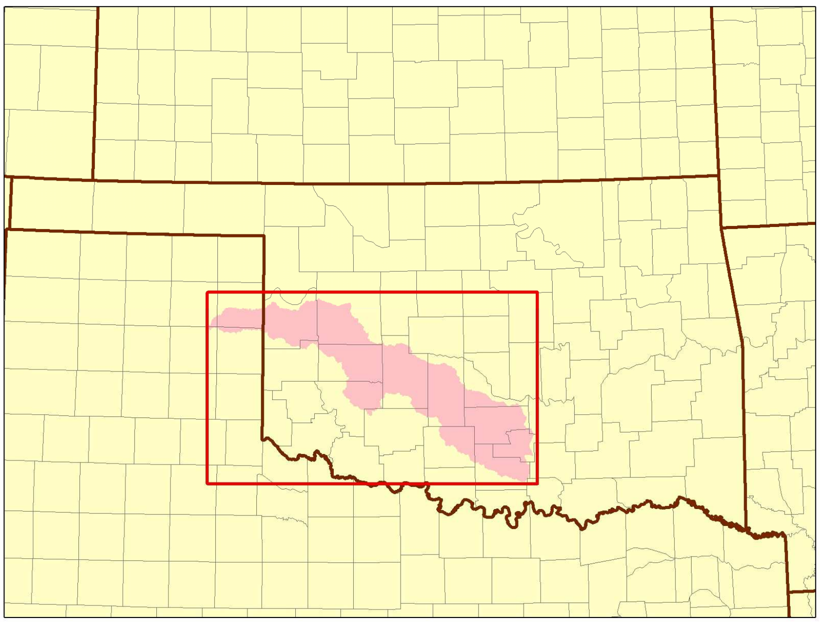
FINAL

BACTERIA TOTAL MAXIMUM DAILY LOADS FOR THE WASHITA RIVER, OKLAHOMA (OK310800, OK310810, OK310820, OK310830, OK310840)



Prepared for:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

Prepared by:

PARSONS

SEPTEMBER 17, 2007

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OKWBID

OK310800010240, OK310800020010, OK310800020040, OK310800020190, OK310810010010, OK310810020170, OK310810020200, OK310820010030, OK310830010010, OK310830030010, OK310830060030, OK310840010010, OK310840010060

Prepared for:

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SEPTEMBER 17, 2007

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

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ACRONYMS AND ABBREVIATIONS

AEMS	Agricultural Environmental Management Service
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

Response to Comment

Comments from Oklahoma Farm Bureau

On behalf of the state's largest agriculture organization, with more than 166,000 member families, thank you for the opportunity to comment on this draft TMDL. my comments will address the conclusions from the Oklahoma Department of Environmental Quality's (ODEQ) August 2, Public Notice: "The Washita and Lower Red River watershed are in violation of Oklahoma Water Quality Standards with respect to pathogens. Most of the pathogens come from nonpoint sources though it is not known which sources these are specifically from without additional study."

I do not dispute the ODEQ's conclusion that the rivers and streams are impaired for pathogens/bacteria based on Oklahoma's existing water quality standards. For at least three years I have had concerns about our pathogens/bacteria standard applying to our streams and rivers. It is my understanding that Oklahoma is applying a swimming beach standard for pathogens/bacteria to our rivers and streams. If I don't have confidence the water quality standard has the appropriate criteria, I can't have confidence in the TMDL. (It should be noted I made similar comments in September of 2006 on the Upper Canadian River and Turkey Creek watersheds TMDL.)

Last week when I was in Washinton, D.C., I visited about the pathogens/bacteria issue with Michael Shapiro, Deputy Assistant Adminitstrator, Ofice of Water, Environmental Protection Agency. I expressed concern that TMDLs were being performed needlessly, costing the taxpayers money and the agencies time and money, when there is not confidence in the pathogens/bacteria criteria. Mr. Shapiro said the EPA needed about five years of solid research to determine what the pathogens/bacteria criteria should be. He recommended unofficially that the states should put the stream and river pathogens/bacteria 303(d) listings as a low priority for TMDLs in the interim. Mr. Shapiro acknowledged that he knows Derek Simithee well, as Mr. Smithee has been serving on the national workgroup for this issue.

It seems to me to be a disservice to those residents in the Washita and Lower Red River watersheds to worry them unnecessarily about what may not really be a problem. The state should be focusing its limited resources on real problems.

I agree with Mr. Shapiro's unofficial recommendation. I believed it would be prudent for Oklahoma to place the rivers and streams pathogens bacteria TMDLs as a low priority, until such time as appropriate criteria has been developed.

Response: The Oklahoma Water Resources Board (OWRB) is the state agency in charge of setting water quality standards. This comment will be refered to the OWRB for consideration. Your previous comments regarding pathogen standards had been refered to the OWRB. Before the standards are officially revised, TMDLs must be developed based on the current Oklahoma Water Quality Standards. No changes were made to the report.

Executive Summary

This report documents the data and assessment used to establish Total Maximum Daily Loads (TMDL) for the pathogen indicator bacteria fecal coliform, *Escherichia coli (E. coli),* or Enterococci for certain waterbodies in the Washita 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 processes 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
OK310800010240_00	Oil Creek	19.48	5	2009	N
OK310800020010_00	Washita River at US 177	31.584	5	2005	N
OK310800020040_00	Sand Branch	6.24	5	2009	N
OK310800020190_00	Chigley Sandy Creek	14.39	5	2009	N
OK310810010010_10	Washita River at SH 19	32.858	5	2005	N
OK310810020170_00	Roaring Creek	18.27	5	2009	N
OK310810020200_00	Laflin Creek	12.6	5	2009	N
OK310820010030_00	Bitter Creek	6.02	5	2009	N
OK310830010010_00	Washita River at US 281	29.773	5	2005	N
OK310830030010_00	Washita River at SH 152	52	5	2004	N
OK310830030010_10	Washita River #145	29.878	5	2004	N
OK310830060030_00	Willow Creek	11.01	5	2003	N
OK310840010010_00	Washita River at SH 33	34.32	4	2004	N
OK310840010060_00	Quartermaster Creek	32.98	5	2004	N

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

For the data collected between 1999 and 2002, evidence of nonsupport of the PBCR use based on fecal coliform concentrations was observed in eight waterbodies: Oil Creek (OK310800010240), Sand Branch (OK310800020040), Chigley Sandy Creek (OK310800020190), Roaring Creek (OK310810020170), Laflin Creek (OK310810020200), Bitter Creek (OK310820010030), Willow Creek (OK310830060030), and Quartermaster Creek (OK310840010060). Evidence of nonsupport of the PBCR use based on fecal coliform and Enterococci concentrations were observed in four segments of the Washita River: Washita River at US 177 (OK310800020010_00), Washita River at SH 19 (OK310810010010_10), Washita River at SH 152 (OK310830030010_00), and Washita River #145 (OK310830030010_10). Evidence of nonsupport of the PBCR use based on Enterococci concentrations was observed in one segment of the Washita River at US 281 (OK310830010010_00). Lastly, evidence of nonsupport of the PBCR use based on all three bacterial indicator (fecal coliform, Enterococci and *E. coli*) concentrations was observed in one segment of the Washita River at SH 33 (OK310840010010_00). 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*
OK310800010240P	OK310800010240_00	Oil Creek	X		
OK310800020010-001AT	OK310800020010_00	Washita River at US177	X	X	
OK310800020040C	OK310800020040_00	Sand Branch	X		
OK310800020190K	OK310800020190_00	Chigley Sandy Creek	X		
OK310810010010-001AT	OK310810010010_10	Washita River at SH19	X	X	
OK310810020170G	OK310810020170_00	Roaring Creek	X		
OK310810020200G	OK310810020200_00	Laflin Creek	X		
OK310820010030G	OK310820010030_00	Bitter Creek	X		
OK310830010010-001AT	OK310830010010_00	Washita River at US 281		X	
OK310830030010-001AT	OK310830030010_00	Washita River at SH152	X	X	
OK310830030010P	OK310830030010_10	Washita River #145	X	X	
OK310830060030H	OK310830060030_00	Willow Creek	X		
OK310840010010-001AT	OK310840010010_00	Washita River at SH 33	X	X	X
OK310840010060G	OK310840010060_00	Quartermaster 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 Sand Branch (OK310800020040_00), Chigley Sandy Creek (OK310800020190_00), Roaring Creek (OK310810020170_00), Laflin Creek (OK310810020200_00), and Willow Creek (OK310830060030_00). Nine of the watersheds in the Study Area, including Oil Creek (OK310800010240_00), Washita River at US 177 (OK310800020010_00), Washita River at SH 19 (OK310810010010_10), Bitter Creek (OK310820010030_00), Washita River at US 281 (OK310830010010_00), Washita River at SH 152 (OK310830030010_00), Washita River #145 (OK310830030010_10), Washita River at SH 33 (OK310840010010_00), and Quartermaster Creek (OK310840010060_00), have NPDES-permitted facilities. There are no permitted MS4s within this Study Area.

