Creek, Sycamore and especially Elk River watersheds.

Table 3-2 Sanitary Sewer Overflow Summary

Facility Name	NPDES Permit No.	Receiving Water	Facility ID	Number of Occurrences	Date Range		Amount (Gallons)	
					From	To	Min	Max
Afton	OK0020656	OK121600030160_00 Horse Creek	S21613	10	03/07/1990	12/16/2001	10,500	100,000
Commerce	OK0020320	OK121600040060_00 Tar Creek	S21605	51	06/01/1992	05/13/2003	0	2,500,000
Jay	OK0031976	OK121600030090_00 Drowning Creek	S21614	86	09/18/1991	01/19/2007	0	3,676,000
Locust Grove	OK0022772	OK121600010440_00 Crutchfield Branch	S21620	91	01/17/1990	02/26/1997	0	2,000,000
Miami		OK121600040060_00 Tar Creek	S21602	71	03/14/1990	01/12/2007	1	1,000,000
Miami		OK121600040060_00 Tar Creek	S21606	27	03/14/1993	12/09/1999	70	>1,000,000
Miami (North)		OK121600040060_00 Tar Creek	S21616	1	11/20/1994			270,000
Miami		OK121600040060_00 Tar Creek	S21647	2	01/15/1993	05/05/1995	0	2,000,000
Picher	OK0032263	OK121600040060_00 Tar Creek	S21603	16	02/05/1990	01/29/2001	0	1,500,000

SSOs are a common result of the aging wastewater infrastructure around the state. DEQ has been ahead of other states and, in some cases, EPA itself in its handling of SSOs. Due to the widespread nature of the SSO problem, DEQ has focused its limited resources to first target SSOs that result in definitive environmental harm, such as fish kills, or lead to citizen complaints. All SSOs falling in these two categories are addressed through DEQ's formal enforcement process. A Notice of Violation (NOV) is first issued to the owner of the collection system and a Consent Order (CO) is negotiated between the owner and DEQ to establish a schedule for necessary collection system upgrades to eliminate future SSOs.

Another target area for DEQ is chronic SSOs from OPDES major facilities, those with a total design flow in excess of 1 MGD. DEQ periodically reviews the bypass reports submitted by these major facilities and identifies problem areas and chronic SSOs. When these problems are attributable to wet weather, DEQ endeavors to enter into a CO with the owner of the collection system to establish a schedule for necessary repairs. When the problems seem to be dry weather-related, DEQ will encourage the owner of the collection system to implement the proposed Capacity, Management, Operation, and Maintenance (CMOM) guidelines aimed at minimizing or eliminating dry weather SSOs. This is often accomplished through entering into a Consent Order to establish a schedule for implementation and annual auditing of the CMOM program.

All SSOs are considered unpermitted discharges under State statute and DEQ regulations. The smaller towns have a smaller reserve, are more likely to use utility revenue for general purposes, and/or tend to budget less for ongoing and/or preventive maintenance. If and when DEQ becomes aware of chronic SSOs (more than one from a single location in a year) or receives a complaint about an SSO in a smaller community, DEQ will pursue enforcement action. Enforcement almost always begins with the issuance of an NOV and, if the problem is not corrected by a long-term solution, DEQ will enter into a CO with the facility for a long-term solution. Long-term solutions usually begin with sanitary sewer evaluation surveys (SSESs). Based on the result of the SSES, the facilities can prioritize and take corrective action.

3.1.3 NPDES Municipal Separate Storm Sewer Discharge (MS4)

Phase I MS4

In 1990 the USEPA developed rules establishing Phase I of the NPDES Stormwater Program, designed to prevent harmful pollutants from being washed by stormwater runoff into MS4s (or from being dumped directly into the MS4) and then discharged into local water bodies (USEPA 2005). Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or greater) to implement a stormwater management program as a means to control polluted discharges. Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipal-owned operations, and hazardous waste treatment. There are no Phase I MS4 permits in the Study Area.

Phase II MS4s

Phase II of the rules developed by the USEPA extends coverage of the NPDES Stormwater Program to certain small MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Stormwater Program. Phase II requires operators of regulated small MS4s to obtain NPDES permits and develop a stormwater management program. Programs are designed to reduce discharges of pollutants to the “maximum extent practicable,” protect water quality, and satisfy appropriate water quality requirements of the CWA. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities. Instead, stormwater discharges are required to meet a performance standard of providing treatment to the “maximum extent practical” through the implementation of best management practices (BMPs).

Small MS4 stormwater programs must address the following minimum control measures:

- Public Education and Outreach;
- Public Participation/Involvement;
- Illicit Discharge Detection and Elimination;
- Construction Site Runoff Control;
- Post- Construction Runoff Control; and
- Pollution Prevention/Good Housekeeping.

The small MS4 General Permit for communities in Oklahoma became effective on February 8, 2005. The small MS4 General Permit for communities in Missouri became effective on March 10, 2003 (MO-R004000) and requires all regulated MS4s to have stormwater management program in place by March 2008. The City of Miami, Oklahoma, located in Tar Creek (OK121600040060_00), falls under requirements designated by USEPA for inclusion in the Phase II Stormwater Program. The municipality was designated because its municipal boundaries intersected a U.S. Census-defined Urbanized Area. In an effort to quantify the relative contribution of bacteria loads from the MS4 area of the City of Miami, the percentage of the Tar Creek watershed under MS4 jurisdiction was calculated. The area of the City of Miami MS4 is estimated to be 4,128 acres or 11.8% of the watershed. While this is a relatively small portion of the total watershed the bacterial loads from the City of Miami urban area may be of concern. There are no Phase II MS4s in the following watersheds: Ranger Creek (OK121600010060_00), Fourteenmile Creek (OK121600010100_00), Crutchfield Branch (OK121600010440_00), Drowning Creek (OK121600030090_00), Horse Creek (OK121600030160_00), Fly Creek (OK121600030180_00), Little Horse Creek (OK121600030190_00), Cave Springs Branch (OK121600030340_00), Honey Creek (OK121600030445_00), Sycamore Creek (OK121600030510_00), Cow Creek (OK121600040130_00), Fourmile Creek (OK121600040170_00), and Russell Creek (OK121600040200_00).

ODEQ and the Missouri Department of Natural Resources provide information on the current status of their MS4 programs on their websites found at:

Oklahoma Department of Environmental Quality

http://www.deq.state.ok.us/WQDnew/stormwater/ms4/

Missouri Department of Natural Resources
http://www.dnr.mo.gov/env/wpp/stormwater/sw-local-gov-programs.htm

3.1.4 Concentrated Animal Feeding Operations

There are no NPDES-permitted CAFOs within the Study Area.

3.2 Nonpoint Sources

Nonpoint sources include those sources that cannot be identified as entering the waterbody at a specific location. Bacteria originate from rural, suburban, and urban areas. The following section describes possible major nonpoint sources contributing fecal coliform loading within the Study Area.

These sources include wildlife, various agricultural activities and domesticated animals, land application fields, urban runoff, failing onsite wastewater disposal (OSWD) systems, and domestic pets. As previously stated in Subsection 3.1, there are no NPDES-permitted facilities of any type in the contributing watershed of Fourteenmile Creek, Fly Creek, Little Horse Creek, Cow Creek, Fourmile Creek, and Russell Creek; therefore, nonsupport of PBCR use is caused by nonpoint sources of bacteria only.

Bacteria associated with urban runoff can emanate from humans, wildlife, commercially raised farm animals, and domestic pets. Water quality data collected from streams draining urban communities often show existing concentrations of fecal coliform bacteria at levels greater than a state's instantaneous standards. A study under USEPA's National Urban Runoff Project indicated that the average fecal coliform concentration from 14 watersheds in different areas within the United States was approximately 15,000 /100 mL in stormwater runoff (USEPA 1983). Runoff from urban areas not permitted under the MS4 program can be a significant source of fecal coliform bacteria. Water quality data collected from streams draining many of the nonpermitted communities show existing loads of fecal coliform bacteria at levels greater than the State's instantaneous standards. The specific requirements for bacteria control in a MS4 permit can be found in Appendix E. Appendix E also includes information on a list of BMPs and its effectiveness. Best management practices (BMP) such as buffer strips, repair of leaking sewage collection systems and proper disposal of domestic animal waste can reduce bacteria loading to waterbodies.

3.2.1 Wildlife

Fecal coliform bacteria are produced by all warm-blooded animals, including wildlife such as mammals and birds. In developing bacteria TMDLs it is important to identify the potential for bacteria contributions from wildlife by watershed. Wildlife is naturally attracted to riparian corridors of streams and rivers. With direct access to the stream channel, wildlife can be a concentrated source of bacteria loading to a waterbody. Fecal coliform bacteria from wildlife are also deposited onto land surfaces, where it may be washed into nearby streams by rainfall runoff. Currently there are insufficient data available to estimate populations and spatial distribution of wildlife and avian species by watershed. Consequently it is difficult to assess the magnitude of bacteria contributions from wildlife species as a general category.

However, adequate data are available by county to estimate the number of deer by watershed. This report assumes that deer habitat includes forests, croplands, and pastures. Using Oklahoma Department of Wildlife and Conservation county data, the population of deer can be roughly estimated from the actual number of deer harvested and harvest rate estimates. Because harvest success varies from year to year based on weather and other factors, the average harvest from 1999 to 2003 was combined with an estimated annual harvest rate of 20 percent to predict deer population by county. Using the estimated deer population by county and the percentage of the watershed area within each county, a wild deer population can be calculated for each watershed. Table 3-3 provides the estimated number of deer for each watershed. No attempt was made to adjust the estimated number of deer using different annual harvesting rates specific to the counties of the Study Area located in Kansas, Missouri, or Arkansas.

Table 3-3 Estimated Deer Populations

Waterbody ID	Waterbody Name	Deer	Acre
OK121600010060_00	Ranger Creek	422	13,769
OK121600010100_00	Fourteenmile Creek	1,389	45,421
OK121600010440_00	Crutchfield Branch	163	9,522
OK121600030090_00	Drowning Creek	455	24,951
OK121600030160_00	Horse Creek	469	25,675
OK121600030180_00	Fly Creek	122	6,689
OK121600030190_00	Little Horse Creek	225	12,292
OK121600030340_00	Cave Springs Branch	160	8,922
OK121600030440_00	Elk River	2789	163,015
OK121600030445_00	Honey Creek	635	34,510
OK121600030510_00	Sycamore Creek	637	36,436
OK121600040060_00	Tar Creek	1336	34,946
OK121600040130_00	Cow Creek	410	19,199
OK121600040170_00	Fourmile Creek	2213	19,045
OK121600040200_00	Russell Creek	602	23,994

According to a study conducted by ASAE (the American Society of Agricultural Engineers), deer release approximately $5 x 10^8$ fecal coliform units per animal per day (ASAE 1999). Although only a fraction of the total fecal coliform loading produced by the deer population may actually enter a waterbody, the estimated fecal coliform production for deer provided in Table 3-4 in cfu/day provides a relative magnitude of loading in each watershed.

Table 3-4 Estimated Fecal Coliform Production for Deer

Waterbody ID	Waterbody Name	Watershed Area (acres)	Wild Deer Population	Estimated Wild Deer per acre	Fecal Production (x 10^8 cfu/day) of Deer Population
OK121600010060_00	Ranger Creek	13,769	422	0.031	2,110
OK121600010100_00	Fourteenmile Creek	45,421	1,389	0.031	6,945
OK121600010440_00	Crutchfield Branch	9,522	163	0.017	815
OK121600030090_00	Drowning Creek	24,951	455	0.018	2,275
OK121600030160_00	Horse Creek	25,675	469	0.018	2,345
OK121600030180_00	Fly Creek	6,689	122	0.018	610
OK121600030190_00	Little Horse Creek	12,292	225	0.018	1,125
OK121600030340_00	Cave Springs Branch	8,922	160	0.018	800
OK121600030440_00	Elk River	163,015	2,789	0.017	13,945
OK121600030445_00	Honey Creek	34,510	635	0.018	3,175
OK121600030510_00	Sycamore Creek	36,436	637	0.017	3,185
OK121600040060_00	Tar Creek	34,946	1,336	0.038	6,680
OK121600040130_00	Cow Creek	19,199	410	0.021	2,050
OK121600040170_00	Fourmile Creek	19,045	2,213	0.116	11,065
OK121600040200_00	Russell Creek	23,994	602	0.025	3,010

3.2.2 Non-Permitted Agricultural Activities and Domesticated Animals

There are a number of non-permitted agricultural activities that can also be sources of fecal bacteria loading. Agricultural activities of greatest concern are typically those associated with livestock operations (Drapcho and Hubbs 2002). The following are examples of commercial raised farm animal activities that can contribute to bacteria sources:

- Processed commercially raised farm animal manure is often applied to fields as fertilizer, and can contribute to fecal bacteria loading to waterbodies if washed into streams by runoff.
- Animals grazing in pastures deposits manure containing fecal bacteria onto land surfaces. These bacteria may be washed into waterbodies by runoff.
- Animals often have direct access to waterbodies and can provide a concentrated source of fecal bacteria loading directly into streams.

Table 3-5 provides estimated numbers of commerically raised farm animals by watershed based on the 2002 U.S. Department of Agriculture (USDA) county agricultural census data (USDA 2002). The estimated animal populations in Table 3-5 were derived by using the percentage of the watershed within each county. Because the watersheds are generally much smaller than the counties, and commercially raised farm animals are not evenly distributed across counties or constant with time, these are rough estimates only. Poultry birds are the most abundant species in the Study Area; however, cattle generate the largest amount of fecal coliform and often have direct access to the impaired waterbodies or their tributaries.

Detailed information is not available to describe or quantify the relationship between instream concentrations of bacteria and land application of manure. The estimated acreage by watershed where manure was applied in 2002 is shown in Table 3-5. These estimates are also based on the county level reports from the 2002 USDA county agricultural census, and thus represent approximations of the land application area in each watershed. Because of the lack of specific data, land application of animal manure is not quantified in Table 3-6 but is considered a potential source of bacteria loading to the waterbodies in the Study Area. Most poultry feeding operations are regulated by ODAFF, and are required to land apply chicken waste in accordance with their Animal Waste Management Plans or Comprehensive Nutrient Management Plans. While these plans are not designed to controlled bacteria loading, best management practices and conservation measures, if properly implemented, could greatly reduce the contribution of bacteria from this group of animals to the watershed.

According to a study conducted by the ASAE, the daily fecal coliform production rates by species were estimated as follows (ASAE 1999):

- Beef cattle release approximately 1.04E+11 fecal coliform counts per animal per day;
- Dairy cattle release approximately 1.01E+11 per animal per day
- Swine release approximately 1.08E+10 per animal per day
- Chickens release approximately 1.36E+08 per animal per day
- Sheep release approximately 1.20E+10 per animal per day
- Horses release approximately 4.20E+08 per animal per day;
- Turkey release approximately 9.30E+07 per animal per day
- Ducks release approximately 2.43E+09 per animal per day
- Geese release approximately 4.90E+10 per animal per day

Using the estimated animal populations and the fecal coliform production rates from ASAE, an estimate of fecal coliform production from each group of commercially raised farm animals was calculated in Table 3-6 for each watershed of the Study Area. Note that only a small fraction of these fecal coliform are expected to represent loading into waterbodies, either washed into streams by runoff or by direct deposition from wading animals. Cattle appear to represent the largest source of fecal bacteria. For informational purposes, data on poultry operations provided by Oklahoma Department of Agriculture, Food and Forestry (ODAFF) are provided in Table 3-7. This poultry data was last updated on April 17, 2004. Table 3-7 lists an estimated number of birds within select watersheds for which data are available. These numbers are considered more representative since they are based on the number of contract poultry operations within the selected watershed because they are derived from an ODAFF geographic information system inventory. The general location of poultry operations are shown in Figure 3-1. However, for consistency, estimated fecal coliform production for the general category of poultry is based on USDA county agriculture census numbers as summarized in Table 3-6. Data were available to summarize the number and location of NPDES-permitted poultry processing plants located in the Missouri portion of the Elk River and Cave Springs Branch watersheds. These data are summarized in Table 3-8 and the locations of these poultry facilities are shown in Figure 3-1b.

Table 3-5 Commercially Raised Farm Animals and Manure Application Area Estimates by Watershed

Waterbody ID	Waterbody Name	Cattle & Calves-all	Dairy Cows	Horses & Ponies	Goats	Sheep & Lambs	Hogs & Pigs	Ducks & Geese	Chickens & Turkeys	Acres of Manure Application
OK121600010060_00	Ranger Creek	1,258	66	72	32	20	13	12	24,089	232
OK121600010100_00	Fourteenmile Creek	4,143	216	236	105	65	42	38	79,335	763
OK121600010440_00	Crutchfield Branch	1,701	120	65	36	16	15	6	29,005	264
OK121600030090_00	Drowning Creek	3,601	147	142	117	51	0	12	335,823	1,029
OK121600030160_00	Horse Creek	4,249	140	136	94	44	154	34	257,264	614
OK121600030180_00	Fly Creek	964	39	38	31	14	0	3	89,878	275
OK121600030190_00	Little Horse Creek	2,161	65	63	40	19	108	21	103,981	196
OK121600030340_00	Cave Springs Branch	1,266	48	23	16	13	0	2	148,826	523
OK121600030440_00	Elk River	21,846	713	181	67	206	251	24	2,887,498	11,272
OK121600030445_00	Honey Creek	5,628	202	117	83	74	0	10	784,090	2,383
OK121600030510_00	Sycamore Creek	4,549	118	101	60	37	256	31	240,019	1,342
OK121600040060_00	Tar Creek	5,554	197	200	111	59	223	53	225,962	645
OK121600040130_00	Cow Creek	3,870	72	105	108	20	91	28	95,493	308
OK121600040170_00	Fourmile Creek	2,662	116	123	60	35	68	25	80,138	410
OK121600040200_00	Russell Creek	5,322	51	124	169	16	19	24	33,104	358

Table 3-6 Fecal Coliform Production Estimates for Commercially Raised Farm Animals (x10^9 number/day)

Waterbody ID	Waterbody Name	Cattle & Calves-all	Dairy Cows	Horses & Ponies	Goats	Sheep & Lambs	Hogs & Pigs	Ducks & Geese	Chickens & Turkeys	Total
OK121600010060_00	Ranger Creek	130,813	6,623	30	N/A	237	138	203	3,057	141,101
OK121600010100_00	Fourteenmile Creek	430,829	21,814	99	N/A	780	455	668	10,069	464,713
OK121600010440_00	Crutchfield Branch	176,896	12,087	27	N/A	197	163	97	3,945	193,412
OK121600030090_00	Drowning Creek	374,551	14,882	60	N/A	614	0	231	45,672	436,010
OK121600030160_00	Horse Creek	441,900	14,136	57	N/A	526	1,666	409	34,881	493,575
OK121600030180_00	Fly Creek	100,243	3,983	16	N/A	164	0	62	12,223	116,692
OK121600030190_00	Little Horse Creek	224,722	6,527	26	N/A	229	1,169	234	14,066	246,975
OK121600030340_00	Cave Springs Branch	131,642	4,817	10	N/A	156	0	41	20,112	156,777
OK121600030440_00	Elk River	2,272,029	71,972	76	N/A	2,473	2,716	415	387,955	2,737,637
OK121600030445_00	Honey Creek	585,284	20,422	49	N/A	891	0	191	105,306	712,143
OK121600030510_00	Sycamore Creek	473,091	11,904	43	N/A	442	2,764	357	32,426	521,027
OK121600040060_00	Tar Creek	577,634	19,913	84	N/A	703	2,408	677	30,342	631,761
OK121600040130_00	Cow Creek	402,467	7,284	44	N/A	240	983	308	12,928	424,254
OK121600040170_00	Fourmile Creek	276,828	11,740	52	N/A	418	731	376	10,577	300,720
OK121600040200_00	Russell Creek	553,496	5,110	52	N/A	197	202	276	4,502	563,834

Table 3-7 Estimated Poultry Numbers for Contract Growers Inventoried by ODAFF

Waterbody ID	Waterbody Name	County	Type	Estimated Birds
OK121600010100_00	Fourteenmile Creek	Cherokee	Turkeys	26,134
OK121600010100_00	Fourteenmile Creek	Cherokee	Broilers	235,000
OK121600010440_00	Crutchfield Branch	Mayes	Broilers	80,000
OK121600030090_00	Drowning Creek	Delaware	Layers	70,500
OK121600030090_00	Drowning Creek	Delaware	Broilers	260,000
OK121600030160_00	Horse Creek	Delaware	Genetics	18,000
OK121600030160_00	Horse Creek	Ottawa	Broilers	40,000
OK121600030160_00	Horse Creek	Delaware	Broilers	52,000
OK121600030190_00	Little Horse Creek	Ottawa	Genetics	19,000
OK121600030190_00	Little Horse Creek	Ottawa	Broilers	980,000
OK121600030445_00	Honey Creek	Delaware	Layers	40,000
OK121600030445_00	Honey Creek	Delaware	Broilers	320,000
OK121600040060_00	Tar Creek	Ottawa	Broilers	153,333

Table 3-8 Poultry Processing Plants in the Study Area

NPDES Permit No.	Name	Receiving Water	Facility Type	County Name
MOG010280	Simmons Foods, Inc	OK121600030340_00 Cave Springs Branch	Broil, Fry And Roast Chickens	McDonald
MOG010281	Simmons Foods, Inc	OK121600030340_00 Cave Springs Branch	Broil, Fry And Roast Chickens	McDonald
MOG010282	Simmons Foods, Inc	OK121600030340_00 Cave Springs Branch	Broil, Fry And Roast Chickens	McDonald
MOG010284	Simmons Foods, Inc	OK121600030340_00 Cave Springs Branch	Broil, Fry And Roast Chickens	McDonald
MOG010292	Simmons Foods, Inc	OK121600030340_00 Cave Springs Branch	Broil, Fry And Roast Chickens	McDonald
MOG010297	Simmons Food, Inc	OK121600030440_00 Elk River	Broil, Fry And Roast Chickens	McDonald
MOG010298	Simmons Food, Inc	OK121600030440_00 Elk River	Broil, Fry And Roast Chickens	McDonald
MOG010319	Wilson Brothers, Inc.	OK121600030440_00 Elk River	Broil, Fry And Roast Chickens	McDonald

3.2.3 Failing Onsite Wastewater Disposal Systems and Illicit Discharges

ODEQ is responsible for implementing the regulations of Title 252, Chapter 641 of the Oklahoma Administrative Code, which defines design standards for individual and small public onsite sewage disposal systems (ODEQ 2004). OSWD systems and illicit discharges can be a source of bacteria loading to streams and rivers. Bacteria loading from failing OSWD systems can be transported to streams in a variety of ways, including runoff from surface ponding or through groundwater. Fecal coliform-contaminated groundwater discharges to creeks through springs and seeps.

To estimate the potential magnitude of OSWDs fecal bacteria loading, the number of OSWD systems was estimated for each watershed. The estimate of OSWD systems was derived by using data from the 1990 U.S. Census (U.S. Census Bureau 2000). The density of OSWD systems within each watershed was estimated by dividing the number of OSWD systems in each census block by the number of acres in each census block. This density was then applied to the number of acres of each census block within a WQM station watershed. Census blocks crossing a watershed boundary required additional calculation to estimate the number of OSWD systems based on the proportion of the census tracking falling within each watershed. This step involved adding all OSWD systems for each whole or partial census block.

Over time, most OSWD systems operating at full capacity will fail. OSWD system failures are proportional to the adequacy of a state's minimum design criteria (Hall 2002). The 1995 American Housing Survey conducted by the U.S. Census Bureau estimates that, nationwide, 10 percent of occupied homes with OSWD systems experience malfunctions during the year (U.S. Census Bureau 1995). A study conducted by Reed, Stowe & Yanke, LLC (2001) reported that approximately 12 percent of the OSWD systems in East Texas (adjacent to the Study Area) were chronically malfunctioning. Most studies estimate that the minimum lot size necessary to ensure against contamination is roughly one-half to one acre (Hall 2002). Some studies, however, found that lot sizes in this range or even larger could still cause contamination of ground or surface water (University of Florida 1987). It is estimated that areas with more than 40 OSWD systems per square mile (6.25 septic systems per 100 acres) can be considered to have potential contamination problems (Canter and Knox 1986). Table 3-9 summarizes estimates of sewered and unsewered households for each watershed in the Study Area.

Table 3-9 Estimates of Sewered and Unsewered Households

Waterbody ID	Waterbody Name	Public Sewer	Septic Tank	Other Means	Housing Units	% Sewered
OK121600010060_00	Ranger Creek	47	223	5	275	17%
OK121600010100_00	Fourteenmile Creek	62	620	13	694	9%
OK121600010440_00	Crutchfield Branch	61	239	3	303	20%
OK121600030090_00	Drowning Creek	120	573	27	720	17%
OK121600030160_00	Horse Creek	295	631	10	937	31%
OK121600030180_00	Fly Creek	21	447	11	478	4%
OK121600030190_00	Little Horse Creek	187	132	0	319	59%
OK121600030340_00	Cave Springs Branch	85	213	5	303	28%
OK121600030440_00	Elk River	1,280	2,858	70	4,208	30%
OK121600030445_00	Honey Creek	206	907	15	1,127	18%
OK121600030510_00	Sycamore Creek	387	707	31	1,125	34%
OK121600040060_00	Tar Creek	3,417	328	9	3,754	91%
OK121600040130_00	Cow Creek	70	177	4	251	28%
OK121600040170_00	Fourmile Creek	98	124	7	228	43%
OK121600040200_00	Russell Creek	84	93	7	183	46%

For the purpose of estimating fecal coliform loading in watersheds, an OSWD failure rate of 12 percent was used. Using this 12 percent failure rate, calculations were made to characterize fecal coliform loads in each watershed.

Fecal coliform loads were estimated using the following equation (USEPA 2001):

$$\#\frac{counts}{day} = (\#Failing\_systems)\times\left(\frac{10^6\,counts}{100ml}\right)\times\left(\frac{70gal}{personday}\right)\times\left(\#\frac{person}{household}\right)\times\left(3785.2\frac{ml}{gal}\right)$$

The average of number of people per household was calculated to be 2.44 for counties in the Study Area (U.S. Census Bureau 2000). Approximately 70 gallons of wastewater were estimated to be produced on average per person per day (Metcalf and Eddy 1991). The fecal coliform concentration in septic tank effluent was estimated to be 10^6 per 100 mL of effluent based on reported concentrations from a number of published reports (Metcalf and Eddy 1991; Canter and Knox 1985; Cogger and Carlile 1984). Using this information, the estimated load from failing septic systems within the watersheds was summarized below in Table 3-10.

Table 3-10 Estimated Fecal Coliform Load from OSWD Systems

Waterbody ID	Waterbody Name	Acres	Septic Tank	# of Failing Septic Tanks	Estimated Loads from Septic Tanks (x 10^9 counts/day)
OK121600010060_00	Ranger Creek	13,769	223	18	115
OK121600010100_00	Fourteenmile Creek	45,421	620	50	321
OK121600010440_00	Crutchfield Branch	9,522	239	19	124
OK121600030090_00	Drowning Creek	24,951	573	46	296
OK121600030160_00	Horse Creek	25,675	631	51	327
OK121600030180_00	Fly Creek	6,689	447	36	231
OK121600030190_00	Little Horse Creek	12,292	132	11	68
OK121600030340_00	Cave Springs Branch	8,922	213	17	110
OK121600030440_00	Elk River	163,015	2,858	229	1,478
OK121600030445_00	Honey Creek	34,510	907	73	469
OK121600030510_00	Sycamore Creek	36,436	707	57	365
OK121600040060_00	Tar Creek	34,946	328	26	170
OK121600040130_00	Cow Creek	19,199	177	14	91
OK121600040170_00	Fourmile Creek	19,045	124	10	64
OK121600040200_00	Russell Creek	23,994	93	7	48

3.2.4 Domestic Pets

Fecal matter from dogs and cats is transported to streams by runoff from urban and suburban areas and can be a potential source of bacteria loading. On average nationally, there are 0.58 dogs per household and 0.66 cats per household (American Veterinary Medical Association 2004). Using the U.S. Census data at the block level (U.S. Census Bureau 2000), dog and cat populations can be estimated for each watershed. Table 3-11 summarizes the estimated number of dogs and cats for the watersheds of the Study Area.

Table 3-11 Estimated Numbers of Pets

Waterbody ID	Waterbody Name	Dogs	Cats
OK121600010060_00	Ranger Creek	154	181
OK121600010100_00	Fourteenmile Creek	389	458
OK121600010440_00	Crutchfield Branch	170	200
OK121600030090_00	Drowning Creek	403	475
OK121600030160_00	Horse Creek	525	618
OK121600030180_00	Fly Creek	268	316
OK121600030190_00	Little Horse Creek	179	211
OK121600030340_00	Cave Springs Branch	170	200
OK121600030440_00	Elk River	2,357	2,777
OK121600030445_00	Honey Creek	631	744
OK121600030510_00	Sycamore Creek	630	743
OK121600040060_00	Tar Creek	2,102	2,478
OK121600040130_00	Cow Creek	140	166
OK121600040170_00	Fourmile Creek	128	151
OK121600040200_00	Russell Creek	103	121

Table 3-12 provides an estimate of the fecal coliform load from pets. These estimates are based on estimated fecal coliform production rates of $5.4 x 10^8$ per day for cats and $3.3 x 10^9$ per day for dogs (Schueler 2000).

Table 3-12 Estimated Fecal Coliform Daily Production by Pets (x 10^9)

Waterbody ID	Waterbody Name	Dogs	Cats	Total
OK121600010060_00	Ranger Creek	508	98	606
OK121600010100_00	Fourteenmile Creek	1,283	247	1,531
OK121600010440_00	Crutchfield Branch	561	108	669
OK121600030090_00	Drowning Creek	1,330	257	1,587
OK121600030160_00	Horse Creek	1,731	334	2,065
OK121600030180_00	Fly Creek	884	170	1,054
OK121600030190_00	Little Horse Creek	590	114	704
OK121600030340_00	Cave Springs Branch	560	108	668
OK121600030440_00	Elk River	7,776	1,500	9,276
OK121600030445_00	Honey Creek	2,083	402	2,484
OK121600030510_00	Sycamore Creek	2,079	401	2,480
OK121600040060_00	Tar Creek	6,938	1,338	8,276
OK121600040130_00	Cow Creek	464	89	553
OK121600040170_00	Fourmile Creek	422	81	503
OK121600040200_00	Russell Creek	339	65	404

3.3 Summary of Bacteria Sources

Table 3-13 summarizes the suspected sources of bacteria loading in each impaired watershed. Since there are no NPDES-permitted facilities present in the Fourteenmile Creek, Fly Creek, Little Horse Creek, Cow Creek, Fourmile Creek, and Russell Creek watersheds, nonsupport of the PBCR use is caused entirely by nonpoint sources. In eight of the other nine watersheds since most point sources are relatively minor and for the most part tend to meet instream water quality criteria in their effluent, nonpoint sources are considered to be the major source of bacteria loading. Given the number of dischargers and the MS4 area in the Tar Creek watershed, point source loading may be significant but is still likely to be less than the overall nonpoint source loading contribution.

Table 3-13 Estimated Major Source of Bacteria Loading by Watershed

Waterbody ID	Waterbody Name	Point Sources	Nonpoint Sources	Major Source
OK121600010060_00	Ranger Creek	Yes	Yes	Nonpoint
OK121600010100_00	Fourteenmile Creek	No	Yes	Nonpoint
OK121600010440_00	Crutchfield Branch	Yes	Yes	Nonpoint
OK121600030090_00	Drowning Creek	Yes	Yes	Nonpoint
OK121600030160_00	Horse Creek	Yes	Yes	Nonpoint
OK121600030180_00	Fly Creek	No	Yes	Nonpoint
OK121600030190_00	Little Horse Creek	No	Yes	Nonpoint
OK121600030340_00	Cave Springs Branch	Yes	Yes	Nonpoint
OK121600030440_00	Elk River	Yes	Yes	Nonpoint
OK121600030445_00	Honey Creek	Yes	Yes	Nonpoint
OK121600030510_00	Sycamore Creek	Yes	Yes	Nonpoint
OK121600040060_00	Tar Creek	Yes	Yes	Nonpoint
OK121600040130_00	Cow Creek	No	Yes	Nonpoint
OK121600040170_00	Fourmile Creek	No	Yes	Nonpoint
OK121600040200_00	Russell Creek	No	Yes	Nonpoint

Table 3-14 below provides a summary of the estimated fecal coliform loads in percentage for the four major nonpoint source categories (commerically raised farm animals, pets, deer, and septic tanks) that are contributing to the elevated bacteria concentrations in each watershed. Commercially raised farm animals are estimated to be the primary contributors of fecal coliform loading to land surfaces. It must be noted that while no data are available to estimate populations and fecal loading of wildlife other than deer, a number of bacteria source tracking studies demonstrate that wild birds and mammals represent a major source of the fecal bacteria found in streams.

The magnitude of loading to a stream may not reflect the magnitude of loading to land surfaces. While no studies quantify these effects, bacteria may die off or survive at different rates depending on the manure characteristics and a number of other environmental conditions. Manure handling practices, use of BMPs, and relative location to streams can also affect stream loading. Also, the structural properties of some manure, such as cow patties, may limit their wash off into streams by runoff. Because litter is applied in a pulverized form, it could be a larger source during storm runoff events. The Shoal Creek report showed that poultry litter was about 71% of the high flow load and cow pats contributed only about 28% of it (Missouri Department of Natural Resources, 2003). The Shoal Creek report also showed that poultry litter was insignificant under low flow conditions up to 50% frequency. In contrast, malfunctioning septic tank effluent may be present in pooled water on the surface, or in shallow groundwater, which may enhance its conveyance to streams.

Table 3-14 Summary of Fecal Coliform Load Estimates from Nonpoint Sources to Land Surfaces

Waterbody ID	Waterbody Name	Commercially Raised Farm Animals	Pets	Deer	Estimated Loads from Septic Tanks
OK121600010060_00	Ranger Creek	99.3%	0.4%	0.1%	0.1%
OK121600010100_00	Fourteenmile Creek	99.5%	0.3%	0.1%	0.1%
OK121600010440_00	Crutchfield Branch	99.6%	0.3%	0.0%	0.1%
OK121600030090_00	Drowning Creek	99.5%	0.4%	0.1%	0.1%
OK121600030160_00	Horse Creek	99.5%	0.4%	0.0%	0.1%
OK121600030180_00	Fly Creek	98.9%	0.9%	0.1%	0.2%
OK121600030190_00	Little Horse Creek	99.6%	0.3%	0.0%	0.0%
OK121600030340_00	Cave Springs Branch	99.5%	0.4%	0.1%	0.1%
OK121600030440_00	Elk River	99.6%	0.3%	0.1%	0.1%
OK121600030445_00	Honey Creek	99.5%	0.3%	0.0%	0.1%
OK121600030510_00	Sycamore Creek	99.4%	0.5%	0.1%	0.1%
OK121600040060_00	Tar Creek	98.6%	1.3%	0.1%	0.0%
OK121600040130_00	Cow Creek	99.8%	0.1%	0.0%	0.0%
OK121600040170_00	Fourmile Creek	99.4%	0.2%	0.4%	0.0%
OK121600040200_00	Russell Creek	99.9%	0.1%	0.1%	0.0%

SECTION 4
TECHNICAL APPROACH AND METHODS

The objective of a TMDL is to estimate allowable pollutant loads and to allocate these loads to the known pollutant sources in the watershed so appropriate control measures can be implemented and the WQS achieved. A TMDL is expressed as the sum of three elements as described in the following mathematical equation:

$$TMDL = \Sigma\ WLA + \Sigma\ LA + MOS$$

The WLA is the portion of the TMDL allocated to existing and future point sources. The LA is the portion of the TMDL allocated to nonpoint sources, including natural background sources. The MOS is intended to ensure that WQSs will be met. Thus, the allowable pollutant load that can be allocated to point and nonpoint sources can then be defined as the TMDL minus the MOS.

40 CFR, §130.2(1), states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures. For fecal coliform, *E. coli*, or Enterococci bacteria, TMDLs are expressed as colony-forming units per day, where possible, or as a percent reduction goal (PRG), and represent the maximum one-day load the stream can assimilate while still attaining the WQS.

4.1 Using Load Duration Curves to Develop TMDLs

The TMDL calculations presented in this report are derived from load duration curves (LDC). LDCs facilitate rapid development of TMDLs, and as a TMDL development tool, are effective at identifying whether impairments are associated with point or nonpoint sources. The technical approach for using LDCs for TMDL development includes the four following steps that are described in Subsections 4.2 through 4.4 below:

- Preparing flow duration curves for gaged and ungaged WQM stations;
- Estimating existing bacteria loading in the receiving water using ambient water quality data;
- Using LDCs to identify the critical condition that will dictate loading reductions necessary to attain WQS; and
- Interpreting LDCs to derive TMDL elements – WLA, LA, MOS, and PRG.

Historically, in developing WLAs for pollutants from point sources, it was customary to designate a critical low flow condition (*e.g.*, 7Q2) at which the maximum permissible loading was calculated. As water quality management efforts expanded in scope to quantitatively address nonpoint sources of pollution and types of pollutants, it became clear that this single critical low flow condition was inadequate to ensure adequate water quality across a range of flow conditions. Use of the LDC obviates the need to determine a design storm or selected flow recurrence interval with which to characterize the appropriate flow level for the assessment of critical conditions. For waterbodies impacted by both point and nonpoint sources, the “nonpoint source critical condition” would typically occur during high flows, when rainfall runoff would contribute the bulk of the pollutant load, while the “point source critical condition” would typically occur during low flows, when WWTP effluents would dominate the base flow of the impaired water. However, Flow range is only a general indicator of the relative proportion of point/nonpoint contributions. It is not used in this report to quantify point source or nonpoint source contributions. Violations that occur during low flows may not be caused exclusively by point sources. Violations have been noted in some watersheds that contain no point sources. Research has show that bacteria loading in streams during low flow conditions may be due to direct deposit of cattle manure into streams and faulty septic tank/lateral field systems.

LDCs display the maximum allowable load over the complete range of flow conditions by a line using the calculation of flow multiplied by the water quality criterion. The TMDL can be expressed as a continuous function of flow, equal to the line, or as a discrete value derived from a specific flow condition.

4.2 Development of Flow Duration Curves

Flow duration curves serve as the foundation of LDCs and are graphical representations of the flow characteristics of a stream at a given site. Flow duration curves utilize the historical hydrologic record from stream gages to forecast future recurrence frequencies. Many WQM stations throughout Oklahoma do not have long term flow data and therefore, flow frequencies must be estimated. The most basic method to estimate flows at an ungaged site involves 1) identifying an upstream or downstream flow gage; 2) calculating the contributing drainage areas of the ungaged sites and the flow gage; and 3) calculating daily flows at the ungaged site by using the flow at the gaged site multiplied by the drainage area ratio. The more complex approach used here also considers watershed differences in rainfall, land use, and the hydrologic properties of soil that govern runoff and retention. More than one upstream flow gage may also be considered. A more detailed explanation of the methods for estimating flow at ungaged WQM stations is provided in Appendix C.

Flow duration curves are a type of cumulative distribution function. The flow duration curve represents the fraction of flow observations that exceed a given flow at the site of interest. The observed flow values are first ranked from highest to lowest then, for each observation, the percentage of observations exceeding that flow is calculated. The flow value is read from the ordinate (y-axis), which is typically on a logarithmic scale since the high flows would otherwise overwhelm the low flows. The flow exceedance frequency is read from the abscissa, which is numbered from 0 to 100 percent, and may or may not be logarithmic. The lowest measured flow occurs at an exceedance frequency of 100 percent indicating that flow has equaled or exceeded this value 100 percent of the time, while the highest measured flow is found at an exceedance frequency of 0 percent. The median flow occurs at a flow exceedance frequency of 50 percent. The flow exceedance percentiles for each WQM station addressed in this report are provided in Appendix C.

While the number of observations required to develop a flow duration curve is not rigorously specified, a flow duration curve is usually based on more than 1 year of observations, and encompasses inter-annual and seasonal variation. Ideally, the drought of record and flood of record are included in the observations. For this purpose, the long-term flow gaging stations operated by the USGS are utilized (USGS 2007a).

A typical semi-log flow duration curve exhibits a sigmoidal shape, bending upward near a flow exceedance frequency value of 0 percent and downward at a frequency near 100 percent, often with a relatively constant slope in between. For sites that on occasion exhibit no flow, the curve will intersect the abscissa at a frequency less than 100 percent. As the number of observations at a site increases, the line of the LDC tends to appear smoother. However, at extreme low and high flow values, flow duration curves may exhibit a “stair step” effect due to the USGS flow data rounding conventions near the limits of quantitation.

Figures 4-1 through 4-15 are flow duration curves for each impaired waterbody. No flow gage exists on Ranger Creek, segment OK121600010060_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07191000 (Big Cabin Creek near Big Cabin, OK). The flow period used for this station was 1947 through 2006.

No flow gage exists on Fourteenmile Creek, segment OK121600010100_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 0719855 (Flint Creek near West Siloam Springs, OK). The flow period used for this station was 1979 through 2006.

No flow gage exists on Crutchfield Branch, segment OK121600010440_00. Therefore, naturalized flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07195855 (Flint Creek near West Siloam Springs, OK). The flow period used for this station was 1979 through 2006. Because a continuous point source discharge occurs to Crutchfield Branch, an estimate of the average point source inflow (one-half of the facility design flow of 0.5 million gallons per day [mgd]) was added to the naturalized projected flows.

No flow gage exists on Drowning Creek, segment OK121600030090_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07189542 (Honey Creek near South West City, MO). The flow period used for this station was 1997 through 2006.

No flow gage exists on Horse Creek, segment OK121600030160_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07191000 (Big Cabin Creek near Big Cabin, OK). The flow period used for this station was 1947 through 2006.

No flow gage exists on Fly Creek, segment OK121600030180_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07191000 (Big Cabin Creek near Big Cabin, OK). The flow period used for this station was 1947 through 2006.

No flow gage exists on Little Horse Creek, segment OK121600030190_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07191000 (Big Cabin Creek near Big Cabin, OK). The flow period used for this station was 1947 through 2006.

The flow duration curve for Cave Springs Branch, segment OK121600030340_00 was based on measured flows at USGS gage station 7189540 (Cave Springs Branch near South West City, MO). This gage is co-located with WQM station OK121600030340J. The flow period used for this station was 1997 through 2006.

The flow duration curve for Elk River, segment OK121600030440_00 was based on measured flows at USGS gage station 07189000 (Elk River near Tiff City, Mo). This gage is co-located with WQM station OK121600030440-001AT. The flow duration curve was based on measured flows from 1939 through 2006.

The flow duration curve for Honey Creek, segment OK121600030445_00 was based on measured flows at USGS gage station 07189542 (Honey Creek near South West City, MO). This gage is co-located with WQM station 121600030445-001AT. The flow duration curve was based on measured flows from 1997 through 2006.

No flow gage exists on Sycamore Creek, segment OK121600030510_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07189542 (Honey Creek near South West City, MO). The flow period used for this station was 1997 through 2006.

The flow duration curve for Tar Creek, segment OK121600040060_00 was based on measured flows at USGS gage stations 07185100 (Tar Creek at Miami, OK) and 07185095 (Tar Creek at 22nd Street Bridge at Miami, OK). Both gages occur on the segment but were not operational at the same time. The latter gage is a short distance upstream from the former. The flow duration curve was based on measured flows from 1980 through 1993 and 2004 through 2006.

No flow gage exists on Cow Creek, segment OK121600040130_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07191000 (Big Cabin Creek near Big Cabin, OK). The flow period used for this station was 1947 through 2006.

No flow gage exists on Fourmile Creek, segment OK121600040170_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07191000 (Big Cabin Creek near Big Cabin, OK). The flow period used for this station was 1947 through 2006.

No flow gage exists on Russell Creek, segment OK121600040200_00. Flows for this waterbody were estimated using the watershed area ratio method based on measured flows on an adjacent waterbody at USGS gage station 07191000 (Big Cabin Creek near Big Cabin, OK). The flow period of record used for this station was 1947 through 2006.

Figure 4-1 Flow Duration Curve for Ranger Creek (OK121600010060_00)

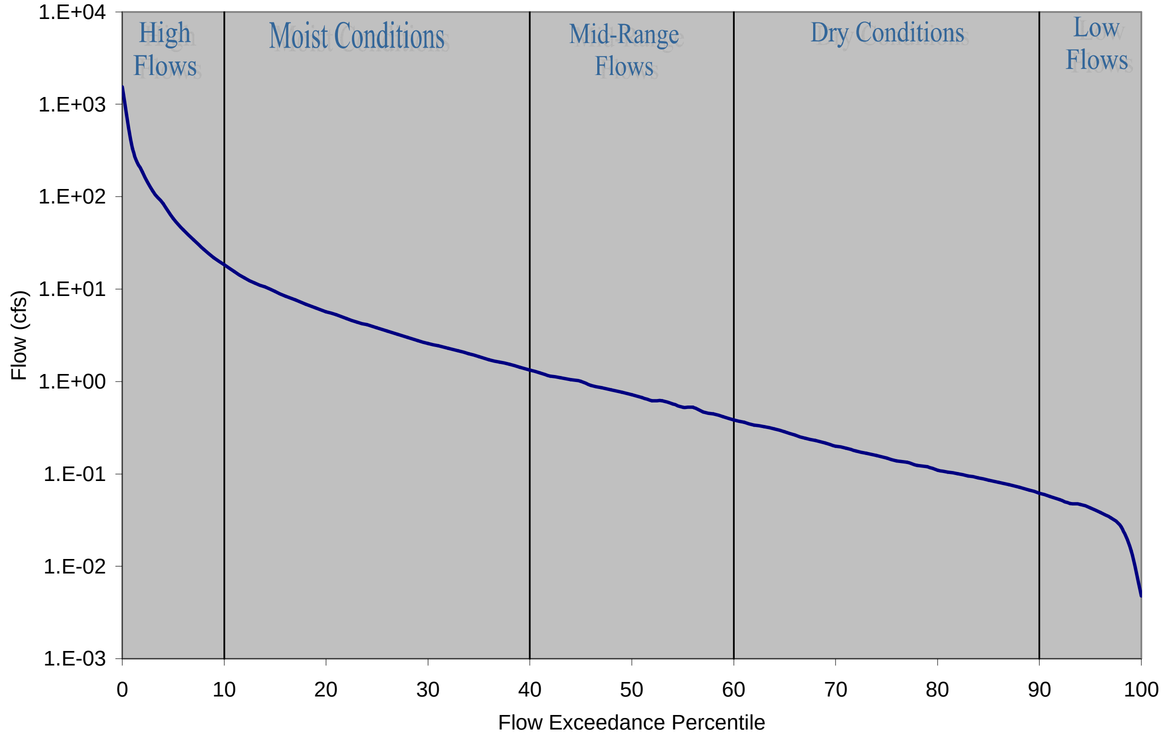


Figure 4-2 Flow Duration Curve for Fourteenmile Creek (OK121600010100_00)

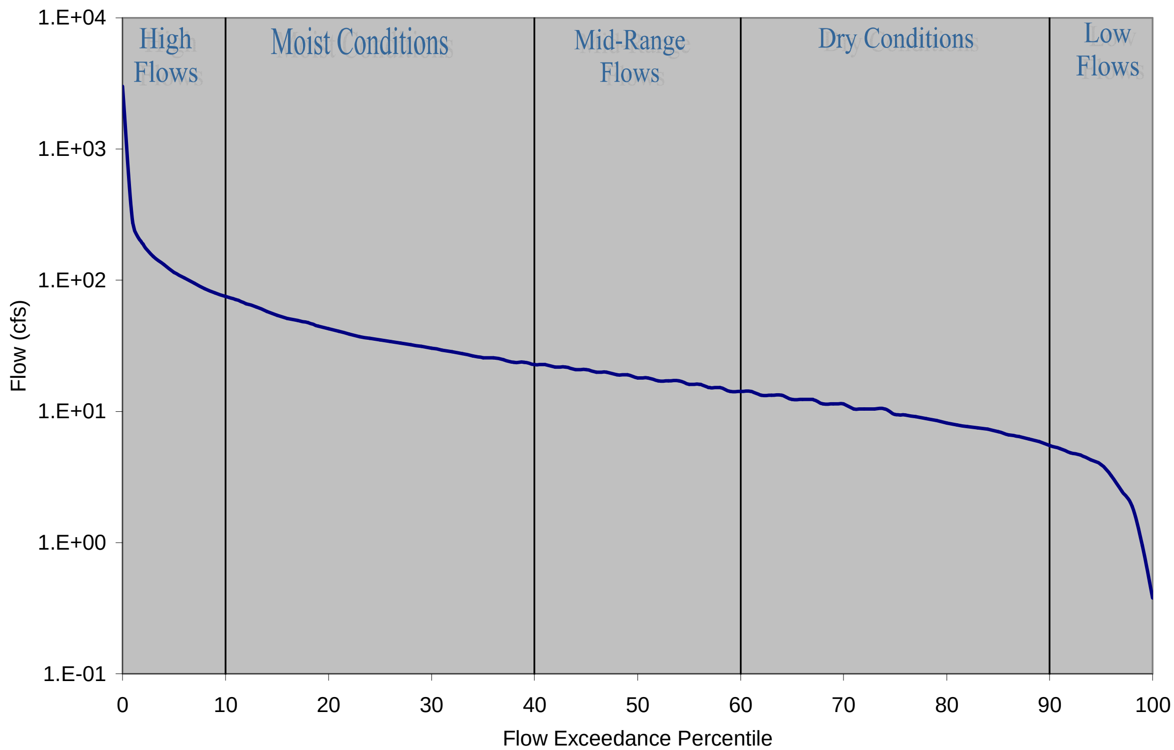


Figure 4-3 Flow Duration Curve for Crutchfield Branch (OK121600010440_00)

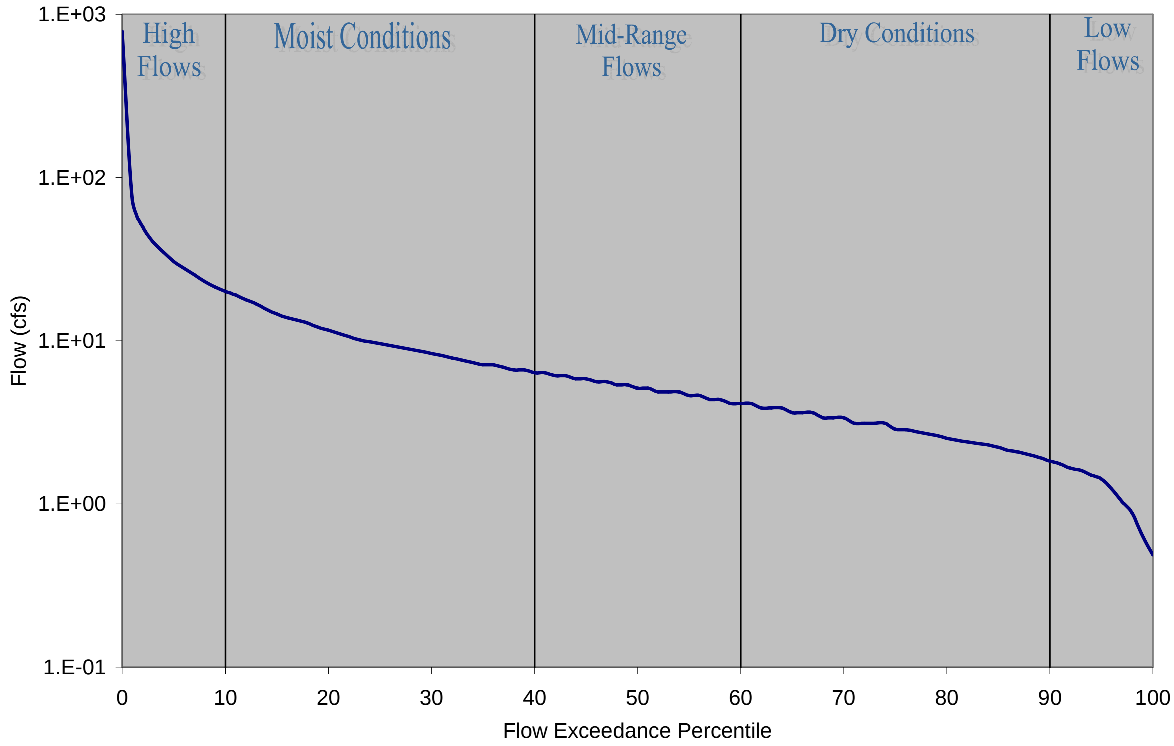


Figure 4-4 Flow Duration Curve for Drowning Creek (OK121600030090_00)

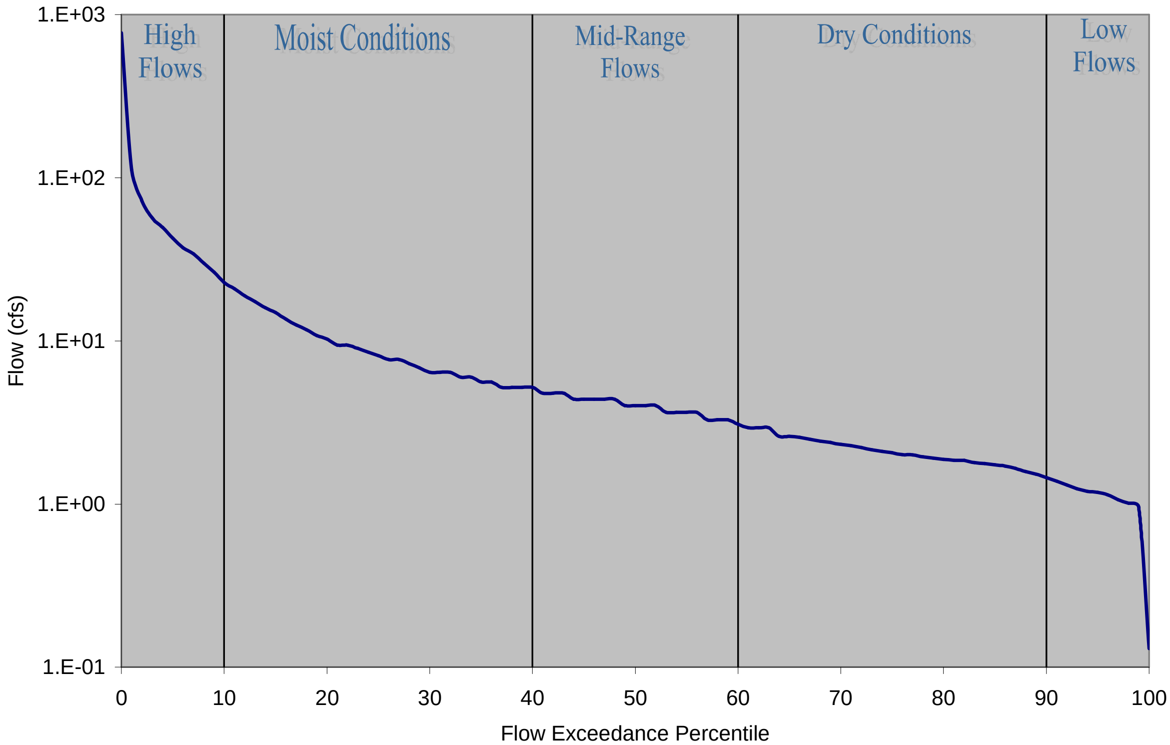


Figure 4-5 Flow Duration Curve for Horse Creek (OK121600030160_00)

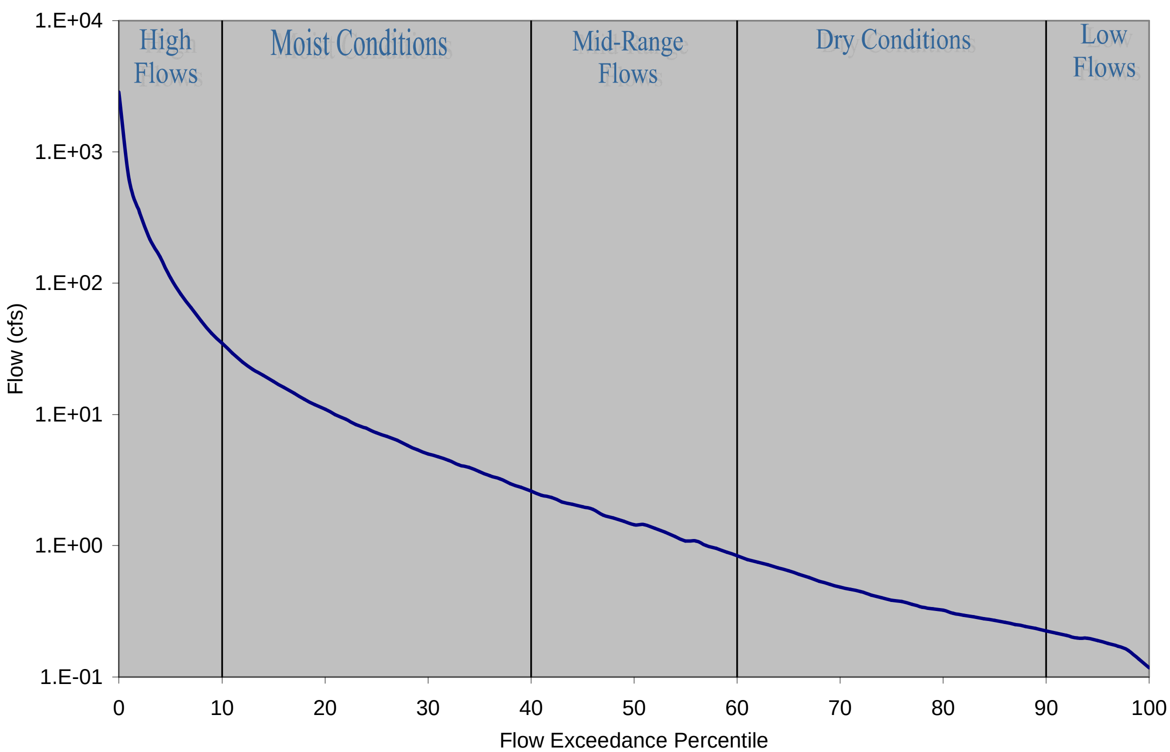


Figure 4-6 Flow Duration Curve for Fly Creek (OK121600030180_00)

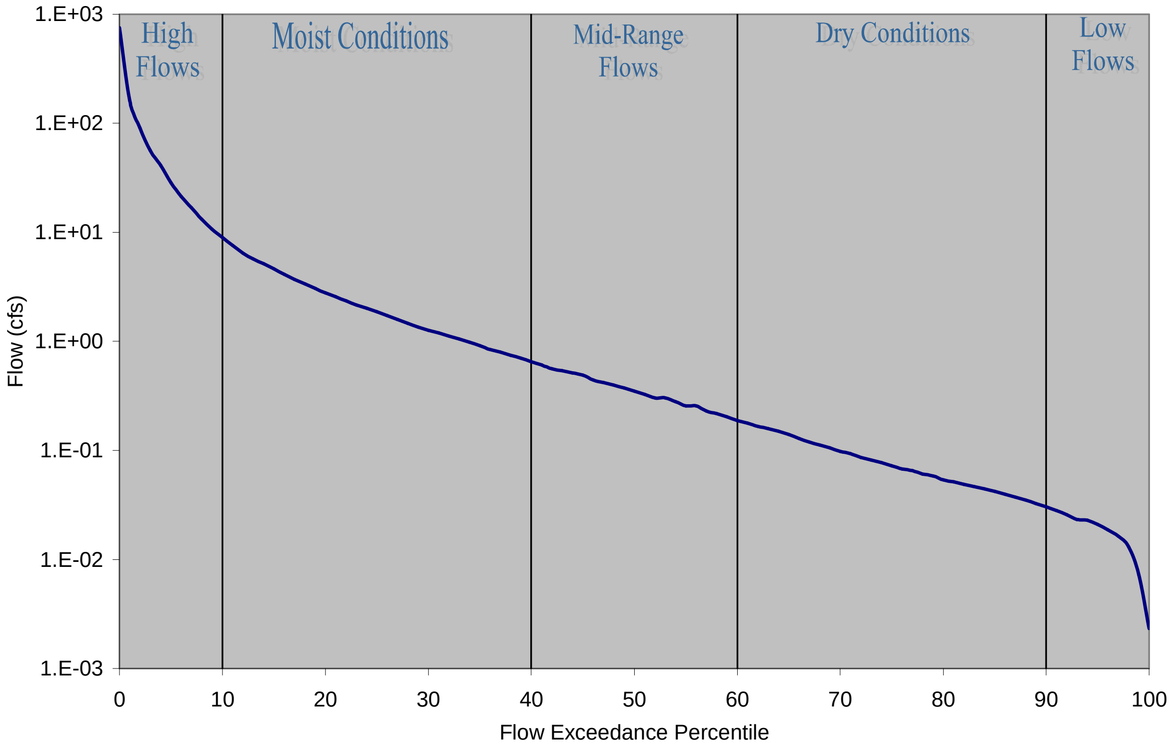


Figure 4-7 Flow Duration Curve for Little Horse Creek (OK121600030190_00)

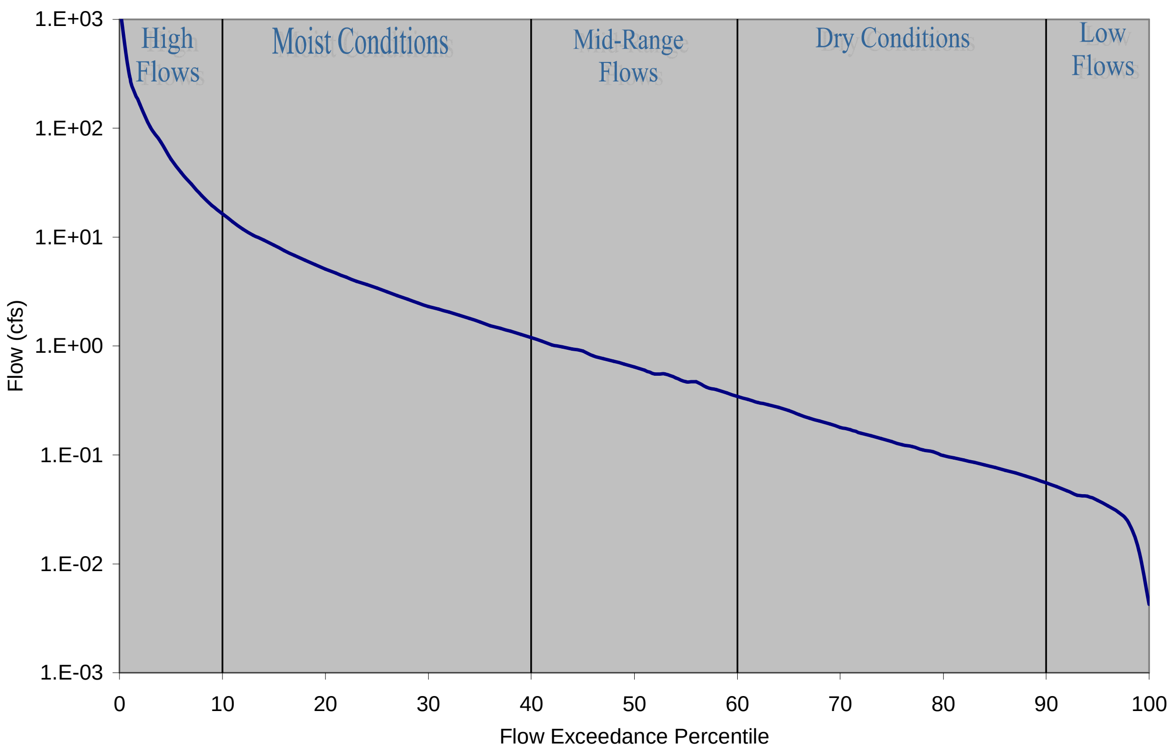


Figure 4-8 Flow Duration Curve for Cave Springs Branch (OK121600030340_00)

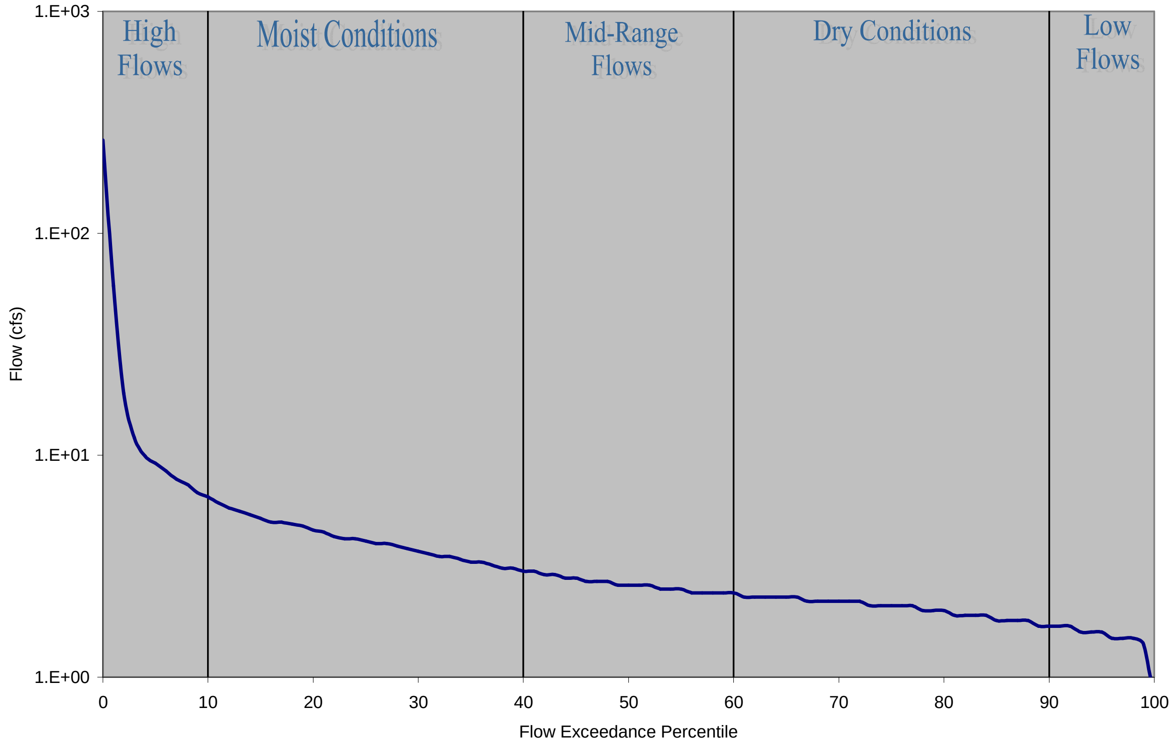


Figure 4-9 Flow Duration Curve for Elk River (OK121600030440_00)

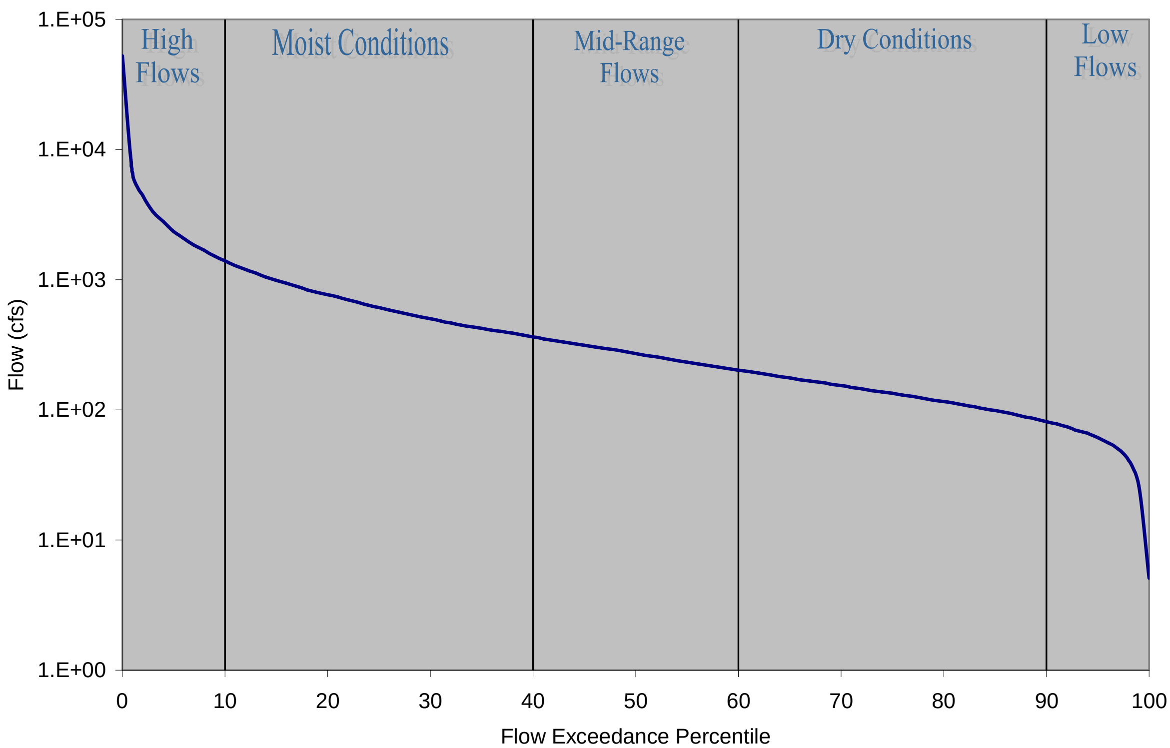


Figure 4-10 Flow Duration Curve for Honey Creek (OK121600030445_00)

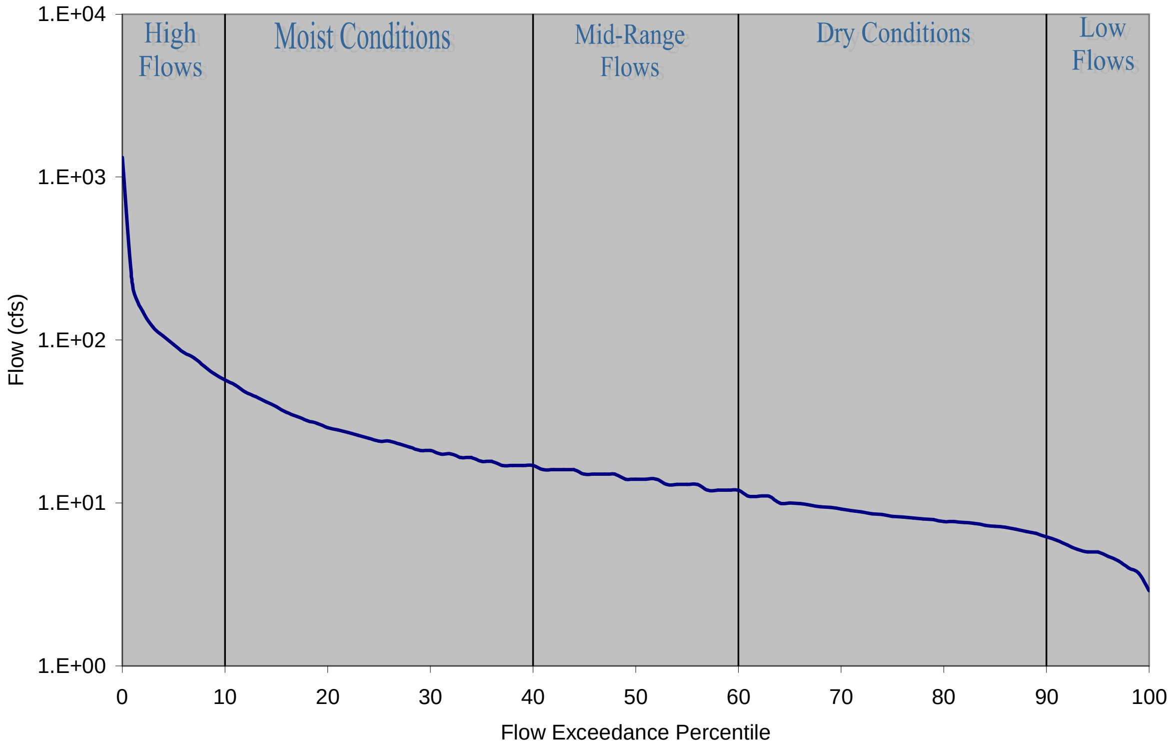


Figure 4-11 Flow Duration Curve for Sycamore Creek (OK121600030510_00)

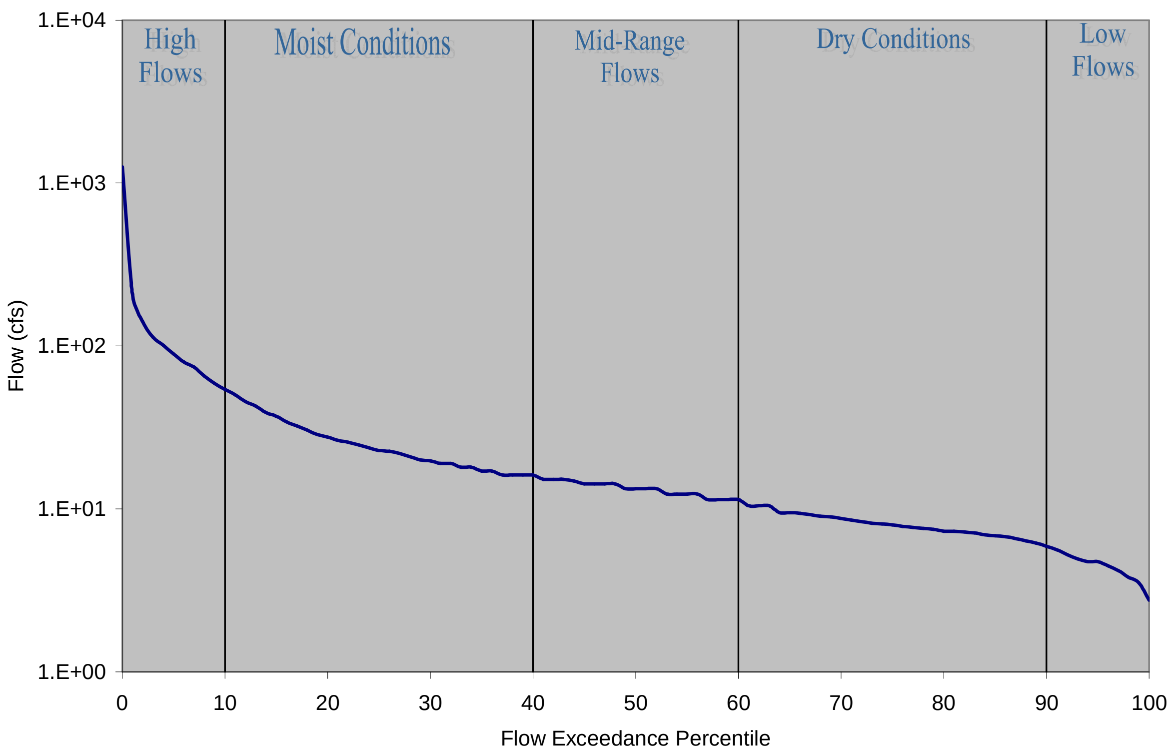


Figure 4-12 Flow Duration Curve for Tar Creek (OK121600040060_00)

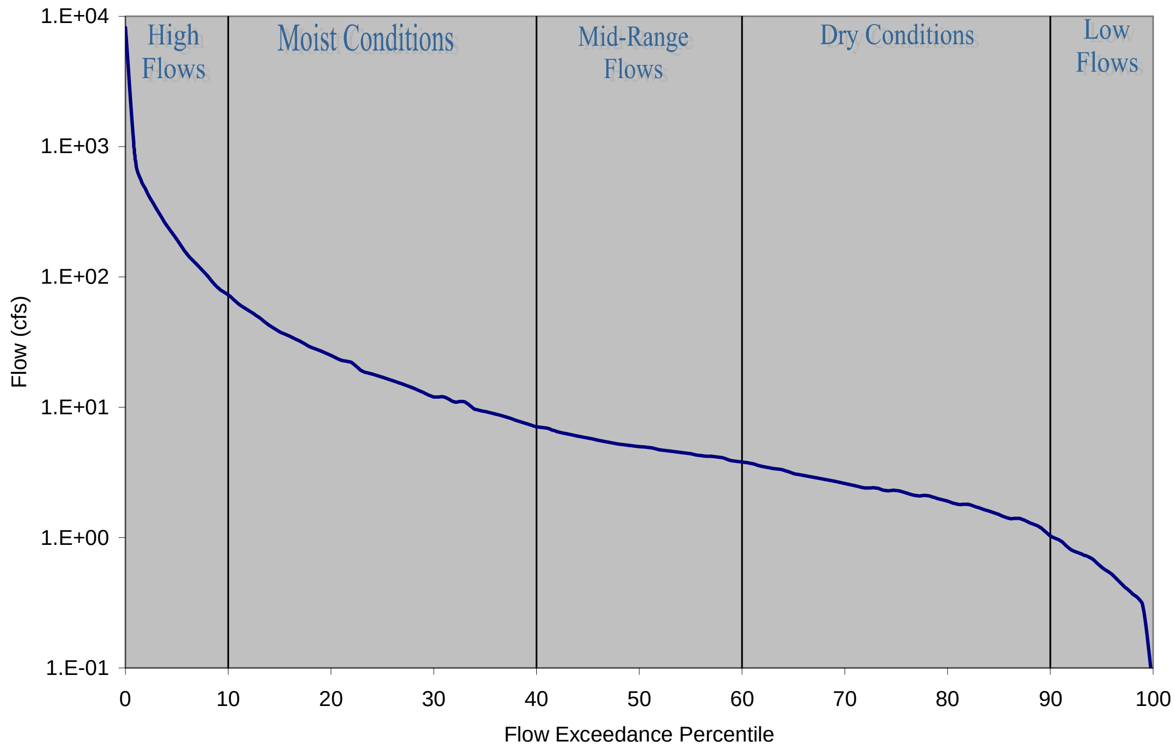


Figure 4-13 Flow Duration Curve for Cow Creek (OK121600040130_00)

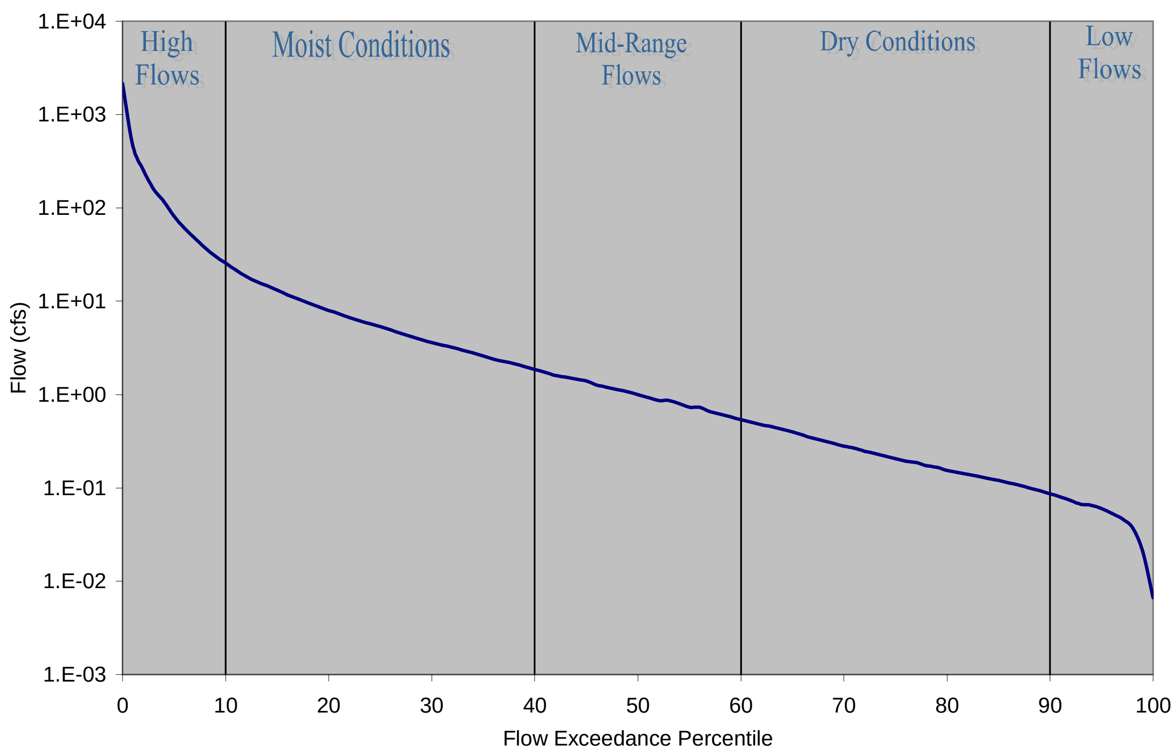


Figure 4-14 Flow Duration Curve for Fourmile Creek (OK121600040170_00)

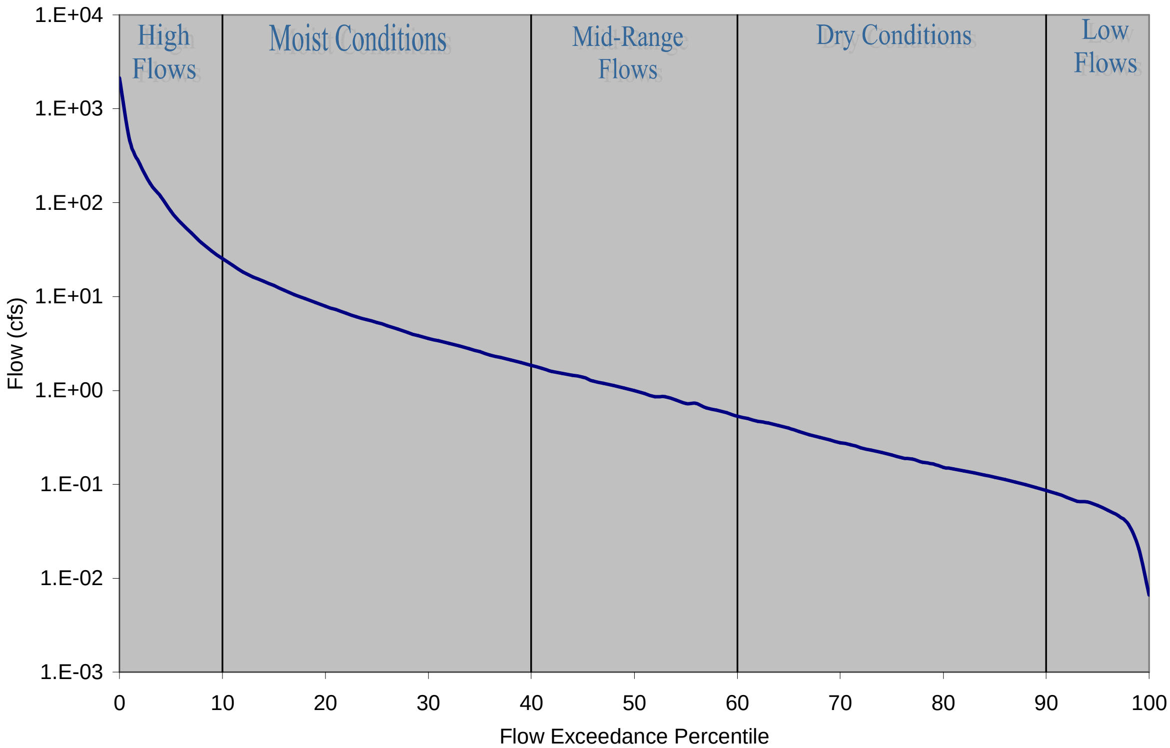
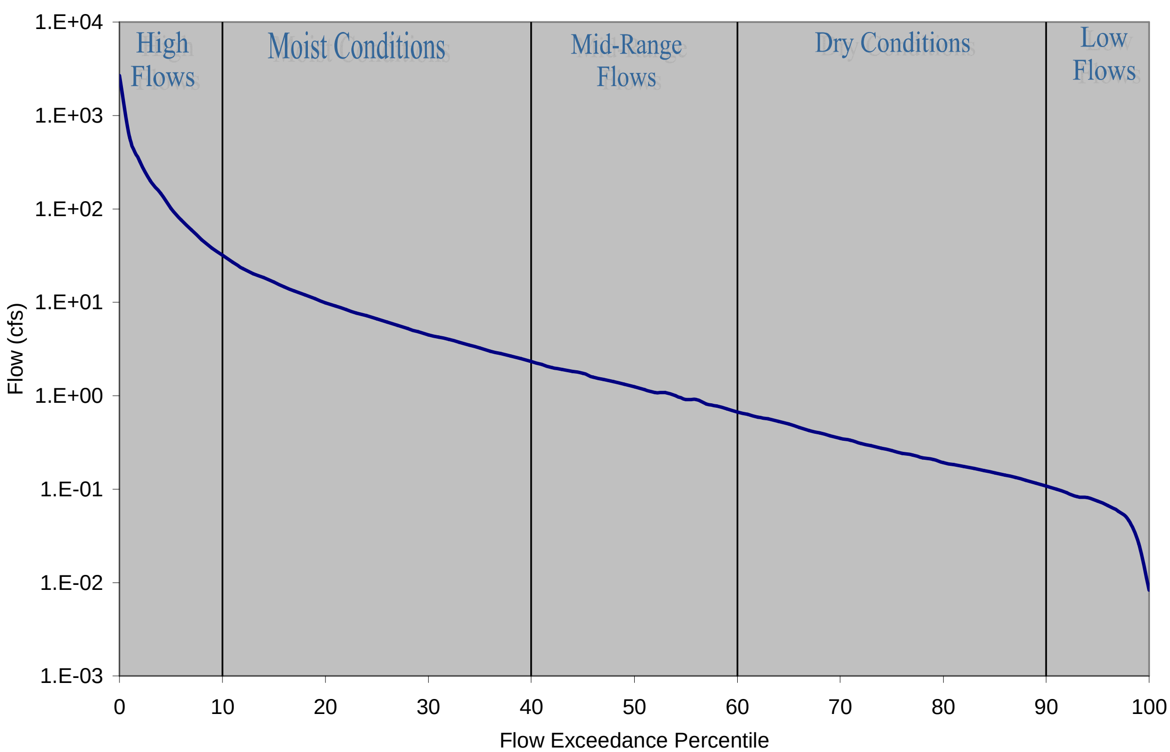


Figure 4-15 Flow Duration Curve for Russell Creek (OK121600040200_00)



Flow duration curves can be subdivided into hydrologic condition classes to facilitate the diagnostic and analytical uses of flow and LDCs. The hydrologic classification scheme utilized in this application is similar to that described by Cleland (2003):

Table 4-1 Hydrologic Classification Scheme

Flow Exceedance Percentile	Hydrologic Condition Class
0-10	High flows
10-40	Moist Conditions
40-60	Mid-Range Conditions
60-90	Dry Conditions
90-100	Low Flows

Flow duration curves are generated using an ODEQ automated application referred to as the bacteria LDC toolbox. A step-by-step procedure on how to generate flow duration curves and flow exceedance percentiles is provided in Appendix C.

The USGS National Water Information System serves as the primary source of flow measurements for the application. All available daily average flow values for all gages in Oklahoma, as well as the nearest upstream and downstream gages in adjacent states, were retrieved for use in the application. The application includes a data update module that automatically downloads the most recent USGS data and appends it to the existing flow database.

Some instantaneous flow measurements were available from various agencies. These were not combined with the daily average flows or used in calculating flow percentiles, but were matched to bacteria grab measurements collected at the same site and time. When available, these instantaneous flow measurements were used in lieu of the daily average flow to calculate instantaneous bacteria loads.

4.3 Estimating Current Point and Nonpoint Loading

Another key step in the use of LDCs for TMDL development is the estimation of existing bacteria loading from point and nonpoint sources and the display of this loading in relation to the TMDL. In Oklahoma, WWTPs that discharge treated sanitary wastewater must meet the state WQSs for fecal bacteria at the point of discharge. However, for TMDL analysis it is necessary to understand the relative contribution of WWTPs to the overall pollutant loading and its general compliance with required effluent limits. The monthly bacteria load for continuous point source dischargers is estimated by multiplying the monthly average flow rates by the monthly geometric mean using a conversion factor. The current pollutant loading from each permitted point source discharge is calculated using the equation below.

*Point Source Loading = monthly average flow rates (mgd) * geometric mean of corresponding fecal coliform concentration * unit conversion factor*

Where:

unit conversion factor = 37,854,120 100-ml/million gallons (mg)

It is difficult to estimate current nonpoint loading due to lack of specific water quality and flow information that would assist in estimating the relative proportion of non-specific sources within the watershed. Therefore, existing instream loads minus the point source loads were used as an estimate for nonpoint loading.

4.4 Development of TMDLs Using Load Duration Curves

The final step in the TMDL calculation process involves a group of additional computations derived from the preparation of LDCs. These computations are necessary to derive a PRG (which is one method of presenting how much bacteria loading must be reduced to meet WQSs in the impaired watershed).

Step 1: Generate Bacteria LDCs. LDCs are similar in appearance to flow duration curves; however, the ordinate is expressed in terms of a bacteria load in cfu/day. The curve represents the single sample water quality criterion for fecal coliform (400 cfu/100 mL), *E. coli* (406 cfu/100 mL), or Enterococci (108 cfu/100 mL) expressed in terms of a load through multiplication by the continuum of flows historically observed at this site. The basic steps to generating an LDC involve:

- obtaining daily flow data for the site of interest from the USGS;
- sorting the flow data and calculating flow exceedance percentiles for the time period and season of interest;
- obtaining the water quality data from the primary contact recreation season (May 1 through September 30);
- matching the water quality observations with the flow data from the same date;
- display a curve on a plot that represents the allowable load multiply the actual or estimated flow by the WQS for each respective indicator;
- multiplying the flow by the water quality parameter concentration to calculate daily loads; then
- plotting the flow exceedance percentiles and daily load observations in a load duration plot.

The culmination of these steps is expressed in the following formula, which is displayed on the LDC as the TMDL curve:

*TMDL (cfu/day) = WQS * flow (cfs) * unit conversion factor*

Where: WQS = 400 cfu /100 ml (Fecal coliform); 406 cfu/100 ml (E. coli); or 108 cfu/100 ml (Enterococci)

*unit conversion factor = 24,465,525 ml*s / ft3*day*

The flow exceedance frequency (x-value of each point) is obtained by looking up the historical exceedance frequency of the measured or estimated flow; in other words, the percent of historical observations that equal or exceed the measured or estimated flow. Historical observations of bacteria concentration are paired with flow data and are plotted on the LDC. The fecal coliform load (or the y-value of each point) is calculated by multiplying the fecal coliform concentration (cfu/100 mL) by the instantaneous flow (cubic feet per second [cfs]) at the same site and time, with appropriate volumetric and time unit conversions. Fecal coliform/*E. coli*/Enterococci loads representing exceedance of water quality criteria fall above the water quality criterion line.

Only those flows and water quality samples observed in the months comprising the primary contact recreation season are used to generate the LDCs. It is inappropriate to compare single sample bacteria observations and instantaneous or daily flow durations to a 30-day geometric mean water quality criterion in the LDC.

As noted earlier, runoff has a strong influence on loading of nonpoint pollution. Yet flows do not always correspond directly to local runoff; high flows may occur in dry weather and runoff influence may be observed with low or moderate flows.

Step 2: Develop LDCs with MOS. An LDC depicting slightly lower estimates than the TMDL is developed to represent the TMDL with MOS. The MOS may be defined explicitly or implicitly. A typical explicit approach would reserve some fraction of the TMDL (*e.g.,* 10%) as the MOS. In an implicit approach, conservative assumptions used in developing the TMDL are relied upon to provide an MOS to assure that WQSs are attained.

For the TMDLs in this report, an explicit MOS of 10 percent of the TMDL value (10% of the instantaneous water quality criterion) has been selected to slightly reduce assimilative capacity in the watershed. The MOS at any given percent flow exceedance, therefore, is defined as the difference in loading between the TMDL and the TMDL with MOS.

Step 3: Calculate WLA. As previously stated, the pollutant LA for point sources is defined by the WLA. A point source can be either a wastewater (continuous) or stormwater (MS4) discharge. Stormwater point sources are typically associated with urban and industrialized areas, and recent USEPA guidance includes NPDES-permitted stormwater discharges as point source discharges and, therefore, part of the WLA.

The LDC approach recognizes that the assimilative capacity of a waterbody depends on the flow, and that maximum allowable loading will vary with flow condition. TMDLs can be expressed in terms of maximum allowable concentrations, or as different maximum loads allowable under different flow conditions, rather than single maximum load values. This concentration-based approach meets the requirements of 40 CFR, 130.2(i) for expressing TMDLs "in terms of mass per time, toxicity, or other appropriate measures" and is consistent with USEPA's Protocol for Developing Pathogen TMDLs (USEPA 2001).

WLA for WWTP. WLAs may be set to zero for watersheds with no existing or planned continuous permitted point sources. For watersheds with permitted point sources, WLAs may be derived from NPDES permit limits. A WLA may be calculated for each active NPDES wastewater discharger using a mass balance approach as shown in the equation below. The permitted average flow rate used for each point source discharge and the water quality criterion concentration are used to estimate the WLA for each wastewater facility. All WLA values for each NPDES wastewater discharger are then summed to represent the total WLA for the watershed.

*WLA = WQS * flow * unit conversion factor (#/day)*

Where:

Where: WQS = 200 cfu /100 ml (Fecal coliform); 126 cfu/100 ml (E. coli); or 33 cfu/100 ml (Enterococci) *flow (10^6 gal/day) = permitted flow*

unit conversion factor = 37,854,120-10^6gal/day

Step 4: Calculate LA and WLA for MS4s. Given the lack of data and the variability of storm events and discharges from storm sewer system discharges, it is difficult to establish numeric limits on stormwater discharges that accurately address projected loadings. As a result, EPA regulations and guidance recommend expressing NPDES permit limits for MS4s as BMPs.

LAs can be calculated under different flow conditions as the water quality target load minus the WLA. The LA is represented by the area under the LDC but above the WLA. The LA at any particular flow exceedance is calculated as shown in the equation below.

LA = TMDL - WLA_WWTP - WLA_MS4 - MOS

WLA for MS4s. If there are no permitted MS4s in the study area, WLA_MS4 is set to zero. When there are permitted MS4s in the watershed, we can first calculate the sum of LA + WLA_MS4 using the above formula, then separate WLA for MS4s from the sum based on the percentage of a watershed that is under a MS4 jurisdiction. This WLA for MS4s may not be the total load allocated for permitted MS4s unless the whole MS4 area is located within the study watershed boundry. However, in most case the study watershed intersects only a portion of the permitted MS4 coverage areas.

Step 5: Estimate WLA Load Reduction. The WLA load reduction was not calculated as it was assumed that continuous dischargers (NPDES-permitted WWTPs) are adequately regulated under existing permits to achieve water quality standards at the end-of-pipe and, therefore, no WLA reduction would be required. All SSOs are considered unpermitted discharges under State statute and DEQ regulations. For any MS4s that are located within a watershed requiring a TMDL the load reduction will be equal to the PRG established for the overall watershed.

Step 6: Estimate LA Load Reduction.

After existing loading estimates are computed for each bacteria indicator, nonpoint load reduction estimates for each WQM station are calculated by using the difference between estimated existing loading and the allowable load expressed by the LDC (TMDL-MOS). This difference is expressed as the overall percent reduction goal for the impaired waterbody. For fecal coliform the PRG which ensures that no more than 25 percent of the samples exceed the TMDL based on the instantaneous criteria allocates the loads in manner that is also protective of the geometric mean criterion. For *E. coli* and enterococci, because WQ standards are considered to be met if 1) either the geometric mean of all data is less than the geometric mean criteria, or 2) no sample exceeds the instantaneous criteria, the TMDL PRG will be the lesser of that required to meet the geometric mean or instantaneous criteria.

SECTION 5
TMDL CALCULATIONS

5.1 Estimated Loading and Critical Conditions

USEPA regulations at 40 CFR 130.7(c) (1) require TMDLs to take into account critical conditions for stream flow, loading, and all applicable water quality standards. To accomplish this, available instream WQM data were evaluated with respect to flows and magnitude of water quality criteria exceedance using LDCs. Furthermore, TMDLs are derived for all bacteria indicators at any given WQM station placed on the 303(d) list.

To calculate the bacteria load at the WQS, the flow rate at each flow exceedance percentile is multiplied by a unit conversion factor (*24,465,525 ml*s /* ft^3**day*) and the criterion specific to each bacteria indicator. This calculation produces the maximum bacteria load in the stream without exceeding the instantaneous standard over the range of flow conditions. The allowable bacteria (fecal coliform, *E. coli*, or Enterococci) loads at the WQS establish the TMDL and are plotted versus flow exceedance percentile as a LDC. The x-axis indicates the flow exceedance percentile, while the y-axis is expressed in terms of a bacteria load.

To estimate existing loading, bacteria observations for the primary contact recreation season (May 1st through September 30th) from 1999 to 2003 are paired with the flows measured or estimated in that segment on the same date. Pollutant loads are then calculated by multiplying the measured bacteria concentration by the flow rate and a unit conversion factor of *24,465,525 ml*s /* ft^3**day*. The associated flow exceedance percentile is then matched with the measured flow from the tables provided in Appendix C. The observed bacteria loads are then added to the LDC plot as points. These points represent individual ambient water quality samples of bacteria. Points above the LDC indicate the bacteria instantaneous standard was exceeded at the time of sampling. Conversely, points under the LDC indicate the sample met the WQS.

The LDC approach recognizes that the assimilative capacity of a waterbody depends on the flow, and that maximum allowable loading varies with flow condition. Existing loading, and load reductions required to meet the TMDL water quality target can also be calculated under different flow conditions. The difference between existing loading and the water quality target is used to calculate the loading reductions required. Percent reduction goals are calculated for each watershed and bacterial indicator species as the reductions in load required in order that no more than 10 percent of the existing instantaneous water quality observations would exceed the water quality target. This is because for the PBCR use to be supported, criteria for each bacteria indicator must be met in each impaired waterbody.

Table 5-1 presents the percent reductions necessary for each bacteria indicator in each of the impaired waterbodies in the Study Area. Attainment of WQSs in response to TMDL implementation will be based on results measured at each of the WQM stations listed in Table 5-1. Based on this table, the TMDL PRGs for Ranger Creek, Fourteenmile Creek, Crutchfield Branch, Drowning Creek, Little Horse Creek, Elk River, Honey Creek, Sycamore Creek, and Tar Creek will be based on Enterococci; the TMDL PRGs for Horse Creek, Fly Creek, Cow Creek, Fourmile Creek, and Russell Creek will be based on fecal coliform; and the TMDL PRG for Cave Springs Branch will be based on *E. coli*. The PRGs range from 26 to 99 percent.

Table 5-1 TMDL Percent Reductions Required to Meet Water Quality Standards for Impaired Waterbodies in the Neosho River Watershed

Waterbody ID	WQM Station	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instant-aneous	Instant-aneous	Geo-mean	Instant-aneous	Geo-mean
OK121600010060_00	OK121600010060D	Ranger Creek				89%	**67%**
OK121600010100_00	OK121600010100G	Fourteenmile Creek				76%	**69%**
OK121600010440_00	OK121600010440-001SR	Crutchfield Branch	98.6%	97%	96%	99.7%	**99.4%**
OK121600030090_00	OK121600030090G	Drowning Creek	28%			56%	**47%**
OK121600030160_00	OK121600030160G	Horse Creek	**86%**				
OK121600030180_00	OK121600030180D	Fly Creek	**49%**				
OK121600030190_00	OK121600030190A	Little Horse Creek	49%			84%	**77%**
OK121600030340_00	OK121600030340J	Cave Springs Branch	47%	58%	**53%**		
OK121600030440_00	OK121600030440-001AT	Elk River				78%	**52**%
OK121600030445_00	OK121600030445-001AT	Honey Creek	28%			99%	**90%**
OK121600030510_00	OK121600030510D	Sycamore Creek				3%	**26%**
OK121600040060_00	OK121600040060D	Tar Creek				84%	**80%**
OK121600040130_00	OK121600040130G	Cow Creek	**60%**				
OK121600040170_00	OK121600040170G	Fourmile Creek	**55%**				
OK121600040200_00	OK121600040200G	Russell Creek	**49%**				

A subset of the LDCs for each impaired waterbody (representing the primary contact recreation season from 1999 through 2003) are shown in Figures 5-1 through 5-15. While some waterbodies may be listed for multiple bacterial indicators, only one LDC for each waterbody is presented in Figures 5-1 through 5-15 – the LDC for the bacterial indicator that is highlighted by bold text in Table 5-1. In otherwords, Figures 5-1 through 5-15 display a LDC for each waterbody based on the bacterial indicator that represents the most conservative PRG. The LDCs for the other bacterial indicators that require TMDLs are presented in Subsection 5.7 of this report.

The LDC for Ranger Creek (Figure 5-1) is based on enterococcus bacteria measurements during the primary contact recreation season at WQM station OK121600010060D. Enterococcus measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that enterococcus levels exceed the instantaneous water quality criteria during dry and high flow conditions. Due to the preponderance of exceedances during high flow conditions, the majority of the pollution is thought to be due to non-point sources. The exceedances found during dry weather conditions indicate some level of pollution may be due to point sources, failing onsite systems, or direct deposition of animal manure.

The LDC for Fourteenmile Creek (Figure 5-2) is based on enterococcus bacteria measurements during the primary contact recreation season at WQM station OK121600010100G. Enterococcus measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that enterococcus levels exceed the instantaneous water quality criteria under a wide range of flows. Since there are no point sources in the watershed, all loading must be from nonpoint sources.

The LDC for Crutchfield Branch (Figure 5-3) is based on enterococcus bacteria measurements during primary contact recreation season at WQM station OK121600010440-001SR. The LDC indicates that enterococcus levels exceed the instantaneous water quality criteria under a variety of hydrologic conditions, and by a substantial margin under dry weather conditions, indicative of a combination of point and nonpoint sources contributing to water quality impairments.

The LDC for Drowning Creek (Figure 5-4) is based on enterococcus measurements during the primary contact recreation season at WQM station OK121600030090G. Enterococcus measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load at the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that enterococcus levels exceed the instantaneous water quality criteria primarily under moist and dry conditions, possibly indicating a combination of point and nonpoint sources.

The LDC for Horse Creek (Figure 5-5) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK121600030160G. Fecal coliform measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under primary contact recreation season are met; however, this percent reduction is sufficient to ensure that the secondary contact recreation criteria are also met. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria primarily during high through mid-range flow conditions, indicative of nonpoint sources.

The LDC for Fly Creek (Figure 5-6) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK121600030180D. Fecal coliform measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria under a variety of flow conditions, indicative of a combination of point and nonpoint sources.

The LDC for Little Horse Creek (Figure 5-7) is based on enterococcus bacteria measurements during the primary contact recreation season at WQM station OK121600030190A. Enterococcus measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that enterococcus levels exceed the instantaneous water quality criteria during all flow conditions. Since there are no point sources in the watershed, all loading must be nonpoint sources.

The LDC for Cave Springs Branch (Figure 5-8) is based on *E. coli* bacteria measurements during primary contact recreation season at WQM station OK121600030340J. *E. coli* measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that *E. coli* levels sometimes exceed the instantaneous water quality criteria during all flow conditions, and may indicate water quality impairments due to a combination of point and nonpoint sources.

The LDC for Elk River (Figure 5-9) is based on enterococcus measurements during primary contact recreation season at WQM station OK121600030440-001AT (Elk River). Enterococcus measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. Note the LDC indicates that enterococcus levels occasionally exceed the instantaneous water quality criteria under a wide range of flow conditions, indicative of point and nonpoint sources.

The LDC for Honey Creek (Figure 5-10) is based on enterococcus measurements during the primary contact recreation season at WQM station 121600030445-001AT (Honey Creek, off SH 25, Grove). Note the LDC indicates that enterococcus levels exceed the instantaneous water quality criteria primarily under most flow conditions, indicative of a combination of point and nonpoint sources.

The LDC for Sycamore Creek (Figure 5-11) is based on enterococcus measurements during the primary contact recreation season at WQM station OK121600030510D. Enterococcus measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. Note the LDC indicates that enterococcus levels exceeded the instantaneous water quality criteria only under from moist to mid-range flow conditions, indicative of nonpoint sources.

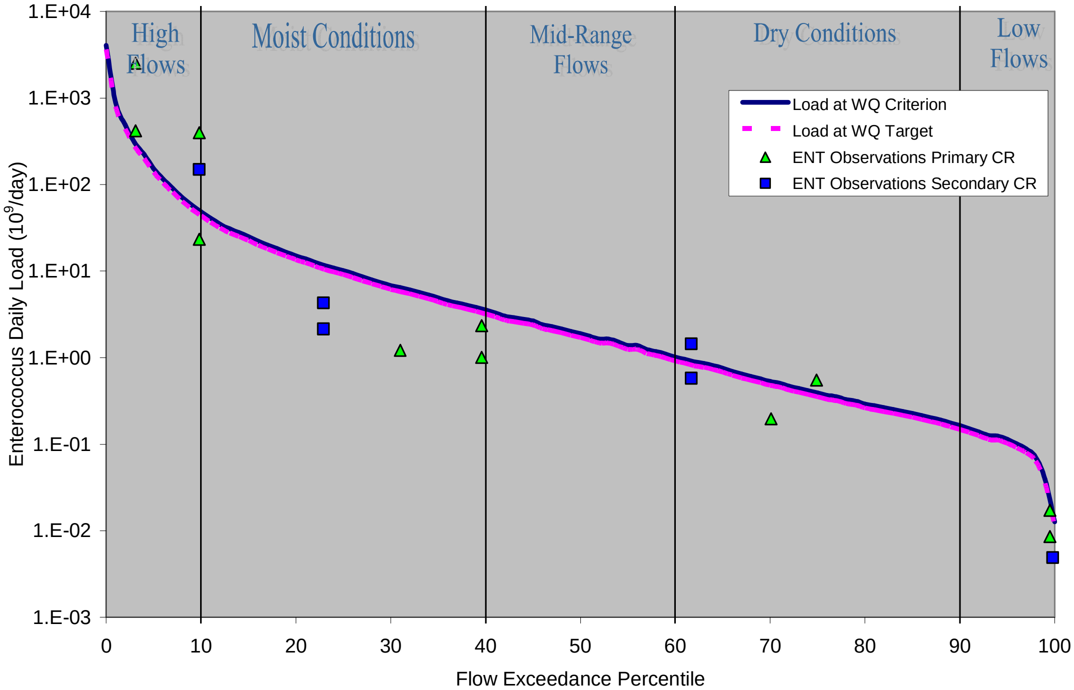
The LDC for Tar Creek (Figure 5-12) is based on enterococcus measurements during the primary contact recreation season at WQM station OK121600040060D. Enterococcus measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. Note the LDC indicates that enterococcus levels exceed the instantaneous water quality criteria from dry to high flow conditions, possibly indicating a combination of point and nonpoint sources.