There are 12 NPDES-permitted no-discharge facilities within the Study Area. For the purposes of these TMDLs, it is assumed that no-discharge facilities do not contribute bacteria loading to the Washita River and its tributaries. However, it is possible the wastewater collection systems associated with those wastewater treatment plants could be a source of bacteria loading, or that discharges may occur during large rainfall events that exceed the systems' storage capacities.

While not all sewer overflows are reported, ODEQ has some data on sanitary sewer overflows (SSO) available. There were 590 SSO occurrences, ranging from 0 to over 1 million gallons, reported from four different waterbodies in the Study Area between January 1990 and April 2007. Given the significant number of occurrences and the size of the overflows reported, SSOs have been a significant source of bacteria loading in the past in the Washita River at US 177 (OK310800020010_00) and Washita River at US 152 (OK310830030010_00) watersheds.

The Municipal separate storm sewer system (MS4) permit for small communities in Oklahoma became effective on February 8, 2005. There are no permitted MS4s within the study area.

There are five concentrated animal feeding operations (CAFO) located in Bitter Creek (OK310820010030_00), Washita River at SH 152 (OK310830030010_00), Washita River #145 (OK310830030010_10), and Oil Creek (OK310800010240_00).

There are no point sources in Sand Branch, Chigley Sandy Creek, Roaring Creek, Laflin Creek, and Willow Creek watersheds; therefore, nonsupport of PBCR use in these watersheds is caused by nonpoint sources of bacteria only. In watersheds with both point and nonpoint sources of bacteria, the available data suggests that the proportion of bacteria from point sources ranges from minor to moderate. Those waterbodies in which point sources are a minor contributor of bacteria include Oil Creek (OK310800010240_00), Bitter Creek (OK310820010030_00), Washita River at SH 19 (OK310810010010_10), Washita River #145 (OK310830030010_10), Washita River at SH 33 (OK310840010010_00), and Quartermaster Creek (OK310840010060_00). In the remaining three watersheds, Washita River at US 177 (OK310800020010_00), Washita River at US 281 (OK310830010010_00), and Washita River at SH 152 (OK310830030010_00), point sources such as WWTP, SSOs, and CAFOs, contribute moderate bacteria loads in proportion to nonpoint sources. However, overall nonpoint sources are considered to be the major source of bacteria loading in each watershed.

The four major nonpoint source categories contributing to the elevated bacteria in each of the watersheds in the Study Area are livestock, pets, deer, and septic tanks. Livestock are estimated to be the largest 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.

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 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.

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.

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:

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

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 Washita River at US 177, Washita River at SH 19, Washita River at US 281, Washita River at SH 152, Washita River # 145, and Washita River at SH 33 will be based on Enterococci. The TMDL PRGs for Oil Creek, Sand Branch, Chigley Sandy Creek, Roaring Creek, Laflin Creek, Bitter Creek, Willow Creek, and Quartermaster Creek will be based on fecal coliform. The PRGs range from 64 to 96 percent.

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

Waterbody ID	WQM Station	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instant-aneous	Instant-aneous	Geo-mean	Instant-aneous	Geo-mean
OK310800010240_00	OK310800010240P	Oil Creek	**91%**				
OK310800020010_00	OK310800020010-001AT	Washita River, US 177	40%			96%	**86%**
OK310800020040_00	OK310800020040C	Sand Branch	**85%**				
OK310800020190_00	OK310800020190K	Chigley Sandy Creek	**70%**				
OK310810010010_10	OK310810010010-001AT	Washita River, SH 19	51%			97%	**87%**
OK310810020170_00	OK310810020170G	Roaring Creek	**80%**				
OK310810020200_00	OK310810020200G	Laflin Creek	**82%**				
OK310820010030_00	OK310820010030G	Bitter Creek	**64%**				
OK310830010010_00	OK310830010010-001AT	Washita River, US 281				95%	**86%**
OK310830030010_00	OK310830030010-001AT	Washita River, SH 152	40%			97%	**94%**
OK310830030010_10	OK310830030010P	Washita River # 145	72%			95%	**88%**
OK310830060030_00	OK310830060030H	Willow Creek	**82%**				
OK310840010010_00	OK310840010010-001AT	Washita River, SH 33	49%	40%	34%	98%	**96%**
OK310840010060_00	OK310840010060G	Quartermaster Creek	**64%**				

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 LDC and the simple equation of:

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

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. There are no permitted MS4s in the study area.. 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† (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
OK310800010240_00	OK310800010240P	Oil Creek	FC	4.32E+10	0	3.89E+10	4.32E+09
OK310800020010_00	OK310800020010-001AT	Washita River, US 177	ENT	1.74E+12	8.47E+09	1.56E+12	1.74E+11
OK310800020040_00	OK310800020040C	Sand Branch	FC	6.79E+08	0	6.11E+08	6.79E+07
OK310800020190_00	OK310800020190K	Chigley Sandy Creek	FC	2.57E+10	0	2.31E+10	2.57E+09
OK310810010010_10	OK310810010010-001AT	Washita River, SH 19	ENT	1.11E+12	0	9.96E+11	1.11E+11
OK310810020170_00	OK310810020170G	Roaring Creek	FC	5.82E+10	0	5.24E+10	5.82E+09
OK310810020200_00	OK310810020200G	Laflin Creek	FC	2.69E+10	0	2.42E+10	2.69E+09
OK310820010030_00	OK310820010030G	Bitter Creek	FC	5.60E+10	0	5.04E+10	5.60E+09
OK310830010010_00	OK310830010010-001AT	Washita River, US 281	ENT	4.97E+11	2.53E+09	4.45E+11	4.97E+10
OK310830030010_00	OK310830030010-001AT	Washita River, SH 152	ENT	1.11E+11	2.63E+09	9.73E+10	1.11E+10
OK310830030010_10	OK310830030010P	Washita River # 145	ENT	8.46E+10	0	7.61E+10	8.46E+09
OK310830060030_00	OK310830060030H	Willow Creek	FC	9.79E+09	0	8.81E+09	9.79E+08
OK310840010010_00	OK310840010010-001AT	Washita River, SH 33, Hammon	ENT	5.02E+10	0	4.52E+10	5.02E+09
OK310840010060_00	OK310840010060G	Quartermaster Creek	FC	4.43E+10	0	3.98E+10	4.43E+09

† Derived for illustrative purposes at the median flow value

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 Washita River area of the Arkansas 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 a potential health risk exists for individuals exposed to the water. Data assessment and TMDL calculations are conducted 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 waterbodies that ODEQ placed in Category 5 of the 2004 Integrated Report [303(d) list] for nonsupport of primary body contact recreation (PBCR):

- Oil Creek (OK310800010240_00),
- Washita River at US 177 (OK310800020010_00),
- Sand Branch (OK310800020040_00),
- Chigley Sandy Creek (OK310800020190_00),
- Washita River at SH 19 (OK310810010010_10),
- Roaring Creek (OK310810020170_00),
- Laflin Creek (OK310810020200_00),
- Bitter Creek (OK310820010030_00),
- Washita River at US 281 (OK310830010010_00),
- Washita River at SH 152 (OK310830030010_00
- Washita River #145 (OK310830030010_10),
- Willow Creek (OK310830060030_00),
- Washita River at SH 33 (OK310840030010_00), and
- Quartermaster Creek (OK310840010060_00).