The LDC for Cow Creek (Figure 5-13) is based on fecal coliform bacteria measurements during the primary contact recreation season at WQM station OK121600040130G. Fecal coliform measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that FC levels exceeded the instantaneous water quality criteria most often during mid-range, moist, and high flow conditions, indicative of nonpoint sources.

The LDC for Fourmile Creek (Figure 5-14) is based on fecal coliform bacteria measurements during the primary contact recreation season at WQM station OK121600040170G. Fecal coliform measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that fecal coliform levels exceeded the instantaneous water quality criteria primarily during mid-range, moist and high flow conditions, indicative of nonpoint sources.

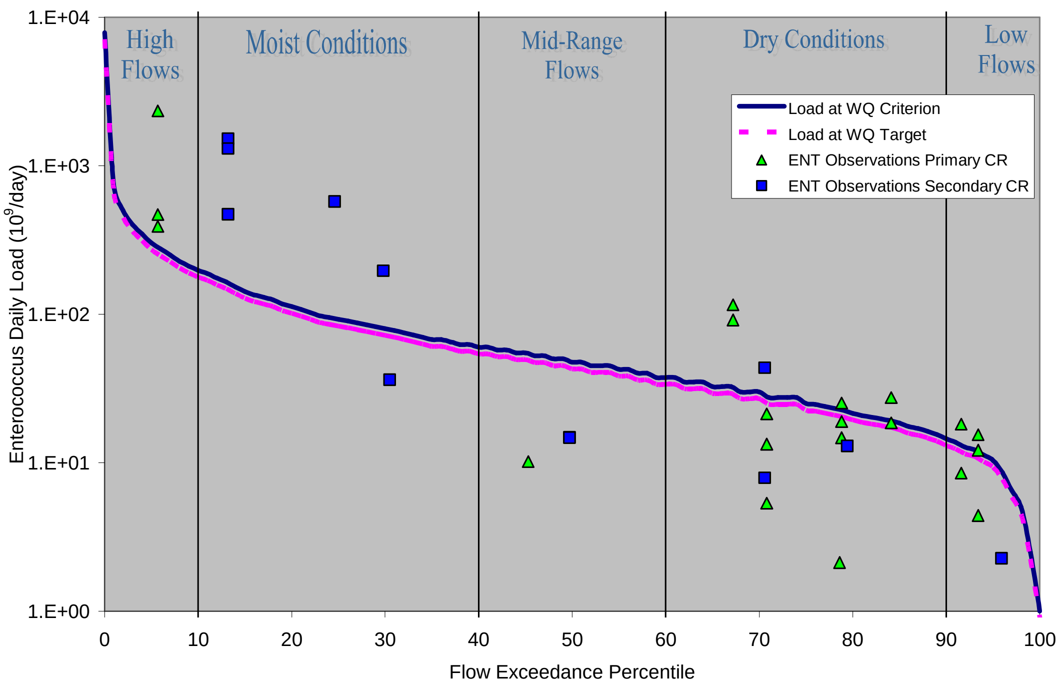
The LDC for Russell Creek (Figure 5-15) is based on fecal coliform bacteria measurements during the primary contact recreation season at WQM station OK121600040200G. Fecal coliform measurements collected during the secondary contact recreation season (October – April) are also displayed on the figure, although the load for the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under the primary contact recreation season are met; however, this percent reduction is sufficient to ensure that secondary contact recreation criteria are also met. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria during moist flow conditions, indicative of nonpoint sources.

Figure 5-1 Load Duration Curve for Enterococci in Ranger Creek (OK121600010060_00)



* there is no wasteload allocation for this waterbody

Figure 5-2 Load Duration Curve for Enterococci in Fourteenmile Creek (OK121600010100_00)



* there is no wasteload allocation for this waterbody

Figure 5-3 Load Duration Curve for Enterococci in Crutchfield Branch (OK121600010440_00)

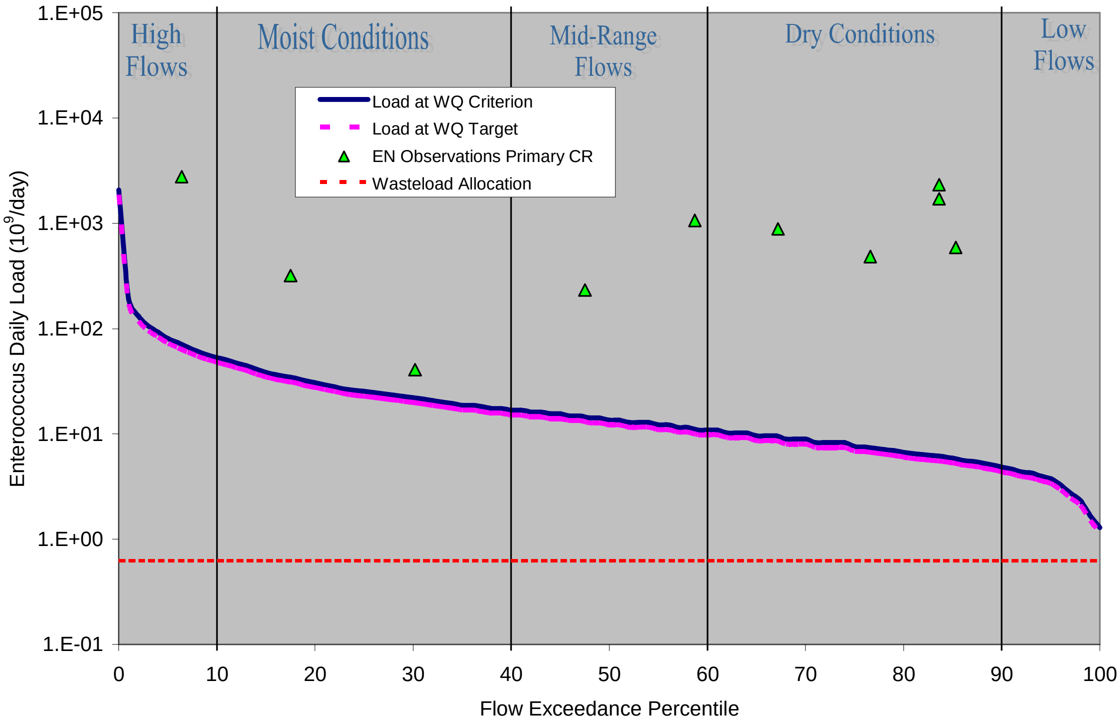


Figure 5-4 Load Duration Curve for Enterococci in Drowning Creek (OK121600030090_00)

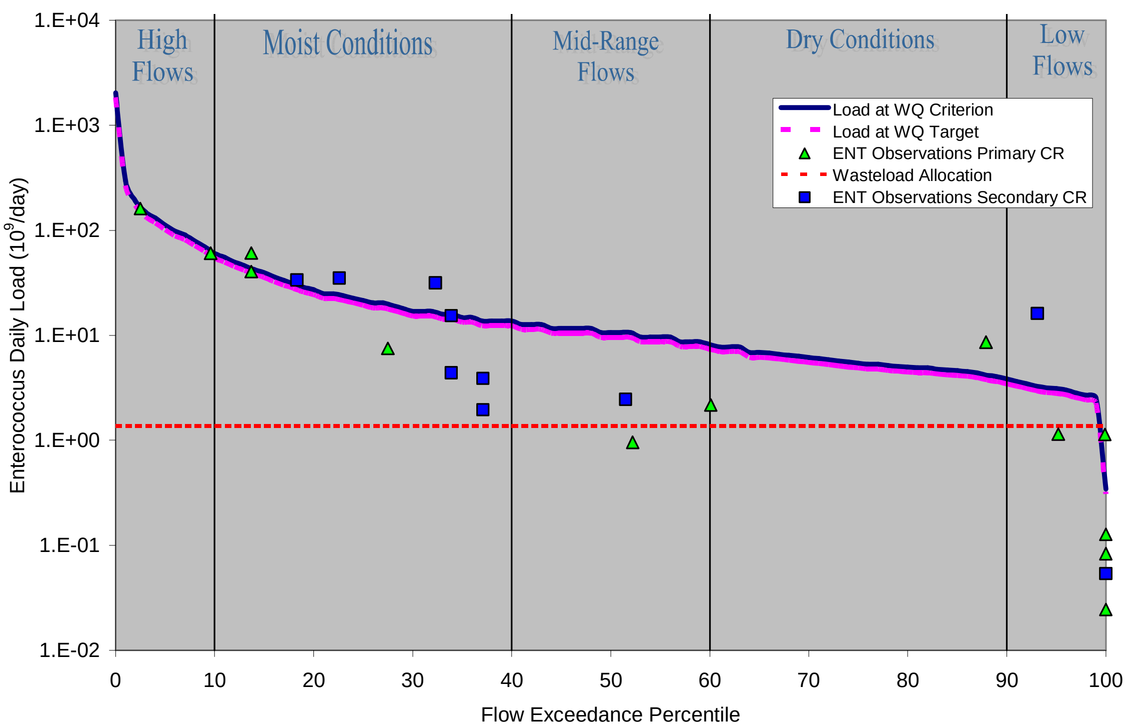
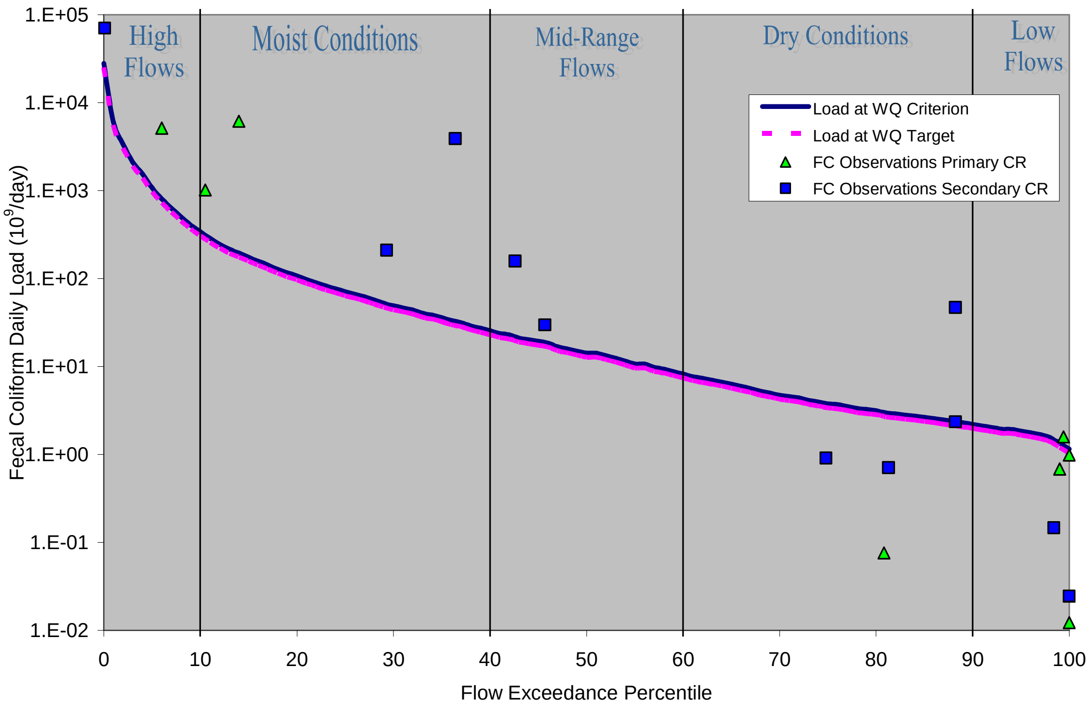
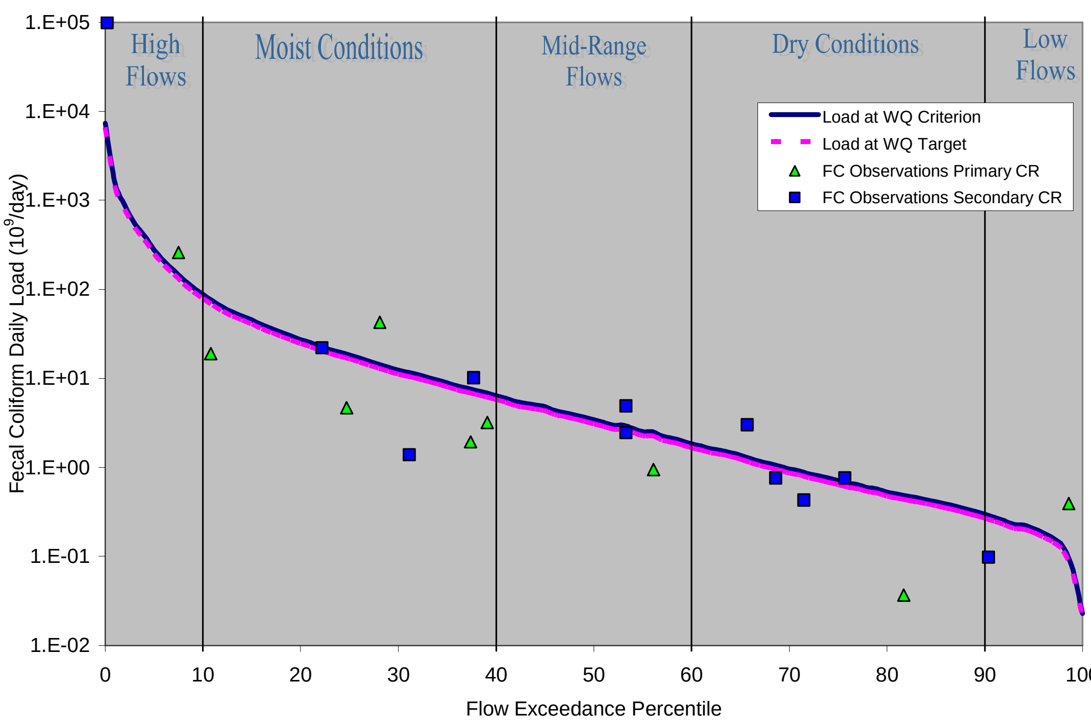


Figure 5-5 Load Duration Curve for Fecal Coliform in Horse Creek (OK121600030160_00)



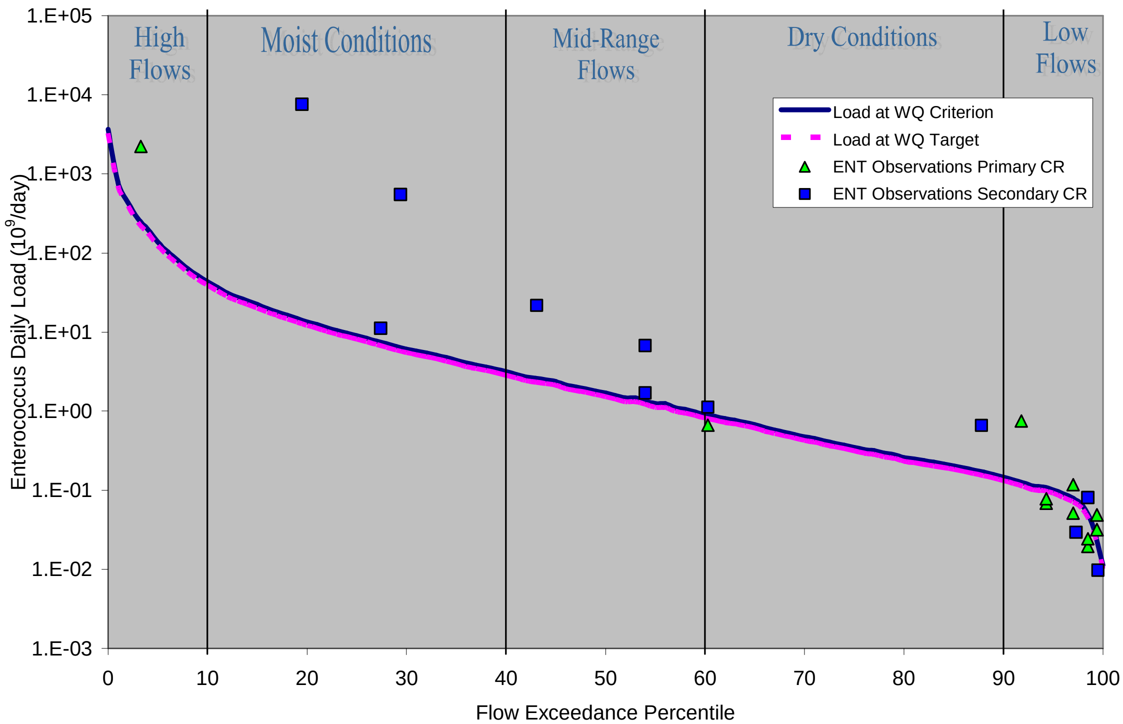
* there is no wasteload allocation for this waterbody

Figure 5-6 Load Duration Curve for Fecal Coliform in Fly Creek (OK121600030180_00)



* there is no wasteload allocation for this waterbody

Figure 5-7 Load Duration Curve for Enterococci in Little Horse Creek (OK121600030190_00)



* there is no wasteload allocation for this waterbody

Figure 5-8 Load Duration Curve for *E. Coli* in Cave Springs Branch (OK121600030340_00)

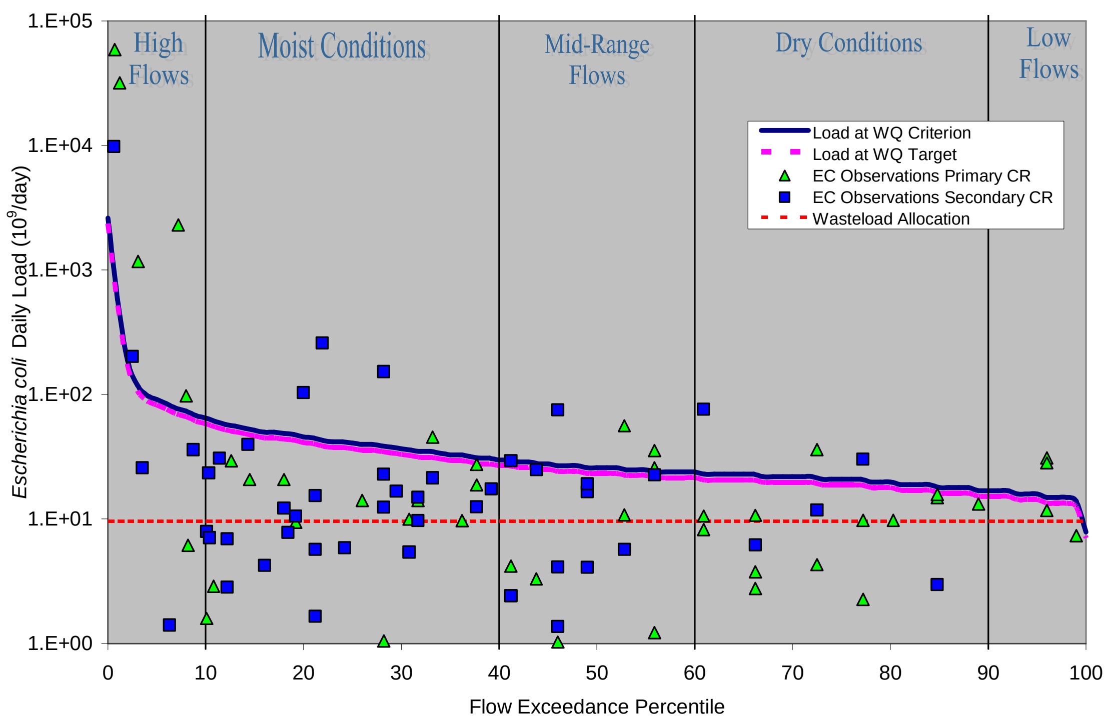


Figure 5-9 Load Duration Curve for Enterococci in Elk River (OK121600030440_00)

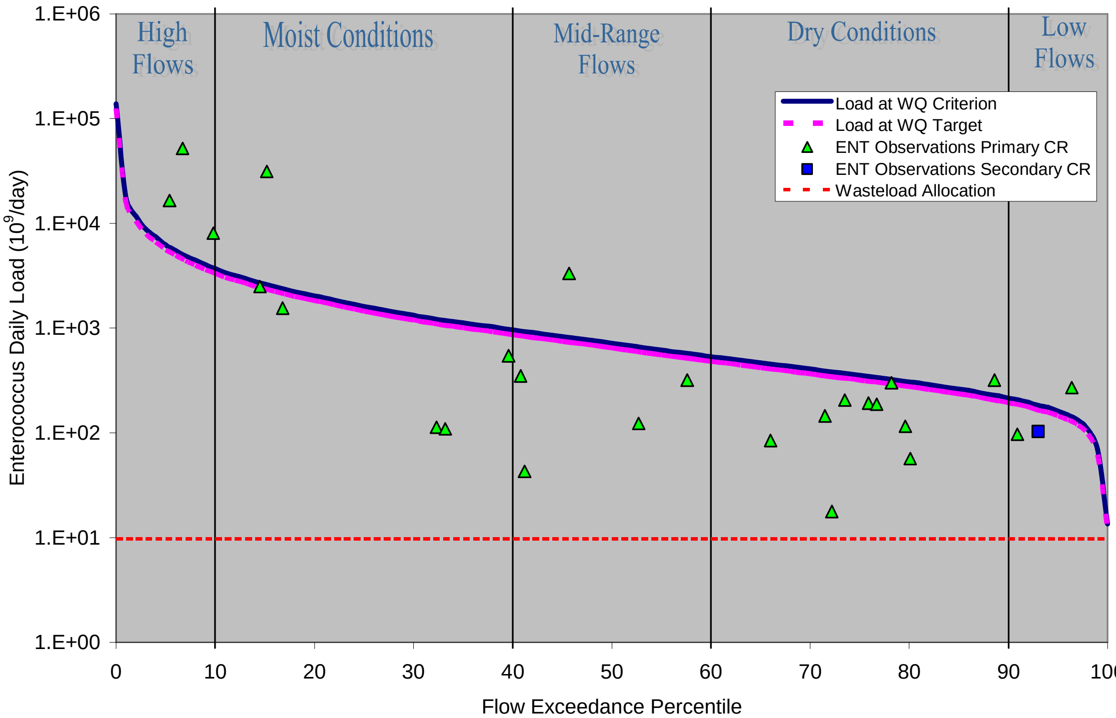


Figure 5-10 Load Duration Curve for Enterococci in Honey Creek (OK121600030445_00)

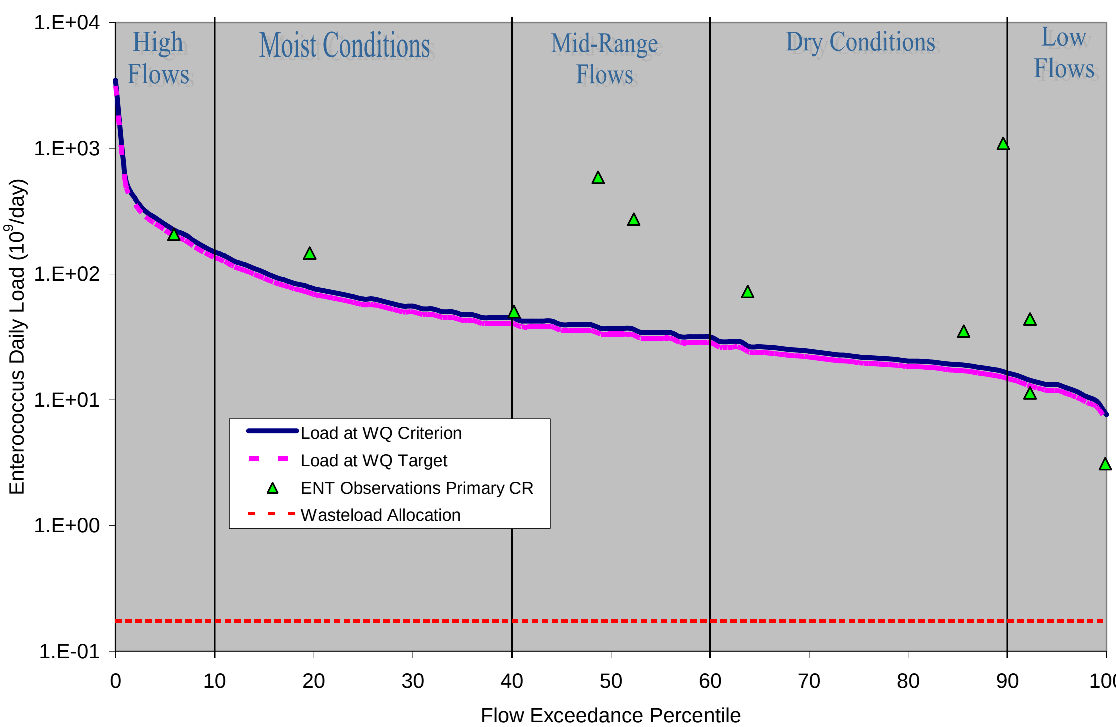
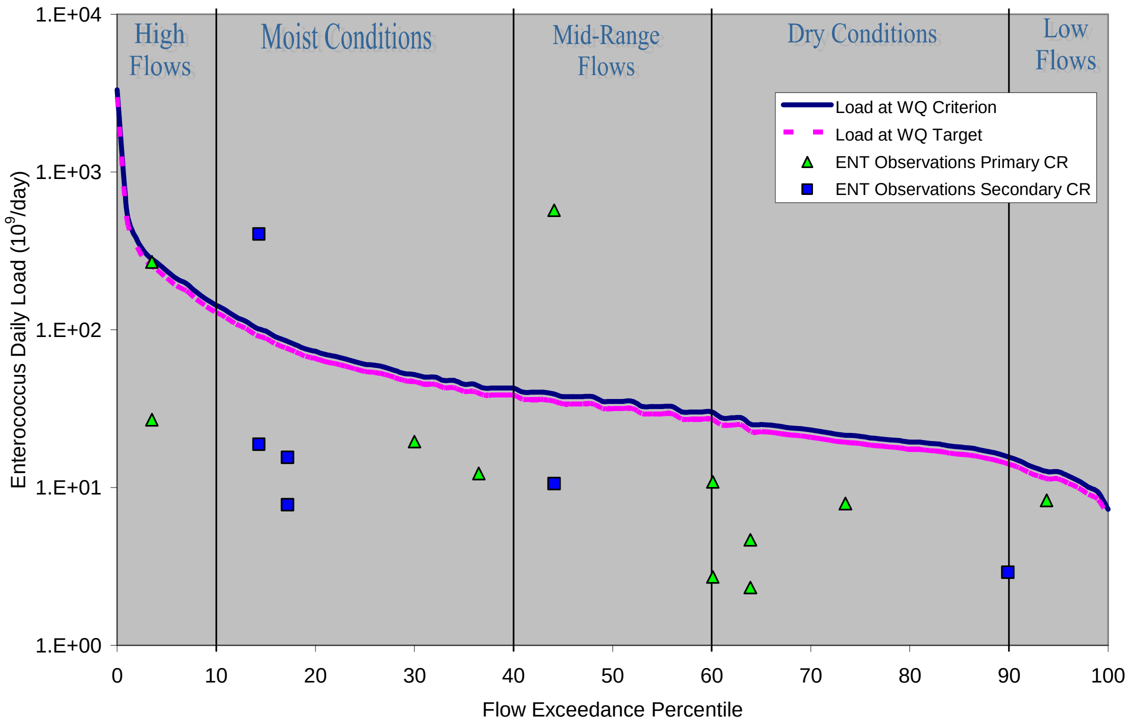


Figure 5-11 Load Duration Curve for Enterococci in Sycamore Creek (OK121600030510_00)



* there is no wasteload allocation for this waterbody

Figure 5-12 Load Duration Curve for Enterococci in Tar Creek (OK121600040060_00)

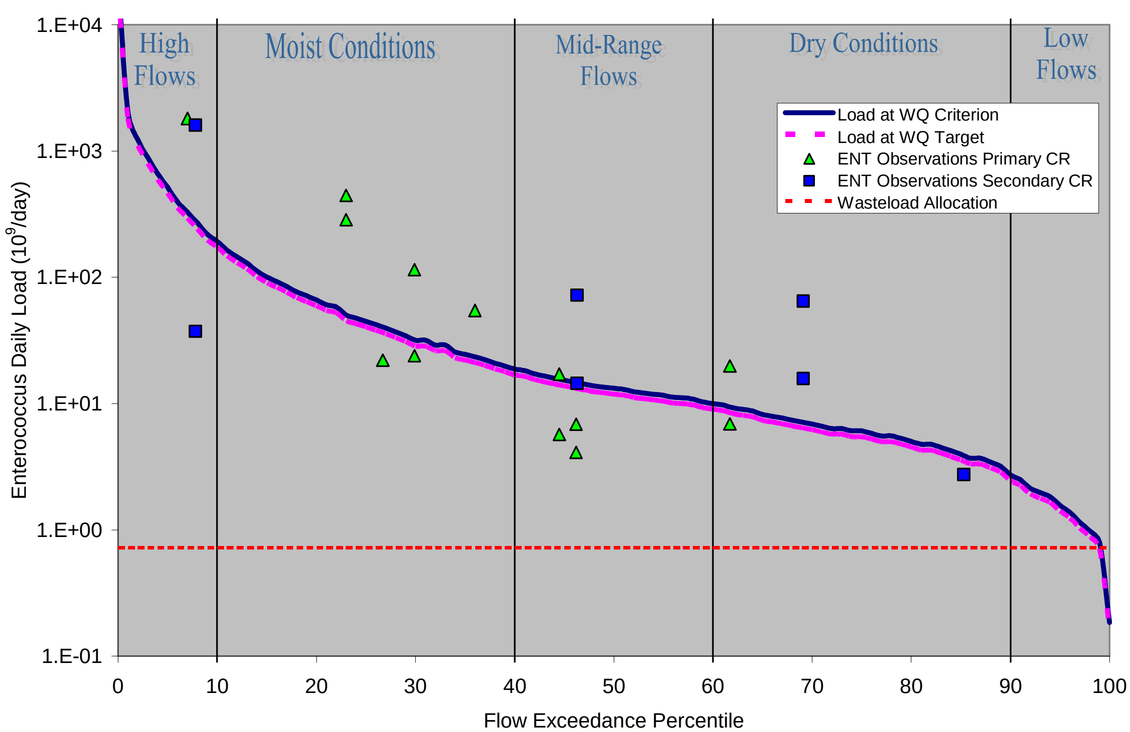
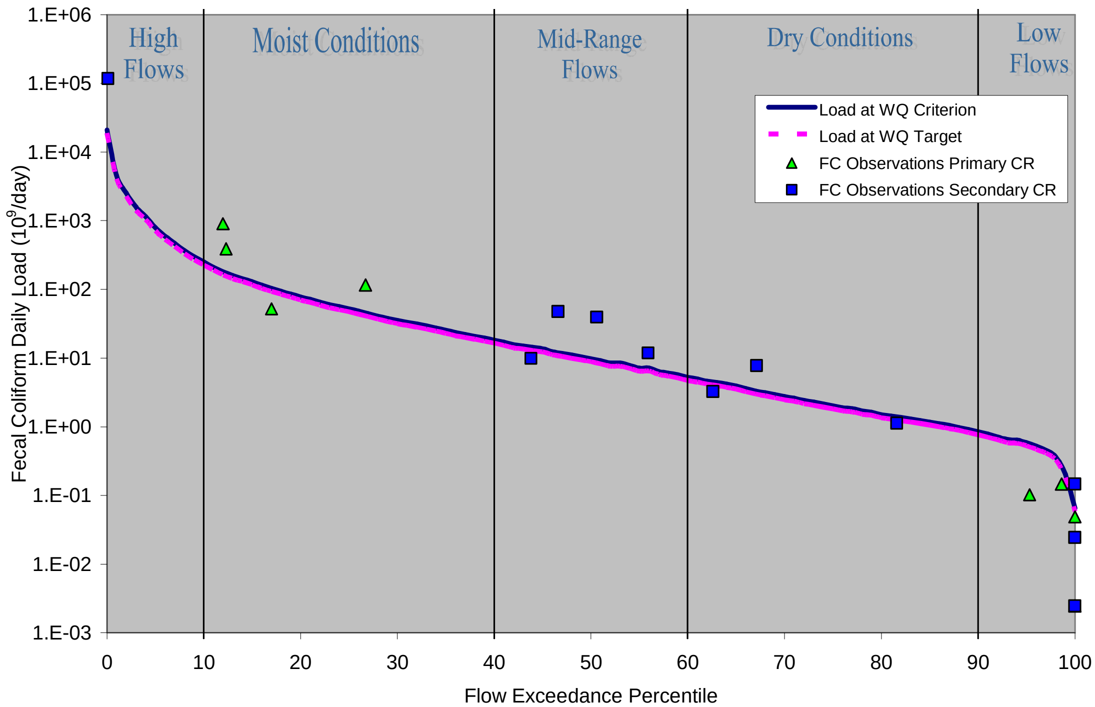
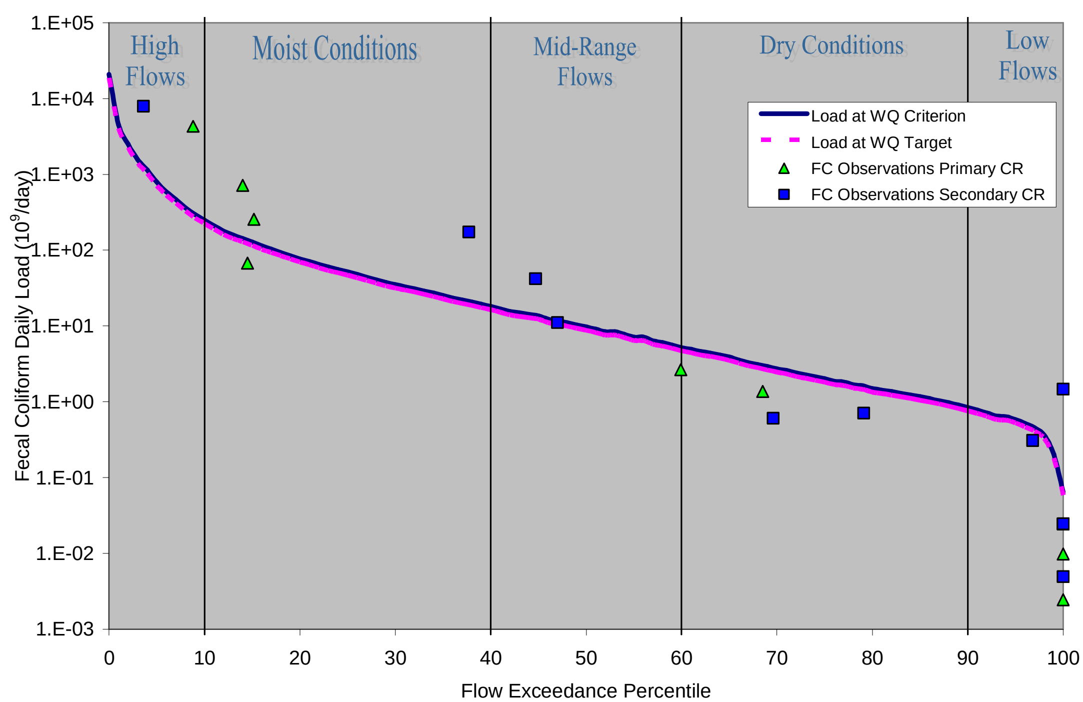


Figure 5-13 Load Duration Curve for Fecal Coliform in Cow Creek (OK121600040130_00)



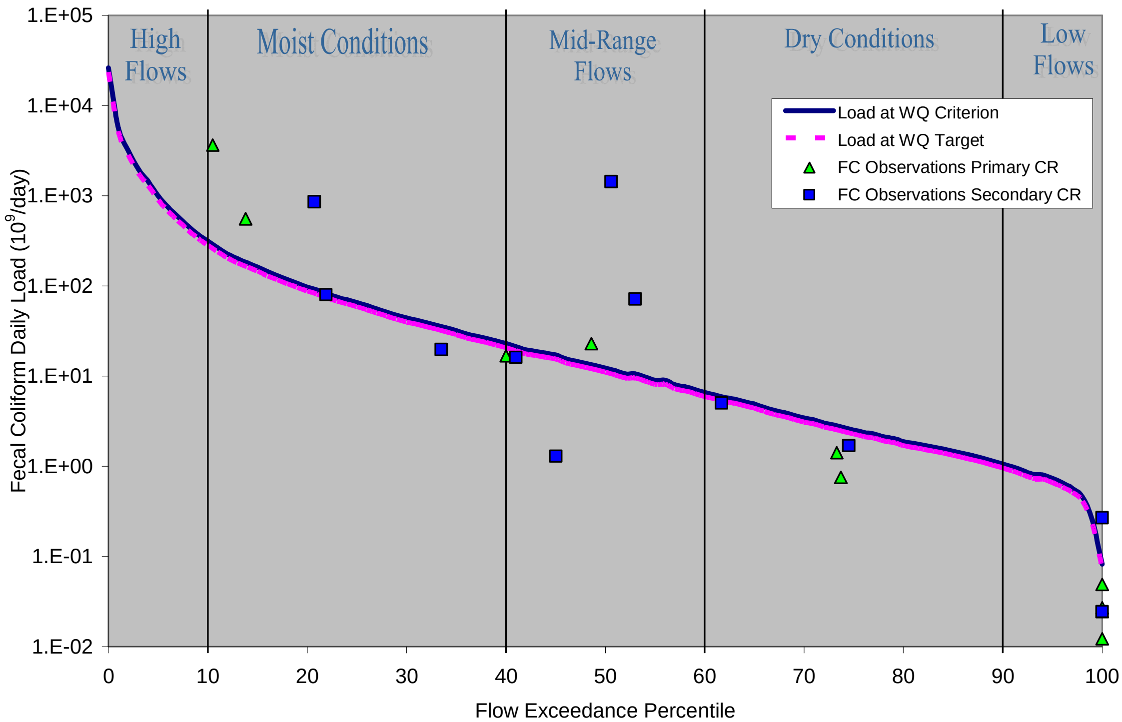
* there is no wasteload allocation for this waterbody

Figure 5-14 Load Duration Curve for Fecal Coliform in Fourmile Creek (OK121600040170_00)



* there is no wasteload allocation for this waterbody

Figure 5-15 Load Duration Curve for Fecal Coliform in Russell Creek (OK121600040200_00)



* there is no wasteload allocation for this waterbody

5.2 Wasteload Allocation

NPDES-permitted facilities are allocated a daily wasteload calculated as their permitted daily average discharge flow rate multiplied by the instream single-sample water quality criterion. In other words, the facilities are required to meet instream criteria in their discharge. Table 5-2 summarizes the WLA for the NPDES-permitted facilities within the Neosho River Study Area. The WLA for each facility is derived from the following equation:

WLA = WQS * flow * unit conversion factor (#/day)

Where:

WQS = 33, 200, and 126 cfu/100ml for Enterococci, fecal coliform, and E. coli respectively

flow (10^6 gal/day) = permitted flow

unit conversion factor = 37,854,120-10^6gal/day

When multiple NPDES facilities occur within a watershed, individual WLAs are summed and the total WLA for continuous point sources is included in the TMDL calculation for the corresponding waterbody. When there are no NPDES WWTPs discharging into the contributing watershed of a WQM station, then the WLA is zero. Compliance with the WLA will be achieved by adhering to the fecal coliform limits and disinfection requirements of NPDES permits. Table 5-2 indicates which point source dischargers within Oklahoma currently have a disinfection requirement in their permit. Certain facilities that utilize lagoons for treatment have not been required to provide disinfection since storage time and exposure to ultraviolet radiation from sunlight should reduce bacteria levels. In the future, all point source dischargers which are assigned a wasteload allocation but do not currently have a bacteria limit in their permit will receive a permit limit consistent with the wasteload allocation as their permits are reissued.

Table 5-2 Wasteload Allocations* for NPDES-Permitted Facilities

Waterbody ID	NPDES Permit No.	Name	Design Flow (mgd)	Disin-fection	Wasteload Allocation (cfu/day)		
					Fecal Coliform	*E. Coli*	Enterococci
OK121600010440_00 Crutchfield Branch	OK0022772	Locust Grove Public Works Authority	0.50	Yes	3.79E+09	2.38E+09	6.25E+08
OK121600030090_00 Drowning Creek	OK0031976	Jay Utilities Authority	1.10	Yes	8.33E+09	5.25E+09	1.37E+09
OK121600030160_00 Horse Creek	OK0020656	Afton Public Works Authority	0.14	Yes	1.06E+09	6.68E+08	1.75E+08
OK121600030340_00 Cave Springs Branch	MO0036773	Simmons Foods, Inc.	2.0	NA	NA	NA	NA
OK121600030440_00 Elk River	AR0036480	City of Sulphur Springs	0.10	NA	NA	NA	NA
	MO0002500	Tyson Food, Inc	2.482	NA	NA	NA	NA
	MO0039926	Neosho, Crowder WWTP	3.0	NA	NA	NA	NA
	MO0054721	Noel WWTP	0.5	NA	NA	NA	NA
	MO0112101	Talbot Ind, Inc - Plant #2	0.402	NA	NA	NA	NA
	MO0112534	Goodman WWTP	0.130	NA	NA	NA	NA
	MO0116505	Park Place Neosho WWTP	0.007	NA	NA	NA	NA
	MO0123986	Quail Meadows MHP	0.004	NA	NA	NA	NA
	MO0130176	Micronics, LLC	1.20	NA	NA	NA	NA
	MOG010319	Wilson Brothers, Inc.	0.0039	NA	NA	NA	NA
OK121600030445_00 Honey Creek	MO0036765	South West City WWTP	0.140	NA	NA	NA	NA
OK121600040060_00 Tar Creek	OK0020320	City of Commerce	0.32	No	2.42E+09	1.53E+09	4.00E+08
	OK0032263	City of Picher	0.18	No	1.36E+09	8.59E+08	2.25E+08
	OK0038962	Cardin Special Utilities	0.05	No	3.79E+08	2.38E+08	6.25E+07
	KS0081698	City of Treece	0.0286	NA	NA	NA	NA

* WLA calculations for facilities outside of Oklahoma are not enforceable

For wastewater treatment facilities in Missouri, Arkansas and Kansas, WLAs are not calculated in Table 5-2 because the state of Oklahoma does not have any regulatory authority over these facilities. The bacteria load from these facilities will be included as load allocation (LA) in the TMDL calculations.

Permitted stormwater discharges are considered point sources. The WLA calculations for MS4s must be expressed as different maximum loads allowable under different flow conditions. Therefore the percentage of a watershed under a MS4 jurisdictional is used to estimate the the MS4 contribution. The only urbanized area designated as an MS4 within this Study Area is the City of Miami located in the Tar Creek (OK121600040060_00) watershed. The flow dependent calculations for the WLA established for the City of Miami MS4 are provided in Tables 5-3 and 5-15.

5.3 Load Allocation

As discussed in Section 3, nonpoint source bacteria loading to the receiving streams of each waterbody emanate from a number of different sources. The data analysis and the LDCs demonstrate that exceedances at the WQM stations are the result of a variety of nonpoint source loading. The LAs for each stream segment are calculated as the difference between the TMDL, MOS, and WLA for WWTP and MS4s as follows:

LA = TMDL – WLA_WWTP – WLA_MS4 - MOS

5.4 Seasonal Variability

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs account for seasonal variation in watershed conditions and pollutant loading. The TMDLs established in this report adhere to the seasonal application of the Oklahoma WQS, which limits the PBCR use to the period of May 1st through September 30th. Seasonal variation was also accounted for in these TMDLs by using more than 5 years of water quality data and by using the longest period of USGS flow records when estimating flows to develop flow exceedance percentiles.

5.5 Margin of Safety

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs include an MOS. The MOS is a conservative measure incorporated into the TMDL equation that accounts for the uncertainty associated with calculating the allowable pollutant loading to ensure WQSs are attained. USEPA guidance allows for use of implicit or explicit expressions of the MOS, or both. When conservative assumptions are used in development of the TMDL, or conservative factors are used in the calculations, the MOS is implicit. When a specific percentage of the TMDL is set aside to account for uncertainty, then the MOS is considered explicit.

For the explicit MOS the water quality target was set at 10 percent lower than the water quality criterion for each pathogen which equates to 360 cfu/100 mL, 365.4 cfu/100 mL, and 97.2/100 mL for fecal coliform, *E. coli*, and Enterococci, respectively. The net effect of the TMDL with MOS is that the assimilative capacity or allowable pollutant loading of each waterbody is slightly reduced. These TMDLs incorporate an explicit MOS by using a curve representing 90 percent of the TMDL as the average MOS. The MOS at any given percent flow exceedance, therefore, can be defined as the difference in loading between the TMDL and the TMDL with MOS. The use of instream bacteria concentrations to estimate existing loading is another conservative element utilized in these TMDLs that can be recognized as an implicit MOS. This conservative approach to establishing the MOS will ensure that both the 30-day geometric mean and instantaneous bacteria standards can be achieved and maintained.

5.6 TMDL Calculations

The bacteria TMDLs for the 303(d)-listed WQM stations covered in this report were derived using LDCs. A TMDL is expressed as the sum of all WLAs (point source loads), LAs (nonpoint source loads), and an appropriate MOS, which attempts to account for uncertainty concerning the relationship between effluent limitations and water quality.

This definition can be expressed by the following equation:

$$TMDL = \Sigma\, WLA + \Sigma\, LA + MOS$$

Where the Σ WLA component can be further divided into WLA for WWTPs and WLA for MS4s:

$$\Sigma\ WLA = WLA\_WWTP + WLA\_MS4$$

For each stream segment the TMDLs presented in this report are expressed as a percent reduction across the full range of flow conditions. The TMDL, WLA, LA, and MOS will vary with flow condition, and are calculated at every 5th flow interval percentile (Tables 5-4 through 5-18). For illustrative purposes, the TMDL, WLA, LA, and MOS are calculated for the median flow at each site in Table 5-3. The WLA component of each TMDL is the sum of all WLAs within the contributing watershed of each WQM station. The sum of the WLAs can be represented as a single line below the LDC. The LDC and the simple equation of:

$$Average\ LA = average\ TMDL - MOS - WLA\_WWTP - WLA\_MS4$$

can provide an individual value for the LA in counts per day, which represents the area under the TMDL target line and above the WLA line. For MS4s the load reduction will be the same as the PRG established for the overall watershed. When there are no continuous point sources the WLA_WWTP is zero. The continuous wastewater discharges in other states are not included in the WLA calculations because Oklahoma does not have any regulatory authority over these facilities. The bacteria load from these facilities will be considered as LA in the TMDL calculations. The LDCs and TMDL calculations for additional bacterial indicators are provided in Subsection 5.7.