Figure 1-1 is a location map showing 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 Description
Oil Creek	OK310800010240_00	OK310800010240P	Oil Creek
Washita River at US 177	OK310800020010_00	OK310800020010-001AT	Washita River, US 177, Durwood
Sand Branch	OK310800020040_00	OK310800020040C	Sand Branch Creek
Chigley Sandy Creek	OK310800020190_00	OK310800020190K	Chigley Sandy Creek
Washita River at SH 19	OK310810010010_10	OK310810010010-001AT	Washita River, SH 19, Pauls Valley
Roaring Creek	OK310810020170_00	OK310810020170G	Roaring Creek
Laflin Creek	OK310810020200_00	OK310810020200G	Laflin Creek
Bitter Creek	OK310820010030_00	OK310820010030G	Bitter Creek
Washita River at US 281	OK310830010010_00	OK310830010010-001AT	Washita River, US 281, Anadarko
Washita River at SH 152	OK310830030010_00	OK310830030010-001AT	Washita River, SH 152, Cordell
Washita River #145	OK310830030010_10	OK310830030010P	Washita River # 145

Waterbody Name	Waterbody ID	WQM Station	WQM Station Location Description
Willow Creek	OK310830060030_00	OK310830060030H	Willow Creek
Washita River at SH 33	OK310840010010_00	OK310840010010-001AT	Washita River, SH 33, Hammon
Quartermaster Creek	OK310840010060_00	OK310840010060G	Quartermaster Creek

1.2 Watershed Description

General. The Washita River Basin is located in the central portion of Oklahoma. The majority of the waterbodies addressed in this report are located in Roger Mills, Custer, Washita, Caddo, Grady, McClain, Garvin, Murray, and Carter Counties. A small portion of Oil Creek and Washita River at US 177 (OK310800020010_00) watersheds falls in Marshall and Johnston Counties. These counties are part of the Central Oklahoma/Texas Plains and Central Great Plains ecoregions. The watersheds in the Study Area are located in the Anadarko Basin geological province. Table 1-2, derived from the 2000 U.S. Census, demonstrates that the counties in which these watersheds are located 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)
Roger Mills	3,436	3
Custer	26,142	26
Washita	11,508	12
Caddo	30,150	24
Grady	45,516	41
McClain	32,500*	49
Garvin	27,210	34
Murray	12,623	30
Carter	45,621	55
Johnston	10,513	16
Marshall	13,184	36

* Census updated in 2006

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 range between 27.0 and 41.1 inches (Oklahoma Climate Survey 2007).

Table 1-3 Average Annual Precipitation by Watershed

Washita River Precipitation Summary		
Waterbody Name	**Waterbody ID**	**Average Annual (Inches)**
Oil Creek	OK310800010240_00	41.1
Washita River at US 177	OK310800020010_00	38.7
Sand Branch	OK310800020040_00	39.3
Chigley Sandy Creek	OK310800020190_00	40.3
Washita River at SH 19	OK310810010010_10	39.0
Roaring Creek	OK310810020170_00	36.1
Laflin Creek	OK310810020200_00	36.0
Bitter Creek	OK310820010030_00	34.1
Washita River at US 281	OK310830010010_00	32.6
Washita River at SH 152	OK310830030010_00	30.3
Washita River #145	OK310830030010_10	29.0
Willow Creek	OK310830060030_00	32.0
Washita River at SH 33	OK310840010010_00	27.4
Quartermaster Creek	OK310840010060_00	27.0

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 Figure 1-2.

The primary land use category in all watersheds in the Washita River Study Area is Grasslands/Herbaceous, except in the Washita River at SH 152 (OK310830030010_00) and Willow Creek (OK310830060030) watersheds. The primary land use category in Washita River at SH 152 (OK310830030010_00) and Willow Creek (OK310830060030) watersheds is row crops, with the secondary land use category being grasslands/herbaceous. The secondary land use category for the watersheds in the western portion of the Study Area is deciduous forest, except for Chigley Sandy Creek (OK310800020190), which is pasture/hay. The secondary land use category for the watersheds in the eastern portion of the Study Area is row crops, except Quartermaster Creek (OK310840010060), which is shrub/scrub.

There are seven cities located the Washita River #145 watershed: Butler, Custer City, Arapaho, Clinton, Foss, Canute, and Putnam. There are also seven cities located in the Washita River at US 281 watershed: Lookeba, Binger, Gracemont, Anadarko, Verden, Cement, and Hinton. There are five cities located in the Washita River at SH 152 watershed: Corn, Bessie, Burns Flat, New Cordell, and Dill City. Washita River at SH 19 watershed has four cities: Wayne, Byars, Pauls Valley, and Paoli. There are four cities that fall within the Washita River at US 177 watershed: Springer, Gene Autry, Dickson, and Ardmore. Quartermaster Creek, Washita River at SH 33, Bitter Creek, and Chigley Sandy Creek watersheds each have one small city: Leedey, Hammon, Amber, and Davis, respectively. There are no urban areas within Oil Creek, Sand Branch, Roaring Creek, Laflin Creek, or Willow Creek watersheds.

Low, medium, and high intensity developed land account for less than 2 percent of the land use in each watershed.

Table 1-4a Land Use Summaries by Watershed

Landuse Category	WQM Station						
	Oil Creek	Washita River at US177	Sand Branch	Chigley Sandy Creek	Washita River at SH19	Roaring Creek	Laflin Creek
Waterbody ID	OK310800010240_00	OK310800020010_00	OK310800020040_00	OK310800020190_00	OK310810010010_10	OK310810020170_00	OK310810020200_00
Percent of Open Water	0.4	1.5	0.6	1.2	2.8	1.0	1.1
Percent of Developed, Open Space	2.2	3.4	4.0	3.6	4.4	2.0	3.7
Percent of Developed, Low Intensity	0.1	1.1	1.6	1.3	0.6	0.0	0.0
Percent of Developed, Medium Intensity	0.0	0.3	0.2	0.2	0.1	0.0	0.0
Percent of Developed, High Intensity	0.0	0.1	0.0	0.1	0.0	0.1	0.0
Percent of Barren Land (Rock/Sand/ Clay)	0.0	0.1	0.8	0.0	0.0	0.0	0.0
Percent of Deciduous Forest	15.6	25.6	37.1	14.5	16.9	12.9	20.6
Percent of Evergreen Forest	4.6	0.8	0.1	0.2	0.0	0.0	0.0
Percent of Mixed Forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent of Shrub/Scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent of Grassland/Herbaceous	54.6	49.5	39.9	53.1	47.1	71.5	64.8
Percent of Pasture/Hay	14.7	12.2	14.6	18.9	13.3	0.5	0.5
Percent of Cultivated Crops	7.8	5.4	1.1	6.9	14.8	12.0	9.2
Percent of Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent of Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acres Open Water (percent of total)	121	4,211	59	243	4,844	410	212
Acres Developed, Open Space	684	9,742	420	743	7,470	855	739
Acres Developed, Low Intensity	24	3,090	163	272	1,029	19	6
Acres Developed, Medium Intensity	1	790	20	34	110	13	4