Table 5-3 TMDL Summary Examples

Waterbody ID	WQM Station	Waterbody Name	Indicator Bacteria Species	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
OK121600010060_00	OK121600010060D	Ranger Creek	EN	1.89E+09	0	0	1.70E+09	1.89E+08
OK121600010100_00	OK121600010100G	Fourteenmile Creek	EN	4.76E+10	0	0	4.28E+10	4.76E+09
OK121600010440_00	OK121600010440-001SR	Crutchfield Branch	EN	1.35E+10	6.25E+08	0	1.15E+10	1.35E+09
OK121600030090_00	OK121600030090G	Drowning Creek	EN	1.06E+10	1.37E+09	0	8.18E+09	1.06E+09
OK121600030160_00	OK121600030160G	Horse Creek	FC	1.41E+10	1.06E+09	0	1.17E+10	1.41E+09
OK121600030180_00	OK121600030180D	Fly Creek	FC	3.43E+09	0	0	3.08E+09	3.43E+08
OK121600030190_00	OK121600030190A	Little Horse Creek	EN	1.69E+09	0	0	1.52E+09	1.69E+08
OK121600030340_00	OK121600030340J	Cave Springs Branch	EC	2.58E+10	0	0	1.37E+10	2.58E+09
OK121600030440_00	OK121600030440-001AT	Elk River	EN	7.16E+11	0	0	6.35E+11	7.16E+10
OK121600030445_00	OK121600030445-001AT	Honey Creek	EN	3.7E+10	0	0	3.31E+10	3.7E+09
OK121600030510_00	OK121600030510D	Sycamore Creek	EN	3.52E+10	0	0	3.17E+10	3.52E+09
OK121600040060_00	OK121600040060D	Tar Creek	EN	1.32E+10	6.87E+08	1.32E+09	9.88E+09	1.32E+09
OK121600040130_00	OK121600040130G	Cow Creek	FC	9.79E+09	0	0	8.81E+09	9.79E+08
OK121600040170_00	OK121600040170G	Fourmile Creek	FC	9.72E+09	0	0	8.75E+09	9.72E+08
OK121600040200_00	OK121600040200G	Russell Creek	FC	1.22E+10	0	0	1.10E+10	1.22E+09

† Derived for illustrative purposes at the median flow value

* WLA calculations for facilities outside of Oklahoma are not enforceable

Table 5-4 Enterococci TMDL Calculations for Ranger Creek (OK121600010060_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1538	4.06E+12	0	3.66E+12	4.06E+11
5	58	1.54E+11	0	1.39E+11	1.54E+10
10	18	4.85E+10	0	4.37E+10	4.85E+09
15	9.5	2.50E+10	0	2.25E+10	2.50E+09
20	5.7	1.50E+10	0	1.35E+10	1.50E+09
25	3.8	1.01E+10	0	9.09E+09	1.01E+09
30	2.6	6.82E+09	0	6.14E+09	6.82E+08
35	1.9	4.92E+09	0	4.43E+09	4.92E+08
40	1.3	3.53E+09	0	3.18E+09	3.53E+08
45	1.0	2.65E+09	0	2.39E+09	2.65E+08
50	0.72	1.89E+09	0	1.70E+09	1.89E+08
55	0.53	1.39E+09	0	1.25E+09	1.39E+08
60	0.38	1.01E+09	0	9.13E+08	1.01E+08
65	0.29	7.57E+08	0	6.82E+08	7.57E+07
70	0.20	5.30E+08	0	4.77E+08	5.30E+07
75	0.15	3.91E+08	0	3.52E+08	3.91E+07
80	0.11	2.90E+08	0	2.61E+08	2.90E+07
85	0.09	2.27E+08	0	2.05E+08	2.27E+07
90	0.06	1.64E+08	0	1.48E+08	1.64E+07
95	0.04	1.14E+08	0	1.02E+08	1.14E+07
100	0.005	1.26E+07	0	1.14E+07	1.26E+06

Table 5-5 Enterococci TMDL Calculations for Fourteenmile Creek (OK121600010100_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	2995	7.91E+12	0	7.12E+12	7.91E+11
5	115	3.03E+11	0	2.73E+11	3.03E+10
10	75	1.98E+11	0	1.78E+11	1.98E+10
15	54	1.43E+11	0	1.28E+11	1.43E+10
20	43	1.13E+11	0	1.01E+11	1.13E+10
25	35	9.27E+10	0	8.34E+10	9.27E+09
30	30	8.02E+10	0	7.21E+10	8.02E+09
35	26	6.76E+10	0	6.09E+10	6.76E+09
40	23	6.01E+10	0	5.41E+10	6.01E+09
45	21	5.51E+10	0	4.96E+10	5.51E+09
50	18	4.76E+10	0	4.28E+10	4.76E+09
55	16	4.26E+10	0	3.83E+10	4.26E+09
60	14	3.76E+10	0	3.38E+10	3.76E+09
65	12	3.26E+10	0	2.93E+10	3.26E+09
70	11	3.01E+10	0	2.71E+10	3.01E+09
75	9.5	2.50E+10	0	2.25E+10	2.50E+09
80	8.2	2.15E+10	0	1.94E+10	2.15E+09
85	7.0	1.85E+10	0	1.67E+10	1.85E+09
90	5.5	1.45E+10	0	1.31E+10	1.45E+09
95	3.9	1.04E+10	0	9.36E+09	1.04E+09
100	0.4	1.00E+09	0	9.02E+08	1.00E+08

Table 5-6 Enterococci TMDL Calculations for Crutchfield Branch (OK121600010440_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	787	2.08E+12	6.25E+08	1.87E+12	2.08E+11
5	30	8.06E+10	6.25E+08	7.19E+10	8.06E+09
10	20	5.30E+10	6.25E+08	4.70E+10	5.30E+09
15	15	3.85E+10	6.25E+08	3.40E+10	3.85E+09
20	12	3.06E+10	6.25E+08	2.69E+10	3.06E+09
25	9.6	2.53E+10	6.25E+08	2.22E+10	2.53E+09
30	8.3	2.21E+10	6.25E+08	1.92E+10	2.21E+09
35	7.1	1.88E+10	6.25E+08	1.63E+10	1.88E+09
40	6.4	1.68E+10	6.25E+08	1.45E+10	1.68E+09
45	5.9	1.55E+10	6.25E+08	1.33E+10	1.55E+09
50	5.1	1.35E+10	6.25E+08	1.15E+10	1.35E+09
55	4.6	1.22E+10	6.25E+08	1.04E+10	1.22E+09
60	4.1	1.09E+10	6.25E+08	9.17E+09	1.09E+09
65	3.6	9.57E+09	6.25E+08	7.99E+09	9.57E+08
70	3.4	8.91E+09	6.25E+08	7.40E+09	8.91E+08
75	2.9	7.60E+09	6.25E+08	6.21E+09	7.60E+08
80	2.5	6.68E+09	6.25E+08	5.38E+09	6.68E+08
85	2.2	5.89E+09	6.25E+08	4.67E+09	5.89E+08
90	1.8	4.84E+09	6.25E+08	3.73E+09	4.84E+08
95	1.4	3.75E+09	6.25E+08	2.75E+09	3.75E+08
100	0.49	1.29E+09	6.25E+08	5.32E+08	1.29E+08

Table 5-7 Enterococci TMDL Calculations for Drowning Creek (OK121600030090_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	773	2.04E+12	1.37E+09	1.84E+12	2.04E+11
5	43	1.12E+11	1.37E+09	9.98E+10	1.12E+10
10	23	6.04E+10	1.37E+09	5.30E+10	6.04E+09
15	15	3.94E+10	1.37E+09	3.41E+10	3.94E+09
20	10	2.71E+10	1.37E+09	2.30E+10	2.71E+09
25	8.1	2.14E+10	1.37E+09	1.79E+10	2.14E+09
30	6.4	1.69E+10	1.37E+09	1.39E+10	1.69E+09
35	5.6	1.48E+10	1.37E+09	1.19E+10	1.48E+09
40	5.2	1.37E+10	1.37E+09	1.10E+10	1.37E+09
45	4.4	1.16E+10	1.37E+09	9.09E+09	1.16E+09
50	4.0	1.06E+10	1.37E+09	8.18E+09	1.06E+09
55	3.6	9.64E+09	1.37E+09	7.30E+09	9.64E+08
60	3.1	8.15E+09	1.37E+09	5.96E+09	8.15E+08
65	2.6	6.86E+09	1.37E+09	4.80E+09	6.86E+08
70	2.3	6.12E+09	1.37E+09	4.13E+09	6.12E+08
75	2.1	5.44E+09	1.37E+09	3.52E+09	5.44E+08
80	1.9	4.97E+09	1.37E+09	3.10E+09	4.97E+08
85	1.7	4.59E+09	1.37E+09	2.76E+09	4.59E+08
90	1.5	3.83E+09	1.37E+09	2.07E+09	3.83E+08
95	1.2	3.11E+09	1.37E+09	1.43E+09	3.11E+08
100	0.1	1.53E+09	1.37E+09	0.00E+00	1.53E+08

Table 5-8 Fecal Coliform TMDL Calculations for Horse Creek (OK121600030160_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	2869	2.81E+13	1.06E+09	2.53E+13	2.81E+12
5	110	1.07E+12	1.06E+09	9.65E+11	1.07E+11
10	35	3.41E+11	1.06E+09	3.06E+11	3.41E+10
15	18	1.75E+11	1.06E+09	1.57E+11	1.75E+10
20	11	1.07E+11	1.06E+09	9.56E+10	1.07E+10
25	7.2	7.08E+10	1.06E+09	6.27E+10	7.08E+09
30	5.0	4.90E+10	1.06E+09	4.31E+10	4.90E+09
35	3.7	3.59E+10	1.06E+09	3.13E+10	3.59E+09
40	2.6	2.55E+10	1.06E+09	2.19E+10	2.55E+09
45	2.0	1.94E+10	1.06E+09	1.64E+10	1.94E+09
50	1.4	1.41E+10	1.06E+09	1.17E+10	1.41E+09
55	1.1	1.07E+10	1.06E+09	8.53E+09	1.07E+09
60	0.84	8.21E+09	1.06E+09	6.33E+09	8.21E+08
65	0.64	6.30E+09	1.06E+09	4.61E+09	6.30E+08
70	0.48	4.73E+09	1.06E+09	3.19E+09	4.73E+08
75	0.38	3.77E+09	1.06E+09	2.33E+09	3.77E+08
80	0.32	3.16E+09	1.06E+09	1.78E+09	3.16E+08
85	0.27	2.63E+09	1.06E+09	1.31E+09	2.63E+08
90	0.22	2.20E+09	1.06E+09	9.18E+08	2.20E+08
95	0.19	1.85E+09	1.06E+09	6.04E+08	1.85E+08
100	0.12	1.18E+09	1.06E+09	0.00E+00	1.18E+08

Table 5-9 Fecal Coliform TMDL Calculations for Fly Creek (OK121600030180_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	751	7.35E+12	0	6.62E+12	7.35E+11
5	28	2.79E+11	0	2.51E+11	2.79E+10
10	9.0	8.78E+10	0	7.90E+10	8.78E+09
15	4.6	4.52E+10	0	4.07E+10	4.52E+09
20	2.8	2.72E+10	0	2.45E+10	2.72E+09
25	1.9	1.83E+10	0	1.64E+10	1.83E+09
30	1.3	1.23E+10	0	1.11E+10	1.23E+09
35	0.9	8.91E+09	0	8.01E+09	8.91E+08
40	0.7	6.39E+09	0	5.75E+09	6.39E+08
45	0.5	4.80E+09	0	4.32E+09	4.80E+08
50	0.35	3.43E+09	0	3.08E+09	3.43E+08
55	0.26	2.51E+09	0	2.26E+09	2.51E+08
60	0.19	1.84E+09	0	1.65E+09	1.84E+08
65	0.14	1.37E+09	0	1.23E+09	1.37E+08
70	0.10	9.59E+08	0	8.63E+08	9.59E+07
75	0.07	7.08E+08	0	6.37E+08	7.08E+07
80	0.05	5.25E+08	0	4.73E+08	5.25E+07
85	0.04	4.11E+08	0	3.70E+08	4.11E+07
90	0.03	2.97E+08	0	2.67E+08	2.97E+07
95	0.02	2.06E+08	0	1.85E+08	2.06E+07
100	0.00	2.28E+07	0	2.06E+07	2.28E+06

Table 5-10 Enterococci TMDL Calculations for Little Horse Creek (OK121600030190_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1375	3.63E+12	0	3.27E+12	3.63E+11
5	52	1.38E+11	0	1.24E+11	1.38E+10
10	16	4.34E+10	0	3.90E+10	4.34E+09
15	8.5	2.23E+10	0	2.01E+10	2.23E+09
20	5.1	1.34E+10	0	1.21E+10	1.34E+09
25	3.4	9.02E+09	0	8.12E+09	9.02E+08
30	2.3	6.09E+09	0	5.48E+09	6.09E+08
35	1.7	4.40E+09	0	3.96E+09	4.40E+08
40	1.2	3.16E+09	0	2.84E+09	3.16E+08
45	0.90	2.37E+09	0	2.13E+09	2.37E+08
50	0.64	1.69E+09	0	1.52E+09	1.69E+08
55	0.47	1.24E+09	0	1.12E+09	1.24E+08
60	0.34	9.07E+08	0	8.16E+08	9.07E+07
65	0.26	6.77E+08	0	6.09E+08	6.77E+07
70	0.18	4.74E+08	0	4.26E+08	4.74E+07
75	0.13	3.50E+08	0	3.15E+08	3.50E+07
80	0.10	2.59E+08	0	2.33E+08	2.59E+07
85	0.08	2.03E+08	0	1.83E+08	2.03E+07
90	0.06	1.47E+08	0	1.32E+08	1.47E+07
95	0.04	1.02E+08	0	9.14E+07	1.02E+07
100	0.004	1.13E+07	0	1.02E+07	1.13E+06

Table 5-11 *E. Coli* TMDL Calculations for Cave Springs Branch (OK121600030340_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	263	2.61E+12	0	2.35E+12	2.61E+11
5	9.2	9.14E+10	0	8.22E+10	9.14E+09
10	6.5	6.46E+10	0	5.81E+10	6.46E+09
15	5.2	5.17E+10	0	4.65E+10	5.17E+09
20	4.6	4.57E+10	0	4.11E+10	4.57E+09
25	4.1	4.07E+10	0	3.67E+10	4.07E+09
30	3.7	3.68E+10	0	3.31E+10	3.68E+09
35	3.3	3.28E+10	0	2.95E+10	3.28E+09
40	3.0	2.98E+10	0	2.68E+10	2.98E+09
45	2.8	2.78E+10	0	2.50E+10	2.78E+09
50	2.6	2.58E+10	0	2.32E+10	2.58E+09
55	2.5	2.48E+10	0	2.23E+10	2.48E+09
60	2.4	2.38E+10	0	2.15E+10	2.38E+09
65	2.3	2.28E+10	0	2.06E+10	2.28E+09
70	2.2	2.19E+10	0	1.97E+10	2.19E+09
75	2.1	2.09E+10	0	1.88E+10	2.09E+09
80	2.0	1.99E+10	0	1.79E+10	1.99E+09
85	1.8	1.79E+10	0	1.61E+10	1.79E+09
90	1.7	1.69E+10	0	1.52E+10	1.69E+09
95	1.6	1.59E+10	0	1.43E+10	1.59E+09
100	0.79	7.85E+09	0	7.06E+09	7.85E+08

Table 5-12 Enterococci TMDL Calculations for Elk River (OK121600030440_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WWTP WLA (cfu/day)	MS4 WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	52500	1.39E+14	0	2.87E+11	1.25E+14	1.39E+13
5	2350	6.21E+12	0	1.29E+10	5.58E+12	6.21E+11
10	1400	3.70E+12	0	7.66E+09	3.32E+12	3.70E+11
15	993	2.62E+12	0	5.43E+09	2.36E+12	2.62E+11
20	767	2.03E+12	0	4.20E+09	1.82E+12	2.03E+11
25	609.5	1.61E+12	0	3.33E+09	1.45E+12	1.61E+11
30	501	1.32E+12	0	2.74E+09	1.19E+12	1.32E+11
35	423	1.12E+12	0	2.31E+09	1.00E+12	1.12E+11
40	364	9.62E+11	0	1.99E+09	8.64E+11	9.62E+10
45	314	8.30E+11	0	1.72E+09	7.45E+11	8.30E+10
50	271	7.16E+11	0	1.48E+09	6.43E+11	7.16E+10
55	233	6.16E+11	0	1.27E+09	5.53E+11	6.16E+10
60	202	5.34E+11	0	1.10E+09	4.79E+11	5.34E+10
65	176	4.65E+11	0	9.63E+08	4.18E+11	4.65E+10
70	154	4.07E+11	0	8.42E+08	3.65E+11	4.07E+10
75	134	3.54E+11	0	7.33E+08	3.18E+11	3.54E+10
80	116	3.07E+11	0	6.34E+08	2.75E+11	3.07E+10
85	99	2.62E+11	0	5.41E+08	2.35E+11	2.62E+10
90	81	2.14E+11	0	4.43E+08	1.92E+11	2.14E+10
95	61	1.61E+11	0	3.34E+08	1.45E+11	1.61E+10
100	5.1	1.35E+10	0	2.79E+07	1.21E+10	1.35E+09

Table 5-13 Enterococci TMDL Calculations for Honey Creek (OK121600030445_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1320	3.49E+12	0	3.14E+12	3.49E+11
5	94	2.48E+11	0	2.24E+11	2.48E+10
10	57	1.50E+11	0	1.35E+11	1.50E+10
15	39	1.03E+11	0	9.27E+10	1.03E+10
20	29	7.66E+10	0	6.90E+10	7.66E+09
25	24	6.34E+10	0	5.71E+10	6.34E+09
30	21	5.55E+10	0	4.99E+10	5.55E+09
35	18	4.76E+10	0	4.28E+10	4.76E+09
40	17	4.49E+10	0	4.04E+10	4.49E+09
45	15	3.96E+10	0	3.57E+10	3.96E+09
50	14	3.70E+10	0	3.33E+10	3.70E+09
55	13	3.43E+10	0	3.09E+10	3.43E+09
60	12	3.17E+10	0	2.85E+10	3.17E+09
65	10	2.64E+10	0	2.38E+10	2.64E+09
70	9.2	2.43E+10	0	2.19E+10	2.43E+09
75	8.3	2.19E+10	0	1.97E+10	2.19E+09
80	7.7	2.03E+10	0	1.83E+10	2.03E+09
85	7.2	1.90E+10	0	1.71E+10	1.90E+09
90	6.2	1.64E+10	0	1.47E+10	1.64E+09
95	5.0	1.32E+10	0	1.19E+10	1.32E+09
100	2.9	7.66E+09	0	6.90E+09	7.66E+08

Table 5-14 Enterococci TMDL Calculations for Sycamore Creek (OK121600030510_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1256	3.32E+12	0	2.99E+12	3.32E+11
5	89	2.36E+11	0	2.13E+11	2.36E+10
10	54	1.43E+11	0	1.29E+11	1.43E+10
15	37	9.80E+10	0	8.82E+10	9.80E+09
20	28	7.29E+10	0	6.56E+10	7.29E+09
25	23	6.03E+10	0	5.43E+10	6.03E+09
30	20	5.20E+10	0	4.68E+10	5.20E+09
35	17	4.52E+10	0	4.07E+10	4.52E+09
40	16	4.27E+10	0	3.85E+10	4.27E+09
45	14	3.77E+10	0	3.39E+10	3.77E+09
50	13	3.52E+10	0	3.17E+10	3.52E+09
55	12	3.27E+10	0	2.94E+10	3.27E+09
60	11	3.02E+10	0	2.71E+10	3.02E+09
65	9.5	2.51E+10	0	2.26E+10	2.51E+09
70	8.8	2.31E+10	0	2.08E+10	2.31E+09
75	8.0	2.11E+10	0	1.90E+10	2.11E+09
80	7.3	1.93E+10	0	1.74E+10	1.93E+09
85	6.8	1.81E+10	0	1.63E+10	1.81E+09
90	5.9	1.56E+10	0	1.40E+10	1.56E+09
95	4.8	1.26E+10	0	1.13E+10	1.26E+09
100	2.8	7.28E+09	0	6.56E+09	7.28E+08

Table 5-15 Enterococci TMDL Calculations for Tar Creek (OK121600040060_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	8200	2.17E+13	6.87E+08	2.30E+12	1.72E+13	2.17E+12
5	195	5.15E+11	6.87E+08	5.46E+10	4.08E+11	5.15E+10
10	73	1.93E+11	6.87E+08	2.04E+10	1.52E+11	1.93E+10
15	38	1.00E+11	6.87E+08	1.06E+10	7.91E+10	1.00E+10
20	25	6.61E+10	6.87E+08	6.94E+09	5.18E+10	6.61E+09
25	17	4.49E+10	6.87E+08	4.69E+09	3.50E+10	4.49E+09
30	12	3.17E+10	6.87E+08	3.29E+09	2.46E+10	3.17E+09
35	9.3	2.46E+10	6.87E+08	2.53E+09	1.89E+10	2.46E+09
40	7.1	1.88E+10	6.87E+08	1.91E+09	1.43E+10	1.88E+09
45	5.8	1.53E+10	6.87E+08	1.55E+09	1.16E+10	1.53E+09
50	5.0	1.32E+10	6.87E+08	1.32E+09	9.88E+09	1.32E+09
55	4.4	1.16E+10	6.87E+08	1.15E+09	8.62E+09	1.16E+09
60	3.8	1.00E+10	6.87E+08	9.86E+08	7.36E+09	1.00E+09
65	3.1	8.19E+09	6.87E+08	7.89E+08	5.90E+09	8.19E+08
70	2.6	6.87E+09	6.87E+08	6.49E+08	4.85E+09	6.87E+08
75	2.3	6.08E+09	6.87E+08	5.65E+08	4.22E+09	6.08E+08
80	1.9	5.02E+09	6.87E+08	4.52E+08	3.38E+09	5.02E+08
85	1.5	3.96E+09	6.87E+08	3.40E+08	2.54E+09	3.96E+08
90	1.0	2.72E+09	6.87E+08	2.08E+08	1.55E+09	2.72E+08
95	0.59	1.56E+09	6.87E+08	8.50E+07	6.35E+08	1.56E+08
100	0.07	8.03E+08	6.87E+08	0.00E+00	0.00E+00	8.03E+07

Table 5-16 Fecal Coliform TMDL Calculations for Cow Creek (OK121600040130_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	2147	2.10E+13	0	1.89E+13	2.10E+12
5	81	7.96E+11	0	7.16E+11	7.96E+10
10	26	2.51E+11	0	2.26E+11	2.51E+10
15	13	1.29E+11	0	1.16E+11	1.29E+10
20	7.9	7.76E+10	0	6.99E+10	7.76E+09
25	5.3	5.22E+10	0	4.70E+10	5.22E+09
30	3.6	3.52E+10	0	3.17E+10	3.52E+09
35	2.6	2.54E+10	0	2.29E+10	2.54E+09
40	1.9	1.83E+10	0	1.64E+10	1.83E+09
45	1.4	1.37E+10	0	1.23E+10	1.37E+09
50	1.0	9.79E+09	0	8.81E+09	9.79E+08
55	0.73	7.18E+09	0	6.46E+09	7.18E+08
60	0.54	5.25E+09	0	4.72E+09	5.25E+08
65	0.40	3.91E+09	0	3.52E+09	3.91E+08
70	0.28	2.74E+09	0	2.47E+09	2.74E+08
75	0.21	2.02E+09	0	1.82E+09	2.02E+08
80	0.15	1.50E+09	0	1.35E+09	1.50E+08
85	0.12	1.17E+09	0	1.06E+09	1.17E+08
90	0.09	8.48E+08	0	7.63E+08	8.48E+07
95	0.06	5.87E+08	0	5.28E+08	5.87E+07
100	0.01	6.52E+07	0	5.87E+07	6.52E+06

Table 5-17 Fecal Coliform TMDL Calculations for Fourmile Creek (OK121600040170_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	2132	2.09E+13	0	1.88E+13	2.09E+12
5	81	7.91E+11	0	7.12E+11	7.91E+10
10	25	2.49E+11	0	2.24E+11	2.49E+10
15	13	1.28E+11	0	1.16E+11	1.28E+10
20	7.9	7.71E+10	0	6.94E+10	7.71E+09
25	5.3	5.18E+10	0	4.67E+10	5.18E+09
30	3.6	3.50E+10	0	3.15E+10	3.50E+09
35	2.6	2.53E+10	0	2.27E+10	2.53E+09
40	1.9	1.81E+10	0	1.63E+10	1.81E+09
45	1.4	1.36E+10	0	1.22E+10	1.36E+09
50	0.99	9.72E+09	0	8.75E+09	9.72E+08
55	0.73	7.13E+09	0	6.42E+09	7.13E+08
60	0.53	5.21E+09	0	4.69E+09	5.21E+08
65	0.40	3.89E+09	0	3.50E+09	3.89E+08
70	0.28	2.72E+09	0	2.45E+09	2.72E+08
75	0.21	2.01E+09	0	1.81E+09	2.01E+08
80	0.15	1.49E+09	0	1.34E+09	1.49E+08
85	0.12	1.17E+09	0	1.05E+09	1.17E+08
90	0.09	8.42E+08	0	7.58E+08	8.42E+07
95	0.06	5.83E+08	0	5.25E+08	5.83E+07
100	0.01	6.48E+07	0	5.83E+07	6.48E+06

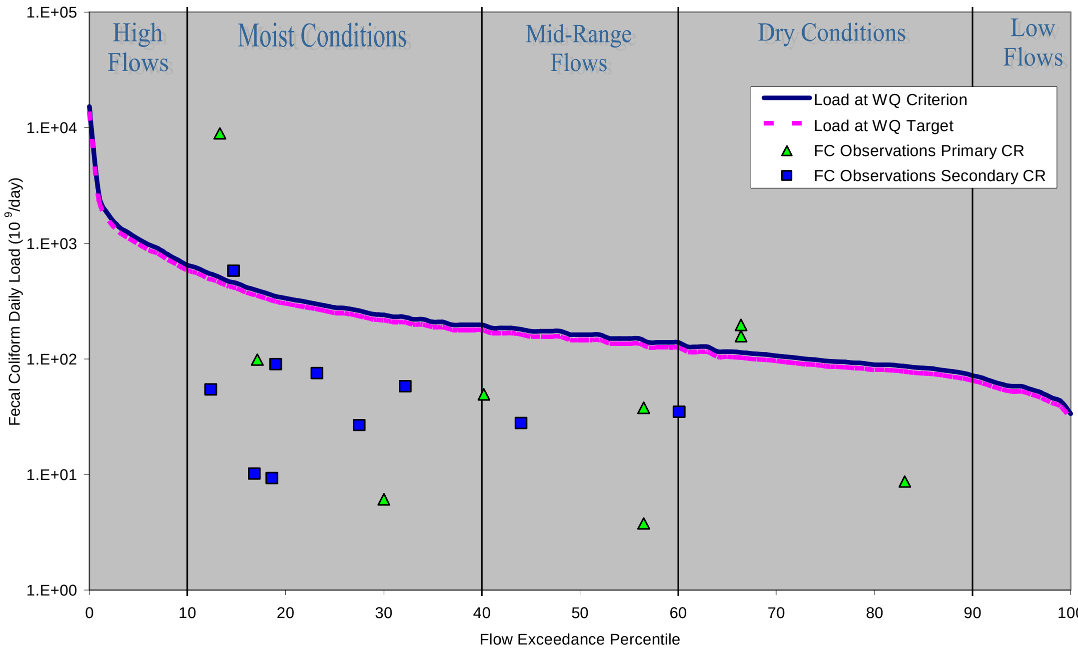
Table 5-18 Fecal Coliform TMDL Calculations for Russell Creek (OK121600040200_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	2,683	2.63E+13	0	2.36E+13	2.63E+12
5	102	9.95E+11	0	8.95E+11	9.95E+10
10	32	3.13E+11	0	2.82E+11	3.13E+10
15	17	1.62E+11	0	1.45E+11	1.62E+10
20	9.9	9.70E+10	0	8.73E+10	9.70E+09
25	6.7	6.52E+10	0	5.87E+10	6.52E+09
30	4.5	4.40E+10	0	3.96E+10	4.40E+09
35	3.3	3.18E+10	0	2.86E+10	3.18E+09
40	2.3	2.28E+10	0	2.06E+10	2.28E+09
45	1.8	1.71E+10	0	1.54E+10	1.71E+09
50	1.3	1.22E+10	0	1.10E+10	1.22E+09
55	0.92	8.97E+09	0	8.07E+09	8.97E+08
60	0.67	6.56E+09	0	5.90E+09	6.56E+08
65	0.50	4.89E+09	0	4.40E+09	4.89E+08
70	0.35	3.43E+09	0	3.08E+09	3.43E+08
75	0.26	2.53E+09	0	2.28E+09	2.53E+08
80	0.19	1.88E+09	0	1.69E+09	1.88E+08
85	0.15	1.47E+09	0	1.32E+09	1.47E+08
90	0.11	1.06E+09	0	9.54E+08	1.06E+08
95	0.08	7.34E+08	0	6.61E+08	7.34E+07
100	0.01	8.16E+07	0	7.34E+07	8.16E+06

5.7 LDCs and TMDL Calculations for Additional Bacterial Indicators

As mentioned previously in Section 5.1, USEPA regulations at 40 CFR 130.7(c) (1) require TMDLs to take into account critical conditions for stream flow, loading, and all applicable water quality standards. To accomplish this, available instream WQM data were evaluated with respect to flows and magnitude of water quality criteria exceedance using LDCs. Furthermore as required, TMDL calculations from LDCs for all bacterial indicators not supporting the PBCR use were prepared. The remaining LDCs and TMDL calculations for additional bacterial indicators are shown in Figures 5-16 through 5-22 and Tables 5-19 through 5-25 respectively.

Figure 5-16 Load Duration Curve for Fecal Coliform in Fourteenmile Creek (OK121600010100_00)

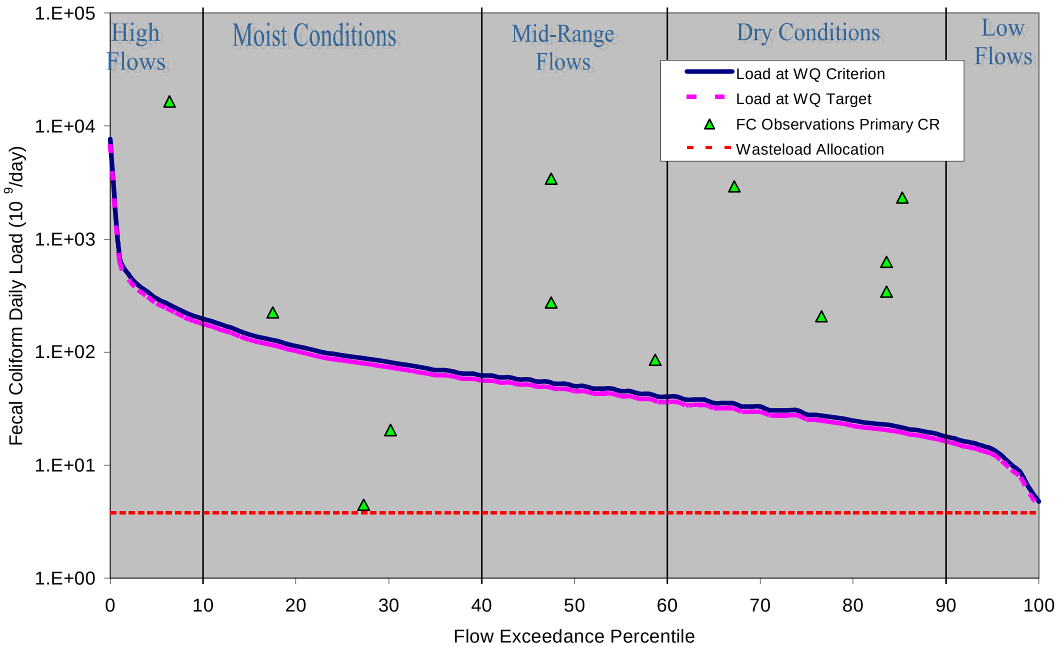


* there is no wasteload allocation for this waterbody

Table 5-19 Fecal Coliform TMDL Calculations for Fourteenmile Creek (OK121600010100_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1566.9	1.53E+13	0	1.38E+13	1.53E+12
5	111.6	1.09E+12	0	9.83E+11	1.09E+11
10	66.3	6.49E+11	0	5.84E+11	6.49E+10
15	46.3	4.53E+11	0	4.08E+11	4.53E+10
20	34.4	3.37E+11	0	3.03E+11	3.37E+10
25	28.5	2.79E+11	0	2.51E+11	2.79E+10
30	24.6	2.40E+11	0	2.16E+11	2.40E+10
35	21.4	2.09E+11	0	1.88E+11	2.09E+10
40	20.2	1.97E+11	0	1.78E+11	1.97E+10
45	17.8	1.74E+11	0	1.57E+11	1.74E+10
50	16.6	1.63E+11	0	1.46E+11	1.63E+10
55	15.4	1.51E+11	0	1.36E+11	1.51E+10
60	14.2	1.39E+11	0	1.25E+11	1.39E+10
65	11.9	1.16E+11	0	1.04E+11	1.16E+10
70	10.9	1.07E+11	0	9.62E+10	1.07E+10
75	9.9	9.64E+10	0	8.68E+10	9.64E+09
80	9.1	8.94E+10	0	8.04E+10	8.94E+09
85	8.5	8.36E+10	0	7.52E+10	8.36E+09
90	7.4	7.20E+10	0	6.48E+10	7.20E+09
95	5.9	5.81E+10	0	5.23E+10	5.81E+09
100	3.4	3.37E+10	0	3.03E+10	3.37E+09

Figure 5-17 Load Duration Curve for Fecal Coliform in Crutchfield Branch (OK121600010440_00)



* there is no wasteload allocation for this waterbody

Table 5-20 Fecal Coliform TMDL Calculations for Crutchfield Branch (OK121600010440_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	786.7	7.70E+12	3.79E+09	6.93E+12	7.70E+11
5	30.5	2.98E+11	3.79E+09	2.65E+11	2.98E+10
10	20.0	1.96E+11	3.79E+09	1.73E+11	1.96E+10
15	14.6	1.43E+11	3.79E+09	1.25E+11	1.43E+10
20	11.6	1.13E+11	3.79E+09	9.82E+10	1.13E+10
25	9.6	9.39E+10	3.79E+09	8.07E+10	9.39E+09
30	8.3	8.17E+10	3.79E+09	6.98E+10	8.17E+09
35	7.1	6.95E+10	3.79E+09	5.88E+10	6.95E+09
40	6.4	6.22E+10	3.79E+09	5.22E+10	6.22E+09
45	5.9	5.74E+10	3.79E+09	4.78E+10	5.74E+09
50	5.11	5.01E+10	3.79E+09	4.13E+10	5.01E+09
55	4.62	4.52E+10	3.79E+09	3.69E+10	4.52E+09
60	4.12	4.03E+10	3.79E+09	3.25E+10	4.03E+09
65	3.62	3.54E+10	3.79E+09	2.81E+10	3.54E+09
70	3.37	3.30E+10	3.79E+09	2.59E+10	3.30E+09
75	2.88	2.81E+10	3.79E+09	2.15E+10	2.81E+09
80	2.53	2.4727E+10	3.79E+09	1.85E+10	2.47E+09
85	2.23	2.1805E+10	3.79E+09	1.58E+10	2.18E+09
90	1.83	1.7909E+10	3.79E+09	1.23E+10	1.79E+09
95	1.42	1.3891E+10	3.79E+09	8.72E+09	1.39E+09
100	0.49	4.76E+09	3.79E+09	4.98E+08	4.76E+08

Figure 5-18 Load Duration Curve for *E. Coli* in Crutchfield Branch (OK121600010440_00)

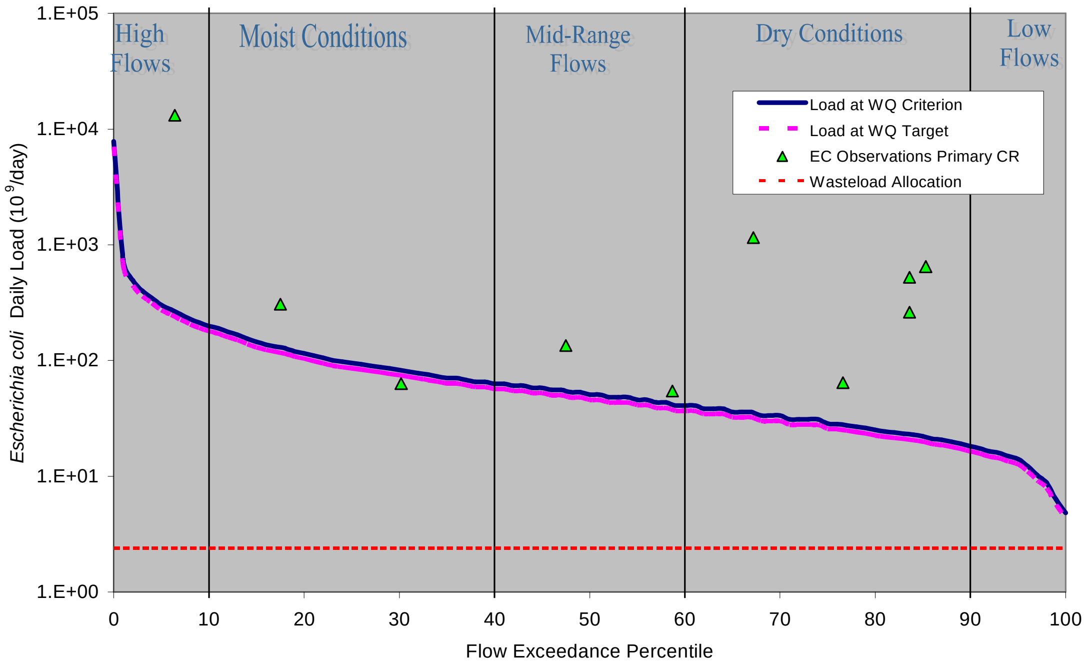


Table 5-21 *E. Coli* TMDL Calculations for Crutchfield Branch (OK121600010440_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	786.7	7.81E+12	2.38E+09	7.03E+12	7.81E+11
5	30.5	3.03E+11	2.38E+09	2.70E+11	3.03E+10
10	20.0	1.99E+11	2.38E+09	1.77E+11	1.99E+10
15	14.6	1.45E+11	2.38E+09	1.28E+11	1.45E+10
20	11.6	1.15E+11	2.38E+09	1.01E+11	1.15E+10
25	9.6	9.53E+10	2.38E+09	8.34E+10	9.53E+09
30	8.3	8.29E+10	2.38E+09	7.23E+10	8.29E+09
35	7.1	7.06E+10	2.38E+09	6.11E+10	7.06E+09
40	6.4	6.32E+10	2.38E+09	5.45E+10	6.32E+09
45	5.9	5.82E+10	2.38E+09	5.00E+10	5.82E+09
50	5.11	5.08E+10	2.38E+09	4.33E+10	5.08E+09
55	4.62	4.59E+10	2.38E+09	3.89E+10	4.59E+09
60	4.12	4.09E+10	2.38E+09	3.44E+10	4.09E+09
65	3.62	3.60E+10	2.38E+09	3.00E+10	3.60E+09
70	3.37	3.35E+10	2.38E+09	2.78E+10	3.35E+09
75	2.88	2.86E+10	2.38E+09	2.33E+10	2.86E+09
80	2.53	2.5098E+10	2.38E+09	2.02E+10	2.51E+09
85	2.23	2.2132E+10	2.38E+09	1.75E+10	2.21E+09
90	1.83	1.8178E+10	2.38E+09	1.40E+10	1.82E+09
95	1.42	1.4099E+10	2.38E+09	1.03E+10	1.41E+09
100	0.49	4.83E+09	2.38E+09	1.96E+09	4.83E+08

Figure 5-19 Load Duration Curve for Fecal Coliform in Drowning Creek (OK121600030090_00)

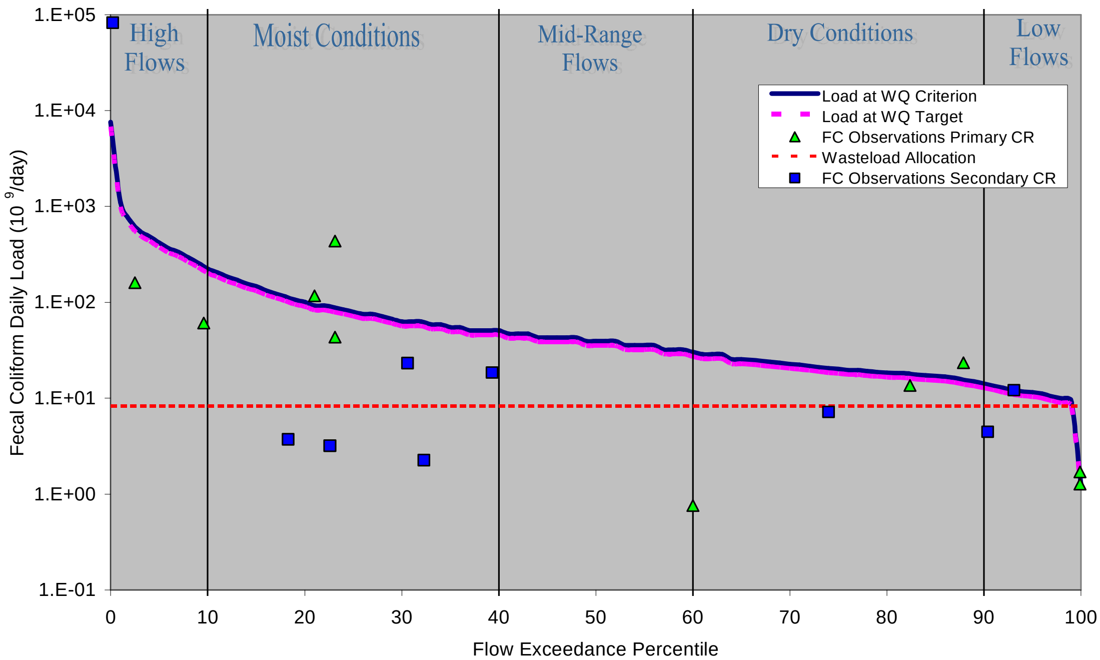


Table 5-22 Fecal Coliform TMDL Calculations for Drowning Creek (OK121600030090_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	773	7.56E+12	8.33E+09	6.80E+12	7.56E+11
5	43	4.16E+11	8.33E+09	3.66E+11	4.16E+10
10	23	2.24E+11	8.33E+09	1.93E+11	2.24E+10
15	15	1.46E+11	8.33E+09	1.23E+11	1.46E+10
20	10	1.00E+11	8.33E+09	8.19E+10	1.00E+10
25	8.1	7.94E+10	8.33E+09	6.32E+10	7.94E+09
30	6.4	6.27E+10	8.33E+09	4.81E+10	6.27E+09
35	5.6	5.47E+10	8.33E+09	4.09E+10	5.47E+09
40	5.2	5.07E+10	8.33E+09	3.73E+10	5.07E+09
45	4.4	4.31E+10	8.33E+09	3.04E+10	4.31E+09
50	4.0	3.93E+10	8.33E+09	2.71E+10	3.93E+09
55	3.6	3.57E+10	8.33E+09	2.38E+10	3.57E+09
60	3.1	3.02E+10	8.33E+09	1.88E+10	3.02E+09
65	2.6	2.54E+10	8.33E+09	1.45E+10	2.54E+09
70	2.3	2.27E+10	8.33E+09	1.21E+10	2.27E+09
75	2.1	2.02E+10	8.33E+09	9.81E+09	2.02E+09
80	1.9	1.84E+10	8.33E+09	8.23E+09	1.84E+09
85	1.7	1.70E+10	8.33E+09	6.99E+09	1.70E+09
90	1.5	1.42E+10	8.33E+09	4.44E+09	1.42E+09
95	1.2	1.15E+10	8.33E+09	2.04E+09	1.15E+09
100	0.1	9.25E+09	8.33E+09	0.00E+00	9.25E+08

Figure 5-20 Load Duration Curve for Fecal Coliform in Little Horse Creek (OK121600030190_00)

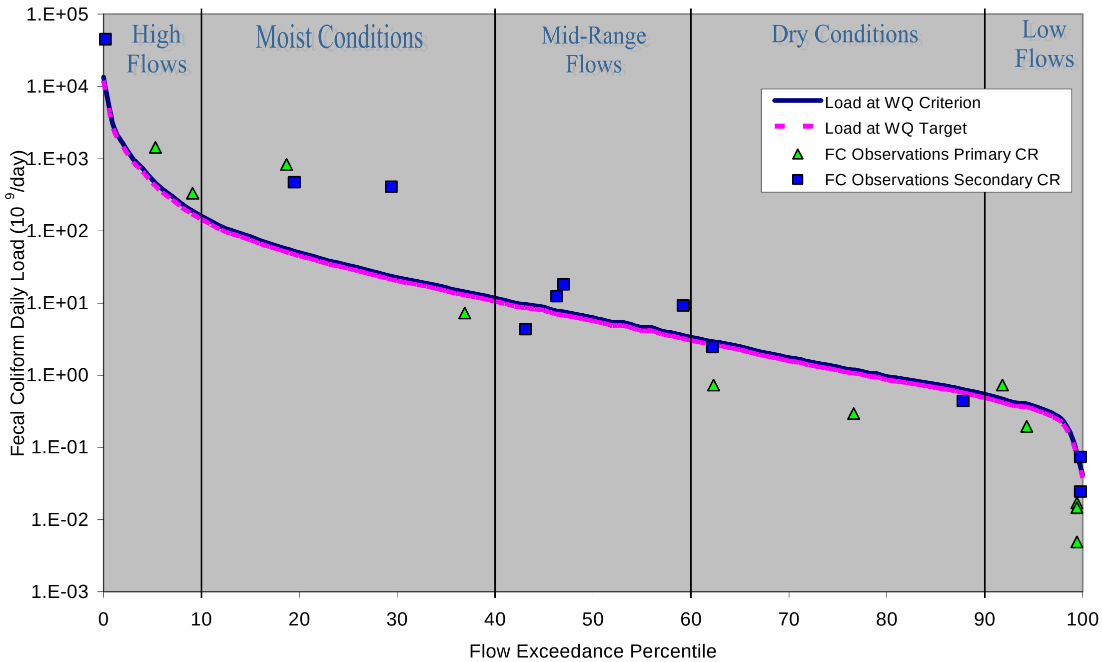


Table 5-23 Fecal Coliform TMDL Calculations for Little Horse Creek (OK121600030190_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1375	1.35E+13	0	1.21E+13	1.35E+12
5	52	5.10E+11	0	4.59E+11	5.10E+10
10	16	1.61E+11	0	1.45E+11	1.61E+10
15	8.5	8.28E+10	0	7.45E+10	8.28E+09
20	5.1	4.97E+10	0	4.47E+10	4.97E+09
25	3.4	3.34E+10	0	3.01E+10	3.34E+09
30	2.3	2.26E+10	0	2.03E+10	2.26E+09
35	1.7	1.63E+10	0	1.47E+10	1.63E+09
40	1.2	1.17E+10	0	1.05E+10	1.17E+09
45	0.90	8.77E+09	0	7.90E+09	8.77E+08
50	0.64	6.27E+09	0	5.64E+09	6.27E+08
55	0.47	4.60E+09	0	4.14E+09	4.60E+08
60	0.34	3.36E+09	0	3.02E+09	3.36E+08
65	0.26	2.51E+09	0	2.26E+09	2.51E+08
70	0.18	1.75E+09	0	1.58E+09	1.75E+08
75	0.13	1.30E+09	0	1.17E+09	1.30E+08
80	0.10	9.61E+08	0	8.65E+08	9.61E+07
85	0.08	7.52E+08	0	6.77E+08	7.52E+07
90	0.06	5.43E+08	0	4.89E+08	5.43E+07
95	0.04	3.76E+08	0	3.38E+08	3.76E+07
100	0.00	4.18E+07	0	3.76E+07	4.18E+06

Figure 5-21 Load Duration Curve for Fecal Coliform in Cave Springs Branch (OK121600030340_00)

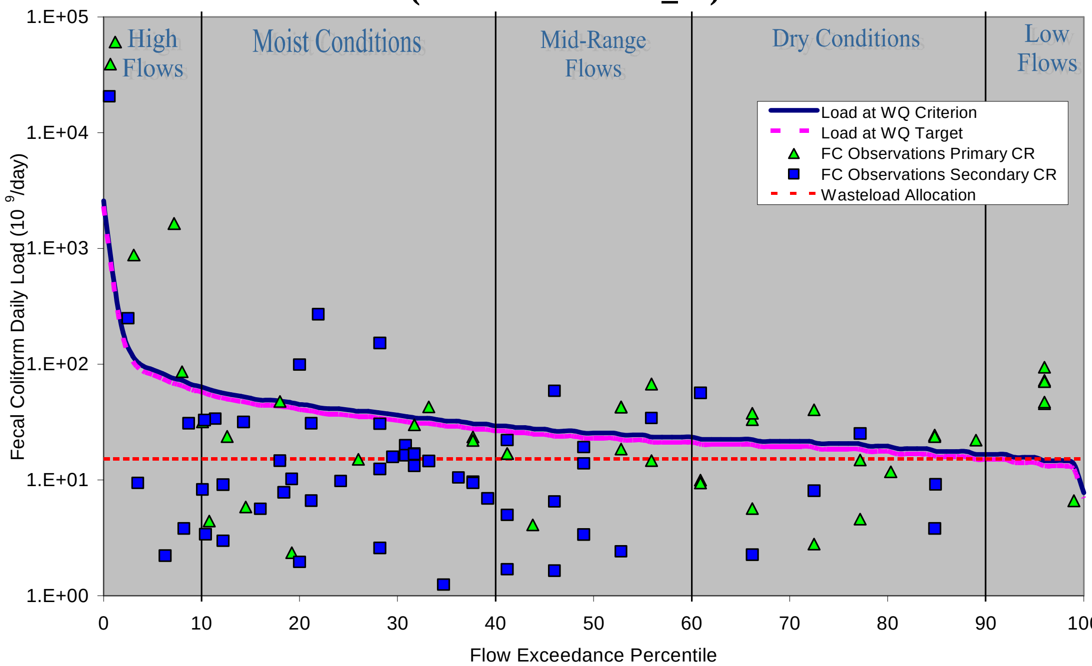


Table 5-24 Fecal Coliform TMDL Calculations for Cave Springs Branch (OK121600030340_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	263	2.57E+12	0	2.32E+12	2.57E+11
5	9.2	9.00E+10	0	8.10E+10	9.00E+09
10	6.5	6.36E+10	0	5.72E+10	6.36E+09
15	5.2	5.09E+10	0	4.58E+10	5.09E+09
20	4.6	4.50E+10	0	4.05E+10	4.50E+09
25	4.1	4.01E+10	0	3.61E+10	4.01E+09
30	3.7	3.62E+10	0	3.26E+10	3.62E+09
35	3.3	3.23E+10	0	2.91E+10	3.23E+09
40	3.0	2.94E+10	0	2.64E+10	2.94E+09
45	2.8	2.74E+10	0	2.47E+10	2.74E+09
50	2.60	2.54E+10	0	2.29E+10	2.54E+09
55	2.50	2.45E+10	0	2.20E+10	2.45E+09
60	2.40	2.35E+10	0	2.11E+10	2.35E+09
65	2.30	2.25E+10	0	2.03E+10	2.25E+09
70	2.20	2.15E+10	0	1.94E+10	2.15E+09
75	2.10	2.06E+10	0	1.85E+10	2.06E+09
80	2.00	1.96E+10	0	1.76E+10	1.96E+09
85	1.80	1.76E+10	0	1.59E+10	1.76E+09
90	1.70	1.66E+10	0	1.50E+10	1.66E+09
95	1.60	1.57E+10	0	1.41E+10	1.57E+09
100	0.79	7.73E+09	0	6.96E+09	7.73E+08

Figure 5-22 Load Duration Curve for Fecal Coliform in Honey Creek (OK121600030445_00)

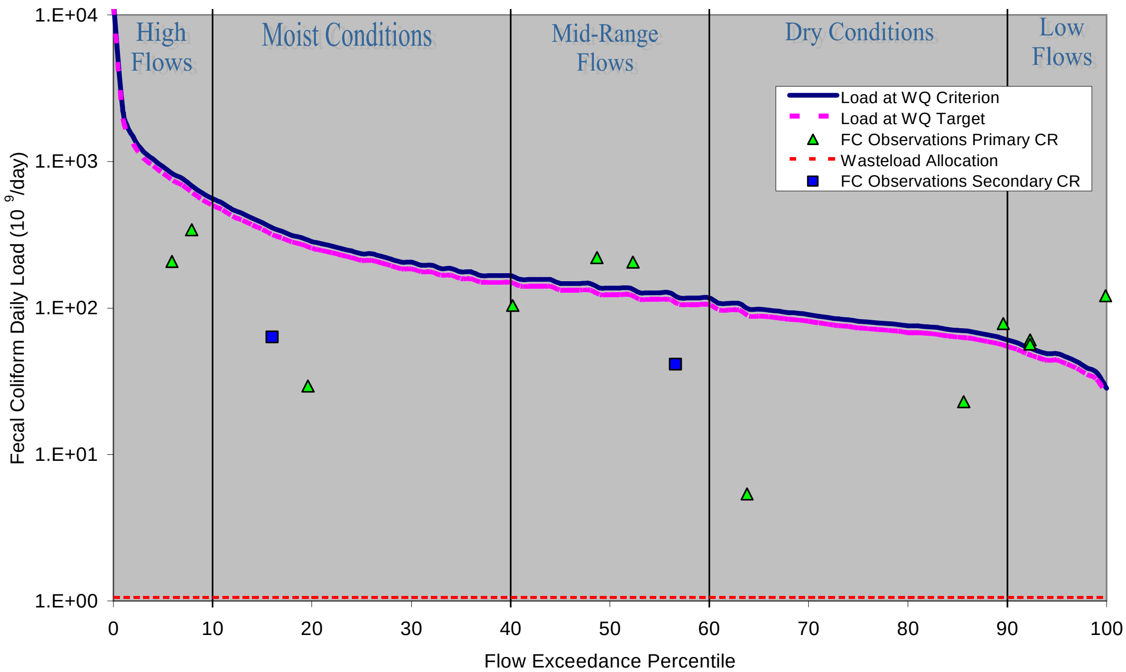


Table 5-25 Fecal Coliform TMDL Calculations for Honey Creek (OK121600030445_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1320	1.29E+13	0	1.16E+13	1.29E+12
5	94	9.20E+11	0	8.28E+11	9.20E+10
10	56.9	5.57E+11	0	5.01E+11	5.57E+10
15	39	3.82E+11	0	3.43E+11	3.82E+10
20	29	2.84E+11	0	2.55E+11	2.84E+10
25	24	2.35E+11	0	2.11E+11	2.35E+10
30	21	2.06E+11	0	1.85E+11	2.06E+10
35	18	1.76E+11	0	1.59E+11	1.76E+10
40	17	1.66E+11	0	1.50E+11	1.66E+10
45	15	1.47E+11	0	1.32E+11	1.47E+10
50	14	1.37E+11	0	1.23E+11	1.37E+10
55	13	1.27E+11	0	1.14E+11	1.27E+10
60	12	1.17E+11	0	1.06E+11	1.17E+10
65	10	9.79E+10	0	8.81E+10	9.79E+09
70	9.2	9.00E+10	0	8.10E+10	9.00E+09
75	8.3	8.12E+10	0	7.31E+10	8.12E+09
80	7.7	7.54E+10	0	6.78E+10	7.54E+09
85	7.2	7.05E+10	0	6.34E+10	7.05E+09
90	6.2	6.07E+10	0	5.46E+10	6.07E+09
95	5	4.89E+10	0	4.40E+10	4.89E+09
100	2.9	2.84E+10	0	2.55E+10	2.84E+09

5.8 Reasonable Assurances

ODEQ will collaborate with a host of other state agencies and local governments working within the boundaries of state and local regulations to target available funding and technical assistance to support implementation of pollution controls and management measures. Various water quality management programs and funding sources provide a reasonable assurance that the pollutant reductions as required by these TMDLs can be achieved and water quality can be restored to maintain designated uses. ODEQ's Continuing Planning Process (CPP), required by the CWA §303(e)(3) and 40 CFR 130.5, summarizes Oklahoma's commitments and programs aimed at restoring and protecting water quality throughout the state (ODEQ 2002). The CPP can be viewed from ODEQ's website at http://www.deq.state.ok.us/WQDnew/pubs/2002_cpp_final.pdf. Table 5-26 provides a partial list of the state partner agencies ODEQ will collaborate with to address point and nonpoint source reduction goals established by TMDLs.

Table 5-26 Partial List of Oklahoma Water Quality Management Agencies

Agency	Web Link
Oklahoma Conservation Commission	http://www.okcc.state.ok.us/WQ/WQ_home.htm
Oklahoma Department of Wildlife Conservation	http://www.wildlifedepartment.com/watchabl.htm
Oklahoma Department of Agriculture, Food, and Forestry	http://www.oda.state.ok.us/water-home.htm
Oklahoma Water Resources Board	http://www.owrb.state.ok.us/quality/index.php

Nonpoint source pollution is managed by the Oklahoma Conservation Commission. The primary mechanisms used for management of nonpoint source pollution are incentive-based programs that support the installation of BMPs and public education and outreach. Other programs include regulations and permits for CAFOs. The CAFO Act, as administered by the ODAFF, provides CAFO operators the necessary tools and information to deal with the manure and wastewater animals produce so streams, lakes, ponds, and groundwater sources are not polluted.

As authorized by Section 402 of the CWA, the ODEQ has delegation of the NPDES Program in Oklahoma, except for certain jurisdictional areas related to agriculture and the oil and gas industry retained by State Department of Agriculture and Oklahoma Corporation Commission, for which the USEPA has retained permitting authority. The NPDES Program in Oklahoma is implemented via Title 252, Chapter 606 of the Oklahoma Pollution Discharge Elimination System (OPDES) Act and in accordance with the agreement between ODEQ and USEPA relating to administration and enforcement of the delegated NPDES Program. Implementation of point source WLAs is done through permits issued under the OPDES program.

When a watershed extends into an adjacent state, the same reduction goal that applies to the watershed within Oklahoma should also be considered to apply to the watershed in the adjacent state. These goals could be achieved by reductions in some combination of nonpoint sources and uncontrolled point sources. Since Oklahoma has no authority over potential bacteria sources in adjacent states, these reductions can only be facilitated through cooperation between Oklahoma agencies, the adjacent state and EPA.

The reduction rates called for in this TMDL report are as high as 99 percent. The ODEQ recognizes that achieving such high reductions may not be realistic, especially since unregulated nonpoint sources are a major cause of the impairment. The high reduction rates are not uncommon for pathogen-impaired waters. Similar reduction rates are often found in other pathogen TMDLs around the nation. The suitability of the current criteria for pathogens and the beneficial uses of the receiving stream should be reviewed. For example, the Kansas Department of Environmental Quality has proposed to exclude certain high flow conditions during which pathogen standards will not apply, although that exclusion was not approved by the USEPA. Additionally, USEPA has been conducting new epidemiology studies and may develop new recommendations for pathogen criteria in the near future.

Revisions to the current pathogen provisions of Oklahoma's WQSs should be considered. There are three basic approaches to such revisions that may apply.

- **Removing the PBCR use:** This revision would require documentation in a Use Attainability Analysis that the use is not existing and cannot be attained. It is unlikely that this approach would be successful since there is evidence that people do swim in these waterbodies, thus constituting an existing use. Existing uses cannot be removed.
- **Modifying application of the existing criteria:** This approach would include considerations such as an exemption under certain high flow conditions, an allowance for wildlife or "natural conditions," a sub-category of the use or other special provision for urban areas, or other special provisions for storm flows. Since large bacteria violations occur over all flow ranges, it is likely that large reductions would still be necessary. However, this approach may have merit and should be considered.
- **Revising the existing numeric criteria:** Oklahoma's current pathogen criteria are based on USEPA guidelines (See Implementation Guidance for Ambient Water Quality Criteria for Bacteria, May 2002 Draft; and Ambient Water Quality Criteria for Bacteria-1986, January 1986). However, those guidelines have received much criticism and USEPA studies that could result in revisions to their recommendations are ongoing. The use of the three indicators specified in Oklahoma's standards should be evaluated. The numeric criteria values should also be evaluated using a risk-based method such as that found in USEPA guidance.