Landuse Category	WQM Station						
	Oil Creek	Washita River at US177	Sand Branch	Chigley Sandy Creek	Washita River at SH19	Roaring Creek	Laflin Creek
Waterbody ID	OK310800010240_00	OK310800020010_00	OK310800020040_00	OK310800020190_00	OK310810010010_10	OK310810020170_00	OK310810020200_00
Acres Developed, High Intensity	0	311	0	16	16	26	0
Acres Barren Land (Rock/Sand/Clay)	13	304	78	0	28	12	0
Acres Deciduous Forest	4,967	73,084	3,853	2,983	28,854	5,541	4,077
Acres Evergreen Forest	1,460	2,385	12	42	46	0	0
Acres Mixed Forest	0	0	0	0	0	0	0
Acres Shrub/Scrub	0	0	0	0	0	2	0
Acres Grassland/ Herbaceous	17,355	141,283	4,144	10,882	80,637	30,599	12,791
Acres Pasture/Hay	4,687	34,783	1,516	3,883	22,775	207	106
Acres Cultivated Crops	2,471	15,353	117	1,408	25,383	5,115	1,817
Acres Woody Wetlands	0	0	0	0	0	0	0
Acres Emergent Herbaceous Wetlands	0	7	0	0	0	0	0
Total (Acres)	**31,782**	**285,343**	**10,380**	**20,505**	**171,191**	**42,798**	**19,754**

Table 1-4b Land Use Summaries by Watershed

Landuse Category	WQM Station						
	Bitter Creek	Washita River at US 281	Washita River at SH152	Washita River #145	Willow Creek	Washita River at SH 33	Quartermaster Creek
Waterbody ID	OK310820010030_00	OK310830010010_00	OK310830030010_00	OK310830030010_10	OK310830060030_00	OK310840010010_00	OK310840010060_00
Percent of Open Water	0.5	1.2	0.3	0.5	1.6	0.3	0.5
Percent of Developed, Open Space	4.0	4.9	3.7	3.4	4.5	1.6	0.8
Percent of Developed, Low Intensity	0.3	0.5	0.4	0.7	0.2	0.2	0.0
Percent of Developed, Medium Intensity	0.4	0.2	0.1	0.1	0.0	0.0	0.0
Percent of Developed, High Intensity	0.0	0.1	0.0	0.0	0.0	0.0	0.0
Percent of Barren Land (Rock/Sand/Clay)	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent of Deciduous Forest	5.2	7.6	0.5	0.2	4.2	0.0	0.0
Percent of Evergreen Forest	0.0	10.6	0.1	0.6	1.1	0.0	0.0
Percent of Mixed Forest	0.0	0.0	0.9	0.6	0.0	0.9	1.0
Percent of Shrub/Scrub	0.0	0.1	7.9	10.0	0.0	21.5	22.0
Percent of Grassland/Herbaceous	63.4	53.1	26.8	54.2	29.3	57.7	67.5
Percent of Pasture/Hay	0.2	0.4	0.0	0.0	0.1	0.0	0.0
Percent of Cultivated Crops	26.0	21.5	59.2	29.5	58.9	17.7	8.2
Percent of Woody Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Percent of Emergent Herbaceous Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acres Open Water (percent of total)	234	3,432	882	1,943	353	187	551
Acres Developed, Open Space	1,803	13,814	12,219	12,543	991	1,133	844

Landuse Category	WQM Station						
	Bitter Creek	**Washita River at US 281**	**Washita River at SH152**	**Washita River #145**	**Willow Creek**	**Washita River at SH 33**	**Quartermaster Creek**
Waterbody ID	**OK310820010030_00**	**OK310830010010_00**	**OK310830030010_00**	**OK310830030010_10**	**OK310830060030_00**	**OK310840010010_00**	**OK310840010060_00**
Acres Developed, Low Intensity	125	1,335	1,216	2,526	38	112	51
Acres Developed, Medium Intensity	157	432	360	435	5	13	18
Acres Developed, High Intensity	8	272	119	158	2	0	2
Acres Barren Land (Rock/Sand/Clay)	0	66	34	46	7	24	29
Acres Deciduous Forest	2,341	21,171	1,721	682	920	0	0
Acres Evergreen Forest	2	29,579	461	2,289	250	0	3
Acres Mixed Forest	0	2	3,062	2,358	0	641	1,079
Acres Shrub/Scrub	2	192	26,359	36,809	10	15,027	24,491
Acres Grassland/Herbaceous	28,347	148,644	88,846	199,795	6,495	40,345	75,321
Acres Pasture/Hay	68	999	24	85	31	0	0
Acres Cultivated Crops	11,635	60,142	196,628	108,710	13,054	12,391	9,146
Acres Woody Wetlands	0	0	126	83	0	20	28
Acres Emergent Herbaceous Wetlands	0	7	0	2	0	0	0
Total (Acres)	**44,723**	**280,086**	**332,061**	**368,463**	**22,156**	**69,892**	**111,563**