Unless or until the WQSs are revised and approved by USEPA, federal rules require that the TMDLs in this report must be based on attainment of the current standards. If revisions to the pathogen standards are approved in the future, reductions specified in these TMDLs will be re-evaluated.

SECTION 6
PUBLIC PARTICIPATION

This TMDL report was sent to other related state agencies and local government agencies for peer review. Then the report was submitted to the EPA for technical review and approval. The report was technically approved by the EPA on January 4, 2008. A public was published on January 24, 2008 and the report was made available for public review and comments. The public comment period started on January 24, 2008 and ended on March 10, 2008. Two written comments were received: one from Dan Butler on behave of Oklahoma Conservation Commission, the other from Quang Pham on behave of Oklahoma Department of Agriculture.

All comments were responded and the report was updated accordingly. The response to comments was included in Appendix F of this report.

SECTION 7
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APPENDIX A
AMBIENT WATER QUALITY BACTERIA DATA – 1997 TO 2006

Appendix A

Ambient Water Quality Bacteria Data – 1997 to 2006

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600010060D	Ranger Creek	9/18/2001	1510	FC	400
OK121600010060D	Ranger Creek	8/14/2001	5	EC	406
OK121600010060D	Ranger Creek	9/18/2001	870	EC	406
OK121600010060D	Ranger Creek	10/23/2001	90	EC	2030
OK121600010060D	Ranger Creek	4/23/2002	340	EC	2030
OK121600010060D	Ranger Creek	5/29/2002	1780	EC	406
OK121600010060D	Ranger Creek	7/9/2002	50	EC	406
OK121600010060D	Ranger Creek	8/6/2002	10	EC	406
OK121600010060D	Ranger Creek	9/10/2002	10	EC	406
OK121600010060D	Ranger Creek	10/15/2002	20	EC	2030
OK121600010060D	Ranger Creek	4/8/2003	10	EC	2030
OK121600010060D	Ranger Creek	5/13/2003	810	EC	406
OK121600010060D	Ranger Creek	6/17/2003	80	EC	406
OK121600010060D	Ranger Creek	8/14/2001	35	ENT	108
OK121600010060D	Ranger Creek	9/18/2001	150	ENT	108
OK121600010060D	Ranger Creek	10/23/2001	50	ENT	540
OK121600010060D	Ranger Creek	10/23/2001	20	ENT	540
OK121600010060D	Ranger Creek	4/23/2002	220	ENT	540
OK121600010060D	Ranger Creek	5/29/2002	900	ENT	108
OK121600010060D	Ranger Creek	5/29/2002	150	ENT	108
OK121600010060D	Ranger Creek	7/9/2002	70	ENT	108
OK121600010060D	Ranger Creek	7/9/2002	30	ENT	108
OK121600010060D	Ranger Creek	8/6/2002	70	ENT	108
OK121600010060D	Ranger Creek	9/10/2002	40	ENT	108
OK121600010060D	Ranger Creek	10/15/2002	20	ENT	540
OK121600010060D	Ranger Creek	4/8/2003	10	ENT	540
OK121600010060D	Ranger Creek	4/8/2003	20	ENT	540
OK121600010060D	Ranger Creek	5/13/2003	850	ENT	108
OK121600010060D	Ranger Creek	5/13/2003	50	ENT	108
OK121600010060D	Ranger Creek	6/17/2003	20	ENT	108
OK121600010100C	Fourteenmile Creek	4/19/1999	500	FC	2000
OK121600010100C	Fourteenmile Creek	6/14/1999	100	FC	400
OK121600010100C	Fourteenmile Creek	9/27/1999	100	FC	400
OK121600010100C	Fourteenmile Creek	12/6/1999	100	FC	2000
OK121600010100C	Fourteenmile Creek	1/10/2000	100	FC	2000
OK121600010100C	Fourteenmile Creek	2/14/2000	100	FC	2000
OK121600010100C	Fourteenmile Creek	3/20/2000	100	FC	2000
OK121600010100C	Fourteenmile Creek	3/28/2000	100	FC	2000
OK121600010100C	Fourteenmile Creek	5/1/2000	7000	FC	400
OK121600010100C	Fourteenmile Creek	6/5/2000	100	FC	400
OK121600010100C	Fourteenmile Creek	7/10/2000	10	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600010100C	Fourteenmile Creek	8/15/2000	10	FC	400
OK121600010100C	Fourteenmile Creek	9/18/2000	40	FC	400
OK121600010100C	Fourteenmile Creek	9/18/2000	10	FC	400
OK121600010100C	Fourteenmile Creek	10/24/2000	60	FC	2000
OK121600010100C	Fourteenmile Creek	11/28/2000	40	FC	2000
OK121600010100C	Fourteenmile Creek	1/8/2001	10	FC	2000
OK121600010100C	Fourteenmile Creek	2/13/2001	40	FC	2000
OK121600010100C	Fourteenmile Creek	3/20/2001	10	FC	2000
OK121600010100C	Fourteenmile Creek	8/15/2000	10	EC	2030
OK121600010100C	Fourteenmile Creek	9/18/2000	10	EC	2030
OK121600010100C	Fourteenmile Creek	10/24/2000	74	EC	2030
OK121600010100C	Fourteenmile Creek	11/28/2000	20	EC	2030
OK121600010100C	Fourteenmile Creek	1/8/2001	10	EC	2030
OK121600010100C	Fourteenmile Creek	2/13/2001	31	EC	20030
OK121600010100C	Fourteenmile Creek	3/20/2001	10	EC	2030
OK121600010100C	Fourteenmile Creek	9/18/2000	10	ENT	108
OK121600010100C	Fourteenmile Creek	10/24/2000	40	ENT	540
OK121600010100C	Fourteenmile Creek	11/28/2000	160	ENT	540
OK121600010100C	Fourteenmile Creek	1/8/2001	20	ENT	540
OK121600010100C	Fourteenmile Creek	2/13/2001	30	ENT	540
OK121600010100C	Fourteenmile Creek	3/20/2001	400	ENT	540
OK121600010100G	Fourteenmile Creek	4/19/1999	500	FC	2000
OK121600010100G	Fourteenmile Creek	6/14/1999	100	FC	400
OK121600010100G	Fourteenmile Creek	9/27/1999	100	FC	400
OK121600010100G	Fourteenmile Creek	12/6/1999	100	FC	2000
OK121600010100G	Fourteenmile Creek	1/10/2000	100	FC	2000
OK121600010100G	Fourteenmile Creek	2/14/2000	100	FC	2000
OK121600010100G	Fourteenmile Creek	3/20/2000	100	FC	2000
OK121600010100G	Fourteenmile Creek	3/28/2000	100	FC	2000
OK121600010100G	Fourteenmile Creek	5/1/2000	7000	FC	400
OK121600010100G	Fourteenmile Creek	6/5/2000	100	FC	400
OK121600010100G	Fourteenmile Creek	7/10/2000	10	FC	400
OK121600010100G	Fourteenmile Creek	8/15/2000	10	FC	400
OK121600010100G	Fourteenmile Creek	9/18/2000	40	FC	400
OK121600010100G	Fourteenmile Creek	10/24/2000	60	FC	2000
OK121600010100G	Fourteenmile Creek	11/28/2000	40	FC	2000
OK121600010100G	Fourteenmile Creek	1/8/2001	10	FC	2000
OK121600010100G	Fourteenmile Creek	2/13/2001	40	FC	2000
OK121600010100G	Fourteenmile Creek	3/20/2001	10	FC	2000
OK121600010100G	Fourteenmile Creek	9/18/2001	550	FC	400
OK121600010100G	Fourteenmile Creek	9/18/2001	690	FC	400
OK121600010100G	Fourteenmile Creek	8/15/2000	10	EC	406
OK121600010100G	Fourteenmile Creek	9/18/2000	10	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600010100G	Fourteenmile Creek	10/24/2000	74	EC	2030
OK121600010100G	Fourteenmile Creek	11/28/2000	20	EC	2030
OK121600010100G	Fourteenmile Creek	1/8/2001	10	EC	2030
OK121600010100G	Fourteenmile Creek	2/13/2001	31	EC	2030
OK121600010100G	Fourteenmile Creek	3/20/2001	10	EC	2030
OK121600010100G	Fourteenmile Creek	8/14/2001	55	EC	406
OK121600010100G	Fourteenmile Creek	9/18/2001	510	EC	406
OK121600010100G	Fourteenmile Creek	10/23/2001	70	EC	2030
OK121600010100G	Fourteenmile Creek	4/23/2002	1460	EC	2030
OK121600010100G	Fourteenmile Creek	5/29/2002	340	EC	406
OK121600010100G	Fourteenmile Creek	7/9/2002	490	EC	406
OK121600010100G	Fourteenmile Creek	8/6/2002	100	EC	406
OK121600010100G	Fourteenmile Creek	9/10/2002	110	EC	406
OK121600010100G	Fourteenmile Creek	10/15/2002	20	EC	2030
OK121600010100G	Fourteenmile Creek	4/7/2003	30	EC	2030
OK121600010100G	Fourteenmile Creek	5/13/2003	170	EC	406
OK121600010100G	Fourteenmile Creek	6/17/2003	20	EC	406
OK121600010100G	Fourteenmile Creek	9/18/2000	10	ENT	108
OK121600010100G	Fourteenmile Creek	10/24/2000	40	ENT	540
OK121600010100G	Fourteenmile Creek	11/28/2000	160	ENT	540
OK121600010100G	Fourteenmile Creek	1/8/2001	20	ENT	540
OK121600010100G	Fourteenmile Creek	2/13/2001	30	ENT	540
OK121600010100G	Fourteenmile Creek	3/20/2001	400	ENT	540
OK121600010100G	Fourteenmile Creek	8/14/2001	155	ENT	108
OK121600010100G	Fourteenmile Creek	8/14/2001	105	ENT	108
OK121600010100G	Fourteenmile Creek	9/18/2001	320	ENT	108
OK121600010100G	Fourteenmile Creek	9/18/2001	405	ENT	108
OK121600010100G	Fourteenmile Creek	10/23/2001	20	ENT	540
OK121600010100G	Fourteenmile Creek	10/23/2001	110	ENT	540
OK121600010100G	Fourteenmile Creek	4/23/2002	710	ENT	540
OK121600010100G	Fourteenmile Creek	4/23/2002	610	ENT	540
OK121600010100G	Fourteenmile Creek	4/23/2002	220	ENT	540
OK121600010100G	Fourteenmile Creek	5/29/2002	180	ENT	108
OK121600010100G	Fourteenmile Creek	5/29/2002	150	ENT	108
OK121600010100G	Fourteenmile Creek	5/29/2002	900	ENT	108
OK121600010100G	Fourteenmile Creek	7/9/2002	120	ENT	108
OK121600010100G	Fourteenmile Creek	7/9/2002	70	ENT	108
OK121600010100G	Fourteenmile Creek	7/9/2002	90	ENT	108
OK121600010100G	Fourteenmile Creek	8/6/2002	150	ENT	108
OK121600010100G	Fourteenmile Creek	8/6/2002	70	ENT	108
OK121600010100G	Fourteenmile Creek	9/10/2002	110	ENT	108
OK121600010100G	Fourteenmile Creek	9/10/2002	140	ENT	108
OK121600010100G	Fourteenmile Creek	9/10/2002	40	ENT	108
OK121600010100G	Fourteenmile Creek	10/15/2002	20	ENT	540

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600010100G	Fourteenmile Creek	4/7/2003	20	ENT	540
OK121600010100G	Fourteenmile Creek	5/13/2003	50	ENT	108
OK121600010100G	Fourteenmile Creek	5/13/2003	20	ENT	108
OK121600010100G	Fourteenmile Creek	5/13/2003	80	ENT	108
OK121600010100G	Fourteenmile Creek	6/17/2003	20	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	05/21/2001	100	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	06/27/2001	800	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	07/30/2001	3000	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	08/27/2001	33000	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/24/2001	6000	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/24/2001	11000	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	11/26/2001	20	FC	2000
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	06/19/2002	700	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	07/23/2002	2000	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	07/23/2002	24192	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	08/14/2002	24900	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/17/2002	43000	FC	400
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	05/21/2001	309	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	06/27/2001	512	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	07/30/2001	934	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	08/27/2001	12999.5	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/24/2001	9208	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/24/2001	4611	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	06/19/2002	959	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	07/23/2002	985	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	08/14/2002	19862	EC	406
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/17/2002	12033	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	05/21/2001	200	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	06/27/2001	10000	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	07/30/2001	7000	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	08/27/2001	10000	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/24/2001	41000	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/24/2001	30000	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	06/19/2002	1000	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	07/23/2002	1700	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	08/14/2002	4200	ENT	108
121600010440-001SR	Crutchfield Branch, off US 412, Locust Grove	09/17/2002	11000	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	06/27/2001	17000	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	07/30/2001	6000	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	08/27/2001	4000	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	05/21/2002	700	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	06/19/2002	1200	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	07/23/2002	1100	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	08/14/2002	16600	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	09/17/2002	230	FC	400
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	06/27/2001	4106	EC	406
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	07/30/2001	285	EC	406
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	08/27/2001	1354	EC	406
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	05/21/2002	529	EC	406
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	06/19/2002	984	EC	406
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	07/23/2002	1576	EC	406
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	08/14/2002	9208	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	09/17/2002	262	EC	406
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	06/27/2001	1800	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	07/30/2001	2000	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	08/27/2001	9000	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	05/21/2002	600	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	06/19/2002	800	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	07/23/2002	1600	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	08/14/2002	11200	ENT	108
121600010440-002SR	Crutchfield Branch, off US 82, Locust Grove	09/17/2002	110	ENT	108
OK121600030090G	Drowning Creek	4/26/1999	8000	FC	2000
OK121600030090G	Drowning Creek	5/24/1999	100	FC	400
OK121600030090G	Drowning Creek	6/21/1999	100	FC	400
OK121600030090G	Drowning Creek	7/19/1999	100	FC	400
OK121600030090G	Drowning Creek	8/23/1999	300	FC	400
OK121600030090G	Drowning Creek	10/4/1999	100	FC	2000
OK121600030090G	Drowning Creek	12/13/1999	100	FC	2000
OK121600030090G	Drowning Creek	1/18/2000	100	FC	2000
OK121600030090G	Drowning Creek	2/22/2000	100	FC	2000
OK121600030090G	Drowning Creek	3/27/2000	100	FC	2000
OK121600030090G	Drowning Creek	5/2/2000	2000	FC	400
OK121600030090G	Drowning Creek	5/2/2000	200	FC	400
OK121600030090G	Drowning Creek	6/6/2000	100	FC	400
OK121600030090G	Drowning Creek	7/11/2000	500	FC	400
OK121600030090G	Drowning Creek	8/14/2000	10	FC	400
OK121600030090G	Drowning Creek	9/19/2000	120	FC	400
OK121600030090G	Drowning Creek	10/23/2000	300	FC	2000
OK121600030090G	Drowning Creek	1/9/2001	10	FC	2000
OK121600030090G	Drowning Creek	2/12/2001	10	FC	2000
OK121600030090G	Drowning Creek	3/19/2001	10	FC	2000
OK121600030090G	Drowning Creek	9/17/2001	600	FC	400
OK121600030090G	Drowning Creek	8/14/2000	10	EC	406
OK121600030090G	Drowning Creek	9/19/2000	74	EC	406
OK121600030090G	Drowning Creek	10/23/2000	487	EC	2030
OK121600030090G	Drowning Creek	1/9/2001	20	EC	2030
OK121600030090G	Drowning Creek	2/12/2001	10	EC	2030
OK121600030090G	Drowning Creek	3/19/2001	10	EC	2030
OK121600030090G	Drowning Creek	8/13/2001	25	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030090G	Drowning Creek	9/17/2001	1040	EC	406
OK121600030090G	Drowning Creek	10/22/2001	100	EC	2030
OK121600030090G	Drowning Creek	4/22/2002	10	EC	2030
OK121600030090G	Drowning Creek	5/28/2002	40	EC	406
OK121600030090G	Drowning Creek	7/8/2002	10	EC	406
OK121600030090G	Drowning Creek	8/5/2002	100	EC	406
OK121600030090G	Drowning Creek	9/9/2002	20	EC	406
OK121600030090G	Drowning Creek	10/14/2002	40	EC	2030
OK121600030090G	Drowning Creek	4/7/2003	80	EC	2030
OK121600030090G	Drowning Creek	5/13/2003	10	EC	406
OK121600030090G	Drowning Creek	6/16/2003	20	EC	406
OK121600030090G	Drowning Creek	9/19/2000	80	ENT	108
OK121600030090G	Drowning Creek	10/23/2000	400	ENT	540
OK121600030090G	Drowning Creek	1/9/2001	110	ENT	540
OK121600030090G	Drowning Creek	2/12/2001	90	ENT	540
OK121600030090G	Drowning Creek	3/19/2001	140	ENT	540
OK121600030090G	Drowning Creek	8/13/2001	40	ENT	108
OK121600030090G	Drowning Creek	9/17/2001	220	ENT	108
OK121600030090G	Drowning Creek	10/22/2001	20	ENT	540
OK121600030090G	Drowning Creek	4/22/2002	10	ENT	540
OK121600030090G	Drowning Creek	4/22/2002	20	ENT	540
OK121600030090G	Drowning Creek	5/28/2002	150	ENT	108
OK121600030090G	Drowning Creek	5/28/2002	100	ENT	108
OK121600030090G	Drowning Creek	7/8/2002	30	ENT	108
OK121600030090G	Drowning Creek	8/5/2002	10	ENT	108
OK121600030090G	Drowning Creek	9/9/2002	40	ENT	108
OK121600030090G	Drowning Creek	10/14/2002	20	ENT	540
OK121600030090G	Drowning Creek	4/7/2003	70	ENT	540
OK121600030090G	Drowning Creek	4/7/2003	20	ENT	540
OK121600030090G	Drowning Creek	5/13/2003	10	ENT	108
OK121600030090G	Drowning Creek	6/16/2003	40	ENT	108
OK121600030160G	Horse Creek	4/26/1999	1500	FC	2000
OK121600030160G	Horse Creek	5/24/1999	1300	FC	400
OK121600030160G	Horse Creek	6/21/1999	2500	FC	400
OK121600030160G	Horse Creek	7/19/1999	500	FC	400
OK121600030160G	Horse Creek	8/23/1999	100	FC	400
OK121600030160G	Horse Creek	10/4/1999	400	FC	2000
OK121600030160G	Horse Creek	11/9/1999	100	FC	2000
OK121600030160G	Horse Creek	12/13/1999	600	FC	2000
OK121600030160G	Horse Creek	1/18/2000	100	FC	2000
OK121600030160G	Horse Creek	2/22/2000	100	FC	2000
OK121600030160G	Horse Creek	3/27/2000	2600	FC	2000
OK121600030160G	Horse Creek	5/2/2000	12500	FC	400
OK121600030160G	Horse Creek	6/6/2000	200	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030160G	Horse Creek	7/11/2000	10	FC	400
OK121600030160G	Horse Creek	8/14/2000	50	FC	400
OK121600030160G	Horse Creek	9/19/2000	4000	FC	400
OK121600030160G	Horse Creek	10/23/2000	8000	FC	2000
OK121600030160G	Horse Creek	11/27/2000	40	FC	2000
OK121600030160G	Horse Creek	1/9/2001	42000	FC	2000
OK121600030160G	Horse Creek	2/12/2001	1400	FC	2000
OK121600030160G	Horse Creek	3/19/2001	30	FC	2000
OK121600030160G	Horse Creek	8/14/2000	62	EC	406
OK121600030160G	Horse Creek	9/19/2000	2489	EC	406
OK121600030160G	Horse Creek	10/23/2000	4106	EC	2030
OK121600030160G	Horse Creek	11/27/2000	86	EC	2030
OK121600030160G	Horse Creek	1/9/2001	24192	EC	2030
OK121600030160G	Horse Creek	2/12/2001	1014	EC	2030
OK121600030160G	Horse Creek	3/19/2001	52	EC	2030
OK121600030160G	Horse Creek	9/19/2000	16000	ENT	108
OK121600030160G	Horse Creek	10/23/2000	22000	ENT	540
OK121600030160G	Horse Creek	11/27/2000	30	ENT	540
OK121600030160G	Horse Creek	1/9/2001	145000	ENT	540
OK121600030160G	Horse Creek	2/12/2001	300	ENT	540
OK121600030160G	Horse Creek	3/19/2001	1500	ENT	540
OK121600030180D	Fly Creek	4/26/1999	8000	FC	2000
OK121600030180D	Fly Creek	5/24/1999	100	FC	400
OK121600030180D	Fly Creek	6/21/1999	700	FC	400
OK121600030180D	Fly Creek	7/19/1999	100	FC	400
OK121600030180D	Fly Creek	8/23/1999	1600	FC	400
OK121600030180D	Fly Creek	10/4/1999	100	FC	2000
OK121600030180D	Fly Creek	11/9/1999	200	FC	2000
OK121600030180D	Fly Creek	12/13/1999	100	FC	2000
OK121600030180D	Fly Creek	1/18/2000	100	FC	2000
OK121600030180D	Fly Creek	2/22/2000	300	FC	2000
OK121600030180D	Fly Creek	3/27/2000	200	FC	2000
OK121600030180D	Fly Creek	5/2/2000	1200	FC	400
OK121600030180D	Fly Creek	6/6/2000	100	FC	400
OK121600030180D	Fly Creek	7/11/2000	190	FC	400
OK121600030180D	Fly Creek	8/14/2000	160	FC	400
OK121600030180D	Fly Creek	9/19/2000	30	FC	400
OK121600030180D	Fly Creek	10/23/2000	200	FC	2000
OK121600030180D	Fly Creek	11/27/2000	70	FC	2000
OK121600030180D	Fly Creek	1/9/2001	20	FC	2000
OK121600030180D	Fly Creek	2/12/2001	200	FC	2000
OK121600030180D	Fly Creek	3/19/2001	40	FC	2000
OK121600030180D	Fly Creek	8/14/2000	30	EC	406
OK121600030180D	Fly Creek	9/19/2000	121	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030180D	Fly Creek	10/23/2000	404	EC	2030
OK121600030180D	Fly Creek	11/27/2000	10	EC	2030
OK121600030180D	Fly Creek	1/9/2001	233	EC	2030
OK121600030180D	Fly Creek	2/12/2001	341	EC	2030
OK121600030180D	Fly Creek	3/19/2001	20	EC	2030
OK121600030180D	Fly Creek	9/19/2000	470	ENT	108
OK121600030180D	Fly Creek	10/23/2000	13000	ENT	540
OK121600030180D	Fly Creek	11/27/2000	10	ENT	540
OK121600030180D	Fly Creek	1/9/2001	17000	ENT	540
OK121600030180D	Fly Creek	2/12/2001	600	ENT	540
OK121600030180D	Fly Creek	3/19/2001	200	ENT	540
OK121600030190A	Little Horse Creek	4/26/1999	2000	FC	2000
OK121600030190A	Little Horse Creek	5/24/1999	700	FC	400
OK121600030190A	Little Horse Creek	6/21/1999	1200	FC	400
OK121600030190A	Little Horse Creek	7/19/1999	100	FC	400
OK121600030190A	Little Horse Creek	8/23/1999	100	FC	400
OK121600030190A	Little Horse Creek	10/4/1999	300	FC	2000
OK121600030190A	Little Horse Creek	11/9/1999	100	FC	2000
OK121600030190A	Little Horse Creek	12/13/1999	200	FC	2000
OK121600030190A	Little Horse Creek	1/18/2000	100	FC	2000
OK121600030190A	Little Horse Creek	2/22/2000	300	FC	2000
OK121600030190A	Little Horse Creek	3/27/2000	300	FC	2000
OK121600030190A	Little Horse Creek	5/2/2000	6000	FC	400
OK121600030190A	Little Horse Creek	6/6/2000	200	FC	400
OK121600030190A	Little Horse Creek	7/11/2000	200	FC	400
OK121600030190A	Little Horse Creek	8/14/2000	20	FC	400
OK121600030190A	Little Horse Creek	9/19/2000	70	FC	400
OK121600030190A	Little Horse Creek	11/27/2000	200	FC	2000
OK121600030190A	Little Horse Creek	1/9/2001	2000	FC	2000
OK121600030190A	Little Horse Creek	2/12/2001	3000	FC	2000
OK121600030190A	Little Horse Creek	3/19/2001	60	FC	2000
OK121600030190A	Little Horse Creek	9/17/2001	600	FC	400
OK121600030190A	Little Horse Creek	7/8/2002	60	FC	400
OK121600030190A	Little Horse Creek	8/14/2000	10	EC	406
OK121600030190A	Little Horse Creek	9/19/2000	20	EC	406
OK121600030190A	Little Horse Creek	11/27/2000	171	EC	2030
OK121600030190A	Little Horse Creek	1/9/2001	1313	EC	2030
OK121600030190A	Little Horse Creek	2/12/2001	2187	EC	2030
OK121600030190A	Little Horse Creek	3/19/2001	10	EC	2030
OK121600030190A	Little Horse Creek	8/13/2001	5	EC	406
OK121600030190A	Little Horse Creek	9/17/2001	600	EC	406
OK121600030190A	Little Horse Creek	10/23/2001	50	EC	2030
OK121600030190A	Little Horse Creek	4/22/2002	50	EC	2030
OK121600030190A	Little Horse Creek	5/28/2002	800	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030190A	Little Horse Creek	7/8/2002	20	EC	406
OK121600030190A	Little Horse Creek	8/5/2002	15	EC	406
OK121600030190A	Little Horse Creek	9/9/2002	10	EC	406
OK121600030190A	Little Horse Creek	10/14/2002	20	EC	2030
OK121600030190A	Little Horse Creek	4/7/2003	2500	EC	2030
OK121600030190A	Little Horse Creek	5/12/2003	10	EC	406
OK121600030190A	Little Horse Creek	6/16/2003	100	EC	406
OK121600030190A	Little Horse Creek	9/19/2000	100	ENT	108
OK121600030190A	Little Horse Creek	11/27/2000	300	ENT	540
OK121600030190A	Little Horse Creek	1/9/2001	32000	ENT	540
OK121600030190A	Little Horse Creek	2/12/2001	4000	ENT	540
OK121600030190A	Little Horse Creek	3/19/2001	300	ENT	540
OK121600030190A	Little Horse Creek	8/13/2001	160	ENT	108
OK121600030190A	Little Horse Creek	9/17/2001	600	ENT	108
OK121600030190A	Little Horse Creek	10/23/2001	110	ENT	540
OK121600030190A	Little Horse Creek	10/23/2001	30	ENT	540
OK121600030190A	Little Horse Creek	4/22/2002	40	ENT	540
OK121600030190A	Little Horse Creek	4/22/2002	160	ENT	540
OK121600030190A	Little Horse Creek	5/28/2002	950	ENT	108
OK121600030190A	Little Horse Creek	7/8/2002	40	ENT	108
OK121600030190A	Little Horse Creek	7/8/2002	130	ENT	108
OK121600030190A	Little Horse Creek	8/5/2002	80	ENT	108
OK121600030190A	Little Horse Creek	8/5/2002	70	ENT	108
OK121600030190A	Little Horse Creek	9/9/2002	50	ENT	108
OK121600030190A	Little Horse Creek	9/9/2002	200	ENT	108
OK121600030190A	Little Horse Creek	10/14/2002	20	ENT	540
OK121600030190A	Little Horse Creek	10/14/2002	150	ENT	540
OK121600030190A	Little Horse Creek	4/7/2003	660	ENT	540
OK121600030190A	Little Horse Creek	4/7/2003	70	ENT	540
OK121600030190A	Little Horse Creek	5/12/2003	80	ENT	108
OK121600030190A	Little Horse Creek	5/12/2003	135	ENT	108
OK121600030190A	Little Horse Creek	6/16/2003	160	ENT	108
OK121600030340B	Cave Springs Branch Site 1	10/21/1999	200	FC	2000
OK121600030340H	Cave Springs Branch downstream of Sinkhole	10/21/1999	400	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/26/1997	58	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/15/1997	390	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/15/1997	130	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/18/1997	220	FC	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/15/1997	15	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/14/1998	21	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/19/1998	27	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/11/1998	17	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/24/1998	1	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/12/1998	229	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/12/1998	230	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/3/1998	590	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/15/1998	1160	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/15/1998	1200	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/19/1998	1850	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/19/1998	1800	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/23/1998	525	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/23/1998	520	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/21/1998	280	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/17/1998	180	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/8/1998	170	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/7/1999	320	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/3/1999	64	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/16/1999	8600	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/7/1999	230	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/4/1999	46000	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/9/1999	200	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/15/1999	45	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/20/1999	2400	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/14/1999	100	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/21/1999	200	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/22/1999	150	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/3/1999	82	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/2/1999	560	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/19/2000	210	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/17/2000	860	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/22/2000	192	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/22/2000	190	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/11/2000	1600	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/9/2000	18000	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/27/2000	470	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/18/2000	500	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/14/2000	300	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/13/2000	240	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/10/2000	290	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/14/2000	130	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/11/2000	150	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/31/2001	210	FC	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/14/2001	180	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/20/2001	65	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/12/2001	40	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/22/2001	52	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/19/2001	89	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/24/2001	180	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/13/2001	510	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/25/2001	150	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/22/2001	860	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/14/2001	123	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/14/2001	120	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/12/2001	300	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/22/2002	24	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/8/2002	3	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/18/2002	60	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/11/2002	52	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/28/2002	3000	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/12/2002	8600	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/19/2002	673	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/19/2002	670	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/12/2002	240	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/9/2002	490	FC	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/6/2002	38	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/10/2002	960	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/28/2003	95	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/21/2003	120	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/26/2003	87	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/22/2003	170	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/28/2003	29	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/26/2003	3	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/22/2003	290	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/27/2003	500	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/24/2003	170	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/29/2003	51	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/18/2003	2500	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/9/2003	23	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/26/2004	45	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/24/2004	95	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/30/2004	22	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/27/2004	240	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/18/2004	170	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/23/2004	20	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/27/2004	340	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/25/2004	280	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/28/2004	12	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/21/2004	2	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/30/2004	680	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/21/2004	11	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/19/2005	35	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/28/2005	21	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/28/2005	91	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/27/2005	68	FC	2000
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/31/2005	670	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/27/2005	160	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/19/2005	290	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/30/2005	750	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/28/2005	1100	FC	400
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/26/1997	47	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/15/1997	170	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/15/1997	120	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/18/1997	110	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/15/1997	6	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/14/1998	34	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/19/1998	11	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/11/1998	2	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/24/1998	3	EC	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/12/1998	57	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/3/1998	190	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/15/1998	300	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/19/1998	790	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/23/1998	320	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/21/1998	140	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/17/1998	60	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/8/1998	250	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/7/1999	240	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/3/1999	49	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/16/1999	4100	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/7/1999	210	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/4/1999	24000	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/9/1999	10	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/15/1999	160	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/20/1999	720	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/14/1999	49	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/22/1999	220	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/3/1999	64	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/2/1999	370	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/19/2000	250	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/17/2000	1100	EC	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/22/2000	110	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/11/2000	1600	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/9/2000	27000	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/27/2000	530	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/18/2000	530	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/14/2000	350	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/13/2000	420	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/10/2000	290	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/14/2000	130	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/11/2000	170	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/31/2001	150	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/14/2001	210	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/20/2001	65	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/12/2001	110	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/22/2001	80	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/19/2001	44	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/24/2001	200	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/13/2001	340	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/25/2001	140	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/22/2001	900	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/14/2001	160	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/12/2001	400	EC	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/22/2002	20	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/8/2002	15	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/18/2002	52	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/11/2002	50	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/28/2002	4000	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/12/2002	12000	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/19/2002	880	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/12/2002	200	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/9/2002	590	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/6/2002	90	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/10/2002	1300	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/28/2003	60	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/21/2003	100	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/26/2003	90	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/22/2003	180	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/28/2003	19	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/26/2003	15	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/22/2003	170	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/27/2003	300	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/24/2003	140	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/29/2003	62	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/18/2003	2400	EC	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/9/2003	33	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/26/2004	34	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/24/2004	57	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/30/2004	46	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/27/2004	300	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/18/2004	210	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/23/2004	80	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/27/2004	160	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/25/2004	240	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/28/2004	20	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	10/21/2004	350	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	11/30/2004	550	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	12/21/2004	7	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	1/19/2005	96	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	2/28/2005	20	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	3/28/2005	230	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	4/27/2005	33	EC	2030
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	5/31/2005	67	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	6/27/2005	180	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	7/19/2005	190	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	8/30/2005	670	EC	406
OK121600030340J	Cave Springs Branch site 2 near South West City, MO	9/28/2005	580	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/9/1997	9	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/6/1997	31	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/1997	160	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/7/1998	920	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/9/1998	7	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/11/1998	13	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/14/1998	33	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/13/1998	62	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/9/1998	92	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/14/1998	29	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/12/1998	37	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/2/1998	27	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/7/1998	6600	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/3/1998	240	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/1998	15	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/12/1999	6	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/3/1999	9	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/10/1999	430	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/7/1999	21	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/18/1999	440	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/8/1999	48	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/29/1999	160	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/13/1999	37	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/26/1999	160	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/18/1999	50	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/24/1999	14	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/14/1999	21	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/27/1999	20	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/5/1999	18	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/2/1999	20	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/1/1999	3	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/10/2000	4	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/15/2000	2	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/21/2000	11	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/12/2000	21	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/23/2000	15	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/24/2000	420	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/6/2000	37	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/28/2000	100	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/25/2000	22	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/1/2000	60	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/15/2000	18	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/30/2000	60	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/6/2000	78	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/11/2000	7	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/28/2000	64	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/11/2000	14	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/16/2001	21	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/6/2001	75	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/20/2001	17	FC	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/16/2001	43	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/1/2001	50	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/22/2001	60	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/5/2001	700	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/12/2001	46	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/17/2001	80	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/7/2001	70	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/20/2001	42	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/18/2001	160	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/25/2001	10	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/24/2001	4	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/27/2001	57	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/11/2001	64	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/7/2002	3	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/11/2002	3	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/12/2002	23	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/16/2002	22	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/21/2002	160	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/22/2002	2000	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/4/2002	10	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/18/2002	120	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/9/2002	10	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/23/2002	83	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/26/2002	20	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/4/2002	30	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/10/2002	16	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/1/2002	50	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/5/2002	31	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/2002	5	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/22/2003	27	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/10/2003	1	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/24/2003	8	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/14/2003	5	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/12/2003	8	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/13/2003	30	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/3/2003	60	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/16/2003	10	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/16/2003	21	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/7/2003	33	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/8/2003	20	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/22/2003	40	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/12/2003	30	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/20/2003	18	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/26/2003	10	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/16/2003	20	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/30/2003	30	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/14/2003	18	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/3/2003	8	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/2003	13	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/22/2004	82	FC	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/9/2004	1	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/10/2004	28	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/20/2004	54	FC	2000
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/10/2004	15	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/8/2004	27	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/20/2004	4	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/23/2004	13	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/14/2004	13	FC	400
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/9/1997	12	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/6/1997	21	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/1997	110	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/7/1998	1000	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/9/1998	3	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/11/1998	5	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/14/1998	23	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/13/1998	50	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/9/1998	320	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/14/1998	15	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/12/1998	28	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/2/1998	24	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/7/1998	3000	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/3/1998	270	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/1998	21	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/12/1999	6	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/3/1999	11	EC	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/10/1999	340	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/7/1999	21	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/18/1999	340	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/8/1999	40	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/29/1999	74	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/13/1999	48	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/26/1999	41	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/18/1999	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/24/1999	11	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/14/1999	21	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/27/1999	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/5/1999	11	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/2/1999	8	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/1/1999	2	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/10/2000	2	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/15/2000	2	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/21/2000	10	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/12/2000	15	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/23/2000	8	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/24/2000	457	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/6/2000	26	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/28/2000	86	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/25/2000	22	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/1/2000	41	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/15/2000	25	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/30/2000	20	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/6/2000	38	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/11/2000	6	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/28/2000	21	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/11/2000	2	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/16/2001	35	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/6/2001	43	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/20/2001	12	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/16/2001	20	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/1/2001	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/22/2001	49	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/5/2001	490	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/12/2001	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/17/2001	20	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/7/2001	41	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/20/2001	12	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/18/2001	130	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/25/2001	20	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/24/2001	20	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/27/2001	10	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/11/2001	44	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/7/2002	1	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/11/2002	1	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/12/2002	23	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/16/2002	5	EC	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/21/2002	50	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/22/2002	41	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/4/2002	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/18/2002	48	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/9/2002	31	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/23/2002	29	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/26/2002	1	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/4/2002	20	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/10/2002	5	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/1/2002	41	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/5/2002	16	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/2002	3	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/22/2003	7	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/10/2003	1	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/24/2003	5	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/14/2003	1	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/12/2003	5	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/13/2003	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/3/2003	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/16/2003	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/16/2003	25	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/7/2003	7	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/8/2003	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/22/2003	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/12/2003	10	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/20/2003	16	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/26/2003	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/16/2003	10	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/30/2003	41	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/14/2003	1	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	11/3/2003	4	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	12/9/2003	13	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	1/22/2004	28	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	2/9/2004	1	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	3/10/2004	10	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	4/20/2004	69	EC	2030
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/10/2004	8	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/8/2004	24	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/20/2004	12	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/23/2004	9	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/14/2004	3	EC	406
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/29/1999	230	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/26/1999	5	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/18/1999	20	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/27/1999	60	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/24/2000	440	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/28/2000	1100	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/1/2000	70	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/30/2000	40	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/1/2001	20	ENT	108

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/5/2001	1300	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/17/2001	60	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/7/2001	60	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/25/2001	5	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/22/2002	300	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/4/2002	100	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/9/2002	40	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/4/2002	20	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	10/1/2002	60	ENT	540
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	5/13/2003	60	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/3/2003	10	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	6/16/2003	10	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/8/2003	40	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	7/22/2003	60	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/12/2003	150	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	8/26/2003	200	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/16/2003	100	ENT	108
OK121600030440-001AT	Elk River at SH 43 near Tiff City, MO	9/30/2003	50	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	06/05/2001	600	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/17/2001	20	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/07/2001	130	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	11/06/2001	130	FC	2000
OK121600030445-001AT	Honey Creek, off SH 25, Grove	03/12/2002	70	FC	2000
OK121600030445-001AT	Honey Creek, off SH 25, Grove	04/09/2002	200	FC	2000
OK121600030445-001AT	Honey Creek, off SH 25, Grove	05/22/2002	100	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030445-001AT	Honey Creek, off SH 25, Grove	06/04/2002	40	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/09/2002	600	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	09/04/2002	500	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	10/01/2002	40	FC	2000
OK121600030445-001AT	Honey Creek, off SH 25, Grove	05/22/2006	250	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/18/2006	450	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/07/2006	1600	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/29/2006	420	FC	400
OK121600030445-001AT	Honey Creek, off SH 25, Grove	06/05/2001	379	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/17/2001	10	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/07/2001	10	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	05/22/2002	41	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	06/04/2002	97	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/09/2002	211	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	09/04/2002	119	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	10/01/2002	185	EC	2030
OK121600030445-001AT	Honey Creek, off SH 25, Grove	05/22/2006	98	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/18/2006	108	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/07/2006	631	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/29/2006	108	EC	406
OK121600030445-001AT	Honey Creek, off SH 25, Grove	06/05/2001	1600	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/17/2001	270	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/07/2001	200	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	05/22/2002	100	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	06/04/2002	200	ENT	108

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/09/2002	800	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	09/04/2002	7000	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	10/01/2002	900	ENT	540
OK121600030445-001AT	Honey Creek, off SH 25, Grove	05/22/2006	121	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	07/18/2006	84	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/07/2006	41	ENT	108
OK121600030445-001AT	Honey Creek, off SH 25, Grove	08/29/2006	327	ENT	108
OK121600030510D	Sycamore Creek	9/17/2001	850	FC	400
OK121600030510D	Sycamore Creek	8/13/2001	5	EC	406
OK121600030510D	Sycamore Creek	9/17/2001	610	EC	406
OK121600030510D	Sycamore Creek	10/22/2001	40	EC	2030
OK121600030510D	Sycamore Creek	4/22/2002	10	EC	2030
OK121600030510D	Sycamore Creek	5/28/2002	120	EC	406
OK121600030510D	Sycamore Creek	7/8/2002	20	EC	406
OK121600030510D	Sycamore Creek	8/5/2002	50	EC	406
OK121600030510D	Sycamore Creek	9/9/2002	10	EC	406
OK121600030510D	Sycamore Creek	10/14/2002	40	EC	2030
OK121600030510D	Sycamore Creek	4/7/2003	10	EC	2030
OK121600030510D	Sycamore Creek	5/12/2003	10	EC	406
OK121600030510D	Sycamore Creek	6/16/2003	20	EC	406
OK121600030510D	Sycamore Creek	8/13/2001	70	ENT	108
OK121600030510D	Sycamore Creek	9/17/2001	1630	ENT	108
OK121600030510D	Sycamore Creek	10/22/2001	30	ENT	540
OK121600030510D	Sycamore Creek	4/22/2002	20	ENT	540
OK121600030510D	Sycamore Creek	4/22/2002	10	ENT	540
OK121600030510D	Sycamore Creek	5/28/2002	100	ENT	108
OK121600030510D	Sycamore Creek	5/28/2002	10	ENT	108
OK121600030510D	Sycamore Creek	7/8/2002	30	ENT	108
OK121600030510D	Sycamore Creek	8/5/2002	10	ENT	108
OK121600030510D	Sycamore Creek	8/5/2002	20	ENT	108
OK121600030510D	Sycamore Creek	9/9/2002	40	ENT	108
OK121600030510D	Sycamore Creek	10/14/2002	20	ENT	540
OK121600030510D	Sycamore Creek	4/7/2003	20	ENT	540
OK121600030510D	Sycamore Creek	4/7/2003	430	ENT	540
OK121600030510D	Sycamore Creek	5/12/2003	10	ENT	108
OK121600030510D	Sycamore Creek	5/12/2003	40	ENT	108
OK121600030510D	Sycamore Creek	6/16/2003	40	ENT	108
OK121600040060D	Tar Creek at Miami, OK	9/17/2001	600	FC	400
OK121600040060D	Tar Creek at Miami, OK	8/13/2001	400	EC	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600040060D	Tar Creek at Miami, OK	9/17/2001	800	EC	406
OK121600040060D	Tar Creek at Miami, OK	10/23/2001	1730	EC	2030
OK121600040060D	Tar Creek at Miami, OK	4/22/2002	960	EC	2030
OK121600040060D	Tar Creek at Miami, OK	5/28/2002	1970	EC	406
OK121600040060D	Tar Creek at Miami, OK	7/8/2002	360	EC	406
OK121600040060D	Tar Creek at Miami, OK	8/5/2002	330	EC	406
OK121600040060D	Tar Creek at Miami, OK	9/9/2002	70	EC	406
OK121600040060D	Tar Creek at Miami, OK	10/14/2002	360	EC	2030
OK121600040060D	Tar Creek at Miami, OK	4/7/2003	2000	EC	2030
OK121600040060D	Tar Creek at Miami, OK	5/12/2003	760	EC	406
OK121600040060D	Tar Creek at Miami, OK	6/16/2003	80	EC	406
OK121600040060D	Tar Creek at Miami, OK	8/13/2001	250	ENT	108
OK121600040060D	Tar Creek at Miami, OK	9/17/2001	580	ENT	108
OK121600040060D	Tar Creek at Miami, OK	10/23/2001	390	ENT	540
OK121600040060D	Tar Creek at Miami, OK	10/23/2001	95	ENT	540
OK121600040060D	Tar Creek at Miami, OK	4/22/2002	200	ENT	540
OK121600040060D	Tar Creek at Miami, OK	4/22/2002	40	ENT	540
OK121600040060D	Tar Creek at Miami, OK	5/28/2002	610	ENT	108
OK121600040060D	Tar Creek at Miami, OK	5/28/2002	950	ENT	108
OK121600040060D	Tar Creek at Miami, OK	7/8/2002	120	ENT	108
OK121600040060D	Tar Creek at Miami, OK	7/8/2002	40	ENT	108
OK121600040060D	Tar Creek at Miami, OK	8/5/2002	230	ENT	108
OK121600040060D	Tar Creek at Miami, OK	8/5/2002	80	ENT	108
OK121600040060D	Tar Creek at Miami, OK	9/9/2002	30	ENT	108
OK121600040060D	Tar Creek at Miami, OK	9/9/2002	50	ENT	108
OK121600040060D	Tar Creek at Miami, OK	10/14/2002	40	ENT	540
OK121600040060D	Tar Creek at Miami, OK	4/7/2003	430	ENT	540
OK121600040060D	Tar Creek at Miami, OK	4/7/2003	10	ENT	540
OK121600040060D	Tar Creek at Miami, OK	5/12/2003	385	ENT	108
OK121600040060D	Tar Creek at Miami, OK	5/12/2003	80	ENT	108
OK121600040060D	Tar Creek at Miami, OK	6/16/2003	60	ENT	108
OK121600040130G	Cow Creek	4/27/1999	3000	FC	2000
OK121600040130G	Cow Creek	5/25/1999	200	FC	400
OK121600040130G	Cow Creek	6/22/1999	900	FC	400
OK121600040130G	Cow Creek	7/20/1999	200	FC	400
OK121600040130G	Cow Creek	8/24/1999	200	FC	400
OK121600040130G	Cow Creek	10/5/1999	100	FC	2000
OK121600040130G	Cow Creek	12/13/1999	500	FC	2000
OK121600040130G	Cow Creek	1/18/2000	200	FC	2000
OK121600040130G	Cow Creek	2/23/2000	500	FC	2000
OK121600040130G	Cow Creek	3/28/2000	200	FC	2000
OK121600040130G	Cow Creek	5/8/2000	2000	FC	400
OK121600040130G	Cow Creek	6/12/2000	1000	FC	400
OK121600040130G	Cow Creek	7/17/2000	70	FC	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600040130G	Cow Creek	8/21/2000	10	FC	400
OK121600040130G	Cow Creek	10/30/2000	600	FC	2000
OK121600040130G	Cow Creek	12/6/2000	10	FC	2000
OK121600040130G	Cow Creek	1/16/2001	300	FC	2000
OK121600040130G	Cow Creek	2/20/2001	90	FC	2000
OK121600040130G	Cow Creek	3/26/2001	90	FC	2000
OK121600040130G	Cow Creek	8/21/2000	20	EC	406
OK121600040130G	Cow Creek	10/30/2000	598	EC	2030
OK121600040130G	Cow Creek	12/6/2000	134	EC	2030
OK121600040130G	Cow Creek	1/16/2001	240	EC	2030
OK121600040130G	Cow Creek	2/20/2001	201	EC	2030
OK121600040130G	Cow Creek	3/26/2001	20	EC	2030
OK121600040130G	Cow Creek	10/30/2000	14000	ENT	540
OK121600040130G	Cow Creek	12/6/2000	10	ENT	540
OK121600040130G	Cow Creek	1/16/2001	1500	ENT	540
OK121600040130G	Cow Creek	2/20/2001	70	ENT	540
OK121600040130G	Cow Creek	3/26/2001	40	ENT	540
OK121600040170G	Fourmile Creek	4/27/1999	2000	FC	2000
OK121600040170G	Fourmile Creek	5/25/1999	5500	FC	400
OK121600040170G	Fourmile Creek	6/22/1999	200	FC	400
OK121600040170G	Fourmile Creek	7/20/1999	200	FC	400
OK121600040170G	Fourmile Creek	8/24/1999	100	FC	400
OK121600040170G	Fourmile Creek	10/5/1999	100	FC	2000
OK121600040170G	Fourmile Creek	11/8/1999	100	FC	2000
OK121600040170G	Fourmile Creek	12/13/1999	400	FC	2000
OK121600040170G	Fourmile Creek	1/18/2000	100	FC	2000
OK121600040170G	Fourmile Creek	2/23/2000	1200	FC	2000
OK121600040170G	Fourmile Creek	5/8/2000	800	FC	400
OK121600040170G	Fourmile Creek	6/12/2000	2000	FC	400
OK121600040170G	Fourmile Creek	7/17/2000	180	FC	400
OK121600040170G	Fourmile Creek	8/21/2000	40	FC	400
OK121600040170G	Fourmile Creek	9/25/2000	10	FC	400
OK121600040170G	Fourmile Creek	10/30/2000	6000	FC	2000
OK121600040170G	Fourmile Creek	12/6/2000	20	FC	2000
OK121600040170G	Fourmile Creek	1/16/2001	180	FC	2000
OK121600040170G	Fourmile Creek	2/20/2001	120	FC	2000
OK121600040170G	Fourmile Creek	3/26/2001	30	FC	2000
OK121600040170G	Fourmile Creek	8/21/2000	73	EC	406
OK121600040170G	Fourmile Creek	9/25/2000	10	EC	406
OK121600040170G	Fourmile Creek	10/30/2000	31	EC	2030
OK121600040170G	Fourmile Creek	12/6/2000	10	EC	2030
OK121600040170G	Fourmile Creek	1/16/2001	134	EC	2030
OK121600040170G	Fourmile Creek	2/20/2001	160	EC	2030
OK121600040170G	Fourmile Creek	3/26/2001	31	EC	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100ml)
OK121600040170G	Fourmile Creek	9/25/2000	90	ENT	108
OK121600040170G	Fourmile Creek	10/30/2000	66000	ENT	540
OK121600040170G	Fourmile Creek	12/6/2000	40	ENT	540
OK121600040170G	Fourmile Creek	1/16/2001	1000	ENT	540
OK121600040170G	Fourmile Creek	2/20/2001	200	ENT	540
OK121600040170G	Fourmile Creek	3/26/2001	30	ENT	540
OK121600040200G	Russell Creek	4/20/1999	14600	FC	2000
OK121600040200G	Russell Creek	5/18/1999	5000	FC	400
OK121600040200G	Russell Creek	6/15/1999	700	FC	400
OK121600040200G	Russell Creek	7/13/1999	300	FC	400
OK121600040200G	Russell Creek	8/17/1999	200	FC	400
OK121600040200G	Russell Creek	9/28/1999	100	FC	400
OK121600040200G	Russell Creek	11/2/1999	100	FC	2000
OK121600040200G	Russell Creek	12/6/1999	2000	FC	2000
OK121600040200G	Russell Creek	1/10/2000	100	FC	2000
OK121600040200G	Russell Creek	2/14/2000	100	FC	2000
OK121600040200G	Russell Creek	3/21/2000	200	FC	2000
OK121600040200G	Russell Creek	5/8/2000	1200	FC	400
OK121600040200G	Russell Creek	6/12/2000	200	FC	400
OK121600040200G	Russell Creek	7/17/2000	110	FC	400
OK121600040200G	Russell Creek	8/21/2000	110	FC	400
OK121600040200G	Russell Creek	9/25/2000	50	FC	400
OK121600040200G	Russell Creek	10/31/2000	1100	FC	2000
OK121600040200G	Russell Creek	12/6/2000	110	FC	2000
OK121600040200G	Russell Creek	1/16/2001	10	FC	2000
OK121600040200G	Russell Creek	2/20/2001	90	FC	2000
OK121600040200G	Russell Creek	3/27/2001	800	FC	2000
OK121600040200G	Russell Creek	8/21/2000	146	EC	406
OK121600040200G	Russell Creek	9/25/2000	52	EC	406
OK121600040200G	Russell Creek	10/31/2000	148	EC	2030
OK121600040200G	Russell Creek	12/6/2000	10	EC	2030
OK121600040200G	Russell Creek	1/16/2001	10	EC	2030
OK121600040200G	Russell Creek	2/20/2001	52	EC	2030
OK121600040200G	Russell Creek	3/27/2001	98	EC	2030
OK121600040200G	Russell Creek	9/25/2000	550	ENT	108
OK121600040200G	Russell Creek	10/31/2000	8000	ENT	540
OK121600040200G	Russell Creek	12/6/2000	2900	ENT	540
OK121600040200G	Russell Creek	1/16/2001	140	ENT	540
OK121600040200G	Russell Creek	2/20/2001	90	ENT	540
OK121600040200G	Russell Creek	3/27/2001	60	ENT	540

EC = E. coli; ENT = enterococci; FC = fecal coliform
* Single sample criterion for secondary contact recreation season is shown for all samples collected between October 1st and April 30th.

APPENDIX B
NPDES PERMIT DISCHARGE MONITORING REPORT DATA AND SANITARY SEWER OVERFLOW DATA

Appendix B

NPDES Permit Discharge Monitoring Report Data 1998-2007

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0020656	10	10	001	5/31/1998	74055	FC	0.16	0.368	50050	Flow
OK0020656	10	10	001	6/30/1998	74055	FC	0.118	0.188	50050	Flow
OK0020656	10	10	001	7/31/1998	74055	FC	0.139	0.35	50050	Flow
OK0020656	10	10	001	8/31/1998	74055	FC	0.118	0.342	50050	Flow
OK0020656	< 10	< 10	001	9/30/1998	74055	FC	0.151	0.458	50050	Flow
OK0020656	22	50	001	5/31/1999	74055	FC	0.243	0.574	50050	Flow
OK0020656	< 10	< 10	001	6/30/1999	74055	FC	0.242	0.464	50050	Flow
OK0020656	75	190	001	7/31/1999	74055	FC	0.149	0.436	50050	Flow
OK0020656	267	310	001	8/31/1999	74055	FC	0.0964	0.126	50050	Flow
OK0020656	28	22000	001	9/30/1999	74055	FC	0.091	0.194	50050	Flow
OK0020656	10	10	001	5/31/2000	74055	FC	0.194	0.426	50050	Flow
OK0020656	36	180	001	6/30/2000	74055	FC	0.259	0.535	50050	Flow
OK0020656	20	40	001	7/31/2000	74055	FC	0.122	0.265	50050	Flow
OK0020656	34	116	001	8/31/2000	74055	FC	0.0907	0.279	50050	Flow
OK0020656	10.95	60	001	9/30/2000	74055	FC	0.0799	0.261	50050	Flow
OK0020656	7650	10000	001	5/31/2001	74055	FC	0.116	0.323	50050	Flow
OK0020656	106	600	001	6/30/2001	74055	FC	0.156	0.397	50050	Flow
OK0020656	56	360	001	7/31/2001	74055	FC	0.099	0.174	50050	Flow
OK0020656	5	5	001	8/31/2001	74055	FC	0.106	0.25	50050	Flow
OK0020656	116	180	001	9/30/2001	74055	FC	0.103	0.296	50050	Flow
OK0020656	1248	5900	001	5/31/2002	74055	FC	0.2586	0.663	50050	Flow
OK0020656	83.9	176	001	6/30/2002	74055	FC	0.134	0.387	50050	Flow
OK0020656	778.1	1700	001	7/31/2002	74055	FC	0.084	0.192	50050	Flow
OK0020656	34.6	120	001	8/31/2002	74055	FC	0.084	0.141	50050	Flow
OK0020656	97.98	160	001	9/30/2002	74055	FC	0.079	0.135	50050	Flow
OK0020656	10	10	001	5/31/2003	74055	FC	0.161	0.475	50050	Flow
OK0020656	17	30	001	6/30/2003	74055	FC	0.149	0.459	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0020656	< 10	< 10	001	7/31/2003	74055	FC	0.09	0.143	50050	Flow
OK0020656	< 10	< 10	001	8/31/2003	74055	FC	0.096	0.334	50050	Flow
OK0020656	< 10	< 10	001	9/30/2003	74055	FC	0.08	0.215	50050	Flow
OK0020656	100.39	360	001	5/31/2004	74055	FC	0.143	0.386	50050	Flow
OK0020656	< 10	< 10	001	6/30/2004	74055	FC	0.124	0.417	50050	Flow
OK0020656	< 10	< 10	001	7/31/2004	74055	FC	0.188	0.501	50050	Flow
OK0020656	< 10	< 10	001	8/31/2004	74055	FC	0.091	0.111	50050	Flow
OK0020656	< 10	< 10	001	9/30/2004	74055	FC	0.07	0.131	50050	Flow
OK0020656	13	26	001	5/31/2005	74055	FC	0.0938	0.373	50050	Flow
OK0020656	< 10	< 10	001	6/30/2005	74055	FC	0.103	0.334	50050	Flow
OK0020656	< 10	< 10	001	7/31/2005	74055	FC	0.067	0.123	50050	Flow
OK0020656	< 10	< 10	001	8/31/2005	74055	FC	0.087	0.336	50050	Flow
OK0020656	< 10	< 10	001	9/30/2005	74055	FC	0.0726	0.13	50050	Flow
OK0020656	4.9	6	001	5/31/2006	74055	FC	0.131	0.336	50050	Flow
OK0020656	7.07	25	001	6/30/2006	74055	FC	0.084	0.225	50050	Flow
OK0020656	19.1	26	001	7/31/2006	74055	FC	0.074	0.145	50050	Flow
OK0020656	13.9	39	001	8/31/2006	74055	FC	0.0721	0.152	50050	Flow
OK0020656	141	622	001	9/30/2006	74055	FC	0.072	0.24	50050	Flow
OK0022772			001	6/30/2005	74055	FC	0.197	0.348	50050	Flow
OK0022772	49	2400	001	7/31/2005	74055	FC	0.138	0.18	50050	Flow
OK0022772	0	0	001	8/31/2005	74055	FC	0.154	0.28	50050	Flow
OK0022772	23.1	4100	001	9/30/2005	74055	FC	0.15	0.315	50050	Flow
OK0022772	2	2	001	5/31/2006	74055	FC	0.618	0.849	50050	Flow
OK0022772	< 2.29	12	001	6/30/2006	74055	FC	0.179	0.557	50050	Flow
OK0022772	<1	1	001	7/31/2006	74055	FC	0.154	0.234	50050	Flow
OK0022772	<3.141	31	001	8/31/2006	74055	FC	0.205	0.345	50050	Flow
OK0022772	4.25	25.5	001	9/30/2006	74055	FC	0.212	0.447	50050	Flow
OK0031976	10	10	001	5/31/1998	74055	FC	0.864	1.04	50050	Flow
OK0031976	31	150	001	6/30/1998	74055	FC	0.89	1.057	50050	Flow
OK0031976	10	10	001	7/31/1998	74055	FC	0.817	0.926	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0031976	10	10	001	8/31/1998	74055	FC	0.897	1.849	50050	Flow
OK0031976	19	70	001	9/30/1998	74055	FC	0.961	2.519	50050	Flow
OK0031976	146	6200	001	5/31/1999	74055	FC	1.268	2.668	50050	Flow
OK0031976	1319	62000	001	6/30/1999	74055	FC	1.385	2.607	50050	Flow
OK0031976	1248	12000	001	7/31/1999	74055	FC	1.008	2.762	50050	Flow
OK0031976	24879	100000	001	8/31/1999	74055	FC	0.828	1.199	50050	Flow
OK0031976	599	1800	001	9/30/1999	74055	FC	0.915	2.063	50050	Flow
OK0031976	259	38000	001	5/31/2000	74055	FC	0.69	0.892	50050	Flow
OK0031976	36	120	001	6/30/2000	74055	FC	0.591	0.739	50050	Flow
OK0031976	30	90	001	7/31/2000	74055	FC	0.488	0.69	50050	Flow
OK0031976	35	160	001	8/31/2000	74055	FC	0.439	0.632	50050	Flow
OK0031976	13	140	001	9/30/2000	74055	FC	0.426	0.629	50050	Flow
OK0031976	5.5	60	001	6/30/2001	74055	FC	0.385	0.624	50050	Flow
OK0031976	4	4	001	7/31/2001	74055	FC	11.466	0.447	50050	Flow
OK0031976	4	4	001	8/31/2001	74055	FC	0.328	0.476	50050	Flow
OK0031976	395	866	001	9/30/2001	74055	FC	0.375	0.464	50050	Flow
OK0031976	48.28	62.8	001	6/30/2002	74055	FC	0.739	1.061	50050	Flow
OK0031976	32.4	180	001	7/31/2002	74055	FC	0.672	1.069	50050	Flow
OK0031976	39.69	179.6	001	8/31/2002	74055	FC	0.734	1.052	50050	Flow
OK0031976	75.18	126.8	001	9/30/2002	74055	FC	0.641	0.934	50050	Flow
OK0031976	16.65	22.7	001	6/30/2003	74055	FC	0.719	1.201	50050	Flow
OK0031976	17.8	37.8	001	7/31/2003	74055	FC	0.668	0.994	50050	Flow
OK0031976	12.56	35.2	001	8/31/2003	74055	FC	0.638	0.994	50050	Flow
OK0031976	53.27	150.8	001	9/30/2003	74055	FC	0.685	1.122	50050	Flow
OK0031976	7.07	9.4	001	6/30/2004	74055	FC	0.766	1.065	50050	Flow
OK0031976	10.48	38.9	001	7/31/2004	74055	FC	1.067	1.854	50050	Flow
OK0031976	101.87	147.5	001	8/31/2004	74055	FC	0.663	0.945	50050	Flow
OK0031976	94.52	156.9	001	9/30/2004	74055	FC	0.712	1.029	50050	Flow
OK0031976	53.61	86.2	001	6/30/2005	74055	FC	0.972	1.552	50050	Flow
OK0031976	156.48	185.7	001	7/31/2005	74055	FC	0.805	1.254	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0031976	104.96	148.7	001	8/31/2005	74055	FC	0.798	1.476	50050	Flow
OK0031976	90.51	117	001	9/30/2005	74055	FC	0.714	1.23	50050	Flow
OK0031976	44.34	98.1	001	6/30/2006	74055	FC	0.779	1.176	50050	Flow
OK0031976	49.95	59	001	7/31/2006	74055	FC	0.693	1.114	50050	Flow
OK0031976	43.92	60.14	001	8/31/2006	74055	FC	0.764	1.44	50050	Flow
OK0031976	54.51	68.18	001	9/30/2006	74055	FC	0.67	1.353	50050	Flow
OK0032263			001	5/31/2006	74055	FC	0.098	0.3	50050	Flow
OK0032263			001	6/30/2006	74055	FC	0.068	0.08	50050	Flow
OK0032263			001	7/31/2006	74055	FC	0.03	0.06	50050	Flow
OK0032263	< 10	< 10	001	8/31/2006	74055	FC	0.036	0.06	50050	Flow
OK0032263	25	30	001	9/30/2006	74055	FC	0.045	0.075	50050	Flow
Arkansas Facilities										
AR0036480	1	1	1	1/31/1998	74055	FC	0.0446	0.2568	50050	Flow
AR0036480	1	1	1	2/28/1998	74055	FC	0.045	0.1037	50050	Flow
AR0036480	1	1	1	3/31/1998	74055	FC	0.0533	0.1392	50050	Flow
AR0036480	1	1	1	4/30/1998	74055	FC	0.0378	0.1392	50050	Flow
AR0036480	1	1	1	5/31/1998	74055	FC	0.1089	0.1811	50050	Flow
AR0036480	1	1	1	6/30/1998	74055	FC	0.0587	0.2046	50050	Flow
AR0036480	<0000001	<0000001	1	7/31/1998	74055	FC	0.0578	0.2298	50050	Flow
AR0036480	1	1	1	8/31/1998	74055	FC	0.0436	0.2298	50050	Flow
AR0036480	<0000001	<0000001	1	9/30/1998	74055	FC	0.0546	0.2298	50050	Flow
AR0036480	<0000001	<0000001	1	10/31/1998	74055	FC	0.0523	0.1811	50050	Flow
AR0036480	<0000001	<0000001	1	11/30/1998	74055	FC	0.03687	0.2568	50050	Flow
AR0036480	1	1	1	12/31/1998	74055	FC	0.0442	0.1593	50050	Flow
AR0036480	104	5150	1	1/31/1999	74055	FC	0.07006	0.3164	50050	Flow
AR0036480	1	1	1	2/28/1999	74055	FC	0.0655	0.1811	50050	Flow
AR0036480	2	3	1	3/31/1999	74055	FC	0.051342	0.181098	50050	Flow
AR0036480	1	1	1	4/30/1999	74055	FC	0.04412	0.1392	50050	Flow
AR0036480	25	308	1	5/31/1999	74055	FC	0.0719	0.3008	50050	Flow
AR0036480	12	42	1	6/30/1999	74055	FC	0.090102	0.54168	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
AR0036480	1	1	1	7/31/1999	74055	FC	0.04268	0.20459	50050	Flow
AR0036480	4	16	1	8/31/1999	74055	FC	0.10955	0.27102	50050	Flow
AR0036480	1	1	1	9/30/1999	74055	FC	0.06415	0.19263	50050	Flow
AR0036480	1	1	1	10/31/1999	74055	FC	0.054197	0.229824	50050	Flow
AR0036480	3	5	1	11/30/1999	74055	FC	0.0524	0.2298	50050	Flow
AR0036480	35	42400	1	12/31/1999	74055	FC	0.043919	0.419985	50050	Flow
AR0036480	2	4	1	1/31/2000	74055	FC	0.05284	0.229824	50050	Flow
AR0036480	1	1	1	2/29/2000	74055	FC	0.0627	0.2298	50050	Flow
AR0036480	4	13	1	3/31/2000	74055	FC	0.0709	0.2857	50050	Flow
AR0036480	26	675	1	4/30/2000	74055	FC	0.021013	0.2857	50050	Flow
AR0036480	1	1	1	5/31/2000	74055	FC	0.011056	0.074243	50050	Flow
AR0036480	1	1	1	6/30/2000	74055	FC	0.004351	0.018326	50050	Flow
AR0036480	1	1	1	7/31/2000	74055	FC	0.003862	0.032014	50050	Flow
AR0036480	1	1	1	8/31/2000	74055	FC	0.002985	0.013125	50050	Flow
AR0036480	1	1	1	9/30/2000	74055	FC	0.001389	0.005659	50050	Flow
AR0036480	1	1	1	10/31/2000	74055	FC	0.003477	0.013326	50050	Flow
AR0036480	1	1	1	11/30/2000	74055	FC	0.00511	0.032014	50050	Flow
AR0036480	1	1	1	12/31/2000	74055	FC	0.002674	0.008927	50050	Flow
AR0036480	1	1	1	1/31/2001	74055	FC	0.001811	0.00324	50050	Flow
AR0036480	1	1	1	2/28/2001	74055	FC	0.003217	0.018326	50050	Flow
AR0036480	1	1	1	3/31/2001	74055	FC	0.002038	0.008927	50050	Flow
AR0036480	1	1	1	4/30/2001	74055	FC	0.00172	0.00324	50050	Flow
AR0036480	1	1	1	5/31/2001	74055	FC	0.00425	0.032014	50050	Flow
AR0036480	1	1	1	6/30/2001	74055	FC	0.003636	0.032014	50050	Flow
AR0036480	1	1	1	7/31/2001	74055	FC	0.00452	0.032	50050	Flow
AR0036480	1	1	1	8/31/2001	74055	FC	0.001811	0.008927	50050	Flow
AR0036480	1	1	1	9/30/2001	74055	FC	0.003182	0.008927	50050	Flow
AR0036480	1	1	1	10/31/2001	74055	FC	0.002382	0.008927	50050	Flow
AR0036480	1	1	1	11/30/2001	74055	FC	0.002847	0.008927	50050	Flow
AR0036480	1	1	1	12/31/2001	74055	FC	0.006865	0.032014	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
AR0036480	1	1	1	1/31/2002	74055	FC	0.003653	0.032014	50050	Flow
AR0036480	1	1	1	2/28/2002	74055	FC	0.004424	0.008927	50050	Flow
AR0036480	1	1	1	3/31/2002	74055	FC	0.016036	0.040627	50050	Flow
AR0036480	9	25	1	4/30/2002	74055	FC	0.018357	0.139162	50050	Flow
AR0036480	1	1	1	5/31/2002	74055	FC	0.039082	0.285671	50050	Flow
AR0036480	1	1	1	6/30/2002	74055	FC	0.009528	0.181098	50050	Flow
AR0036480	1	1	1	7/31/2002	74055	FC	0.006238	0.103666	50050	Flow
AR0036480	3	9	1	8/31/2002	74055	FC	0.002913	0.013125	50050	Flow
AR0036480	102	125	1	9/30/2002	74055	FC	0.000832	0.00232	50050	Flow
AR0036480	580	1050	1	10/31/2002	74055	FC	0.001801	0.008927	50050	Flow
AR0036480	1	1	1	11/30/2002	74055	FC	0.000619	0.00232	50050	Flow
AR0036480	1	1	1	12/31/2002	74055	FC	0.000223	0.000573	50050	Flow
AR0036480	1	1	1	1/31/2003	74055	FC	0.000639	0.008927	50050	Flow
AR0036480	1	1	1	2/28/2003	74055	FC	0.012099	0.074243	50050	Flow
AR0036480	1	1	1	3/31/2003	74055	FC	0.006354	0.032014	50050	Flow
AR0036480	2	4	1	4/30/2003	74055	FC	0.00505	0.032014	50050	Flow
AR0036480	1	1	1	5/31/2003	74055	FC	0.030392	0.285671	50050	Flow
AR0036480	1	2	1	6/30/2003	74055	FC	0.04584	0.229824	50050	Flow
AR0036480	2	4	1	7/31/2003	74055	FC	0.115771	0.285671	50050	Flow
AR0036480	6	33	1	8/31/2003	74055	FC	0.029233	0.064696	50050	Flow
AR0036480	2	6	1	9/30/2003	74055	FC	0.033964	0.055926	50050	Flow
AR0036480	1	1	1	10/31/2003	74055	FC	0.032048	0.055926	50050	Flow
AR0036480	1	1	1	11/30/2003	74055	FC	0.04711	0.074243	50050	Flow
AR0036480	2	5	1	12/31/2003	74055	FC	0.039484	0.055926	50050	Flow
AR0036480	23	109	1	1/31/2004	74055	FC	0.054521	0.081051	50050	Flow
AR0036480	1	1	1	2/29/2004	74055	FC	0.044216	0.074243	50050	Flow
AR0036480	1	1	1	3/31/2004	74055	FC	0.061682	0.139162	50050	Flow
AR0036480	1	1	1	4/30/2004	74055	FC	0.055286	0.08822	50050	Flow
AR0036480	54	54	1	5/31/2004	74055	FC	0.053252	0.074243	50050	Flow
AR0036480	188	188	1	6/30/2004	74055	FC	0.050777	0.074243	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
AR0036480	1	1	1	7/31/2004	74055	FC	0.056952	0.074243	50050	Flow
AR0036480	75	75	1	8/31/2004	74055	FC	0.050143	0.061687	50050	Flow
AR0036480	3	3	1	9/30/2004	74055	FC	0.049837	0.061687	50050	Flow
AR0036480	<0000001	<0000001	1	10/31/2004	74055	FC	0.04117	0.0505	50050	Flow
AR0036480	<0000001	<0000001	1	11/30/2004	74055	FC	0.031652	0.061687	50050	Flow
AR0036480	1	1	1	12/31/2004	74055	FC	0.038615	0.074243	50050	Flow
AR0036480	<0000001	<0000001	1	1/31/2005	74055	FC	0.031202	0.0505	50050	Flow
AR0036480	<0000001	<0000001	1	2/28/2005	74055	FC	0.032279	0.0505	50050	Flow
AR0036480	<0000001	<0000001	1	3/31/2005	74055	FC	0.036693	0.055926	50050	Flow
AR0036480	<0000001	<0000001	1	4/30/2005	74055	FC	0.04405	0.061687	50050	Flow
AR0036480	<0000001	<0000001	1	5/31/2005	74055	FC	0.063246	0.1404	50050	Flow
AR0036480	1	1	1	6/30/2005	74055	FC	0.073788	0.1404	50050	Flow
AR0036480	<0000001	<0000001	1	7/31/2005	74055	FC	0.005699	0.018326	50050	Flow
AR0036480	<0000001	<0000001	1	8/31/2005	74055	FC	0.011452	0.074243	50050	Flow
AR0036480	<0000001	<0000001	1	9/30/2005	74055	FC	0.011963	0.139162	50050	Flow
AR0036480	<0000001	<0000001	1	10/31/2005	74055	FC	0.009506	0.139162	50050	Flow
AR0036480	<0000001	<0000001	1	11/30/2005	74055	FC	0.011252	0.139162	50050	Flow
AR0036480	<0000001	<0000001	1	12/31/2005	74055	FC	0.010325	0.032014	50050	Flow
AR0036480	1200	1200	1	1/31/2006	74055	FC	0.014551	0.103666	50050	Flow
AR0036480	<0000001	<0000001	1	2/28/2006	74055	FC	0.006269	0.018326	50050	Flow
AR0036480	4	4	1	3/31/2006	74055	FC	0.016902	0.103666	50050	Flow
AR0036480	<0000001	<0000001	1	4/30/2006	74055	FC	0.014225	0.103666	50050	Flow
AR0036480	<0000353	2250	1	5/31/2006	74055	FC	0.035757	0.139162	50050	Flow
AR0036480	<0000001	<0000001	1	6/30/2006	74055	FC	0.01952	0.103666	50050	Flow
AR0036480	1	1	1	7/31/2006	74055	FC	0.003	0.005	50050	Flow
AR0036480	2	2	1	8/31/2006	74055	FC	0.003	0.018	50050	Flow
AR0036480	2	2	1	9/30/2006	74055	FC	0.004	0.01	50050	Flow
AR0036480	2	2	1	10/31/2006	74055	FC	0.006	0.043	50050	Flow
AR0036480	1	1	1	11/30/2006	74055	FC	0.03	0.52	50050	Flow
AR0036480	2	2	1	12/31/2006	74055	FC	0.02	0.03	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
AR0036480	2	2	1	1/31/2007	74055	FC	0.01	0.02	50050	Flow
AR0036480	1	1	1	2/28/2007	74055	FC	0.01	0.01	50050	Flow
Missouri Facilities										
MO0002500	2	2	FAC	5/31/2005	74055	FC	0.958	1.339	50050	Flow
MO0002500	2	2	FAC	7/31/2005	74055	FC	0.814	1.104	50050	Flow
MO0002500	6	6	FAC	8/31/2005	74055	FC	1.084	1.365	50050	Flow
MO0002500	2	2	FAC	9/30/2005	74055	FC	0.989	1.325	50050	Flow
MO0002500	2	2	FAC	10/31/2005	74055	FC	0.893	1.104	50050	Flow
MO0002500	100	100	2	3/31/2006	74055	FC	0.031398	0.031398	50050	Flow
MO0002500	6733	10000	3	3/31/2006	74055	FC	0.08	0.108	50050	Flow
MO0002500	22000	22000	4	3/31/2006	74055	FC	0.074	0.074	50050	Flow
MO0002500	2.75	4	1	4/30/2006	74055	FC	0.88	1.647	50050	Flow
MO0002500	2	2	1	5/31/2006	74055	FC	1.113	1.647	50050	Flow
MO0002500	2	3	1	6/30/2006	74055	FC	0.929	1.197	50050	Flow
MO0002500	760	760	2	6/30/2006	74055	FC	0.08841	0.08841	50050	Flow
MO0002500	1600	1600	3	6/30/2006	74055	FC	0.12607	0.12607	50050	Flow
MO0002500			4	6/30/2006	74055	FC	0.071427	0.071427	50050	Flow
MO0002500	2	2	1	7/31/2006	74055	FC	0.897	1.137	50050	Flow
MO0002500	2	2	1	8/31/2006	74055	FC	0.917	1.109	50050	Flow
MO0002500	2	2	1	9/30/2006	74055	FC	0.89	1.108	50050	Flow
MO0002500	4900	4900	3	9/30/2006	74055	FC	0.151021	0.151021	50050	Flow
MO0002500	5900	5900	4	9/30/2006	74055	FC	0.122598	0.122598	50050	Flow
MO0002500	3	6	1	10/31/2006	74055	FC	0.833	1.336	50050	Flow
MO0002500	240	240	2	3/31/2007	74055	FC	0.050651	0.059861	50050	Flow
MO0002500	5700	5700	3	3/31/2007	74055	FC	0.07227	0.085359	50050	Flow
MO0002500	6100	6100	4	3/31/2007	74055	FC	0.047973	0.047973	50050	Flow
MO0036765	800	800	1	6/30/2005	74055	FC	0.069	0.087	50050	Flow
MO0036765	1000	1000	1	7/31/2005	74055	FC	0.058	0.058	50050	Flow
MO0036765	640	640	1	8/31/2005	74055	FC	0.058	0.087	50050	Flow
MO0036765	520	520	1	9/30/2005	74055	FC	0.058	0.067	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036765	310	310	1	10/31/2005	74055	FC	0.058	0.058	50050	Flow
MO0036765	560	560	1	4/30/2006	74055	FC	0.058	0.058	50050	Flow
MO0036765	300	300	1	5/31/2006	74055	FC	0.058	0.058	50050	Flow
MO0036765	260	260	1	6/30/2006	74055	FC	0.058	0.058	50050	Flow
MO0036765	200	200	1	7/31/2006	74055	FC	0.058	0.058	50050	Flow
MO0036765	210	210	1	8/31/2006	74055	FC	0.058	0.058	50050	Flow
MO0036765	176	176	1	9/30/2006	74055	FC	0.058	0.058	50050	Flow
MO0036765	184	184	1	10/31/2006	74055	FC	0.058	0.058	50050	Flow
MO0036773	8881	35000	2	4/30/1999	74055	FC			50050	Flow
MO0036773	2.25	5	4	4/30/1999	74055	FC			50050	Flow
MO0036773	91	1	5	4/30/1999	74055	FC			50050	Flow
MO0036773	205	300	2	5/31/1999	74055	FC			50050	Flow
MO0036773	73	285	4	5/31/1999	74055	FC			50050	Flow
MO0036773	24346	95000	5	5/31/1999	74055	FC			50050	Flow
MO0036773	2761.25	8600	2	6/30/1999	74055	FC	0.21	0.448	50050	Flow
MO0036773	2	3	4	6/30/1999	74055	FC	1.61	1.709	50050	Flow
MO0036773	160	320	5	6/30/1999	74055	FC	0.05	0.141	50050	Flow
MO0036773	186.63	400	2	7/31/1999	74055	FC	0.24	0.493	50050	Flow
MO0036773	221	550	4	7/31/1999	74055	FC	1.45	1.629	50050	Flow
MO0036773	348	650	5	7/31/1999	74055	FC	0.15	0.538	50050	Flow
MO0036773	19	50	4	8/31/1999	74055	FC	1.34	1.462	50050	Flow
MO0036773	47	105	5	8/31/1999	74055	FC			50050	Flow
MO0036773	48	140	4	9/30/1999	74055	FC	1.39	1.596	50050	Flow
MO0036773	14	40	4	10/31/1999	74055	FC			50050	Flow
MO0036773	55	180	5	10/31/1999	74055	FC			50050	Flow
MO0036773	200.8	200.8	4	11/30/1999	74055	FC			50050	Flow
MO0036773	12.25	12.25	5	11/30/1999	74055	FC			50050	Flow
MO0036773	120	120	2	12/31/1999	74055	FC	0.014	0.014	50050	Flow
MO0036773	47	200	4	12/31/1999	74055	FC	1.472	1.531	50050	Flow
MO0036773	46.2	150	5	12/31/1999	74055	FC	0.02	0.117	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036773	108	320	4	1/31/2000	74055	FC	1.41	1.469	50050	Flow
MO0036773	139	480	5	1/31/2000	74055	FC	0.001	0.001	50050	Flow
MO0036773	110.5	400	4	2/29/2000	74055	FC			50050	Flow
MO0036773	162	580	5	2/29/2000	74055	FC			50050	Flow
MO0036773	91	300	2	3/31/2000	74055	FC			50050	Flow
MO0036773	0	0	4	3/31/2000	74055	FC			50050	Flow
MO0036773	16	52	5	3/31/2000	74055	FC			50050	Flow
MO0036773	1	1	4	4/30/2000	74055	FC	1.54	1.54	50050	Flow
MO0036773	90	90	5	4/30/2000	74055	FC	0.001	0.001	50050	Flow
MO0036773	102.5	102.5	2	5/31/2000	74055	FC			50050	Flow
MO0036773	6.4	6.4	4	5/31/2000	74055	FC	1.47	1.47	50050	Flow
MO0036773	21.75	21.75	5	5/31/2000	74055	FC	0.022	0.022	50050	Flow
MO0036773	300	400	2	6/30/2000	74055	FC	0.74	0.74	50050	Flow
MO0036773	110	220	4	6/30/2000	74055	FC	1.5	1.5	50050	Flow
MO0036773	290	860	5	6/30/2000	74055	FC	0.82	0.82	50050	Flow
MO0036773	40	40	2	7/31/2000	74055	FC	0.021	0.021	50050	Flow
MO0036773	3.5	3.5	4	7/31/2000	74055	FC	1.25	1.25	50050	Flow
MO0036773	157.75	157.75	5	7/31/2000	74055	FC	0.001	0.001	50050	Flow
MO0036773	73	73	4	8/31/2000	74055	FC	1.42	1.42	50050	Flow
MO0036773	232.5	232.5	5	8/31/2000	74055	FC	0.0001	0.0001	50050	Flow
MO0036773	6	6	4	9/30/2000	74055	FC	1.23	1.23	50050	Flow
MO0036773	362	362	5	9/30/2000	74055	FC	0.001	0.001	50050	Flow
MO0036773	5	5	4	10/31/2000	74055	FC	1.46	1.46	50050	Flow
MO0036773	42	42	5	10/31/2000	74055	FC	0.001	0.001	50050	Flow
MO0036773	455	455	2	11/30/2000	74055	FC	0.03	0.03	50050	Flow
MO0036773	5.5	5.5	4	11/30/2000	74055	FC	1.5	1.5	50050	Flow
MO0036773	16	16	5	11/30/2000	74055	FC	0.001	0.001	50050	Flow
MO0036773	2	2	4	12/31/2000	74055	FC	1.504	1.504	50050	Flow
MO0036773	7	7	5	12/31/2000	74055	FC	0.001	0.001	50050	Flow
MO0036773	11	11	2	1/31/2001	74055	FC	0.16	0.16	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036773	1	1	4	1/31/2001	74055	FC	1.28	1.28	50050	Flow
MO0036773	3	3	5	1/31/2001	74055	FC	0.0426	0.0426	50050	Flow
MO0036773	12	12	2	2/28/2001	74055	FC	0.16	0.16	50050	Flow
MO0036773	0.25	0.25	4	2/28/2001	74055	FC	1.5	1.5	50050	Flow
MO0036773	3	3	5	2/28/2001	74055	FC	0.0403	0.0403	50050	Flow
MO0036773	15	15	2	3/31/2001	74055	FC	0.08	0.08	50050	Flow
MO0036773	3	3	4	3/31/2001	74055	FC	1.44	1.44	50050	Flow
MO0036773	6	6	5	3/31/2001	74055	FC	0.0034	0.0034	50050	Flow
MO0036773	0	0	4	4/30/2001	74055	FC	1.35	1.35	50050	Flow
MO0036773	2	2	5	4/30/2001	74055	FC	0.001	0.001	50050	Flow
MO0036773	0	0	4	5/31/2001	74055	FC	1.13	1.13	50050	Flow
MO0036773	5	5	5	5/31/2001	74055	FC	0.001	0.001	50050	Flow
MO0036773	100	100	4	6/30/2001	74055	FC	1.4	1.4	50050	Flow
MO0036773	135	135	5	6/30/2001	74055	FC	0.001	0.001	50050	Flow
MO0036773	19	19	4	7/31/2001	74055	FC	1.1	1.1	50050	Flow
MO0036773	186	186	5	7/31/2001	74055	FC	0.001	0.001	50050	Flow
MO0036773	2.4	8	4	8/31/2001	74055	FC	1.179	1.647	50050	Flow
MO0036773	400	400	2	9/30/2001	74055	FC	0.01	0.01	50050	Flow
MO0036773	3	5	4	9/30/2001	74055	FC	1.32	1.159	50050	Flow
MO0036773	191	280	5	9/30/2001	74055	FC	0.0005	0.0005	50050	Flow
MO0036773	100	100	2	10/31/2001	74055	FC	0.021	0.021	50050	Flow
MO0036773	1	1	4	10/31/2001	74055	FC	1.52	1.52	50050	Flow
MO0036773	58	58	5	10/31/2001	74055	FC	0.001	0.001	50050	Flow
MO0036773	0	0	2	11/30/2001	74055	FC			50050	Flow
MO0036773	0	0	4	11/30/2001	74055	FC			50050	Flow
MO0036773	37	37	5	11/30/2001	74055	FC	0.001	0.001	50050	Flow
MO0036773	380	380	2	12/31/2001	74055	FC	0.21	0.21	50050	Flow
MO0036773	1	1	4	12/31/2001	74055	FC	1.56	1.56	50050	Flow
MO0036773	63	63	5	12/31/2001	74055	FC	0.004	0.004	50050	Flow
MO0036773	0	0	4	1/31/2002	74055	FC	1.5	1.5	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036773	1	1	5	1/31/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	40	40	2	2/28/2002	74055	FC	0.011	0.011	50050	Flow
MO0036773	0	0	4	2/28/2002	74055	FC	1.458	1.458	50050	Flow
MO0036773	45	45	5	2/28/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	47.5	47.5	2	3/31/2002	74055	FC	0.084	0.084	50050	Flow
MO0036773	0.25	0.25	4	3/31/2002	74055	FC	1.55	1.55	50050	Flow
MO0036773	21	21	5	3/31/2002	74055	FC	0.0073	0.0073	50050	Flow
MO0036773	165	165	2	4/30/2002	74055	FC	0.029	0.029	50050	Flow
MO0036773	1	1	4	4/30/2002	74055	FC	1.78	1.78	50050	Flow
MO0036773	64	64	5	4/30/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	2	2	4	5/31/2002	74055	FC	1.6	1.6	50050	Flow
MO0036773	127	127	5	5/31/2002	74055	FC	0.4	0.4	50050	Flow
MO0036773	190	190	2	6/30/2002	74055	FC	0.287	0.287	50050	Flow
MO0036773	1	1	4	6/30/2002	74055	FC	1.54	1.54	50050	Flow
MO0036773	77	77	5	6/30/2002	74055	FC	0.172	0.172	50050	Flow
MO0036773	8	8	4	7/31/2002	74055	FC	1.52	1.52	50050	Flow
MO0036773	8	8	5	7/31/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	7	7	4	8/31/2002	74055	FC	1.39	1.39	50050	Flow
MO0036773	192	192	5	8/31/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	34	34	4	9/30/2002	74055	FC	1.52	1.52	50050	Flow
MO0036773	123	123	5	9/30/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	100	100	2	10/31/2002	74055	FC	0.42	0.42	50050	Flow
MO0036773	0	0	4	10/31/2002	74055	FC	1.481	1.481	50050	Flow
MO0036773	127	127	5	10/31/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	0.3	0.3	4	11/30/2002	74055	FC	1.469	1.645	50050	Flow
MO0036773	78	78	5	11/30/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	0	1	4	12/31/2002	74055	FC	1.5	1.5	50050	Flow
MO0036773	17	17	5	12/31/2002	74055	FC	0.001	0.001	50050	Flow
MO0036773	1	1	4	1/31/2003	74055	FC	1.479	1.479	50050	Flow
MO0036773	100	100	5	1/31/2003	74055	FC	0.001	0.001	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036773	1	1	4	2/28/2003	74055	FC	1.66	1.66	50050	Flow
MO0036773	52	52	5	2/28/2003	74055	FC	0.001	0.001	50050	Flow
MO0036773	47	47	2	3/31/2003	74055	FC	0.084	0.084	50050	Flow
MO0036773	0	0	4	3/31/2003	74055	FC	1.55	1.55	50050	Flow
MO0036773	0.25	0.25	5	3/31/2003	74055	FC	0.0073	0.0073	50050	Flow
MO0036773	1	1	2	4/30/2003	74055	FC	0.04	0.18	50050	Flow
MO0036773	1	1	4	4/30/2003	74055	FC	1.57	1.88	50050	Flow
MO0036773	26	26	5	4/30/2003	74055	FC	0.001	0.001	50050	Flow
MO0036773	3	3	2	5/31/2003	74055	FC	0.158	0.246	50050	Flow
MO0036773	1	1	4	5/31/2003	74055	FC	1.455	2.102	50050	Flow
MO0036773	34	34	5	5/31/2003	74055	FC	0.355	0.592	50050	Flow
MO0036773	3	3	4	6/30/2003	74055	FC	1.55	1.55	50050	Flow
MO0036773	36	36	5	6/30/2003	74055	FC	0.0968	0.0968	50050	Flow
MO0036773	5	5	4	7/31/2003	74055	FC	1.42	1.81	50050	Flow
MO0036773	5	10	5	7/31/2003	74055	FC	1.42	1.81	50050	Flow
MO0036773	2	2	4	8/31/2003	74055	FC	1.32	1.32	50050	Flow
MO0036773	174	174	5	8/31/2003	74055	FC	0.001	0.001	50050	Flow
MO0036773	2	2	4	9/30/2003	74055	FC	1.39	1.39	50050	Flow
MO0036773	62	62	5	9/30/2003	74055	FC	0.001	0.001	50050	Flow
MO0036773	5	5	4	10/31/2003	74055	FC	1.44	1.734	50050	Flow
MO0036773	144	190	5	10/31/2003	74055	FC	0.001	0.001	50050	Flow
MO0036773	2	2	4	11/30/2003	74055	FC	1.71	1.935	50050	Flow
MO0036773	69	69	5	11/30/2003	74055	FC	0.001	0.001	50050	Flow
MO0036773	1	1	4	12/31/2003	74055	FC	1.4	1.4	50050	Flow
MO0036773	11	11	5	12/31/2003	74055	FC	0.001	0.001	50050	Flow
MO0036773	120	120	2	1/31/2004	74055	FC	0.021	0.021	50050	Flow
MO0036773	8	8	4	1/31/2004	74055	FC	1.46	1.46	50050	Flow
MO0036773	7	7	5	1/31/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	0	0	2	2/29/2004	74055	FC	0.025	0.07	50050	Flow
MO0036773	4	4	4	2/29/2004	74055	FC	1.636	2.027	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036773	4	4	5	2/29/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	121	160	2	3/31/2004	74055	FC	0.384	1.088	50050	Flow
MO0036773	8	27	4	3/31/2004	74055	FC	1.65	1.799	50050	Flow
MO0036773	15	70	5	3/31/2004	74055	FC	0.005	0.026	50050	Flow
MO0036773	24	27	2	4/30/2004	74055	FC	0.1	0.28	50050	Flow
MO0036773	14	34	4	4/30/2004	74055	FC	1.76	1.994	50050	Flow
MO0036773	22	41	5	4/30/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	80	150	2	5/31/2004	74055	FC	0.145	0.207	50050	Flow
MO0036773	6	18	4	5/31/2004	74055	FC	1.79	1.938	50050	Flow
MO0036773	84	144	5	5/31/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	8	28	4	6/30/2004	74055	FC	1.69	1.78	50050	Flow
MO0036773	104	136	5	6/30/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	1444	3000	2	7/31/2004	74055	FC	0.197	0.24	50050	Flow
MO0036773	3	4	4	7/31/2004	74055	FC	1.44	1.489	50050	Flow
MO0036773	122	166	5	7/31/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	15	15	4	8/31/2004	74055	FC	1.48	1.48	50050	Flow
MO0036773	95	210	5	8/31/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	45	220	4	9/30/2004	74055	FC	1.62	1.771	50050	Flow
MO0036773	87	270	5	9/30/2004	74055	FC	0.001	0.001	50050	Flow
MO0036773	7.5	10	4	10/31/2004	74055	FC	1.54	1.88	50050	Flow
MO0036773	28.5	34	5	10/31/2004	74055	FC			50050	Flow
MO0036773	44	44	2	11/30/2004	74055	FC	0.19	1.68	50050	Flow
MO0036773	6	7	4	11/30/2004	74055	FC	1.49	1.738	50050	Flow
MO0036773	21	88	5	11/30/2004	74055	FC	0.0183	0.07	50050	Flow
MO0036773	34	60	2	12/31/2004	74055	FC	0.15	0.243	50050	Flow
MO0036773	12	28	4	12/31/2004	74055	FC	1.68	1.796	50050	Flow
MO0036773	35	64	5	12/31/2004	74055	FC	0.021	0.074	50050	Flow
MO0036773	14	22	2	1/31/2005	74055	FC	0.22	1.61	50050	Flow
MO0036773	15	15	4	1/31/2005	74055	FC	1.65	1.995	50050	Flow
MO0036773	14.75	27	5	1/31/2005	74055	FC	0.15	1.23	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036773	0	0	2	2/28/2005	74055	FC			50050	Flow
MO0036773	9.25	22	4	2/28/2005	74055	FC	1.75	1.83	50050	Flow
MO0036773	21.25	40	5	2/28/2005	74055	FC	0.001	0.001	50050	Flow
MO0036773	4	9	4	3/31/2005	74055	FC	1.64	1.857	50050	Flow
MO0036773	12	24	5	3/31/2005	74055	FC			50050	Flow
MO0036773	2	2	4	4/30/2005	74055	FC	1.59	1.97	50050	Flow
MO0036773	14	25	5	4/30/2005	74055	FC			50050	Flow
MO0036773	22	40	4	5/31/2005	74055	FC	1.31	1.567	50050	Flow
MO0036773	69	120	5	5/31/2005	74055	FC	0.001	0.001	50050	Flow
MO0036773	2	2	4	6/30/2005	74055	FC	1.27	1.27	50050	Flow
MO0036773	9	9	5	6/30/2005	74055	FC	0.001	0.001	50050	Flow
MO0036773	3	5	4	7/31/2005	74055	FC	1.403	1.668	50050	Flow
MO0036773	17	26	5	7/31/2005	74055	FC			50050	Flow
MO0036773	2.6	5	4	8/31/2005	74055	FC	1.54	2.19	50050	Flow
MO0036773	2	42	5	8/31/2005	74055	FC	0.001	0.001	50050	Flow
MO0036773	4	8	4	9/30/2005	74055	FC	1.177	35.32	50050	Flow
MO0036773	15	33	5	9/30/2005	74055	FC			50050	Flow
MO0036773	1.542	1.743	4	10/31/2005	74055	FC	1.57	1.743	50050	Flow
MO0036773	16	22	5	10/31/2005	74055	FC	0.001	0.001	50050	Flow
MO0036773	9	16	4	11/30/2005	74055	FC	1.51	1.532	50050	Flow
MO0036773	22	37	5	11/30/2005	74055	FC	0.001	0.001	50050	Flow
MO0036773	11	23	4	12/31/2005	74055	FC	1.58	1.808	50050	Flow
MO0036773	27	46	5	12/31/2005	74055	FC	0.001	0.001	50050	Flow
MO0036773	2	3	4	1/31/2006	74055	FC	1.34	1.606	50050	Flow
MO0036773	9	12	5	1/31/2006	74055	FC	0.0009	0.0009	50050	Flow
MO0036773	4	5	4	2/28/2006	74055	FC	1.24	1.615	50050	Flow
MO0036773	11	13	5	2/28/2006	74055	FC	0.001	0.001	50050	Flow
MO0036773	4	5	4	3/31/2006	74055	FC	1.39	1.689	50050	Flow
MO0036773	5	7	5	3/31/2006	74055	FC	0.001	0.001	50050	Flow
MO0036773	2	4	4	4/30/2006	74055	FC	1.18	1.278	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0036773	6	7	5	4/30/2006	74055	FC	0.001	0.001	50050	Flow
MO0036773	29	36	2	5/31/2006	74055	FC	0.055	0.055	50050	Flow
MO0036773	3	5	4	5/31/2006	74055	FC	1.475	2.14	50050	Flow
MO0036773	12	47	5	5/31/2006	74055	FC	0.149	0.739	50050	Flow
MO0036773	24	42	4	6/30/2006	74055	FC	1.54	1.54	50050	Flow
MO0036773	40	49	5	6/30/2006	74055	FC	0.001	0.001	50050	Flow
MO0036773	10	26	4	7/31/2006	74055	FC	1.2	1.26	50050	Flow
MO0036773	21	41	5	7/31/2006	74055	FC	0.001	0.001	50050	Flow
MO0036773	3	6	4	9/30/2006	74055	FC	1.61	2.011	50050	Flow
MO0036773	2	4	4	10/31/2006	74055	FC	1.47	1.725	50050	Flow
MO0036773	1	1	4	11/30/2006	74055	FC	1.31	1.463	50050	Flow
MO0039926	0	0	2	4/30/1999	74055	FC			50050	Flow
MO0039926	0	0	2	7/31/1999	74055	FC			50050	Flow
MO0039926	0	0	2	8/31/1999	74055	FC			50050	Flow
MO0039926	29	70	1	9/30/1999	74055	FC			50050	Flow
MO0039926	0	0	2	9/30/1999	74055	FC			50050	Flow
MO0039926	0.005	0.005	2	10/31/1999	74055	FC	0.000124	0.000124	50050	Flow
MO0039926	0	0	2	11/30/1999	74055	FC			50050	Flow
MO0039926	0	0	2	3/31/2000	74055	FC	1.1	1.1	50050	Flow
MO0039926	0	0	2	4/30/2000	74055	FC	0.8	0.8	50050	Flow
MO0039926	2	2	2	5/31/2000	74055	FC	0.5	0.5	50050	Flow
MO0039926	2	2	2	6/30/2000	74055	FC			50050	Flow
MO0039926	0	0	2	7/31/2000	74055	FC			50050	Flow
MO0039926	2	2	2	8/31/2000	74055	FC	0.5	1.5	50050	Flow
MO0039926	4	4	2	9/30/2000	74055	FC	12.1	12.1	50050	Flow
MO0039926	0	0	2	10/31/2000	74055	FC			50050	Flow
MO0039926	0	0	2	3/31/2001	74055	FC			50050	Flow
MO0039926	0	0	2	4/30/2001	74055	FC			50050	Flow
MO0039926	2	2	2	5/31/2001	74055	FC	0.72	0.72	50050	Flow
MO0039926	0		2	6/30/2001	74055	FC			50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0039926	0	0	2	7/31/2001	74055	FC	0.53	0.53	50050	Flow
MO0039926	0	0	2	8/31/2001	74055	FC	0.6541	1.3	50050	Flow
MO0039926	0	0	2	9/30/2001	74055	FC			50050	Flow
MO0039926	0	0	2	11/30/2001	74055	FC	1.2	3.2	50050	Flow
MO0039926	0	0	2	4/30/2002	74055	FC			50050	Flow
MO0039926	0	0	2	6/30/2002	74055	FC			50050	Flow
MO0039926	0	0	2	7/31/2002	74055	FC			50050	Flow
MO0039926	0	0	2	8/31/2002	74055	FC			50050	Flow
MO0039926	0	0	2	9/30/2002	74055	FC			50050	Flow
MO0039926	0	0	2	10/31/2002	74055	FC	0.55	0.7	50050	Flow
MO0039926	1	1	2	4/30/2003	74055	FC	1.25	1.6	50050	Flow
MO0039926	1	1	2	5/31/2003	74055	FC	0.73	1.8	50050	Flow
MO0039926	1	1	2	6/30/2003	74055	FC	1	2.7	50050	Flow
MO0039926	0	0	2	7/31/2003	74055	FC	0.6	1	50050	Flow
MO0039926		1	2	9/30/2003	74055	FC	0.7	1.1	50050	Flow
MO0039926	5	12	1	10/31/2003	74055	FC	1.74	2.3	50050	Flow
MO0039926		0	2	10/31/2003	74055	FC	0.55	1.1	50050	Flow
MO0039926		1	2	7/31/2004	74055	FC	0.74	1.4	50050	Flow
MO0039926		0	2	8/31/2004	74055	FC	0.59	1.2	50050	Flow
MO0039926		0	2	9/30/2004	74055	FC	0.5	0.7	50050	Flow
MO0039926		0	2	10/31/2004	74055	FC	0.6	0.7	50050	Flow
MO0039926		0.1	2	4/30/2005	74055	FC	0.63	0.7	50050	Flow
MO0039926		<1	2	5/31/2005	74055	FC	0.5	0.5	50050	Flow
MO0039926		0	2	6/30/2005	74055	FC	0	0	50050	Flow
MO0039926		0	2	7/31/2005	74055	FC	0.6	0.6	50050	Flow
MO0039926		<1	2	8/31/2005	74055	FC	0.5	0.8	50050	Flow
MO0039926		<1	2	9/30/2005	74055	FC	0.5	1	50050	Flow
MO0039926		<1	2	10/31/2005	74055	FC	0	0	50050	Flow
MO0039926		< 1	2	3/31/2006	74055	FC	1	1	50050	Flow
MO0039926		<1	2	5/31/2006	74055	FC	1.2	3	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0039926		0	2	7/31/2006	74055	FC	0.4	0.6	50050	Flow
MO0039926		0	2	8/31/2006	74055	FC	0.5	0.9	50050	Flow
MO0039926			2	10/31/2006	74055	FC	0.8	3	50050	Flow
MO0039926	0	0	1	1/31/2007	74055	FC	0.8	1.5	50050	Flow
MO0054721	<2	<2	1	6/30/2005	74055	FC	0.124	0.23	50050	Flow
MO0054721	4	4	1	7/31/2005	74055	FC	0.1188	0.1688	50050	Flow
MO0054721	3	3	1	8/31/2005	74055	FC	0.132	0.266	50050	Flow
MO0054721	3	3	1	9/30/2005	74055	FC	0.119	0.176	50050	Flow
MO0054721	11	11	1	10/31/2005	74055	FC	0.1012	0.159	50050	Flow
MO0054721	3.1	3.1	1	4/30/2006	74055	FC	0.135	0.456	50050	Flow
MO0054721	24	24	1	5/31/2006	74055	FC	0.190871	0.6171	50050	Flow
MO0054721	<2	<2	1	6/30/2006	74055	FC	0.12	0.165	50050	Flow
MO0054721	2	2	1	7/31/2006	74055	FC	0.11	0.134	50050	Flow
MO0054721	1	1	1	8/31/2006	74055	FC	0.1184	0.1867	50050	Flow
MO0054721	1	1	1	9/30/2006	74055	FC	0.115913	0.2003	50050	Flow
MO0054721	4	4	1	10/31/2006	74055	FC	0.101748	0.1855	50050	Flow
MO0112534	1	1	1	5/31/1999	74055	FC			50050	Flow
MO0112534	10	10	1	6/30/2005	74055	FC	0.102	0.149	50050	Flow
MO0112534	1	1	1	7/31/2005	74055	FC	0.0965	0.148	50050	Flow
MO0112534	1	1	1	8/31/2005	74055	FC	0.103	0.135	50050	Flow
MO0112534	< 2	< 2	1	9/30/2005	74055	FC	0.0974	0.121	50050	Flow
MO0112534	<2	<2	1	10/31/2005	74055	FC	0.00009	0.00017	50050	Flow
MO0112534	<2	<2	1	11/30/2005	74055	FC	0.096	0.169	50050	Flow
MO0112534	6	6	1	12/31/2005	74055	FC	0.101	0.137	50050	Flow
MO0112534	< 2	< 2	1	1/31/2006	74055	FC	0.083129	0.122	50050	Flow
MO0112534	< 2	< 2	1	2/28/2006	74055	FC	0.070785	0.105	50050	Flow
MO0112534	2	2	1	3/31/2006	74055	FC	0.072	0.105	50050	Flow
MO0112534	8	8	1	4/30/2006	74055	FC	0.067	0.168	50050	Flow
MO0112534	3	3	1	5/31/2006	74055	FC	0.069	0.136	50050	Flow
MO0112534	<2	<2	1	6/30/2006	74055	FC	0.058	0.105	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
MO0112534	2	2	1	7/31/2006	74055	FC	0.055	0.099	50050	Flow
MO0112534	1	1	1	8/31/2006	74055	FC	0.058032	0.156	50050	Flow
MO0112534	1	1	1	9/30/2006	74055	FC	0.0516	0.127	50050	Flow
MO0112534	1	1	1	10/31/2006	74055	FC	0.05	0.071	50050	Flow
MO0112534	1	1	1	11/30/2006	74055	FC	0.0541	0.068	50050	Flow
MO0112534	1.9	1.9	1	12/31/2006	74055	FC	0.0565	0.08	50050	Flow
MO0112534	5	5	1	1/31/2007	74055	FC	0.04936	0.064	50050	Flow
MO0112534	11	112	1	2/28/2007	74055	FC	0.056035	0.114	50050	Flow
MO0112534	3	3	1	3/31/2007	74055	FC	0.051258	0.092	50050	Flow
MO0123986	630	630	1	6/30/2005	74055	FC	0.001	0.001	50050	Flow
MO0123986	0	0	1	9/30/2005	74055	FC	0.001	0.001	50050	Flow
MO0123986	110	110	1	12/31/2005	74055	FC	0.002	0.002	50050	Flow
MO0123986	< 1	< 1	1	3/31/2006	74055	FC	< .001	< .001	50050	Flow