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

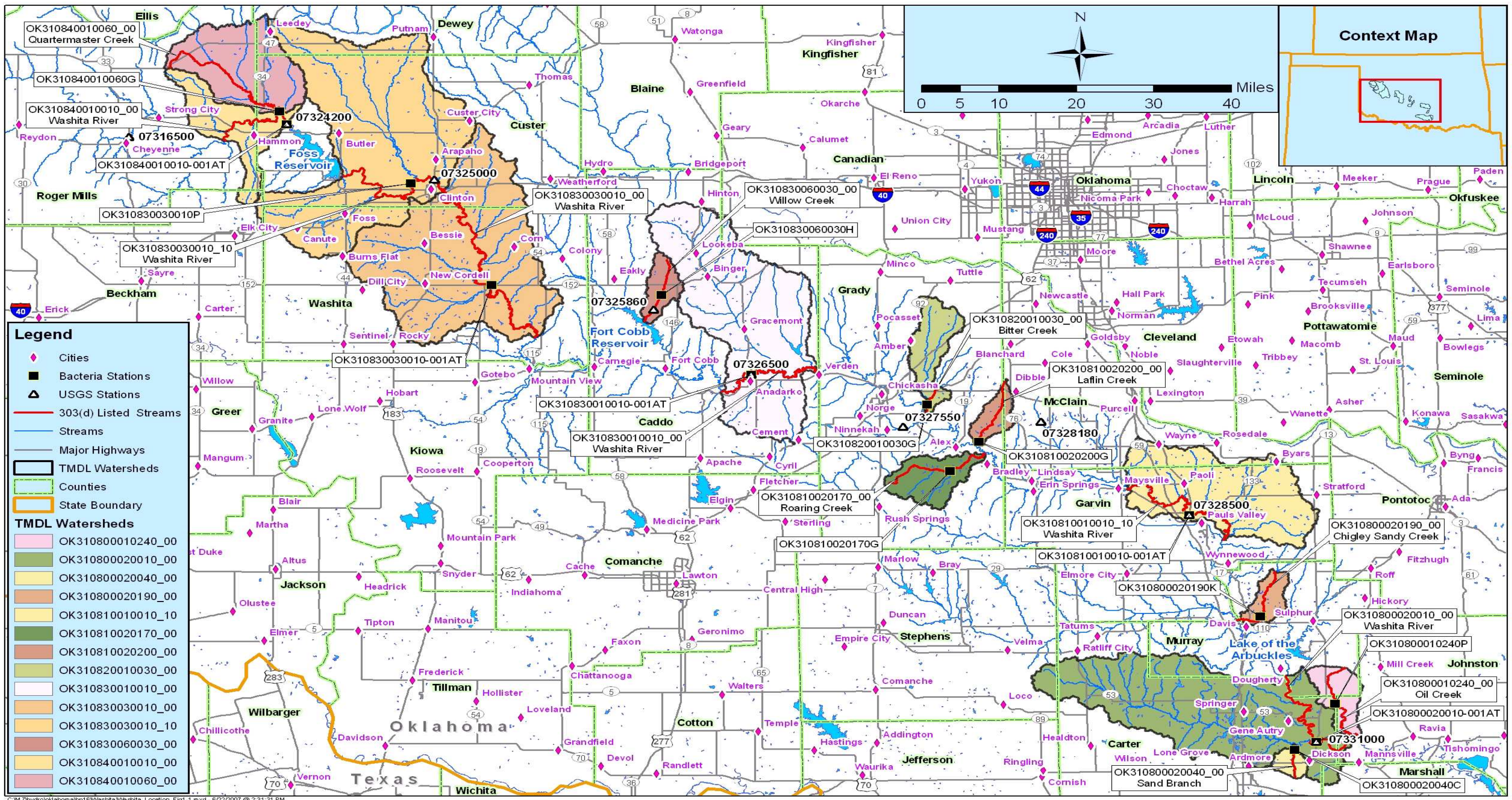
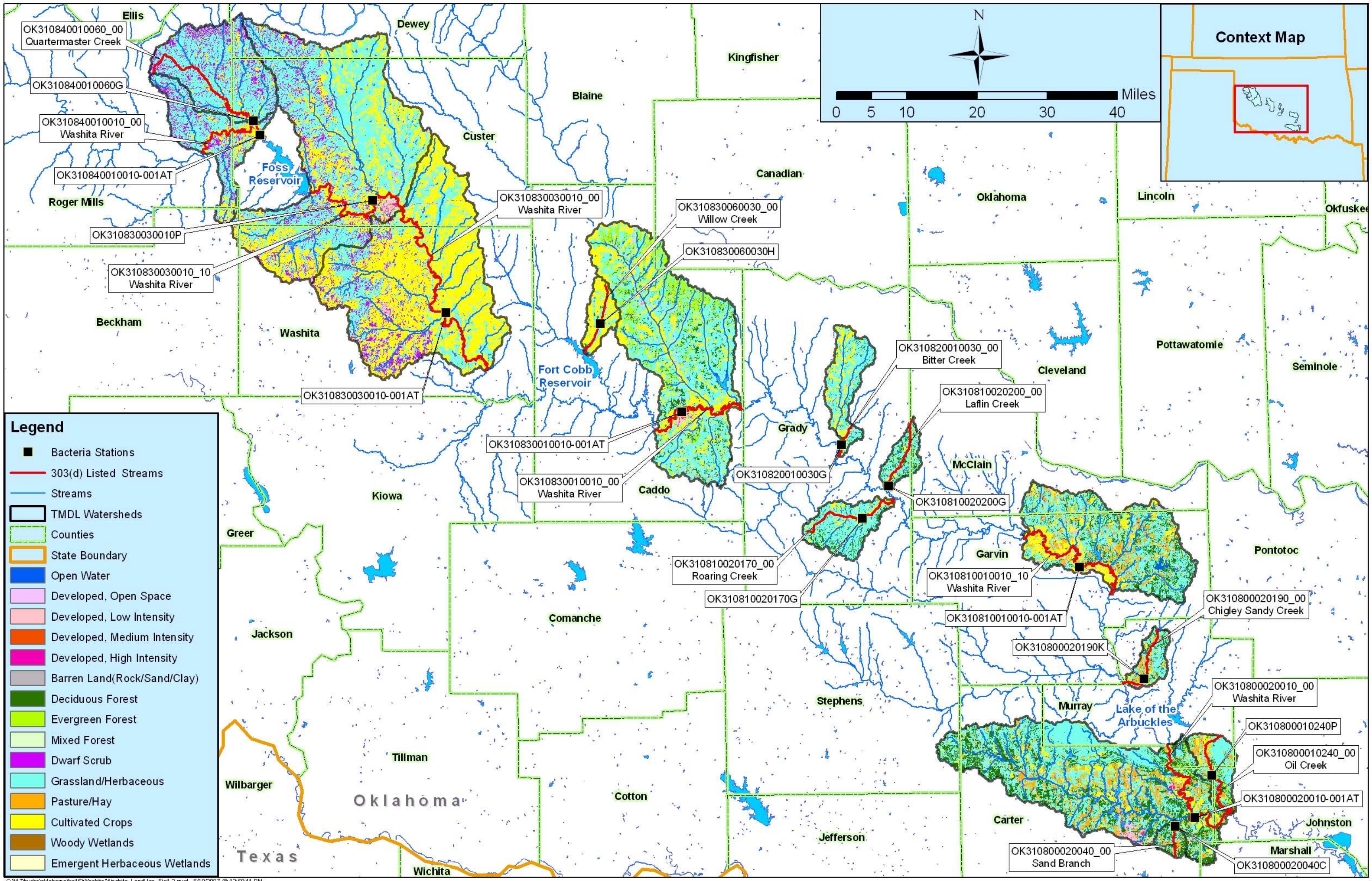


Figure 1-2 Land Use Map by Watershed



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 and implementation procedures (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 Oil Creek (OK310800010240), Washita River at US 177 (OK310800020010), Sand Branch (OK310800020040), Chigley Sandy Creek (OK310800020190), Washita River at SH 19 (OK310810010010), Roaring Creek (OK310810020170), Laflin Creek (OK310810020200), Bitter Creek (OK310820010030), Washita River at US 281 (OK310830010010), Washita River at SH 152 (OK310830030010_00), Washita River #145 (OK310830030010_10), Willow Creek (OK310830060030), Washita River at SH 33 (OK310840030010), and Quartermaster Creek (OK310840010060) include PBCR, public/private water supply, warm water aquatic community, industrial and municipal process and cooling water, agricultural water supply, fish consumption, sensitive water supply 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 and the priority for TMDL development established by ODEQ for the impaired waterbodies of the Study Area. 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
OK310800010240_00	Oil Creek	19.48	5	2009	N
OK310800020010_00	Washita River at US 177	31.584	5	2005	N
OK310800020040_00	Sand Branch	6.24	5	2009	N

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK310800020190_00	Chigley Sandy Creek	14.39	5	2009	N
OK310810010010_10	Washita River at SH 19	32.858	5	2005	N
OK310810020170_00	Roaring Creek	18.27	5	2009	N
OK310810020200_00	Laflin Creek	12.6	5	2009	N
OK310820010030_00	Bitter Creek	6.02	5	2009	N
OK310830010010_00	Washita River at US 281	29.773	5	2005	N
OK310830030010_00	Washita River at SH 152	52	5	2004	N
OK310830030010_10	Washita River #145	29.878	5	2004	N
OK310830060030_00	Willow Creek	11.01	5	2003	N
OK310840010010_00	Washita River at SH 33	34.32	4	2004	N
OK310840010060_00	Quartermaster Creek	32.98	5	2004	N

N = Not Attaining
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 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 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.