ODEQ Summary of Available Reports of Sanitary Sewer Overflows

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
AFTON	3/7/1990	S21613	EAST CLARIFIER	10500	HEAVY RAIN CAUSED INFLOW AND TELESCOPIC VALVE STOPPED UP	
AFTON	3/14/1990	S21613	EAST CLARIFIER	19860	HEAVY RAINFALL	
AFTON	3/24/1990	S21613	EAST CLARIFIER	14760	HEAVY RAIN - VALVE CLOSED	
AFTON	3/26/1990	S21613	EAST CLARIFIER	47900	ICE STORM RUN OFF - VALVE CLOSED	
AFTON	4/25/1990	S21613	BOTH CLARIFIERS FLOODED	100000	EXCESSIVE RAINFALL	
AFTON	11/4/1990	S21613	EAST CLARIFIER	30000	VALVE FAILURE	
AFTON	9/14/1998	S21613	MONROE & NATIONAL ON HWY 66	40,000	RAIN	
AFTON	10/5/1998	S21613	HWY 69 MANHOLE BETWEEN MONROE & NATIONAL	30,000	RAIN	
AFTON	5/9/2000	S21613	HWY 69 & MONROE & NATIONAL	50,000	RAIN	
AFTON	12/16/2001	S21613	E. OF TOWN, 1/4 MILE FROM WWP	15,000	RAIN	LIFT STATION
COMMERCE	9/14/1998	S11206	N. CEDAR ST. & N. ELM ON 4TH/E. "C" ST. IN 100 BLK.		RAIN	
COMMERCE	6/1/1992	S1605	WWTP	0	EXCESSIVE RAINFALL	
COMMERCE	7/1/1992	S21605	WWTP	0	I/I FROM EXCESSIVE RAINFALL	
COMMERCE	11/13/1992	S21605	PLANT HEADWORKS	535680	PUMPS BURNED OUT	
COMMERCE	12/12/1992	S21605	WET WELL AT LAGOONS		HEAVY RAINFALL I/I	
COMMERCE	5/7/1993	S21605	WET WELL AT PLANT	500000	HYDROLIC OVERLOAD FROM I/I AND FLOODING	
COMMERCE	5/7/1993	S21605	WET WELL-SEWAGE TANK-LAGOONS	0	HEAVY RAIN.	
COMMERCE	9/24/1993	S21605	LAGOONS	0	FLOODING CONDITIONS	
COMMERCE	12/12/1993	S21605	LAGOON		EXCESSIVE RAIN	
COMMERCE	7/5/1994	S21605	WTTP	0	TRANSFORMER FAILURE	
COMMERCE	8/31/1994	S21605	MIDWAY VILLAGE LIFT STATION	2000	POWER FAILURE	
COMMERCE	11/5/1994	S21605	AT PLANT	0	RAIN I/I AND PUMP FAILURE AT HEADWORKS	
COMMERCE	11/5/1994	S21605	C ST AND VINE	0	RAIN I/I AND PUMP FAILURE AT HEADWORKS	
COMMERCE	11/5/1994	S21605	E COMMERCE AND L STREET	0	RAIN I/I AND PUMP FAILURE AT HEADWORKS	
COMMERCE	11/6/1994	S21605	AT PLANT HEADWORKS	0	RAIN I/I AND PUMP FAILURE AT HEADWORKS	
COMMERCE	11/6/1994	S21605	C AND SOUTH VINE	0	RAIN I/I AND PUMP FAILURE AT HEADWORKS	
COMMERCE	11/6/1994	S21605	COMMERCE AND L STREET	0	RAIN I/I AND PUMP FAILURE AT HEADWORKS	
COMMERCE	11/18/1994	S21605	CANARY AND MIDWAY	0	LINE BLOCKAGE	
COMMERCE	11/19/1994	S21605	506 MEADOWLARK	0	RAIN I/I	
COMMERCE	11/19/1994	S21605	CEDAR AND ELM	0	RAIN I/I	
COMMERCE	11/19/1994	S21605	COMMERCE AND ELM	0	RAIN I/I	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
COMMERCE	12/8/1994	S21605	MIDWAY AND CANARY	0	LINE STOPPAGE	
COMMERCE	3/18/1995	S21605	MIDWAY & CANARY LANE	0	LINE BLOCKED	
COMMERCE	5/7/1995	S21605	MANHOLES @ C & S. VINE, 4TH ST, & N. ELM & CEDAR	0	INFILTRATION OF WASTE WATER	
COMMERCE	5/7/1995	S21605	WASTEWATER WET WELL	0	INFILTRATION OF RAIN	
COMMERCE	11/24/1996	S21605	WET WELL AT LAGOON	0	POWER FAILURE	
COMMERCE	5/9/1998	S21605	LAGOON WETWELL BEHIND 406 S. RIVER		RAIN	
COMMERCE	5/24/1998	S21605	406 S. RIVER	200,000	HIGH INFILTRATION	
COMMERCE	5/24/1998	S21605	COMMERCE AVE & L	100,000	OVERFLOW	
COMMERCE	5/24/1998	S21605	WASTEWATER LAGOON	2.5 MILL	PUMP FAILURE	
COMMERCE	5/26/1998	S21605	406 S. RIVER	100,000	INFILTRATIONS	
COMMERCE	5/26/1998	S21605	LAGOON WETWELL	100,000	MALFUNCTION	
COMMERCE	9/24/1999	S21605	MIDWAY L.S.	2,000	ELECTRICAL FAILURE	
COMMERCE	9/27/1999	S21605	MIDWAY L.S.	2,500	MOTOR PROBLEM	
COMMERCE	12/15/1999	S21605	LAGOON	8,500	PUMP FAILURE	
COMMERCE	5/9/2000	S21605	1ST & COMMERCE AVE	2,000	RAIN	
COMMERCE	5/9/2000	S21605	500 BLK OF MEADOWLARK LANE	2,000	RAIN	
COMMERCE	5/9/2000	S21605	LAGOON		RAINFALL	
COMMERCE	5/9/2000	S21605	MIDWAY L.S.	5,000	RAIN	
COMMERCE	6/21/2000	S21605	506 MEADOWLARK LN.	1,000 GPH	RAIN	
COMMERCE	6/21/2000	S21605	COMMERCE AVE. & "L" ST	250 GPH	RAIN	
COMMERCE	12/4/2001	S21605	LAGOON AREA	5,000	POWER FAILURE	
COMMERCE	5/13/2003	S21605	LAGOON WET WELL	4,000	ELECTRICAL OUTAGE	LAGOON/BASIN
COMMERCE		S21605	COMMERCE & ELM		RAIN	
COMMERCE WWTP	5/29/2001	S21605	WET WELL, LAGOON	10208	PUMP FAILURE, ELECTRICAL OVERLOAD, PUMPS PLUGGED WITH DEBRIS	LAGOON/BASIN
COMMERCE	3/19/1995	S21605	MIDWAY AND CANARY LANE	35000	LINE BLOCKAGE	
COMMERCE	5/7/1995	S21605	4TH BETWEEN N ELM AND N CEDAR	20000	RAIN I/I	
COMMERCE	5/7/1995	S21605	506 MEADOWLARK	20000	RAIN I/I	
COMMERCE	5/7/1995	S21605	C & SOUTH VINE	20000	RAIN I/I	
COMMERCE	5/7/1995	S21605	L STREET AND COMMERCE AVE EAST	20000	RAIN I/I	
COMMERCE	5/7/1995	S21605	WWTP WET WELL L.S. AT LAGOON	2300000	RAIN I/I	
JAY	1/19/2007	21614	21ST & MULBERRY		PUMP FAILURE	LIFT STATION
JAY	5/9/1994	S20614	7TH AND DIAL	4680	LINE STOPPAGE	
JAY	11/4/1994	S21416	7TH AND DIAL	300000	RAIN I/I	
JAY	11/4/1994	S21416	GRAY ST BETWEEN 4TH & 5TH	300000	RAIN I/I	
JAY	11/4/1994	S21416	PARKING LOT AT WALMART	300000	RAIN I/I	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
JAY	5/27/1995	S21604	AT PLANT	3676000	RAIN I/I	
JAY	9/18/1991	S21614	TREATMENT PLANT		OVERLOAD CONDITIONS FROM EXCESSIVE I/I	
JAY	6/3/1992	S21614	WWTP	2865000	HEAVY RAINFALL I/I	
JAY	12/15/1992	S21614	WWTP & MH AT DIAL ST BETWEEN 4TH AND 5TH	2430000	I/I FROM HEAVY RAINFALL	
JAY	12/8/1993	S21614	MH 100' WEST OF EAST DIAL	3182	GREASE BLOCKAGE	
JAY	2/28/1994	S21614	LAGOON # 3	0	RAINFALL I/I	
JAY	3/11/1994	S21614	LAGOONS	2075000	HYDROLIC OVERLOAD FROM EXCESS RAINFALL	
JAY	3/11/1994	S21614	STORM SIDE STREAM BASIN	2500000	SNOW MELT AND RAIN	
JAY	11/19/1994	S21614	THIRD LAGOON	2400000	RAIN I/I	
JAY	4/19/1995	S21614	AT PLANT	2000000	RAIN I/I	
JAY	5/7/1995	S21614	4TH AND 5TH ON DIAL	8000	RAIN I/I	
JAY	5/7/1995	S21614	4TH AND 5TH ON GRAY	8000	RAIN I/I	
JAY	5/7/1995	S21614	7TH AND DIAL	8000	RAIN I/I	
JAY	5/8/1995	S21614	7TH & DIAL, BETWEEN 4TH & 5TH ON DIAL, 4TH & 5TH ON GRAY	0	I & I	
JAY	6/11/1995	S21614	AT WWTP NUMBER 2 AERATION BASIN	5000	RAIN I/I	
JAY	6/11/1995	S21614	IN PLANT	5000	I.I	
JAY	10/19/1995	S21614	SLUDGE BED AT PLANT	400	OPERATIONAL ERROR(GATES SET WRONG)	
JAY	1/11/1996	S21614	EQUALIZATION BASIN #3	144	RAIN	
JAY	3/28/1996	S21614		6000	RAINFALL	
JAY	3/28/1996	S21614	EQ. BASIN #3	6000	I&I	
JAY	3/28/1996	S21614	IN PLANT FBE	6000	RAIN	
JAY	9/26/1996	S21614	WALMART PARKING LOT/7TH & DIAL/BETWEEN 4TH & 5TH ON DIAL; MH	49	RAIN	
JAY	10/27/1996	S21614	LAWN ON COMMUNITY CENTER; ACROSS THE STREET BEHIND WW LAB	91	I&I	
JAY	10/27/1996	S21614	WALMART PARKING LOT; BETWEEN 4 & 5 ON DIAL ST.	91	I&I	
JAY	11/1/1996	S21614	N. SIDE OF DIKE BETWEEN EQUALIZATION BASIN #3 & POND	144	RAIN	
JAY	11/7/1996	S21614	EQUALIZATION BASIN #3	800	RAIN	
JAY	11/29/1996	S21614	FLOW EQUALIZATION BASIN TO POND & STREAM	288	RAIN	
JAY	12/31/1996	S21614	WWT PLANT			
JAY	2/20/1997	S21614	WALMART PARKING LOT/DIAL BETWEEN 4 & 5/MH E. OF WWTP	468	RAIN	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
JAY	2/21/1997	S21614	DIKE BETWEEN EQUALIZATION BASIN #3 AND AN OLD POND	144	RAIN	
JAY	2/26/1997	S21614	WALMART PARKING LOT	102	RAIN	
JAY	3/13/1997	S21614		3		
JAY	4/9/1997	S21614				
JAY	5/7/1997	S21614			RAIN	
JAY	8/17/1997	S21614	MH ON DIAL BETWEEN FOURTH & FIFTH ST.	20	RAIN	
JAY	12/23/1997	S21614	BASINS		RAINS	
JAY	1/5/1998	S21614	WWP		RAIN	
JAY	3/18/1998	S21614	MH'S		RAIN	
JAY	6/15/1998	S21614	WWTP		BLOCKAGE	
JAY	8/9/1998	S21614	WWTP		OVERLOAD	
JAY	9/12/1998	S21614	MANHOLES THROUGHOUT CITY			
JAY	10/5/1998	S21614	MANHOLES THRU CITY	1.6 MILL		
JAY	11/1/1998	S21614	WWTP			
JAY	11/30/1998	S21614	WWTP		OVERLOAD	
JAY	2/3/1999	S21614		100,000	RAIN	
JAY	2/6/1999	S21614	WALMART PARKING LOT BETWEEN 4TH & 5TH ON DIAL ST.	500,000	RAIN	
JAY	3/8/1999	S21614				
JAY	3/12/1999	S21614			RAIN	
JAY	3/19/1999	S21614			L.S. MALFUNCTION	
JAY	3/31/1999	S21614	BASIN #3			
JAY	4/14/1999	S21614			RAIN	
JAY	4/21/1999	S21614	EQUALIZATION PONDS		RAINS	
JAY	4/26/1999	S21614	4TH & 5TH ON GRAY & DIAL/5TH & BAGBY/7TH & DIAL/WALMART		RAIN	
JAY	5/20/1999	S21614			OVERLOAD	
JAY	6/20/1999	S21614	MANHOLE WALMART PARKING LOT, MH BETWEEN 4 & 5, MH 5 & BAGBY	UNKNOWN	I/I FROM 5 INCHES RAIN ON 6-16,6-18,6-19	
JAY	6/20/1999	S21614	MN WALMART, MH ON DIAL STREET, 5 & BAGBY	UNKNOWN	I/I FROM 5 INCHES RAIN ON 6-16,6-18,6-19	
JAY	6/23/1999	S21614	MH 7 & DIAL, DIAL 4 & 5,5 & BAGBY, GRAY, WALMART PARKING LOT	UNKNOWN	I/I FROM 3.3 INCHES RAIN ON 6-22 AND 6-24	
JAY	6/23/1999	S21614	MH 7 & DIAL, MH 4 & 5, MH 5 & BAGBY, MH GRAY, MH WALMART LOT	UNKNOWN	I/I FROM ACCUMULATED RAIN ON 6-22 AND 6-24	
JAY	7/1/1999	S21614			RAIN	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
JAY	8/16/1999	S21614				
JAY	9/12/1999	S21614			RAIN	
JAY	12/4/1999	S21614	WWTP		RAIN	
JAY	12/8/1999	S21614	WWTP & AT 5TH & BAGBOY - WALMART PARKING LOT		RAINFALL	
JAY	12/9/1999	S21614	WOW		RAINFALL	
JAY	2/22/2000	S21614			RAIN	
JAY	2/25/2000	S21614	WWTP		RAIN	
JAY	4/26/2000	S21614			LOSS OF DIKE	
JAY	5/9/2000	S21614			RAIN	
JAY	9/19/2000	S21614	WWTP	42,556	OPERATOR ERROR	
JAY	11/20/2003	S21614	HOLDING PONDS		BREACH IN DYKES	
JAY	3/4/2004	S21614	4TH & 5TH AT GRAY		RAIN	
JAY	3/4/2004	S21614	4TH & 5TH ON DIAL		RAIN	
JAY	3/4/2004	S21614	7TH & DIAL		RAIN	
JAY	5/13/2004	S21614	4TH & 5TH ON GRAY/ 4TH & 5TH ON DIAL		RAIN	MANHOLE
JAY	7/2/2004	S21614	4TH & 5TH AT GRAY		RAIN	
JAY	7/9/2004	S21614	4TH & 5TH ON DIAL		RAIN	
JAY	7/19/2004	S21614	20TH & BOSTON		L.S. MALFUNCTION	MANHOLE
JAY		S21614				
JAY		S21614		49		
JAY WWTP	1/4/1998	21614	MANHOLE ON DIAL ST. BETWEEN 4TH & 5TH, 7TH, ACROSS FROM LAB	82500	I&I FROM 1.8" OF RAIN WITHIN 5 HR PERIOD	
JAY WWTP	3/7/1998	21614	MANHOLE WALMART PARKING LOT	76800	I/I INTO COLLECTION SYSTEM FROM EXCESSIVE RAINFALL	
LOCUST GROVE	5/10/1993	21620	W. HARRIETT ST.		FLOODING	
LOCUST GROVE	5/10/1993	21620	WYNNEDOTE & SARGAR ST.		FLOODING	
LOCUST GROVE	1/17/1990	S21620	WEST HARRIET SE	0	HEAVY RAINS	
LOCUST GROVE	3/11/1990	S21620	WEST HARRIET ST.		HEAVY RAINFALL	
LOCUST GROVE	3/19/1990	S21620	WEST HARRIETT ST.		HEAVY RAINFALL	
LOCUST GROVE	5/21/1991	S21620	N. DELAWARE BETWEEN ROSS & WILLARD STONE STREET		STOPPED UP LINE	
LOCUST GROVE	10/26/1991	S21620	W HARRIETT ST		LINE STOPPAGE	
LOCUST GROVE	10/26/1991	S21620	WEST HARRIET STREET, MANHOLE	0	STOPPED UP SEWER LINE	
LOCUST GROVE	6/19/1992	S21620	HARRIET STREET		EXCESSIVE RAINFALL	
LOCUST GROVE	6/19/1992	S21620	SARGEAR & WYANDOTT ST		EXCESSIVE RAINFALL	
LOCUST GROVE	6/20/1992	S21620	CORNER SARGEAR & WYANDOTTE		EXCESSIVE RAINS	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
LOCUST GROVE	6/20/1992	S21620	W. HARRIET ST. MANHOLE		EXCESSIVE RAINS	
LOCUST GROVE	12/13/1992	S21620	SARGEAR & WYANDOTTE	0	RAINFALL I/I	
LOCUST GROVE	4/1/1993	S21620	HOLDING POND	35	HEAVY RAINFALL ALL SPRING	
LOCUST GROVE	9/14/1993	S21620	WEST END OF HARRIET	1000	HEAVY RAIN	
LOCUST GROVE	11/4/1993	S21620	DELAWARE AND WILLARD STONE	100	GREASE BLOCKAGE	
LOCUST GROVE	12/13/1993	S21620	82 HIWY BY PIERCE	1000	GREASE STOPPAGE	
LOCUST GROVE	12/15/1993	S21620	DELAWARE AND ROSS	1000	GREASE STOPPAGE	
LOCUST GROVE	2/15/1994	S21620	JOE KOELCH & 82 HIWAY	0	GREASE STOPPAGE	
LOCUST GROVE	3/6/1994	S21620	AT FACILITY	0	HOLDING POND FULL AND OVERFLOWING INTO CREEK	
LOCUST GROVE	5/1/1994	S21620	HOLDING POND	10000	RAIN I/I	
LOCUST GROVE	9/16/1994	S21620	WILLARD SABER AND DELAWARE	75	GREASE BLOCKAGE	
LOCUST GROVE	11/6/1994	S21620	107 WEST HARRIET	0	RAIN I/I	
LOCUST GROVE	11/9/1994	S21620	107 HARRIET STREET	0	RAIN I/I HYDROLIC OVERLOAD	
LOCUST GROVE	11/14/1994	S21620	STORM HOLDING POND	2000000	RAIN I/I	
LOCUST GROVE	1/17/1995	S21620	AT PLANT HOLDING POND	0	RAIN I/I	
LOCUST GROVE	1/17/1995	S21620	I/I POND	0	SYSTEM I/I	
LOCUST GROVE	1/17/1995	S21620	SEWER PLANT HOLDING POND	0	HEAVY RAINS	
LOCUST GROVE	3/13/1995	S21620	AT PLANT	200000	RAIN I/I	
LOCUST GROVE	3/13/1995	S21620	I/I POND	0	RAIN I/I	
LOCUST GROVE	4/16/1995	S21620	I/I PONDS	200000	RAIN I/I	
LOCUST GROVE	4/16/1995	S21620	LOCUST GROVE SEWER TREATMENT POND	0	HEAVY RAINS	
LOCUST GROVE	5/9/1995	S21620	HCR 64 BOX 15	300	GREASE STOPPAGE	
LOCUST GROVE	12/11/1995	S21620	GRADE SCHOOL AT COUCH & SPRING PARK	1200	LINE STOPPAGE	
LOCUST GROVE	3/13/1996	S21620	507 EARL SMITHS ROAD	200	LINE STOPPAGE	
LOCUST GROVE	3/13/1996	S21620	EARL SMITH RD. RES. AREA	200	CLOGGED MAIN	
LOCUST GROVE	3/20/1996	S21620	1 MILE N. OF WWTP	42000	FAULTY FILTERS	
LOCUST GROVE	3/21/1996	S21620	1 MILE N. OF WWTP	42000	FAULTY FILTERS	
LOCUST GROVE	3/22/1996	S21620	1 MILE N. OF WWTP	42000	FAULTY FILTERS	
LOCUST GROVE	3/22/1996	S21620	JOE KOELCH DR.	2000	GREASE CLOGGED LINES	
LOCUST GROVE	3/23/1996	S21620	1 MILE N. OF WWTP	49000	FAULTY FILTERS	
LOCUST GROVE	3/24/1996	S21620	1 MILE N. OF WWTP	14000	FAULTY FILTERS	
LOCUST GROVE	3/24/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	3/26/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	3/26/1996	S21620	WATER PLANT	42000	FAULTY FILTERS	
LOCUST GROVE	3/28/1996	S21620	WATER PLANT	42000	WATER PLANT	
LOCUST GROVE	3/29/1996	S21620	WATER PLANT	42000	WATER PLANT	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
LOCUST GROVE	3/30/1996	S21620	WATER PLANT	28000	FILTERS	
LOCUST GROVE	3/31/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	4/1/1996	S21620	WATER PLANT	42000	FAULTY FILTERS	
LOCUST GROVE	4/2/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	4/2/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	4/4/1996	S21620	WATER PLANT	49000	FAULTY FILTERS	
LOCUST GROVE	4/5/1996	S21620	WATER PLANT	35000	FAULTY FILTERS	
LOCUST GROVE	4/6/1996	S21620	WATER PLANT	49000	FAULTY FILTERS	
LOCUST GROVE	4/7/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	4/7/1996	S21620	WATER PLANT	42000	FAULTY FILTERS	
LOCUST GROVE	4/9/1996	S21620	WWTP	28000	FAULTY FILTERS	
LOCUST GROVE	4/9/1996	S21620	WWTP	35000	FAULTY FILTERS	
LOCUST GROVE	4/11/1996	S21620	WWTP	28000	FAULTY FILTERS	
LOCUST GROVE	4/12/1996	S21620	WWTP	14000	FAULTY FILTERS	
LOCUST GROVE	4/13/1996	S21620	WWTP		FAULTY FILTERS	
LOCUST GROVE	4/14/1996	S21620	WWTP	28000	FAULTY FILTERS	
LOCUST GROVE	4/15/1996	S21620	WWTP		FAULTY FILTERS	
LOCUST GROVE	4/16/1996	S21620	WWTP	21000	FAULTY FILTERS	
LOCUST GROVE	4/17/1996	S21620	WWTP	42000	FAULTY FILTERS	
LOCUST GROVE	4/18/1996	S21620	WWTP	35000	FAULTY FILTERS	
LOCUST GROVE	4/19/1996	S21620	WWTP	35000	FAULTY FILTERS	
LOCUST GROVE	4/20/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	4/21/1996	S21620	WATER PLANT	35000	FAULTY FILTERS	
LOCUST GROVE	4/22/1996	S21620	WATER PLANT	28000	FAULTY FILTERS	
LOCUST GROVE	4/23/1996	S21620	WATER PLANT	35000	FAULTY FILTERS	
LOCUST GROVE	4/24/1996	S21620	WATER PLANT	28000	WATER PLANT	
LOCUST GROVE	5/5/1996	S21620	1 MILE N. OF LOCUST GROVE AT WATER PLANT	14	FAULTY FILTERS	
LOCUST GROVE	5/6/1996	S21620	WATER PLANT	35	FAULTY FILTERS	
LOCUST GROVE	5/7/1996	S21620	WATER PLANT	21	FAULTY FILTERS	
LOCUST GROVE	9/30/1996	S21620	WASTEWATER LAGOON OVERFLOW	291	RAIN	
LOCUST GROVE	10/3/1996	S21620	LAGOON ON PLANT SITE N. OF CITY	53	RAINFALL	
LOCUST GROVE	10/4/1996	S21620	LAGOON AT PLANT SITE N. OF CITY	12	RAINFALL	
LOCUST GROVE	12/8/1996	S21620	WWP	420	RAIN	
LOCUST GROVE	12/9/1996	S21620	WWP	397	RAIN	
LOCUST GROVE	12/10/1996	S21620	WWP	272	RAIN	
LOCUST GROVE	12/11/1996	S21620	WWP	233	RAIN	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
LOCUST GROVE	12/12/1996	S21620	WWP	172	RAIN	
LOCUST GROVE	12/13/1996	S21620	WWP	106	RAIN	
LOCUST GROVE	12/14/1996	S21620	WWP	76	RAIN	
LOCUST GROVE	12/15/1996	S21620	WWP	37	RAIN	
LOCUST GROVE	12/16/1996	S21620	WWP LAGOON	15	RAIN	
LOCUST GROVE	2/26/1997	S21620			RAINFALL	
LOCUST GROVE		S21620	WATER PLANT	21	FAULTY FILTERS	
LOCUST GROVE		S21620	WATER PLANT	21	FAULTY FILTERS	
MIAMI	5/8/2002		N. ELM & WASHINGTON	117,931		
MIAMI	5/9/2002					HEAD WORKS
MIAMI	5/9/2002		5TH & "B" S.W.	500		
MIAMI				1,000		
MIAMI	1/5/2005	S2160	BJ TUNNEL BLVD. & "B" ST. N.W.	1,660	RAIN	MANHOLE
MIAMI	1/5/2005	S2160	WASHINGTON & ELM	600	RAIN	MANHOLE
MIAMI	3/14/1990	S21602	SEWAGE TREATMENT PLANT	7	NEOSHO FLOODED FOR 5 DAYS	
MIAMI	9/16/1991	S21602	BEHIND JR HIGH PRACTICE FIELD	30	ROOT STOPPAGE	
MIAMI	12/20/1991	S21602	WASHINGTON & ELM ST. & BJ TUNNEL & A ST. NW	1	FLOODING	
MIAMI	9/22/1992	S21602	18TH & F ST. NE	70	18" SEWER LINE STOPPAGE	
MIAMI	7/31/1994	S21602		2	EXCESS RAINFALL	
MIAMI	6/16/1995	S21602	2ND AND 'L' NORTHEAST	50000	LINE WASHED OUT	
MIAMI	7/11/1998	S21602	9TH AVE. & "A" S.E.	20,000	RAIN	
MIAMI	7/22/1998	S21602	633 "H" ST. S.E.	1 MILL	CONTRACTORS PUMPED PLUGGED NO BACKUP PROVISION	
MIAMI	2/11/1999	S21602	9TH & "A" ST. S.E.	10,000	MALFUNCTION	
MIAMI	6/29/1999	S21602	"A" & "BJ" TUNNEL N.W./ ELM & WASHINGTON N.E.		RAIN	
MIAMI	6/29/1999	S21602	5TH 7 "D" & "B" S.W.		RAIN	
MIAMI	7/1/1999	S21602	5TH & "B" S.W.\ "D" & 5TH S.W.	14,332	RAIN	
MIAMI	7/1/1999	S21602	CENTRAL & "M" N.E.	14,332	RAIN	
MIAMI	7/1/1999	S21602	WASHINGTON & ELM	124,833	RAIN	
MIAMI	9/11/1999	S21602	801 "H" ST. S.E.	5,000	PUMPS PLUGGED	
MIAMI	10/24/1999	S21602	2ND ST. S.E. AT "B" & "C" ST.	5,000		
MIAMI	11/2/1999	S21602	"A" N.W. & 5TH	10	SEWER BACKUP	
MIAMI	12/4/1999	S21602	WASHINGTON & ELM	15,000	RAINFALL	
MIAMI	12/9/1999	S21602	S.E. TREATMENT PLANT - WASHINGTON & ELM	21,517	RAINFALL	
MIAMI	1/10/2000	S21602	ELM ST. S. OF STEVE OWENS BLVD.	1,000	GREASE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
MIAMI	2/23/2000	S21602	700 FT. S.W. OF FAIRGROUNDS	500	TRASH	
MIAMI	2/28/2000	S21602	700 FT. S.W. OF FAIRGROUNDS	200	L.S. MALFUNCTION	
MIAMI	3/3/2000	S21602	104 "F" S.W.	1,750	GREASE	
MIAMI	3/3/2000	S21602	MH 1,273 FT S.W. OF FAIRGROUNDS	13,000	VANDALISM	
MIAMI	3/3/2000	S21602	MH 954 FT. S.W. OF FAIRGROUNDS	13,000	VANDALISM	
MIAMI	3/3/2000	S21602	WASHINGTON DR. & ELM ST.	1,000	RAIN	
MIAMI	3/3/2000	S21602	WASHINGTON DR. & GARFIELD BLVD.	800	RAINFALL	
MIAMI	5/8/2000	S21602	MH 954 FT. S.W. OF FAIRGROUNDS	3,000	RAINFALL	
MIAMI	5/9/2000	S21602	1022 E. STEVE OWENS BLVD.	920	RAIN	
MIAMI	5/9/2000	S21602	5TH & "B" S.W.	625	RAIN	
MIAMI	5/9/2000	S21602	5TH & "D" S.E.	625	RAIN	
MIAMI	5/9/2000	S21602	B.J. TUNNEL AT "A" & "B" N.W.	500	RAIN	
MIAMI	5/9/2000	S21602	N. ELM & WASHINGTON	1,800	RAIN	
MIAMI	5/9/2000	S21602	WASHINGTON & GARFIELD	1,400	RAIN	
MIAMI	6/20/2000	S21602	5TH & "D" S.E.	1,750	RAIN	
MIAMI	6/20/2000	S21602	N. ELM & WASHINGTON	2,300	RAIN	
MIAMI	6/21/2000	S21602	5TH & "B" S.W.	875	RAIN	
MIAMI	6/21/2000	S21602	N. ELM & WASHINGTON	984	RAINFALL	
MIAMI	6/26/2000	S21602	5TH & "B" S.W.	250	RAIN	
MIAMI	6/26/2000	S21602	BJ TUNNEL & AST N.W.	234	RAIN	
MIAMI	6/26/2000	S21602	N. ELM & WASHINGTON	354	RAIN	
MIAMI	11/25/2000	S21602	S.E. PLANT	1,000	BROKEN LINE	
MIAMI	3/7/2001	S21602	L.S. SOUTH LAGOON	40,000	PUMP FAILURE	
MIAMI	5/8/2001	S21602	S.W. OF INCINERATOR AT 1117 22ND N.W.	100	PUMP FAILURE	
MIAMI	6/21/2001	S21602	N. ELM & WASHINGTON	1,400	RAIN	
MIAMI	6/21/2001	S21602	WASHINGTON & GARFIELD	1,000	RAIN	
MIAMI	5/9/2002	S21602	S.E. TREATMENT PLANT	1,000	RAIN	LAGOON/BASIN
MIAMI	5/17/2002	S21602	ELM & WASHINGTON / 1610 WASHINGTON	1,500	RAIN	MANHOLE
MIAMI	6/12/2002	S21602	1610 WASHINGTON	325	RAIN	MANHOLE
MIAMI	6/12/2002	S21602	CENTER OF STREET AT ELM & WASHINGTON	475	RAIN	MANHOLE
MIAMI	6/12/2002	S21602	STEVE OWENS BLVD. AT "L" & "M" S.W	175	RAIN	MANHOLE
MIAMI	3/5/2004	S21602	BETWEEN 2ND & 3RD AVE & "L" N.W.	59,250	RAIN	MANHOLE
MIAMI	4/14/2005	S21602	20TH N.E. AT "C" & "D"	500	STOPPAGE	MANHOLE
MIAMI	10/13/2005	S21602	BEHIND 1804 E. ST. S.W.	15,000	BLOCKAGE	MANHOLE
MIAMI	10/24/2005	S21602	1400 BLK. OF EAST S.W.	5,000	BLOCKAGE	MANHOLE
MIAMI	11/23/2005	S21602	1400 BLK. E. STREET S.W.	500	BLOCKAGE	MANHOLE
MIAMI	9/21/2006	S21602	1025 "J" N.W.	200	PLUGGED LINE	PIPE

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
MIAMI	9/29/2006	S21602	311 "G" N.W.	150	BROKEN CLEAN OUT	PIPE
MIAMI	11/2/2006	S21602	504 GOODRICH BLVD.	20	PLUGGED LINE	MANHOLE
MIAMI	1/10/2007	S21602	1008 MCKINLEY	25	PLUGGED LINE	MANHOLE
MIAMI	1/12/2007	S21602	1501 8TH AVE. N.W.	75	BROKEN LINE	PIPE
MIAMI		S21602	PLANT		OVERLOAD	
MIAMI	1/3/1994	S21606	2414 N MAIN	2000	GREASE BLOCKAGE	
MIAMI	7/26/1994	S21606	715 11TH AVE N E	80000	RAIN OVERLOAD	
MIAMI	11/6/1996	S21606	N.E. TREATMENT PLANT	127	RAIN	
MIAMI	6/26/1997	S21606	EAST LAGOONS			
MIAMI	5/29/1998	S21606	100 YDS. N.W. OF PLANT AT 715 11 AVE. NE	5,000	RAIN	
MIAMI	7/23/1998	S21606		1 MILL	PLUGGED LINE	
MIAMI	4/3/1999	S21606	1ST MH N.E. OF N.E. TREATMENT PLANT	223,200	RAINS	
MIAMI	4/14/1999	S21606	N.E. OF PLANT	446,400	RAINFALL	
MIAMI	4/22/1999	S21606	MH N.E. OF PLANT	187,200	RAIN	
MIAMI	4/25/1999	S21606				
MIAMI	4/25/1999	S21606	1ST. MH N. OF PLANT	>1 MILLN	RAINFALL	
MIAMI	5/4/1999	S21606	MH N. OF PLANT	777,600	FLOODING	
MIAMI	5/17/1999	S21606	1ST MH N. OF PLANT	365,000		
MIAMI	5/21/1999	S21606	WWTP	230,400		
MIAMI	5/23/1999	S21606	WWTP	158,400		
MIAMI	6/16/1999	S21606	MH N. OF PLANT	187,200	RAIN	
MIAMI	6/19/1999	S21606			RAIN	
MIAMI	7/1/1999	S21606	MH'S		RAIN	
MIAMI	12/4/1999	S21606	715 11TH ST N.E.		RAIN	
MIAMI	12/4/1999	S21606	MH N.W OF PLANT	417,600	RAINFALL	
MIAMI	12/4/1999	S21606	WASHINGTON & ELM	15,000	RAIN	
MIAMI	12/9/1999	S21606	MH N.W. OF PLANT	284,400	RAINFALL	
MIAMI	12/9/1999	S21606	MH N.W. OF PLANT	284,400	RAINFALL	
MIAMI		S21606	PLANTS		OVERLOAD	
MIAMI	1/15/1993	S21647	FOUNTAIN EAST LAGOON/EAST OF MIAMI	0	INFILTRATION OF WATER.	
MIAMI	5/5/1995	S21647	LAGOONS	2000000	RAIN I/I	
MIAMI N.	10/5/1998	S21606	N.E. PLANT 715 11 ST.	1 MILL		
MIAMI S.	10/5/1998	S21602	S.E. PLANT 800 "H" ST.			
MIAMI (NORTH)	3/14/1993	S21606	715 11TH AVE N E	1000	DEBRIS BLOCKAGE	
MIAMI (NORTH)	5/9/1993	S21606	715 ELEVENTH AVE NE	70	FLOODING	
MIAMI (NORTH)	11/20/1994	S21616	715 11TH AVE EAST	270000	RAIN I/I	
MIAMI (SOUTH)	12/14/1992	S21602	1ST AND ELM NE	10000	RAINS	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type Of Source
MIAMI (SOUTH)	6/4/1993	S21602	2ND L STREET AND NW	80000	FLOODING FROM EXCESSIVE RAIN	
PICHER	2/5/1990	S21603	LIFT STATION 8TH & CONNELL	800000	LIFT STATION PUMP OUT	
PICHER	2/22/1990	S21603	8TH & CONNELL	300000	PUMP DOWN	
PICHER	3/26/1990	S21603	8TH/CONNELL	1500000	PUMPS TO SMALL FOR LIFT STATION	
PICHER	4/27/1990	S21603	8TH & CONNELL	600000	PUMPS TOO SMALL FOR LIFT STATION	
PICHER	6/1/1990	S21603	8TH AND CONNELL	1500000		
PICHER	12/12/1991	S21603	8TH AND CONNELL(LIFT STATION)		PUMPS COULDN'T KEEP UP	
PICHER	11/19/1994	S21603	8TH & FRANCIS ST.- MANHOLE	500000	EXCESSIVE WATER CAUSED FLOODING	
PICHER	3/27/1995	S21603	CORNER OF 2ND & COLUMBUS	600	BROKEN LINE	
PICHER	4/18/1995	S21603	700 S CORNELL	2000	LINE STOPPAGE	
PICHER	4/18/1995	S21603	700S. CONNELL	2000	STOPPED UP LINE	
PICHER	4/30/1995	S21603	638 S. ONEIDA	0	HEAVY RAIN	
PICHER	5/30/1995	S21603	614 S. ONEIDA	0	HEAVY RAIN	
PICHER	4/29/1996	S21603		1000000	STORM	
PICHER	6/18/2000	S21603	200 E. 2	300,000	RAIN	
PICHER	6/21/2000	S21603	200 E. 2	600,000	RAINS	
PICHER	1/29/2001	S21603	8TH & CONNELL	300,000	TRANSFORMER BLEW	

APPENDIX C
ESTIMATED FLOW EXCEEDANCE PERCENTILES

Appendix C

Estimated Flow Exceedance Percentiles

WQ Station	OK121600010060D Ranger Creek	OK121600010100G Fourteen-mile Creek	OK121600010440-001SR Crutch-field Branch	OK121600030090G Drowning Creek	OK121600030160G Horse Creek	OK121600030180D Fly Creek	OK121600030190A Little Horse Creek	OK121600030340J Cave Springs Branch	OK121600030440-001AT Elk River	OK121600030445-001AT Honey Creek	OK121600030510D Sycamore Creek	OK121600040060D Tar Creek	OK121600040130G Cow Creek	OK121600040170G Fourmile Creek	OK121600040200G Russell Creek
WBID Segment	OK121600010060_00	OK121600010100_00	OK121600010440_00	OK121600030090_00	OK121600030160_00	OK121600030180_00	OK121600030190_00	OK121600030340_00	OK121600030440_00	OK121600030445_00	OK121600030510_00	OK121600040060_00	OK121600040130_00	OK121600040170_00	OK121600040200_00
USGS Gage Reference	07191000	00719855	07195855	07189542	07191000	07191000	07191000	07189540	07189000	07189542	07189542	07185100	07191000	07191000	07191000
Watershed Area (sq. mile)	21.5	71.0	14.9	39.0	40.1	10.5	19.2	13.9	254.7	53.9	56.9	54.6	30.0	29.8	37.5
NRCS Curve Number	64.9	64.6	68.1	64.8	75.9	69.5	77.8	68.6	64.3	66.6	65.6	82.6	75.1	78.9	72.4
Average Annual Rainfall (inch)	46.3	47.0	44.7	46.2	44.7	44.7	44.8	45.6	45.3	46.1	44.4	45.4	44.8	44.9	44.1
Percentile	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**
0	1538	2995	787	773	2869	751	1375	263	52500	1320	1256	8200	2147	2132	2683
1	332	273	72	112	615	162	296	58	6590	219	208	765	463	460	578
2	185	188	50	72	346	90	165	19	4430	150	141	464	258	256	322
3	115	152	40	57	216	56	103	12	3325	120	113	336	161	160	201
4	84	132	35	49	158	41	75	9.9	2800	106	101	250	117	117	147
5	58	115	30	43	110	28	52	9.2	2350	94	89	195	81	81	102
6	44	104	28	37	83	21	39	8.5	2080	84	80	150	61	60	76
7	34	95	25	34	65	17	31	7.8	1845	78	74	124	48	47	60
8	27	86	23	30	51	13	24	7.4	1680	69	66	102	38	37	47
9	22	80	21	26	41	11	20	6.8	1520	62	59	83	31	30	38
10	18	75	20	23	35	9.0	16	6.5	1400	57	54	73	26	25	32
11	15	71	19	21	29	7.6	14	6.1	1280	53	50	62	22	21	27
12	13	66	18	19	25	6.4	12	5.8	1200	48	46	55	18	18	23
13	12	63	17	17	22	5.7	10	5.6	1130	45	43	49	16	16	20
14	11	58	16	16	20	5.1	9.4	5.4	1050	42	39	42	15	15	18
15	9.5	54	15	15	18	4.6	8.5	5.2	993	39	37	38	13	13	17
16	8.4	51	14	14	16	4.1	7.5	5	941	36	34	35	12	12	15
17	7.6	49	13	13	15	3.7	6.8	5	890	34	32	32	11	11	13
18	6.9	47	13	12	13	3.4	6.1	4.9	839	32	30	29	10	10	12
19	6.3	45	12	11	12	3.1	5.6	4.8	802	31	29	27	8.7	8.7	11
20	5.7	43	12	10	11	2.8	5.1	4.6	767	29	28	25	7.9	7.9	10
21	5.3	41	11	9.4	10	2.6	4.7	4.5	737	28	26	23	7.3	7.3	9.2
22	4.8	39	11	9.4	9.2	2.3	4.3	4.3	700	27	26	22	6.7	6.6	8.4
23	4.4	37	10	9.0	8.4	2.1	3.9	4.2	667	26	25	19	6.1	6.1	7.7
24	4.1	36	10	8.6	7.9	2.0	3.7	4.2	636	25	24	18	5.7	5.7	7.2
25	3.8	35	10	8.1	7.2	1.9	3.4	4.1	610	24	23	17	5.3	5.3	6.7
26	3.5	34	9.3	7.7	6.8	1.7	3.2	4	585	24	23	16	4.9	4.9	6.2
27	3.2	33	9.1	7.7	6.3	1.6	2.9	4	561	23	22	15	4.5	4.5	5.7
28	3.0	32	8.8	7.3	5.8	1.5	2.7	3.9	538	22	21	14	4.2	4.2	5.2
29	2.8	31	8.6	6.8	5.4	1.4	2.5	3.8	520	21	20	13	3.9	3.8	4.8
30	2.6	30	8.3	6.4	5.0	1.3	2.3	3.7	501	21	20	12	3.6	3.6	4.5
31	2.4	29	8.1	6.4	4.7	1.2	2.2	3.6	482	20	19	12	3.4	3.4	4.3
32	2.3	28	7.9	6.4	4.5	1.1	2.0	3.5	466	20	19	11	3.2	3.2	4.0
33	2.2	27	7.6	6.0	4.1	1.1	1.9	3.5	448	19	18	11	3.0	3.0	3.8
34	2.0	27	7.4	6.0	3.9	1.0	1.8	3.4	437	19	18	10	2.8	2.8	3.5

WQ Station	OK121600010060D	OK121600010100G	OK121600010440-001SR	OK121600030090G	OK121600030160G	OK121600030180D	OK121600030190A	OK121600030340J	OK121600030440-001AT	OK121600030445-001AT	OK121600030510D	OK121600040060D	OK121600040130G	OK121600040170G	OK121600040200G
	Ranger Creek	**Fourteen-mile Creek**	**Crutch-field Branch**	**Drowning Creek**	**Horse Creek**	**Fly Creek**	**Little Horse Creek**	**Cave Springs Branch**	**Elk River**	**Honey Creek**	**Sycamore Creek**	**Tar Creek**	**Cow Creek**	**Fourmile Creek**	**Russell Creek**
WBID Segment	OK121600010060_00	OK121600010100_00	OK121600010440_00	OK121600030090_00	OK121600030160_00	OK121600030180_00	OK121600030190_00	OK121600030340_00	OK121600030440_00	OK121600030445_00	OK121600030510_00	OK121600040060_00	OK121600040130_00	OK121600040170_00	OK121600040200_00
USGS Gage Reference	07191000	00719855	07195855	07189542	07191000	07191000	07191000	07189540	07189000	07189542	07189542	07185100	07191000	07191000	07191000
Watershed Area (sq. mile)	21.5	71.0	14.9	39.0	40.1	10.5	19.2	13.9	254.7	53.9	56.9	54.6	30.0	29.8	37.5
NRCS Curve Number	64.9	64.6	68.1	64.8	75.9	69.5	77.8	68.6	64.3	66.6	65.6	82.6	75.1	78.9	72.4
Average Annual Rainfall (inch)	46.3	47.0	44.7	46.2	44.7	44.7	44.8	45.6	45.3	46.1	44.4	45.4	44.8	44.9	44.1
Percentile	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**
35	1.9	26	7.1	5.6	3.7	0.91	1.7	3.3	423	18	17	9.3	2.6	2.6	3.3
36	1.7	26	7.1	5.6	3.4	0.84	1.5	3.3	410	18	17	8.9	2.4	2.4	3.0
37	1.6	25	6.9	5.2	3.2	0.79	1.5	3.2	400	17	16	8.4	2.3	2.3	2.8
38	1.5	24	6.6	5.2	3.0	0.75	1.4	3.1	388	17	16	7.9	2.1	2.1	2.7
39	1.4	24	6.6	5.2	2.8	0.70	1.3	3.1	375	17	16	7.5	2.0	2.0	2.5
40	1.3	23	6.4	5.2	2.6	0.65	1.2	3.0	364	17	16	7.1	1.9	1.9	2.3
41	1.2	23	6.4	4.8	2.4	0.61	1.1	3.0	352	16	15	6.9	1.7	1.7	2.2
42	1.1	22	6.1	4.8	2.3	0.56	1.0	2.9	342	16	15	6.5	1.6	1.6	2.0
43	1.1	22	6.1	4.8	2.2	0.54	0.98	2.9	332	16	15	6.2	1.5	1.5	1.9
44	1.1	21	5.9	4.4	2.1	0.51	0.94	2.8	323	16	15	6.0	1.5	1.5	1.8
45	1.0	21	5.9	4.4	2.0	0.49	0.90	2.8	314	15	14	5.8	1.4	1.4	1.8
46	0.91	20	5.6	4.4	1.9	0.44	0.81	2.7	305	15	14	5.6	1.3	1.3	1.6
47	0.86	20	5.6	4.4	1.7	0.42	0.77	2.7	297	15	14	5.4	1.2	1.2	1.5
48	0.81	19	5.4	4.4	1.6	0.40	0.73	2.7	289	15	14	5.2	1.1	1.1	1.4
49	0.76	19	5.4	4.0	1.5	0.37	0.68	2.6	280	14	13	5.1	1.1	1.1	1.3
50	0.72	18	5.1	4.0	1.4	0.35	0.64	2.6	271	14	13	5.0	1.0	1.0	1.3
51	0.67	18	5.1	4.0	1.4	0.33	0.60	2.6	263	14	13	4.9	0.93	0.93	1.2
52	0.62	17	4.9	4.0	1.4	0.30	0.55	2.6	256	14	13	4.7	0.87	0.86	1.1
53	0.62	17	4.9	3.6	1.3	0.30	0.55	2.5	247	13	12	4.6	0.87	0.86	1.1
54	0.57	17	4.9	3.6	1.2	0.28	0.51	2.5	240	13	12	4.5	0.80	0.79	1.0
55	0.53	16	4.6	3.6	1.1	0.26	0.47	2.5	233	13	12	4.4	0.73	0.73	0.92
56	0.53	16	4.6	3.6	1.1	0.26	0.47	2.4	226	13	12	4.3	0.73	0.73	0.92
57	0.47	15	4.4	3.3	1.0	0.23	0.42	2.4	220	12	11	4.2	0.65	0.65	0.82
58	0.44	15	4.4	3.3	1.0	0.22	0.40	2.4	214	12	11	4.1	0.62	0.62	0.78
59	0.42	14	4.1	3.3	0.9	0.20	0.37	2.4	208	12	11	3.9	0.58	0.58	0.73
60	0.38	14	4.1	3.1	0.84	0.19	0.34	2.4	202	12	11	3.8	0.54	0.53	0.67
61	0.36	14	4.1	2.9	0.79	0.18	0.32	2.3	197	11	10	3.7	0.51	0.50	0.63
62	0.34	13	3.9	2.9	0.75	0.17	0.30	2.3	192	11	10	3.5	0.47	0.47	0.59
63	0.32	13	3.9	2.9	0.71	0.16	0.29	2.3	186	11	10	3.4	0.45	0.45	0.57
64	0.31	13	3.9	2.6	0.68	0.15	0.27	2.3	181	10	10	3.3	0.43	0.42	0.53
65	0.29	12	3.6	2.6	0.64	0.14	0.26	2.3	176	10	10	3.1	0.40	0.40	0.50
66	0.26	12	3.6	2.6	0.61	0.13	0.23	2.3	171	9.9	9.4	3.0	0.37	0.36	0.46
67	0.24	12	3.6	2.5	0.57	0.12	0.22	2.2	167	9.7	9.2	2.9	0.34	0.34	0.43
68	0.23	11	3.4	2.4	0.54	0.11	0.20	2.2	163	9.5	9.0	2.8	0.32	0.32	0.40
69	0.22	11	3.4	2.4	0.51	0.11	0.19	2.2	158	9.4	8.9	2.7	0.30	0.30	0.38
70	0.20	11	3.4	2.3	0.48	0.10	0.18	2.2	154	9.2	8.8	2.6	0.28	0.28	0.35
71	0.19	10	3.1	2.3	0.47	0.09	0.17	2.2	149	9.0	8.6	2.5	0.27	0.26	0.33
72	0.18	10	3.1	2.2	0.45	0.09	0.16	2.2	145	8.8	8.4	2.4	0.25	0.25	0.31

WQ Station	OK121600010060D	OK121600010100G	OK121600010440-001SR	OK121600030090G	OK121600030160G	OK121600030180D	OK121600030190A	OK121600030340J	OK121600030440-001AT	OK121600030445-001AT	OK121600030510D	OK121600040060D	OK121600040130G	OK121600040170G	OK121600040200G
	Ranger Creek	**Fourteen-mile Creek**	**Crutch-field Branch**	**Drowning Creek**	**Horse Creek**	**Fly Creek**	**Little Horse Creek**	**Cave Springs Branch**	**Elk River**	**Honey Creek**	**Sycamore Creek**	**Tar Creek**	**Cow Creek**	**Fourmile Creek**	**Russell Creek**
WBID Segment	OK121600010060_00	OK121600010100_00	OK121600010440_00	OK121600030090_00	OK121600030160_00	OK121600030180_00	OK121600030190_00	OK121600030340_00	OK121600030440_00	OK121600030445_00	OK121600030510_00	OK121600040060_00	OK121600040130_00	OK121600040170_00	OK121600040200_00
USGS Gage Reference	07191000	00719855	07195855	07189542	07191000	07191000	07191000	07189540	07189000	07189542	07189542	07185100	07191000	07191000	07191000
Watershed Area (sq. mile)	21.5	71.0	14.9	39.0	40.1	10.5	19.2	13.9	254.7	53.9	56.9	54.6	30.0	29.8	37.5
NRCS Curve Number	64.9	64.6	68.1	64.8	75.9	69.5	77.8	68.6	64.3	66.6	65.6	82.6	75.1	78.9	72.4
Average Annual Rainfall (inch)	46.3	47.0	44.7	46.2	44.7	44.7	44.8	45.6	45.3	46.1	44.4	45.4	44.8	44.9	44.1
Percentile	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**
73	0.17	10	3.1	2.2	0.42	0.08	0.15	2.1	141	8.6	8.2	2.4	0.23	0.23	0.29
74	0.16	10	3.1	2.1	0.40	0.08	0.14	2.1	138	8.5	8.1	2.3	0.22	0.22	0.28
75	0.15	9.5	2.9	2.1	0.38	0.07	0.13	2.1	134	8.3	8.0	2.3	0.21	0.21	0.26
76	0.14	9.4	2.9	2.0	0.38	0.07	0.12	2.1	130	8.2	7.8	2.2	0.19	0.19	0.24
77	0.13	9.1	2.8	2.0	0.36	0.07	0.12	2.1	127	8.1	7.7	2.1	0.19	0.19	0.23
78	0.12	8.8	2.7	1.9	0.34	0.06	0.11	2.0	123	8.0	7.6	2.1	0.17	0.17	0.22
79	0.12	8.5	2.6	1.9	0.33	0.06	0.11	2.0	119	7.9	7.5	2.0	0.17	0.17	0.21
80	0.11	8.2	2.5	1.9	0.32	0.05	0.10	2.0	116	7.7	7.3	1.9	0.15	0.15	0.19
81	0.11	7.9	2.5	1.9	0.30	0.05	0.09	1.9	113	7.7	7.3	1.8	0.15	0.15	0.18
82	0.10	7.7	2.4	1.9	0.30	0.05	0.09	1.9	109	7.6	7.2	1.8	0.14	0.14	0.18
83	0.10	7.5	2.4	1.8	0.29	0.05	0.09	1.9	106	7.5	7.1	1.7	0.13	0.13	0.17
84	0.09	7.3	2.3	1.8	0.28	0.04	0.08	1.9	102	7.3	6.9	1.6	0.13	0.13	0.16
85	0.09	7.0	2.2	1.7	0.27	0.04	0.08	1.8	99	7.2	6.8	1.5	0.12	0.12	0.15
86	0.08	6.6	2.1	1.7	0.26	0.04	0.07	1.8	96	7.1	6.8	1.4	0.11	0.11	0.14
87	0.08	6.4	2.1	1.7	0.25	0.04	0.07	1.8	92	6.9	6.6	1.4	0.11	0.11	0.13
88	0.07	6.2	2.0	1.6	0.24	0.04	0.06	1.8	88	6.7	6.4	1.3	0.10	0.10	0.13
89	0.07	5.9	1.9	1.5	0.23	0.03	0.06	1.7	85	6.5	6.2	1.2	0.09	0.09	0.12
90	0.06	5.5	1.8	1.5	0.22	0.03	0.06	1.7	81	6.2	5.9	1.0	0.09	0.09	0.11
91	0.06	5.2	1.8	1.4	0.22	0.03	0.05	1.7	78	5.9	5.6	0.9	0.08	0.08	0.10
92	0.05	4.8	1.7	1.3	0.21	0.03	0.05	1.7	74	5.5	5.2	0.8	0.07	0.07	0.09
93	0.05	4.6	1.6	1.2	0.20	0.02	0.04	1.6	69	5.2	4.9	0.7	0.07	0.07	0.08
94	0.05	4.3	1.5	1.2	0.20	0.02	0.04	1.6	66	5.0	4.8	0.7	0.07	0.06	0.08
95	0.04	3.9	1.4	1.2	0.19	0.02	0.04	1.6	61	5.0	4.8	0.6	0.06	0.06	0.08
96	0.04	3.2	1.2	1.1	0.18	0.02	0.03	1.5	56	4.7	4.5	0.5	0.05	0.05	0.07
97	0.03	2.5	1.0	1.1	0.17	0.02	0.03	1.5	50	4.4	4.2	0.4	0.05	0.05	0.06
98	0.03	1.9	0.88	1.0	0.16	0.01	0.02	1.5	41	4.0	3.8	0.4	0.04	0.04	0.05
99	0.01	0.9	0.64	1.0	0.14	0.01	0.01	1.4	26	3.7	3.5	0.3	0.02	0.02	0.03
100	0.00	0.4	0.49	0.1	0.12	0.00	0.00	0.79	5.1	2.9	2.8	0.07	0.01	0.01	0.01

Appendix C
General Methodology for Estimating Flow at WQM Stations

Flows duration curve will be developed using existing USGS measured flow where the data exist from a gage on the stream segment of interest, or by estimating flow for stream segments with no corresponding flow record. Flow data to support flow duration curves and load duration curves will be derived for each Oklahoma stream segment in the following priority:

i) In cases where a USGS flow gage occurs on, or within one-half mile upstream or downstream of the Oklahoma stream segment.

   a. If simultaneously-collected flow data matching the water quality sample collection date are available, these flow measurements will be used.

   b. If flow measurements at the coincident gage are missing for some dates on which water quality samples were collected, the gaps in the flow record will be filled, or the record will be extended, by estimating flow based on measured streamflows at a nearby gage. First, the most appropriate nearby stream gage is identified. All flow data are first log-transformed to linearize the data because flow data are highly skewed. Linear regressions are then developed between 1) daily streamflow at the gage to be filled/extended, and 2) streamflow at all gages within 95 miles that have at least 300 daily flow measurements on matching dates. The station with the best flow relationship, as indicated by the highest r-squared value, is selected as the index gage. R-squared indicates the fraction of the variance in flow explained by the regression. The regression is then used to estimate flow at the gage to be filled/extended from flow at the index station. Flows will not be estimated based on regressions with r-squared values less than 0.25, even if that is the best regression. In some cases, it will be necessary to fill/extend flow records from two or more index gages. The flow record will be filled/extended to the extent possible based on the best index gage (highest r-squared value), and remaining gaps will be filled from the next best index gage (second highest r-squared value), and so forth.

   c. Flow duration curves will be based on measured flows only, not on the filled or extended flow time series calculated from other gages using regression.

   d. On a stream impounded by dams to form reservoirs of sufficient size to impact stream flow, only flows measured after the date of the most recent impoundment will be used to develop the flow duration curve. This also applies to reservoirs on major tributaries to the stream.

ii) In the case no coincident flow data are available for a stream segment, but flow gage(s) are present upstream and/or downstream without a major reservoir between, flows will be estimated for the stream segment from an upstream or downstream gage using a watershed area ratio method derived by delineating subwatersheds, and relying on the National Resources Conservation Service (NRCS) runoff curve numbers and antecedent rainfall condition. Drainage subbasins will first be delineated for all impaired 303(d)-listed WQM stations, along with all USGS flow stations located in the 8-digit HUCs with impaired streams. Parsons will then identify all the USGS gage stations upstream and downstream of the subwatersheds with 303(d) listed WQM stations.

a. Watershed delineations are performed using ESRI Arc Hydro with a 30 m resolution National Elevation Dataset (NED) digital elevation model, and National Hydrography Dataset (NHD) streams. The area of each watershed will be calculated following watershed delineation.

b. The watershed average curve number is calculated from soil properties and land cover as described in the U.S. Department of Agriculture (USDA) Publication *TR-55: Urban Hydrology for Small Watersheds*. The soil hydrologic group is extracted from NRCS STATSGO soil data, and land use category from the 2001 National Land Cover Dataset (NLCD). Based on land use and the hydrologic soil group, SCS curve numbers are estimated at the 30-meter resolution of the NLCD grid as shown in Table 7. The average curve number is then calculated from all the grid cells within the delineated watershed.

c. The average rainfall is calculated for each watershed from gridded average annual precipitation datasets for the period 1971-2000 (Spatial Climate Analysis Service, Oregon State University, http://www.ocs.oregonstate.edu/prism/, created 20 Feb 2004).

Table C-1 Runoff Curve Numbers for Various Land Use Categories and Hydrologic Soil Groups

NLCD Land Use Category	Curve number for hydrologic soil group			
	A	B	C	D
0 in case of zero	100	100	100	100
11 Open Water	100	100	100	100
12 Perennial Ice/Snow	100	100	100	100
21 Developed, Open Space	39	61	74	80
22 Developed, Low Intensity	57	72	81	86
23 Developed, Medium Intensity	77	85	90	92
24 Developed, High Intensity	89	92	94	95
31 Barren Land (Rock/Sand/Clay)	77	86	91	94
32 Unconsolidated Shore	77	86	91	94
41 Deciduous Forest	37	48	57	63
42 Evergreen Forest	45	58	73	80
43 Mixed Forest	43	65	76	82
51 Dwarf Scrub	40	51	63	70
52 Shrub/Scrub	40	51	63	70
71 Grasslands/Herbaceous	40	51	63	70
72 Sedge/Herbaceous	40	51	63	70
73 Lichens	40	51	63	70
74 Moss	40	51	63	70
81 Pasture/Hay	35	56	70	77
82 Cultivated Crops	64	75	82	85
90-99 Wetlands	100	100	100	100

d. Flow at the ungaged site is calculated from the gaged site. The NRCS runoff curve number equation is:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad (1)$$

where:

Q = runoff (inches)

P = rainfall (inches)

S = potential maximum retention after runoff begins (inches)

I_a = initial abstraction (inches)

If P < 0.2, Q = 0. Initial abstraction has been found to be empirically related to S by the equation

$$I_a = 0.2*S \qquad (2)$$

Thus, the runoff curve number equation can be rewritten:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad (3)$$

S is related to the curve number (CN) by:

$$S = \frac{1000}{CN} - 10 \qquad (4)$$

e. First, S is calculated from the average curve number for the gaged watershed. Next, the daily historic flows at the gage are converted to depth basis (as used in equations 1 and 3) by dividing by its drainage area, then converted to inches. Equation 3 is then solved for daily precipitation depth of the gaged site, P_{gaged}. The daily precipitation depth for the ungaged site is then calculated as the precipitation depth of the gaged site multiplied by the ratio of the long-term average precipitation in the watersheds of the ungaged and gaged sites:

$$P_{ungaged} = P_{gaged}\left(\frac{M_{ungaged}}{M_{gaged}}\right) \qquad (5)$$

where M is the mean annual precipitation of the watershed in inches. The daily precipitation depth for the ungaged watershed, along with the average curve number of the ungaged watershed, are then used to calculate the depth equivalent daily flow Q of the ungaged site. Finally, the volumetric flow rate at the ungaged site is calculated by multiplying by the area of the watershed of the ungaged site and converted to cubic ft..

f. If any flow measurements are available on the stream segment of interest, the projected flows will be compared to the measured flows on each date. If there is poor agreement, projections will be repeated with a simpler approach, using only the watershed area ratio and the gaged site (thereby eliminating the influence of differences in curve number and precipitation between the gaged and ungaged stream watersheds). If this simpler approach provides better agreement with existing data, the projected flows based on the simpler approach will be used.

iii) In the rare case where no coincident flow data are available for a WQM station and no gages are present upstream or downstream, flows will be estimated for the WQM station from a gage on an adjacent watershed of similar size and properties, via the same procedure described above for upstream or downstream gages.

APPENDIX D
STATE OF OKLAHOMA ANTIDEGRADATION POLICY

Appendix D
State of Oklahoma Antidegradation Policy

785:45-3-1. Purpose; Antidegradation policy statement

(a) Waters of the state constitute a valuable resource and shall be protected, maintained and improved for the benefit of all the citizens.

(b) It is the policy of the State of Oklahoma to protect all waters of the state from degradation of water quality, as provided in OAC 785:45-3-2 and Subchapter 13 of OAC 785:46.

785:45-3-2. Applications of antidegradation policy

(a) Application to outstanding resource waters (ORW). Certain waters of the state constitute an outstanding resource or have exceptional recreational and/or ecological significance. These waters include streams designated "Scenic River" or "ORW" in Appendix A of this Chapter, and waters of the State located within watersheds of Scenic Rivers. Additionally, these may include waters located within National and State parks, forests, wilderness areas, wildlife management areas, and wildlife refuges, and waters which contain species listed pursuant to the federal Endangered Species Act as described in 785:45-5-25(c)(2)(A) and 785:46-13-6(c). No degradation of water quality shall be allowed in these waters.

(b) Application to high quality waters (HQW). It is recognized that certain waters of the state possess existing water quality which exceeds those levels necessary to support propagation of fishes, shellfishes, wildlife, and recreation in and on the water. These high quality waters shall be maintained and protected.

(c) Application to beneficial uses. No water quality degradation which will interfere with the attainment or maintenance of an existing or designated beneficial use shall be allowed.

(d) Application to improved waters. As the quality of any waters of the state improve, no degradation of such improved waters shall be allowed.

785:46-13-1. Applicability and scope

(a) The rules in this Subchapter provide a framework for implementing the antidegradation policy stated in OAC 785:45-3-2 for all waters of the state. This policy and framework includes three tiers, or levels, of protection.

(b) The three tiers of protection are as follows:

(1) Tier 1. Attainment or maintenance of an existing or designated beneficial use.

(2) Tier 2. Maintenance or protection of High Quality Waters and Sensitive Public and Private Water Supply waters.

(3) Tier 3. No degradation of water quality allowed in Outstanding Resource Waters.

(c) In addition to the three tiers of protection, this Subchapter provides rules to implement the protection of waters in areas listed in Appendix B of OAC 785:45. Although Appendix B areas are not mentioned in OAC 785:45-3-2, the framework for protection of Appendix B areas is similar to the implementation framework for the antidegradation policy.

(d) In circumstances where more than one beneficial use limitation exists for a waterbody, the most protective limitation shall apply. For example, all antidegradation policy implementation rules applicable to Tier 1 waterbodies shall be applicable also to Tier 2 and Tier 3 waterbodies or areas, and implementation rules applicable to Tier 2 waterbodies shall be applicable also to Tier 3 waterbodies.

(e) Publicly owned treatment works may use design flow, mass loadings or concentration, as appropriate, to calculate compliance with the increased loading requirements of this section if those flows, loadings or concentrations were approved by the Oklahoma Department of Environmental Quality as a portion of Oklahoma's Water Quality Management Plan prior to the application of the ORW, HQW or SWS limitation.

785:46-13-2. Definitions

The following words and terms, when used in this Subchapter, shall have the following meaning, unless the context clearly indicates otherwise:

"Specified pollutants" means

(A) Oxygen demanding substances, measured as Carbonaceous Biochemical Oxygen Demand (CBOD) and/or Biochemical Oxygen Demand (BOD);

(B) Ammonia Nitrogen and/or Total Organic Nitrogen;

(C) Phosphorus;

(D) Total Suspended Solids (TSS); and

(E) Such other substances as may be determined by the Oklahoma Water Resources Board or the permitting authority.

785:46-13-3. Tier 1 protection; attainment or maintenance of an existing or designated beneficial use

(a) General.

(1) Beneficial uses which are existing or designated shall be maintained and protected.

(2) The process of issuing permits for discharges to waters of the state is one of several means employed by governmental agencies and affected persons which are designed to attain or maintain beneficial uses which have been designated for those waters. For example, Subchapters 3, 5, 7, 9 and 11 of this Chapter are rules for the permitting process. As such, the latter Subchapters not only implement numerical and narrative criteria, but also implement Tier 1 of the antidegradation policy.

(b) Thermal pollution. Thermal pollution shall be prohibited in all waters of the state. Temperatures greater than 52 degrees Centigrade shall constitute thermal pollution and shall be prohibited in all waters of the state.

(c) Prohibition against degradation of improved waters. As the quality of any waters of the state improves, no degradation of such improved waters shall be allowed.

785:46-13-4. Tier 2 protection; maintenance and protection of High Quality Waters and Sensitive Water Supplies

(a) General rules for High Quality Waters. New point source discharges of any pollutant after June 11, 1989, and increased load or concentration of any specified pollutant from any point source discharge existing as of June 11, 1989, shall be prohibited in any waterbody or watershed designated in Appendix A of OAC 785:45 with the limitation "HQW". Any discharge of any pollutant to a waterbody designated "HQW" which would, if it occurred, lower existing water quality shall be prohibited. Provided however, new point source discharges or increased load or concentration of any specified pollutant from a discharge existing as of June 11, 1989, may be approved by the permitting authority in circumstances where the discharger demonstrates to the satisfaction of the permitting authority that such new discharge or increased load or concentration would result in maintaining or improving the level of water quality which exceeds that necessary to support recreation and propagation of fishes, shellfishes, and wildlife in the receiving water.

(b) General rules for Sensitive Public and Private Water Supplies. New point source discharges of any pollutant after June 11, 1989, and increased load of any specified pollutant from any point source discharge existing as of June 11, 1989, shall be prohibited in any waterbody or watershed designated in Appendix A of OAC 785:45 with the limitation "SWS". Any discharge of any pollutant to a waterbody designated "SWS" which would, if it occurred, lower existing water quality shall be prohibited. Provided however, new point source discharges or increased load of any specified pollutant from a discharge existing as of June 11, 1989, may be approved by the permitting authority in circumstances where the discharger demonstrates to the satisfaction of the permitting authority that such new discharge or increased load will result in maintaining or improving the water quality in both the direct receiving water, if designated SWS, and any downstream waterbodies designated SWS.

(c) Stormwater discharges. Regardless of subsections (a) and (b) of this Section, point source discharges of stormwater to waterbodies and watersheds designated "HQW" and "SWS" may be approved by the permitting authority.

(d) Nonpoint source discharges or runoff. Best management practices for control of nonpoint source discharges or runoff should be implemented in watersheds of waterbodies designated "HQW" or "SWS" in Appendix A of OAC 785:45.

785:46-13-5. Tier 3 protection; prohibition against degradation of water quality in outstanding resource waters

(a) General. New point source discharges of any pollutant after June 11, 1989, and increased load of any pollutant from any point source discharge existing as of June 11, 1989, shall be prohibited in any waterbody or watershed designated in Appendix A of OAC 785:45 with the limitation "ORW" and/or "Scenic River", and in any waterbody located within the watershed of any waterbody designated with the limitation "Scenic River". Any discharge of any pollutant to a waterbody designated "ORW" or "Scenic River" which would, if it occurred, lower existing water quality shall be prohibited.

(b) Stormwater discharges. Regardless of 785:46-13-5(a), point source discharges of stormwater from temporary construction activities to waterbodies and watersheds designated "ORW" and/or "Scenic River" may be permitted by the permitting authority. Regardless of 785:46-13-5(a), discharges of stormwater to waterbodies and watersheds designated "ORW" and/or "Scenic River" from point sources existing as of June 25, 1992, whether or not such stormwater discharges were permitted as point sources prior to June 25, 1992, may be permitted by the permitting authority; provided, however, increased load of any pollutant from such stormwater discharge shall be prohibited.

(c) Nonpoint source discharges or runoff. Best management practices for control of nonpoint source discharges or runoff should be implemented in watersheds of waterbodies designated "ORW" in Appendix A of OAC 785:45, provided, however, that development of conservation plans shall be required in sub-watersheds where discharges or runoff from nonpoint sources are identified as causing or significantly contributing to degradation in a waterbody designated "ORW".

(d) LMFO's. No licensed managed feeding operation (LMFO) established after June 10, 1998 which applies for a new or expanding license from the State Department of Agriculture after March 9, 1998 shall be located...[w]ithin three (3) miles of any designated scenic river area as specified by the Scenic Rivers Act in 82 O.S. Section 1451 and following, or [w]ithin one (1) mile of a waterbody [2:9-210.3(D)] designated in Appendix A of OAC 785:45 as "ORW".

785:46-13-6. Protection for Appendix B areas

(a) General. Appendix B of OAC 785:45 identifies areas in Oklahoma with waters of recreational and/or ecological significance. These areas are divided into Table 1, which includes national and state parks, national forests, wildlife areas, wildlife management areas and wildlife refuges; and Table 2, which includes areas which contain threatened or endangered species listed as such by the federal government pursuant to the federal Endangered Species Act as amended.

(b) Protection for Table 1 areas. New discharges of pollutants after June 11, 1989, or increased loading of pollutants from discharges existing as of June 11, 1989, to waters within the boundaries of areas listed in Table 1 of Appendix B of OAC 785:45 may be approved by the permitting authority under such conditions as ensure that the recreational and ecological significance of these waters will be maintained.

(c) Protection for Table 2 areas. Discharges or other activities associated with those waters within the boundaries listed in Table 2 of Appendix B of OAC 785:45 may be restricted through agreements between appropriate regulatory agencies and the United States Fish and Wildlife Service. Discharges or other activities in such areas shall not substantially disrupt the threatened or endangered species inhabiting the receiving water.

(d) Nonpoint source discharges or runoff. Best management practices for control of nonpoint source discharges or runoff should be implemented in watersheds located within areas listed in Appendix B of OAC 785:45.

APPENDIX E
STORM WATER PERMITTING REQUIREMENTS AND PRESUMPTIVE BEST MANAGEMENT PRACTICES (BMPS) APPROACH

Appendix E

Storm water permitting Requirements and Presumptive Best Management practices (BMP) Approach

A. BACKGROUND

The National Pollutant Discharge Elimination System (NPDES) permitting program for stormwater discharges was established under the Clean Water Act as the result of a 1987 amendment. The Act specifies the level of control to be incorporated into the NPDES stormwater permitting program depending on the source (industrial versus municipal stormwater). These programs contain specific requirements for the regulated communities/facilities to establish a comprehensive stormwater management program (SWMP) or storm water pollution prevention plan (SWPPP) to implement any requirements of the total maximum daily load (TMDL) allocation. [See 40 CFR §130.]

Storm water discharges are highly variable both in terms of flow and pollutant concentration, and the relationships between discharges and water quality can be complex. For municipal stormwater discharges in particular, the current use of system-wide permits and a variety of jurisdiction-wide BMPs, including educational and programmatic BMPs, does not easily lend itself to the existing methodologies for deriving numeric water quality-based effluent limitations. These methodologies were designed primarily for process wastewater discharges which occur at predictable rates with predictable pollutant loadings under low flow conditions in receiving waters.

EPA has recognized these problems and developed permitting guidance for stormwater permits. [See "Interim Permitting Approach for Water Quality-Based Effluent Limitations in Stormwater Permits" (EPA-833-D-96-00, Date published: 09/01/1996)] Due to the nature of storm water discharges, and the typical lack of information on which to base numeric water quality-based effluent limitations (expressed as concentration and mass), EPA recommends an interim permitting approach for NPDES storm water permits which is based on BMPs. "The interim permitting approach uses best management practices (BMPs) in first-round storm water permits, and expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards." (*ibid.*)

A monitoring component is also included in the recommended BMP approach. "Each storm water permit should include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate conditions or limitations for subsequent permits." (*ibid.*)

This approach was further elaborated in a guidance memo issued in 2002. [See Memorandum from Robert Wayland, Director of OWOW and James Hanlon, Director of OWM to Regional Water Division Directors: "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit requirements Based on Those WLAs " (Date published: 11/22/2002)] "The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. …… If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the storm water component of the TMDL, EPA recommends that the TMDL reflect this.” This TMDL adopts the EPA recommended approach and relies on appropriate BMPs for implementation. No numeric effluent limitations are required or anticipated for municipal stormwater discharge permits.

B. SPECIFIC SWMP/SWPPP REQUIREMENTS

As noted in Section 3 of this report, Oklahoma Pollutant Discharge Elimination System (OPDES)-permitted facilities and non-point sources (e.g., wildlife, agricultural activities and domesticated animals, land application fields, urban runoff, failing onsite wastewater disposal system, and domestic pets) could contribute to exceedances of the water quality criteria. In particular, stormwater runoff from the Phase 1 and 2 municipal separate storm sewer systems (MS4s) is likely to contain elevated bacteria concentrations. Permits for these discharges must comply with the provisions of this TMDL. Table E-1 provides a list of Phase 1 and 2 MS4s that are affected by this bacteria TMDL report.

Agricultural activities and other nonpoint sources of bacteria are unregulated. Voluntary measures and incentives should be used and encouraged wherever possible and such sources should strive to attain the reduction goals established in this TMDL.

The provisions of this appendix apply only to OPDES/NPDES regulated stormwater discharges. Regulated CAFOs within the watershed operate under NPDES permits issued and overseen by EPA. In order to comply with this TMDL, those CAFO permits in the watershed and their associated management plans must be reviewed. Further actions to reduce bacteria loads and achieve progress toward meeting the specified reduction goals must be implemented. This provision will be forwarded to EPA, as the responsible permitting agency, for follow up.

Table E-1. MS4 Permits affected by this bacteria TMDL Report

ENTITIES	PHASE 1 OR PHASE 2 MS4	DATE ISSUED	NOTES
Miami, City of	Phase 2 MS4	11/04/05	

To ensure compliance with the TMDL requirements under the permit, stormwater permittees must develop strategies designed to achieve progress toward meeting the reduction goals established in the TMDL. Relying primarily upon a Best Management Practices (BMP) approach, permittees should take advantage of existing information on BMP performance and select a suite of BMPs appropriate to the local community that are expected to result in progress toward meeting the reduction goals established in the TMDL. The permittee should provide guidance on BMP installation and maintenance, as well as a monitoring and/or inspection schedule.

Table E–2 provides a summary description of some BMPs with reported effectiveness in reducing bacteria. Permittees may choose different BMPs to meet the permit requirements, as long as the permittees demonstrate that these practices will result in progress toward attaining water quality standards.

As noted above, when a BMP approach is selected a coordinated monitoring program is necessary to establish the effectiveness of the selected BMPs and demonstrate progress toward attaining water quality standards. The monitoring results should be used to refine bacteria controls in the future. Individual permittees could participate in a coordinated program if there is one in the area or they could develop their own program.

After EPA approval of the final TMDL, existing small MS4 permittees will be notified of the TMDL provisions and schedule. The re-issued permit will contain general provisions addressing this TMDL. Industrial stormwater permittees are not expected to be a significant source of bacteria but if any are identified, similar actions will be required. Compliance with the following provisions will constitute compliance with the requirements of this TMDL.

1. Develop A Bacteria Reduction Plan

Permittees shall submit an approvable Bacteria Reduction Plan to the DEQ within 12 months of notification. Unless disapproved by the Director within 60 days of submission, the plan shall be approved then implemented by the permittee. This plan shall, at a minimum, include the following:

a. Consideration of ordinances or other regulatory mechanisms to require bacteria pollution control, as well enforcement procedures for noncompliance;
b. Evaluation of the existing SWMP in relation to TMDL reduction goals;
c. Educational programs directed at reducing bacterial pollution;
d. Investigation and implementation of BMPs that prevent additional storm water bacteria pollution associated with new development and re-development;
e. Implementation of BMPs applicable to bacteria. Table E-2 below presents summary information on some BMPs that should be considered. Permittees are not limited to BMPs on this list and should select BMPs appropriate to the local community that are expected to meet all or part of the reduction goals established in the TMDL.
f. Modifications to the dry weather field screening and illicit discharge detection and elimination provisions of the SWMP to consider storm water sampling and other measures intended to specifically identify bacterial pollution sources and high priority areas for bacteria reductions.
g. Periodic evaluation of the effectiveness of the bacteria reduction plan to ensure progress toward attainment of water quality standards.
h. An implementation schedule leading to modification of the SWMP and full implementation of the plan within 3 years of notification.

2. Develop Or Participate In A Bacteria Monitoring Program

Permittees may participate in a coordinated regional bacteria monitoring program or develop their own individual program. The monitoring program should be designed to establish the effectiveness of the selected BMPs and demonstrate progress toward the reduction goals of the TMDL and eventual attainment of water quality standards.

a. Within 18 months of notification, the permittee shall prepare and submit to the DEQ either a TMDL monitoring schedule or a commitment to participate in a coordinated regional monitoring program. The schedule or program shall include:

   (1) A detailed description of the goals, monitoring, and sampling and analytical methods;

   (2) A list and map of the selected TMDL monitoring sites;

   (3) The frequency of data collection to occur at each station or site;

   (4) The parameters to be measured, as appropriate for and relevant to the TMDL;

   (5) A Quality Assurance Project Plan that complies with EPA requirements [EPA Requirements for QA Project Plans (QA/R-5)]

b. The monitoring program shall be fully implemented within 3 years of notification.

3. Annual Reporting

The permittee shall include a TMDL implementation report as part of their annual report. The TMDL report shall include the status and actions taken by the permittee to implement the TMDL. The TMDL report shall document relevant actions taken by the permittee that affect MS4 storm water discharges to the waterbody segment that is the subject of the TMDL. This TMDL report also shall identify the status of any applicable TMDL implementation schedule milestones.

Table F–2. Some BMPs Applicable to Bacteria

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
Animal waste management: A planned system designed to manage liquid and solid waste from livestock and poultry. It improves water quality by storing and spreading waste at the proper time, rate and location.	X		75 %[1]	
Artificial wetland/rock reed microbial filter: Long shallow hydroponic plant/rock filter system that treats polluted waste and wastewater. It combines horizontal and vertical flow of water through the filter (filled with aquatic and semi-aquatic plants and microorganisms) and provides a high surface area of support media, such as rocks or crushed stone.	X	X		
Compost facility: Treating organic agricultural wastes in order to reduce the pollution potential to surface and ground water. The composting facility must be constructed, operated and maintained without polluting air and/or water resources.	X	X		DEQ permit needed
Conservation landscaping: The placement of vegetation in and around stormwater management BMPs. Its purpose is to help stabilize disturbed areas, enhance the pollutant removal capabilities of storm water BMP, and improve the overall aesthetics of a storm water BMP.		X		
Detention pond/basin: Detention ponds/basins maintain a permanent pool of water in addition to temporarily detaining storm water. The permanent pool of water enhances the removal of many pollutants. These ponds fill with stormwater and release most of it over a period of a few days, slowly returning to its normal depth of water.	X	X	25 %[1], 40%[2], 51%[3]	
Diversions/earthen embankments: 1). Diversions -Establishing a channel with a supporting ridge on the lower side constructed along the general land slope which improves water quality by directing nutrient and sediment laden water to sites where it can be used or disposed of safely. 2). Earthen embankment- A raised impounding structure made from compacted soil. It is appropriate for use with infiltration, detention,	X	X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
extended-detention or retention facilities.				
Drain Inlet Inserts: A proprietary BMP that is generally easily installed in a drain inlet or catch basin to treat storm water runoff. Three basic types of inlet insert are available, the tray type, bag type and basket type. The tray type allows flow to pass through filter media residing in a tray located around the perimeter of the inlet.		X	5%[2]	
Drip irrigation: An irrigation method that supplies a slow, even application of low-pressure water through polyethylene tubing running from supply line directly to a plant's base. Water soaks into the soil gradually, reducing runoff and evaporation (i.e., salinity). Transmission of nutrients and pathogens spread by splashing water and wet foliage created by overhead sprinkler irrigation is greatly reduced. Weed growth is minimized, thereby reducing herbicide applications. Vegetable farming and virtually every type of landscape situation can benefit from the use of drip irrigation.	X	X		
Fencing: A constructed barrier to livestock, wildlife or people. Standard or conventional (barbed or smooth wire), suspension, woven wire, or electric fences shall consist of acceptable fencing designs to control the animal(s) or people of concern and meet the intended life of the practice.	X		75 %[1]	
Filtration (e.g., sand filters): Intermittent sand filters capture, pre-treat to remove sediments, store while awaiting treatment, and treat to remove pollutants (by percolation through sand media) the most polluted stormwater from a site. Intermittent sand filter BMPs may be constructed in underground vaults, in paved trenches within or at the perimeter of impervious surfaces, or in either earthen or concrete open basins.	X	X	30 %[1], 55%[2], 51%[3]	
Infiltration Basin: A vegetated open impoundment where incoming stormwater runoff is stored until it gradually infiltrates into the soil strata. While flooding and channel erosion control may be achieved within an infiltration basin, they are primarily used for water quality enhancement.		X	50 %[1]	
Infiltration Trench: A shallow, excavated trench backfilled with a coarse stone aggregate to		X	50 %[1]	

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
create an underground reservoir. Stormwater runoff diverted into the trench gradually infiltrates into the surrounding soils from the bottom and sides of the trench. The trench can be either an open surface trench or an underground facility.				
Irrigation water management: The process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner. An irrigation system adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, etc.) must be available and capable of applying water to meet the intended purpose(s).	X	X		
Lagoon pump out: A waste treatment impoundment made by constructing an embankment and/or excavating a pit or dugout in order to biologically treat waste (such as manure and wastewater) and thereby reduce pollution potential by serving as a treatment component of a waste management system.	X	X		
Land-use conversion: BMPs that involve a change in land use in order to retire land contributing detrimentally to the environment. Some examples of BMPs with associated land use changes are: Conservation Reserve Program (CRP) - cropland to pasture; Forest conservation - pervious urban to forest; Forest/grass buffers - cropland to forest/pasture; Tree planting - cropland/pasture to forest; and Conservation tillage – conventional tillage to conservation tillage.	X	X		
Limit livestock access: Excluding livestock from areas where grazing or trampling will cause erosion of stream banks and lowering of water quality by livestock activity in or adjacent to the water. Limitation is generally accomplished by permanent or temporary fencing. In addition, installation of an alternative water source away from the stream has been shown to reduce livestock access.	X			
Litter control: Litter includes larger items and articulates deposited on street surfaces, such as paper, vegetation residues, animal feces, bottles and broken glass, plastics and fallen leaves. Litter-control programs can reduce the amount of		X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
deposition of pollutants by as much as 50%, and may be an effective measure of controlling pollution by storm runoff.				
Livestock water crossing facility: Providing a controlled crossing for livestock and/or farm machinery in order to prevent streambed erosion and reduce sediment.	X		100 %[1]	
Manufactured BMP systems: Structural measures which are specifically designed and sized by the manufacturer to intercept storm water runoff and prevent the transfer of pollutants downstream. They are used solely for water quality enhancement in urban and ultra-urban areas where surface BMPs are not feasible.	X	X		
Onsite treatment system installation: Conventional onsite wastewater treatment and disposal system (onsite system) consists of three major components: a septic tank, a distribution box, and a subsurface soil absorption field (consisting of individual trenches). This system relies on gravity to carry household waste to the septic tank, move effluent from the septic tank to the distribution box, and distribute effluent from the distribution box throughout the subsurface soil absorption field. All of these components are essential for a conventional onsite system to function in an acceptable manner.		X		
Porous pavement: An alternative to conventional pavement, it is made from asphalt (in which fine filler fractions are missing) or modular or poured-in concrete pavements. Its use allows rainfall to percolate through it to the sub-base, providing storage and enhancing soil infiltration that can be used to reduce runoff and combined sewer overflows. The water stored in the sub-base then gradually infiltrates the subsoil.		X	50 %[1]	
Proper site selection for animal feeding facility: Establishing or relocating confined feeding facilities away from environmentally vulnerable areas such as sinkholes, streams, and rivers in order to reduce or eliminate the amount of pollutant runoff reaching these areas.	X			
Rain garden /bio-retention basin: Rain gardens are landscaped gardens of trees, shrubs, and		X	40 %[1]	

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
plants located in commercial or residential areas in order to treat storm water runoff through temporary collection of the water before infiltration. They are slightly depressed areas into which storm water runoff is channeled by pipes, curb openings, or gravity.				
Range and pasture management: Systems of practices to protect the vegetative cover on improved pasture and native rangelands. It includes practices such as seeding or reseeding, brush management (mechanical, chemical, physical, or biological), proper stocking rates and proper grazing use, and deferred rotational systems.	X		50 %[1]	
Retention ponds/basins Retention basin: A storm water facility that includes a permanent pool of water and, therefore, is normally wet even during non-rainfall periods. Inflows from storm water runoff may be temporarily stored above this permanent pool.	X	X	32 %[1]	
Riparian Buffer Zone: A protection method used along streams to reduce erosion, sedimentation, and the pollution of water from agricultural non-point sources.	X	X	43 – 57 %[1]	Forested buffer w/o incentive payment
Septic system pump-out: A typical septic system consists of a tank that receives waste from a residence or business, and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.		X	5 %[1]	
Sewer line maintenance/sewer flushing: Sewer flushing during dry weather is designed to periodically remove solids that have deposited on the bottom of the sewer and the biological slime that grows on the walls of combined sewers during periods of low-flow. Flushing is especially necessary in sewer systems that have low grades which has resulted in velocities during low-flow periods that fall below those needed for self-cleaning.		X		
Stream bank protection and stabilization (e.g., riprap, gabions): Stabilizing shoreline areas	X	X	40 - 75 %[1]	40 % w/o fencing;

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
that are being eroded by landscaping, constructing bulkheads, riprap revetments, gabion systems, or establishing vegetation.				75 % w/ fencing
Terrace: An earth embankment, or a combination ridge and channel, constructed across the field slope. Terraces can be used when there is a need to conserve water, excessive runoff is a problem, and the soils and topography are such that terraces can be constructed and farmed with reasonable effort.	X	X		
Vegetated filter strip: A densely vegetated strip of land engineered to accept runoff from upstream development as overland sheet flow. It may adopt any naturally vegetated form, from grassy meadow to small forest. The purpose of a vegetated filter strip is to enhance the quality of stormwater runoff through filtration, sediment deposition, infiltration and absorption.	X	X		
Waste system/storage (e.g., lagoons, litter shed): Waste treatment lagoons biologically treat liquid waste to reduce the nutrient and BOD content. Lagoons must be emptied and their contents disposed of properly.	X	X	80 – 100 %[1]	
Water treatment (e.g., disinfection, flocculation, carbon filter system) Water treatment: Physical, chemical and/or biological processes used to treat concentrated discharges. Physical-chemical processes that have been demonstrated to effectively treat discharge include sedimentation, vortex separation, screening (e.g., fine-mesh screening), and sand-peat filters. Chemical additives used to enhance separation of particles from liquid include chemical coagulants such as lime, alum, ferric chloride, and various polyelectrolytes. Biological processes that have been demonstrated to effectively treat discharges include contact stabilization, biodiscs, oxidation ponds, aerated lagoons, and facultative lagoons.	X	X		
Wetland development/enhancement: The construction of a wetland for the treatment of animal waste runoff or storm water runoff. Wetlands improve water quality by removing nutrients from animal waste or sediments and nutrients from storm water runoff.	X	X	30 %[1]	Including creation and restora-tion

[1] Sources: BMP Efficiencies Chesapeake Bay Watershed Model (Phase IV) August 1999; Draft FC and Nitrate TMDL IP for Dry River (2001); EPA (1998); EPA (1999b); Novotny (1994); Storm Water Best

Management Practice Categories and Pollutant Removal Efficiencies (2003); USDA (2003); DCR (1999); DEQ/DCR (2001).

[2] Barrett, M.E., Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices, Texas Natural Resource Conservation Commission Report RG-348, June, (1999).

[3] Watershed Protection Techniques. *Vol 3. No. 1*, 1999

APPENDIX F
RESPONSE TO COMMENTS

Appendix F

Response to Comments

A. Comments from Dan Butler on behalf of OK Conservation Commission and OK Dept. of Agriculture, Food, and Forestry

A1. Title page of the report; Since the study areas cover parts of watersheds in Kansas, Missouri and Arkansas the title of the report should be inclusive of these territories.

- Response: Information from adjoining states is included to the extent it is available, however the TMDL applies only to Oklahoma. The title reflects this. No changes were made as a result of this comment.

A2. Page xiii: OCC would prefer that this sentence read: *It is possible that wastewater collection systems associated with WWTPs could be a source of bacteria loading"*

- Response: The suggested change was made.

A3. Page xiii: OCC would like the noted sentence to read: *The data analysis and the load duration curves (LDC) demonstrate that exceedances at the WQM stations are the result of a variety of nonpoint source loading occurring during high flow conditions although because of the number of low flow exceedances, point sources cannot be ruled out as an additional source.*

- Response: The report text was changed as follows. "The data analysis and the load duration curves (LDC) demonstrate that exceedances at the WQM stations are the result of a variety of nonpoint source loading occurring during a range of flow conditions. Low flow exceedances are likely due to a combination of nonpoint sources, uncontrolled point sources, and permit noncompliance." Table 5-2 was modified to indicate which existing point source dischargers have a bacteria limit in their NPDES permit. Language was also added to Section 5.2 clarifying that point source dischargers which are assigned a wasteload allocation but do not currently have a bacteria limit in their permit will receive a permit limit consistent with the wasteload allocation as their permits are reissued.

A4. Page xiii: Research has shown that most of fecal bacteria in streams during low flow conditions are due to direct deposition of cattle manure into streams and to faulty septic tank/lateral field systems. Although we have no problem with this statement as is, you might consider modifying it because so many of your load duration curves show exceedances at a variety of flow conditions. We include more detailed comments in the discussion of the data on pages 5-2 through 5-5.

- Response: The following sentence was added. "Research has shown that bacteria loading in streams during low flow conditions may be due to direct deposition of cattle manure into streams and to faulty septic tank/lateral field systems. (reference Shoal Creek TMDL)"

A5. Page 1-3: this table doesn't really address watershed population as the text states. I agree with the conclusion, but the table doesn't support it. I don't see a great deal of difference between 57/sq mi and 70/sq mi. In the future, it might give these documents a little more credibility if census block pop estimates were applied to the watershed rather than county averages.

- Response: Clarification was added that the table applies only to Oklahoma.

A6. Page 1-4: perhaps this is Locust Grove?

- This typographical error was corrected.

A7. Page 1-9 Figure 1-1a: It looks like the map of the Ranger Creek watershed may be incorrect. The Creek extends outside of the delineated watershed.

- Response: The map is correct. Only the drainage area of the impaired segment of Ranger Creek is shown, not the entire watershed. A clarification and description of Figures 1-1 was added on page 1-3.

A8. Page 2-1: Might need a statement that not all of these uses apply to each waterbody.

- Response: We believe the statement that the uses "include …." Makes that point. No changes were made as a result of this comment.

A9. Page 3-6, Figure 3-1a: Check the correctness of Ranger Creek watershed. The map appears that the creek extends beyond the watershed boundary.

- Response: See the response to comment A7.

A10. Page 3-7, Figure 3-1b: It appears that out of state poultry operations are not shown on these two maps. If so, that should be stated on the map. As is, it shows that there are no poultry operations in the MO and AR portions of Honey Creek, Elk River, Cave Springs Branch and Sycamore Creek. There are many out of state poultry houses in these watersheds.

- The title of the figure was changed to clarify that Oklahoma poultry operations are shown. Additional descriptive text may be found on page 3-13.

A11. Page 3-8: I agree that bacteria are a significant source of loading in these creeks. It's impossible to say anything about Cave Springs, Honey, Sycamore and especially Elk River because no SSO data from the other states was obtained. Most of the Elk River watershed is in MO and AR, and 100% of the monitored watershed was outside of Oklahoma since the monitoring site was in MO. OCC feels that this should be so noted for the streams that have out of state point sources in their watersheds.

- Response: A statement was added that no data on out of state SSOs was available.

A12. Page 3-9: maybe should be changed to may be.

- This typographical error was corrected.

A13. Page 3-10: Might it be possible to mention repair of leaking sewage collection systems if needed, in the same sentence as the highlighted one that mentions buffer strips and domestic animal waste?

- Response: The suggested language was added.

A14. Page 3-11: While harvest numbers weren't calculated for waterbodies in other states, it's better to apply the calculated Oklahoma densities in the out of state areas than to leave them blank. Otherwise, it might be more appropriate to calculate total animals for only the portions of the watersheds that density numbers are in your possession.

- Response: The Oklahoma estimated numbers were applied to out of state areas. The text was clarified and tables were updated.

A15. Page 3-13: The term "*land application*" in common usage only refers to fecal material that is collected and then intentionally applied to a field. Direct defecation of manure by pastured animals is not included under this definition. To make this report more understandable to readers with an agricultural background it would help to have this statement made more clearly so that the reader is aware that ODEQ is referring to both land applied poultry manure and manure from pastured livestock.

- Response: The data on land application area is from the USDA agriculture census. It follows the common usage of the term and does not include manure from pastured livestock. The language was clarified as follows: "These estimates are also based on the county level reports from the 2002 USDA county agricultural census, and thus represent approximations of the land application area in each watershed. Because of the lack of specific data, land application of livestock manure is not quantified in Table 3-6 but is considered a potential source of bacteria loading to the waterbodies in the Study Area." The title of Table 3-5 was also modified.

A16. Page 3-13: OCC suggests deleting "most likely" and replacing it with "largest". This sentence should be followed by mention that there are other significant sources as previously mentioned including wildlife, humans and poultry. Consider citing the Shoal Creek TMDL and discussing that in light of its data, direct deposition in streams by cattle are very probably the dominant base flow source while high flow sources may be dominated by poultry litter.

- Response: "most likely" was replaced with "largest". Points made in the other comments are addressed at other more appropriate locations in the report.

A17. Page 3-16: for ease of understanding by the agricultural community, this might be changed to "poultry processing operations" to clarify that it does not include growers.

- Response: This change was made to the title of Table 3-8 and in the report text on page 3-14.

A18. Page 3-20: Would be very helpful to point out that here, livestock includes poultry. Most in the agriculture business only think of hoofed animals as making up livestock.

- Response: References to "livestock" were changed to "commercially raised farm animals" throughout the report..

A19. Page 3-20: Two BST studies in nearby watersheds having similar land use, geology, land type etc., confirm this statement and show that human sources are important but not dominant at base flow. Poultry litter and cow pats on pasture would be expected to contribute 0% at base flow but be a large source at high flow. The Shoal Creek report showed that poultry litter was about 78% of the high flow load and cow pats contributed to about 20% of it. As noted above, this is probably because the cow pat maintains its integrity during runoff conditions while the litter is applied in a pulverized form. An explicit statement to this effect would be very helpful to the agricultural community.

- Response: The following text was added: "Because litter is applied in a pulverized form, it could be a larger source during storm runoff events. The Shoal Creek report showed that poultry litter was about 71% of the high flow load and cow pats contributed only about 28% of it (Missouri Department of Natural Resources, 2003). The Shoal Creek report also showed that poultry litter was insignificant under low flow conditions up to 50% frequency."

A20. Page 3-21: Table 3-14 would be more useful if % contributions were shown. Again it should be pointed out that livestock includes poultry and hoofed animals in this table. If hoofed animals and poultry could be shown in separate columns it would be even better.

- Response: Table 3-14 was changed to percentage of the total estimated nonpoint load. The clarification on what is included as livestock was addressed in response number A18. Loading estimates for each animal type are found in Table 3-6.

A21. Page 4-13: shouldn't this actually be the instream load minus the point source load?

- Response: The comment is correct. However, some language in this section was inadvertently left in the document from a previous calculation method. The obsolete language was deleted and remaining language was clarified as suggested. The correct calculation of current loading is found in Section 5.1.

A22. Page 4-14: How can high-flows occur during dry weather absent a discharge or a dam rupture?

- Response: A clarification was added. High flows could occur in the absence of local runoff due, for example, to precipitation upstream in the watershed or releases from upstream dams.

A23. Page 4-15: Is this assumption justified given the number of SSOs that occurred in some of the watersheds? If so, perhaps that could be better explained in this text.

- Response: Yes because SSOs are not included in the wasteload allocation component of the TMDL. A description of oversight and enforcement procedures for SSOs was added to Section 3.1.2.

A24. Page 5-2: Suggest wording saying that due to the preponderance of exceedances during high flow conditions the majority of the pollution is thought to be due to nonpoint sources but that the exceedances found during dry weather conditions indicate that some level of pollution may be due to point sources.

- Response: The following language was added: “Due to the preponderance of exceedances during high flow conditions, the majority of the pollution is thought to be due to non-point sources. The exceedances found during dry weather conditions indicate some level of pollution may be due to point sources, failing onsite systems, or direct deposition of animal manure.”

A25. Page 5-3: The statement that criteria were exceeded under a wide range of conditions indicates impairment by both point and non-point sources following the logic found in paragraph 2 of subsection E.3 on page xiii and again in the last paragraph on page 4-1 both of which say that pollution found during high flow conditions indicates nps while pollution found under low flow conditions indicates point sources. Since there are no point sources on this stream there needs to be an explanation of how exceedances can occur under a wide range of conditions given the earlier referenced statements.

As stated in earlier comments, direct application of manure in a stream at low flow conditions by wading cattle causes impairment at low flow conditions yet is still nps. Likewise, direct pipelines of septage to streams and gullies can also contribute to base flow impairment as can transport of septage from lateral fields down to groundwater through karst. Suggest to modify the two paragraphs cited and say that pollution at low flow conditions indicates both point and non-point sources are possible while pollution found at high flow conditions indicates nps in the absence of a bypass or overflow at a WWTP.

In this particular case, all you do say is that nps contributes to impairment. If there are no point sources it has to account for all of the impairment but the low flow exceedances need to be explained in light of other statements that low flow exceedances are caused by point sources.

In the section on Crutchfield Creek below there are exceedances under a wide range of conditions and the conclusion is that it is a combination of point and non point sources contributing to water quality impairment. The conclusions drawn from similar data should also be similar.

- Response: The following text was added to Sections E.3 and 4.1: “However, violations that occur during low flows may not be caused exclusively by point sources. Violations have been noted in some watersheds that contain no point sources. Research has show that bacteria loading in streams during low flow conditions may be due to direct deposit of cattle manure into streams and faulty septic tank/lateral field systems.”

A26. Page 5-3: Logic used in the LDC discussion of other streams would suggest that this be attributed solely to point sources as the author uses the word "*substantial*" do describe the low flow exceedances. When the situation is reversed and the majority, but not all, of the exceedances are at high flow, the author's conclusion is that the problem is due to non point sources.

- Response: See response # A25.

A27. Page 5-3: Consistency dictates that exceedances under a variety of flow conditions indicate a combination of point and non-point sources. I understand that Fly Creek has no point sources, but it needs to be explained here why a stream with no point sources can have exceedances under a variety of flow conditions given the premise of the load duration method that separates point and non-point pollution by the flow conditions under which they are found.

- Response: See response # A25.

A28. Page 5-4: This statement is inconsistent with other conclusions and earlier statements. The results for Cave Springs Branch and other streams are exactly the same, that is there are exceedances under all flow conditions, yet the conclusions are different. Again, given the method used, how can exceedances under a variety of flow conditions indicate nps pollution. It seems that if exceedances are found under a variety of flow conditions, the method may be inappropriate. In this case, where there is nps at high flow conditions and very significant nps under low flow conditions, it may be hard to distinguish between point and non-point sources using flow as a surrogate.

- Response: The following text was added to Section E.3 and 4.1: "Flow range is only a general indicator of the relative proportion of point/nonpoint contributions. It is not used in this report to quantify point source or nonpoint source contributions." See also response # A25.

A29. Page 5-4: same issue. Consistency

- Response: Changed to "a combination of point and nonpoint sources."

A30. Page 5-4: If exceedances found under most flow conditions indicate combination nps and ps, other streams with the same findings should have similar conclusions.

- Response: Agree. Conclusions have been changed where appropriate.

A31. Page 5-5: Are there low flow exceedances not being discussed and do they need to be? The use of the words "most often" imply that this may be true.

- Response: All exceedances, including the low flow exceedances, are shown on Figure 5-13. The few low flow exceedances are not significant compared to the higher flow exceedances. No changes were made as a result of this comment.

A32. Page 5-5: Sounds like there were some low flow or dry weather exceedances that may need explaining.

- Response: All exceedances, including the low flow exceedances, are shown on Figure 5-14. The one low flow exceedance is not significant compared to the higher flow exceedances. No changes were made as a result of this comment.

A33. Page 5-14: This is potentially a very large load that is being attributed to nps by including it with the LA. Is there any way to deal with this in some other way so that Oklahoma nps generators are not asked to develop BMPs for load that is not under their power to deal with? Particularly, in the case of Elk River where the monitoring station was upstream of our border, this should be considered.

- Response: EPA has required this approach of including upstream point source load in the load allocation component. Oklahoma sources are not asked to reduce their loads beyond their power to deal with. The following text was added to Section 5.8:" When a watershed extends into an adjacent state, the same reduction goal that applies to the watershed within Oklahoma should also be considered to apply to the watershed in the adjacent state. These goals could be achieved by reductions in some combination of nonpoint sources and uncontrolled point sources. Since Oklahoma has no authority over potential bacteria sources in adjacent states, these reductions can only be facilitated through cooperation between Oklahoma agencies, the adjacent state and EPA."

A34. Page 5-40: We would prefer to see some other word used. Maybe something on the order of "managed".

- Response: The suggested change was made.

A35. Page 5-41: More appropriate to say "these waterbodies"

- Response: The suggested change was made.

B. Additional comments from Quang Pham on behalf of OK Conservation Commission and OK Dept. of Agriculture, Food, and Forestry

Note: Quang Pham and ODAFF concurred in and repeated the comments submitted above by Dan Butler and OCC. See responses above for those comments. The following additional comments were provided.

B1. (p. 3-8): out-of-state point sources are not included.

- Response: Out of state point sources are included. No information was available on out of state SSOs. See also the response to comment A11.

B2. (p. 3-12): add: poultry waste after "Processed livestock manure"

- Response: See response A18.

B3. (p. 3-13): 3rd line from top of the page: add poultry waste after "of livestock manure"

- Response: See response A18.

B4. (p. 3-13): Add the following clarification of poultry waste management in the first paragraph, immediately after the end of the 4th line: As most of the poultry feeding operations (PFOs) are regulated by ODAFF, they are required to land apply chicken waste in accordance with their Animal Waste Management Plans (AWMP) or Comprehensive Nutrient Management Plans (CNMP). If best management practices (storage shed, fencing…) and conservation measures (setbacks…) are properly implemented, the contribution of bacteria from this group of animals to the watersheds, if any, would be insignificant.

- Response: The following text was added: "Most poultry feeding operations are regulated by ODAFF and are required to land apply poultry waste in accordance with their Animal Waste Management Plans or Comprehensive Nutrient Management Plans. While these plans are not designed to control bacteria loading, best management practices and conservation measures, if properly implemented, could reduce the contribution of bacteria from this group of animals to the watersheds."

B5. (p. 3-13): Fecal Coliform Production Rates: The report used the Beef Cattle release approximately 1.04 E+11, and Dairy Cattle release 1.01 E+11. They are 3 - 5 times as high as the rates used by Gene Yagow, et al., Virginia Tech University in research paper: "TMDL Modeling of Fecal Coliform Bacteria with HSPF", 2001, presented at the ASAE Annual International Meeting 2001, of 2.07 E+10 and 3.11 E+10 respectively.

- Response: The bacteria production rates in the report were taken from the American Society of Agricultural Engineers standards. Many other production rates could be found in the literature. The chosen rates are valid and not significantly different from the proposed reference. No changes were made as a result of this comment.

B6. (p. 3-13): Third paragraph on livestock source (beef and dairies cattle) of fecal bacteria; it is suggested the following sentence be added to the paragraph: <u>As the survival rates of coliform depend on how the manure is stored, when and how it is spread on land, setbacks distances and BMPs conducted by farmers/ranchers, and relative locations of the farms to the streams, numbers of coliform reaching water-bodies from this source should be minimal compared to the amount of bacteria produced on land.</u>

- Response: The following clarification was added in Section 3.3: "Manure handling practices, use of BMPs, and relative location to streams can also affect stream loading."

B7. (p. 3-13): Sentence preceding the last sentence: NPDES permitted "poultry operations" should be replaced by <u>poultry processing plants.</u>

- Response: The change was made.

B8. (p.3-14), table 3-5: "Livestock and Manure Estimates by Watershed": The title should be: "Livestock and Manure Application Area Estimates by Watershed", as no manure amount, but manure application area is included in the table.

- Response: The change was made.

B9. (p.3-14) Number of cattle and calves should be divided in two groups: one as free roaming and the other in feedlots, as the amount of manure produced by each group is quite different.

- Response: This information was not available and would not produce significantly different results. No changes were made as a result of this comment.

B10. (p. 3-15), table 3-6: "Fecal Coliform Production Estimates for Selected Livestock": Since the Coliform Production Rates are over-estimated the numbers of Coliform Production presented in the table are about 5 times as high as they should be.

- Response: See response # B5

B11. (p. 3-16) Table 3-7 "Estimated Poultry Numbers for Contract Growers Inventoried by OPDAFF": the most updated ODAFF's inventory indicated that the number of birds in the study areas are as follows:

Waterbody Name	**County**	**Type**	**Estimated in 1000**	**Actual in 1000**
Fourteenmile Creek	Cherokee	Turkeys	26	18
Fourteenmile Creek	Cherokee	Broilers	235	60
Crutchfield Branch	Mayes	Broilers	80	88
Drowning Creek	Delaware	Layers	70	57
Horse Creek	Ottawa	Broilers	40	28
Honey Creek	Delaware	Layers	40	45
Honey Creek	Delaware	Broilers	320	295
Tar Creek	Ottawa	Broilers	153	100

It results in a reduction of 273,000 birds in the study areas, about 12% of the number of birds estimated. Thus, the overall impact of land application of chicken waste on water quality of streams in the watersheds, if any, is much less than the estimates.

- Response: These numbers are presented for information only. They are not used for loading estimates but are not significantly different from the agriculture census numbers that are used. DEQ will work with ODAFF to update the poultry database for future reports. The date of the data in the table was added.

B12. (p.3-20): second sentence of the second paragraph (immediately below table 3-13). It is suggested that the sentence "Livestock are estimated to be….to land surfaces". be replaced by: <u>Land Application of livestock manure and chicken waste could be considered one of major contributors of coliform loading to land surfaces; however, its</u>

contribution of coliform to the streams in the watersheds may not be significant, if BMPs are properly implemented when land applying manure/ waste.

- Response: The following clarifying language was added to the paragraph following: "Manure handling practices, use of BMPs, and relative location to streams can also affect stream loading."

B13. (p.3-21): poultry and cattle (livestock) should be included in separate columns as amounts of waste/manure generated by each group of animals are completely different.

- Response: Table 3-14 is a summary table. Loading estimates for each individual animal type are found in Table 3-6. No changes were made as a result of this comment.

C. Staff identified Changes

C1. Appendix E: Storm water permitting Requirements and Presumptive Best Management practices (BMP) Approach was added to the report. And a reference to Appendix E was also added in section 3.2.