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 primary contact recreation season from the WQM stations between 1999 and 2002 for each indicator bacteria. This data collected during the primary contact recreation season was used to support the decision to place specific waterbodies within the Study Area on the ODEQ 2004 303(d) list (ODEQ 2004). Table 2-2 also summarizes instances where waterbodies or bacterial indicators are recommended for removal from or addition to the 303(d) list based on further data analysis associated with the preparation of this report. Water quality data from the primary and secondary contact recreation seasons are provided in Appendix A. For the data collected between 1999 and 2002, evidence of nonsupport of the PBCR use based on fecal coliform concentrations was observed in eight waterbodies: Oil Creek (OK310800010240), Sand Branch (OK310800020040), Chigley Sandy Creek (OK310800020190), Roaring Creek (OK310810020170), Laflin Creek (OK310810020200), Bitter Creek (OK310820010030), Willow Creek (OK310830060030) and Quartermaster Creek (OK310840010060). Evidence of nonsupport of the PBCR use based on fecal coliform and Enterococci concentrations were observed in four segments of the Washita River at US 177 (OK310800020010_00), Washita River at SH 19 (OK310810010010_10), Washita River at SH 152 (OK310830030010_00) and Washita River #145(OK310830030010_10). Evidence of nonsupport of the PBCR use based on Enterococci concentrations was observed in one segment of the Washita River at US 281 (OK310830010010_00). Evidence of nonsupport of the PBCR use based on all three bacterial indicator (fecal coliform, Enterococci and *E. coli*) concentrations was observed in one segment of the Washita River at SH 33 (OK310840010010_00). In Appendix C of the ODEQ 2004 Integrated Report total fecal coliform is also identified as a pollutant of concern for some 303(d) listed waterbodies. This indicator is typically associated with evaluating use impairment for waterbodies with drinking water as a designated use. However, because there are no drinking water intakes within 5 miles of the WQM stations associated with total fecal coliform samples collected, the listing of this bacterial indicator in Category 5 of the 2004 Integrated Report does not require the development of a TMDL. 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 bacterial indicators with three different numeric criterion for determining attainment of PBCR use as defined in the Oklahoma WQSs. An individual water quality target is established for each bacterial indicator since each indicator group must demonstrate compliance with the numeric criteria prescribed in the Oklahoma WQS (OWRB 2006). 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 Body Contact Recreation Season, 1999-2002

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
OK310800010240_00	Oil Creek	FC	400	708	10	4	40%	
		EC	406	120	2	0	0%	
		ENT	108	700	1	1	100%	
OK310800020010_00	Washita River at US 177	FC	400	204	19	8	42%	
		EC	406	80	19	4	21%	
		ENT	108	215	19	12	63%	
OK310800020040_00	Sand Branch Creek	FC	400	376	7	3	43%	
		EC	406					No Results Found
		ENT	108					No Results Found
OK310800020190_00	Chigley Sandy Creek	FC	400	405	10	6	60%	
		EC	406	65	2	0	0%	
		ENT	108	210	1	1	100%	
OK310810010010_10	Washita River at SH 19	FC	400	93	18	5	28%	
		EC	406	31	18	2	11%	
		ENT	108	234	18	11	61%	
OK310810020170_00	Roaring Creek	FC	400	927	7	6	86%	
		EC	406	160	5	1	20%	Delist: Low Sample Count
		ENT	108	996	5	4	80%	Delist: Low Sample Count
OK310810020200_00	Laflin Creek	FC	400	825	7	6	86%	
		EC	406	228	6	2	33%	Delist: Low Sample Count
		ENT	108	1083	6	6	100%	Delist: Low Sample Count
OK310820010030_00	Bitter Creek	FC	400	332	7	4	57%	
		EC	406	111	5	1	20%	Delist: Low Sample Count
		ENT	108	195	5	4	80%	Delist: Low Sample Count
OK310820020010_00	Little Washita River	FC	400	296	9	2	22%	Delist: <25%
		EC	406	29	5	0	0%	
		ENT	108	169	7	3	43%	Delist: Low Sample Count

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
OK310830010010_00	Washita River at US 281	FC	400	198	17	3	18%	
		EC	406	58	17	3	18%	
		ENT	108	216	17	11	65%	
OK310830030010_00	Washita River at SH 152	FC	400	264	17	6	35%	
		EC	406	90	18	4	22%	Delist: <GeoMean
		ENT	108	491	18	16	89%	List: >GeoMean+Daily Max
OK310830030010_00	Washita River # 466	FC	400	560	6	3	50%	
		EC	406	201	5	2	40%	Delist: Low Sample Count
		ENT	108	408	5	3	60%	
OK310830030010_10	Washita River # 145	FC	400	536	14	7	50%	
		EC	406	115	11	3	27%	
		ENT	108	240	11	7	64%	
OK310830030230_00	West Barnitz Creek	FC	400	306	8	2	25%	Delist: <25%
		EC	406	106	6	0	0%	
		ENT	108	576	6	6	100%	Delist: Low Sample Count
OK310830060030_00	Willow Creek	FC	400	753	13	6	46%	
		EC	406	159	5	1	20%	Delist: Low Sample Count
		ENT	108	1019	6	6	100%	Delist: Low Sample Count
OK310840010010_00	Washita River at SH 33	FC	400	451	17	7	41%	
		EC	406	173	17	5	29%	List: >GeoMean+Daily Max
		ENT	108	800	16	15	94%	
OK310840010060_00	Quartermaster Creek	FC	400	463	8	4	50%	
		EC	406	74	6	1	17%	Delist: Low Sample Count
		ENT	108	450	6	5	83%	Delist: Low Sample Count

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

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

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria		
			FC	ENT	*E. coli*
OK310800010240P	OK310800010240_00	Oil Creek	X		
OK310800020010-001AT	OK310800020010_00	Washita River at US177	X	X	
OK310800020040C	OK310800020040_00	Sand Branch	X		
OK310800020190K	OK310800020190_00	Chigley Sandy Creek	X		
OK310810010010-001AT	OK310810010010_10	Washita River at SH19	X	X	
OK310810020170G	OK310810020170_00	Roaring Creek	X		
OK310810020200G	OK310810020200_00	Laflin Creek	X		
OK310820010030G	OK310820010030_00	Bitter Creek	X		
OK310830010010-001AT	OK310830010010_00	Washita River at US 281		X	
OK310830030010-001AT	OK310830030010_00	Washita River at SH152	X	X	
OK310830030010P	OK310830030010_10	Washita River #145	X	X	
OK310830060030H	OK310830060030_00	Willow Creek	X		
OK310840010010-001AT	OK310840010010_00	Washita River at SH 33	X	X	X
OK310840010060G	OK310840010060_00	Quartermaster 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 bacterial indicators (fecal coliform, *E coli*, or Enterococci) in accordance with their permits. 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.

3.1 NPDES-Permitted Facilities

Under 40 CFR, §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 plant (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 no permitted MS4s within the study area. 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 Sand Branch (OK310800020040_00), Chigley Sandy Creek (OK310800020190_00), Roaring Creek (OK310810020170_00), Laflin Creek (OK310810020200_00), and Willow Creek (OK310830060030_00). Nine of the watersheds in the Study Area, including Oil Creek (OK310800010240_00), Washita River at US 177 (OK310800020010_00), Washita River at SH 19 (OK310810010010_10), Bitter Creek (OK310820010030_00), Washita River at US 281 (OK310830010010_00), Washita River at SH 152 (OK310830030010_00), Washita River #145 (OK310830030010_10), Washita River at SH 33 (OK310840010010_00), and

Quartermaster Creek (OK310840010060_00), have NPDES-permitted facilities. There are no permitted MS4s within this Study Area.

3.1.1 Continuous Point Source Dischargers

The locations of the NPDES-permitted facilities that discharge wastewater to surface waters addressed in these TMDLs are listed in Table 3-1 and displayed in Figure 3-1. For the purposes of the TMDLs calculated in Chapter 5, only facility types identified in Table 3-1 as Sewerage Systems 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

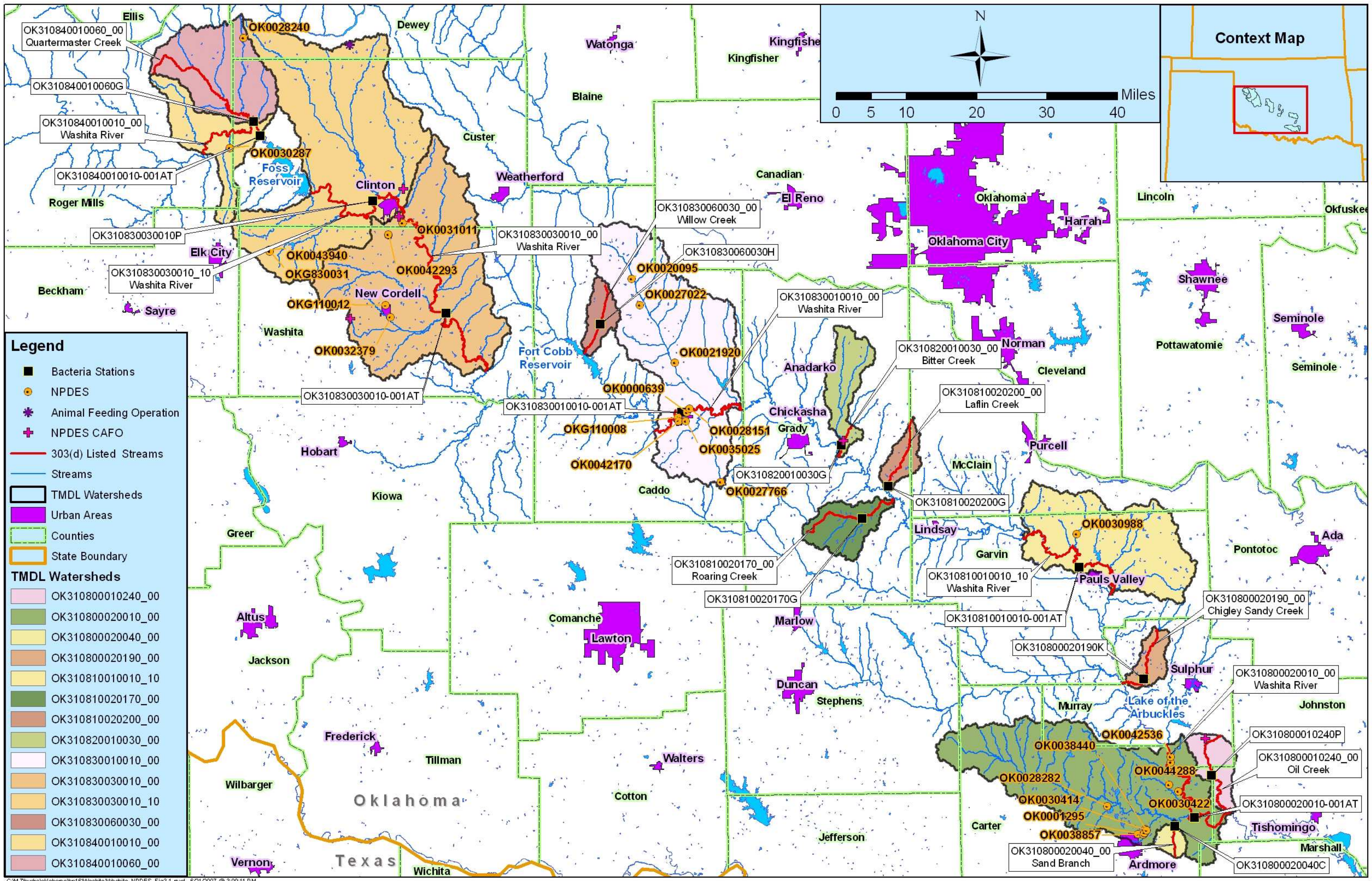
NPDES Permit No.	Name	Receiving Water	Facility Type	County Name	Design Flow (mgd)	Active/ Inactive	Facility ID
OK0030422	City of Ardmore-Industrial Park	OK310800020010_00 Washita River at US 177	Sewerage Systems	Carter	0.130	Active	S10840
OK0028282	Wynnewood Utilities Authority	OK310800020010_00 Washita River at US 177	Sewerage Systems	Garvin	0.750	Active	S10832
OK0038440	City of Ardmore-Central	OK310800020010_00 Washita River at US 177	Sewerage Systems	Carter	5.900	Active	S30804
OK0038857	Koch Materials Co-Ardmore Plant	OK310800020010_00 Washita River at US 177	Paving Mixtures And Blocks	Carter	N/A	Active	N/A
OK0044288	East Jordan Iron Works-Ardmore	OK310800020010_00 Washita River at US 177	Gray Iron Foundries	Carter	N/A	Active	N/A
OK0001295	TPI Petroleum Inc.-Ardmore Rep	OK310800020010_00 Washita River at US 177	Petroleum Refining	Carter	N/A	Active	N/A
OK0027766	Cement Public Works Authority	OK310830010010_00 Washita River at US 281	Sewerage Systems	Caddo	0.085	Active	S10821
OK0028151	Anadarko Public Works Authority	OK310830010010_00 Washita River at US 281	Sewerage Systems	Caddo	1.940	Active	S10817
OK0000639	Western Farmers Elec-Anadarko	OK310830010010_00 Washita River at US 281	Electrical Services	Caddo	N/A	Active	N/A
OK0032379	City of Cordell	OK310830030010_00 Washita River at SH 152	Sewerage Systems	Washita	0.406	Active	S10811
OK0031011	City of Clinton	OK310830030010_00 Washita River at SH 152	Sewerage Systems	Custer	1.700	Active	S10804
OKG110012	Dolese-Cordell Batch Plant	OK310830030010_00 Washita River at SH 152	Ready-Mixed Concrete	Washita	N/A	Active	N/A
OK0042536	Dolese Bros. Co.-Big Canyon	OK310800020010_00 Washita River at US 177	Crushed And Broken Limestone	Carter	N/A	Inactive	N/A

NPDES Permit No.	Name	Receiving Water	Facility Type	County Name	Design Flow (mgd)	Active/ Inactive	Facility ID
OK0030988	Town of Paoli	OK310810010010_10 Washita River at SH 19	Sewerage Services	Garvin	N/A	Inactive	S10828
OK0042170	Anadarko Batch	OK310830010010_00 Washita River at US 281	Ready-Mixed Concrete	Caddo	N/A	Inactive	N/A
OKG110008	Anadarko Batch Plant	OK310830010010_00 Washita River at US 281	Ready-Mixed Concrete	Caddo	N/A	Inactive	N/A
OK0042293	United Parcel Service-Clinton	OK310830030010_00 Washita River at SH 152	Arrangement of Transportation of Freight and Cargo	Washita	N/A	Inactive	N/A
OK0043940	Town of Canute	OK310830030010_10 Washita River #145	Sewerage Services	Washita	N/A	Inactive	S10803
OKG830031	Former Ferguson Gulf	OK310830030010_10 Washita River #145	Sanitary Services, Not Elsewhere Classified	Washita	N/A	Inactive	N/A
OK0028240	Town of Leedey	OK310840010060_00 Quartermaster Creek	Sewerage Services	Dewey	N/A	Inactive	N/A
OK0030414	City of Ardmore (NE WWTP)	OK310800020010_00 Washita River at US 177	Sewerage Systems	Carter	N/A	N/A	N/A
OK0020095	Caddo Co Rwd#1, Lookaba	OK310830010010_00 Washita River at US 281	Sewerage Systems	Caddo	N/A	N/A	N/A
OK0021920	Town of Gracemont	OK310830010010_00 Washita River at US 281	Sewerage Systems	Caddo	N/A	N/A	N/A
OK0027022	Town of Binger Public Works Authority	OK310830010010_00 Washita River at US 281	Sewerage Systems	Caddo	N/A	N/A	N/A
OK0035025	Anadarko Public Works Authority	OK310830010010_00 Washita River at US 281	Sewerage Systems	Caddo	N/A	N/A	N/A
OK0030287	City of Hammon	OK310840010010_00 Washita River at SH 33	Sewerage Systems	Roger Mills	N/A	N/A	N/A

N/A = not available

Discharge Monitoring Reports (DMR) were used to determine the number of fecal coliform analyses performed from 1998 through 2006, the maximum concentration during this period, the number of violations occurring when the monthly geometric mean concentration exceeded 200 colony-forming units (cfu)/100 milliliter (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 Anadarko Public Works Authority, Wynnewood Utilities Authority, City of Clinton, and City of Ardmore-Central (see Appendix B). These data indicate that there are no violations occurring at the Wynnewood Utilities Authority and the City of Clinton. However, Anadarko Public Works Authority violated monthly geometric mean permit limits for fecal coliform 1 percent of the time and City of Ardmore-Central violated monthly geometric mean permit limits 8 percent of the time. Given the limited amount of data, it is not possible to provide an adequate evaluation on the performance of WWTPs in the impaired watersheds with respect to their compliance with fecal coliform permit limits over time.

Figure 3-1 Locations of NPDES-Permitted Facilities in the Study Area



3.1.2 NPDES No-Discharge Facilities and Sanitary Sewer Overflows

There are 12 NPDES-permitted no-discharge facilities within the Study Area. The locations of these facilities are listed in Table 3-2. For the purposes of these TMDLs, it is assumed that no-discharge facilities do not contribute bacteria loading to the Washita 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.

Table 3-2 NPDES No-Discharge Facilities in the Study Area

Facility	Facility ID	County	Facility Type	Type	Watershed	Active/ Inactive
Fox RWD # 1 WWTP	10866	Carter	Lagoon (Total Retention)	Municipal	OK310800020010_00 Washita River at US 177	N/A
Springer WWTP	10880	Carter	Lagoon (Total Retention)	Municipal	OK310800020010_00 Washita River at US 177	N/A
Byars Lagoon	30805	McClain	Lagoon (Total Retention)	Municipal	OK310810010010_10 Washita River at SH 19	N/A
Longmire Rec Area C WWTP	30813	Garvin	Lagoon (Total Retention)	Municipal	OK310810010010_10 Washita River at SH 19	N/A
Longmire Rec Area A WWTP	30814	Garvin	Lagoon (Total Retention)	Municipal	OK310810010010_10 Washita River at SH 19	N/A
Domino Washout & Rest Pens Inc.	WD94-020	Custer	Land Application	Industrial	OK310830030010_00 Washita River at SH 152	N/A
Burns Flat-North Lagoon	10809	Washita	Lagoon (Total Retention)	Municipal	OK310830030010_00 Washita River at SH 152	N/A
Bessie Lagoon	10810	Washita	Lagoon (Total Retention)	Municipal	OK310830030010_00 Washita River at SH 152	N/A
Golden West MHP WWTP	30801	Washita	Lagoon (Total Retention)	Municipal	OK310830030010_00 Washita River at SH 152	N/A
Arapaho WWTP	10807	Custer	Lagoon (Total Retention)	Municipal	OK310830030010_10 Washita River #145	N/A
Foss	20822	Washita	Lagoon (Total Retention)	Municipal	OK310830030010_10 Washita River #145	N/A
Custer City Lagoons	30810	Custer	Lagoon (Total Retention)	Municipal	OK310830030010_10 Washita River #145	N/A

N/A = not available

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 over the last 6 years 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 590 SSO occurrences, ranging from 0 to over 1 million gallons, reported from four different waterbodies in the Study Area between January 1990 and

April 2007. Table 3-3 summarizes the facilities in the Study Area that reported SSOs. Additional data on each individual SSO event are provided in Appendix B. Given the significant number of occurrences and the size of the overflows reported, SSOs have been a significant source of bacteria loading in the past in the Washita River at US 177 (OK310800020010_00) and Washita River at US 152 (OK310830030010_00) watersheds.

Table 3-3 Sanitary Sewer Overflow Summary

Facility Name	NPDES Permit No.	Receiving Water	Facility ID	Number of Occurrences	Date Range		Amount (Gallons)	
					From	To	Min	Max
Ardmore	OK0030422	OK310800020010_00 Washita River at US 177	S10840	80	11/02/2004	04/04/2007	200	245,520
Ardmore	OK0038440	OK310800020010_00 Washita River at US 177	S30804	413	01/17/1990	03/28/2007	0	1,128,000
Wynnewood	OK0028282	OK310800020010_00 Washita River at US 177	S10832	5	03/15/1990	07/16/2001	10	20,000
Paoli	OK0030988	OK310810010010_10 Washita River at SH 19	S10828	25	03/30/1993	04/12/2007	100	3,000
Anadarko	OK0028151	OK310830010010_00 Washita River at US 281	S10817	32	02/14/1992	06/28/2004	0	103,415
Cement	OK0027766	OK310830010010_00 Washita River at US 281	S10821	6	03/28/1995	09/25/2006	27	5,000
Clinton	OK0031011	OK310830030010_00 Washita River at SH 152	S10804	16	11/17/1994	07/29/2006	5	185,000
Cordell	OK0032379	OK310830030010_00 Washita River at SH 152	S10811	13	05/18/1994	10/18/2005	0	200,000

N/A = not available

3.1.3 NPDES Municipal Separate Storm Sewer Discharge

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 MS4

Phase II of the rule 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. 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 MS4 permit for small communities in Oklahoma became effective on February 8, 2005. There are NO permitted MS4s in the study area.

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. ODEQ provides information on the current status of the MS4 program on its website, which can be found at: http://www.deq.state.ok.us/WQDnew/stormwater/ms4/.

3.1.4 Concentrated Animal Feeding Operations

The Agricultural Environmental Management Services (AEMS) of the Oklahoma Department of Agriculture, Food and Forestry (ODAFF) was created to help develop, coordinate, and oversee environmental policies and programs aimed at protecting the Oklahoma environment from pollutants associated with agricultural animals and their waste. Through regulations established by the Oklahoma Concentrated Animal Feeding Operation Act, AEMS works with producers and concerned citizens to ensure that animal waste does not impact the waters of the state. A CAFO is an animal feeding operation that confines and feeds at least 1,000 animal units for 45 days or more in a 12-month period (ODAFF 2005). The CAFO Act is designed to protect water quality through the use of best management practices (BMP) such as dikes, berms, terraces, ditches, or other similar structures used to isolate animal waste from outside surface drainage, except for a 25-year, 24–hour rainfall event (ODAFF 2005). CAFOs are considered no-discharge facilities.

CAFOs are designated by USEPA as significant sources of pollution, and may have the potential to cause serious impacts to water quality if not managed properly. Potential problems for CAFOs can include animal waste discharges to waters of the state and failure to properly operate wastewater lagoons.

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.

Figure 3-1 depicts the locations of the five different CAFO facilities located in Bitter Creek (OK310820010030_00), Washita River at SH 152 (OK310830030010_00), Washita River #145 (OK310830030010_10), and Oil Creek (OK310800010240_00). Table 3-4 lists the CAFOs located in the Study Area. Washita River at US 177, Sand Branch, Chigley Sandy Creek, Washita River at SH 19, Roaring Creek, Laflin Creek, Washita River at US 281, Willow Creek, Washita River at SH 33, and Quartermaster Creek have no CAFOs within their contributing watershed.

Table 3-4 NPDES-Permitted CAFOs in Study Area

ODAFF Owner ID	EPA facility	ODAFF ID	ODAFF License Number	Maximum Number of Permitted Animals at Facility					Total # of Animal Units at Facility	County	Watershed
				Chickens	Chickens laying hens	Slaughter Feeder Cattle	Swine >55 lbs	Swine <55 lbs			
AGN032893	OKG010075	106	1434			1000			1000	Grady	OK310820010030_00 Bitter Creek
AGN021637	OKG010219	34	1155				2000	1994	999	Washita	OK310830030010_00 Washita River at SH 152
WQ0000067	OKG010062	175	58			2500			2500	Custer	OK310830030010_00 Washita River at SH 152
AGN007199	OKG010056	13	52			3000			3000	Custer	OK310830030010_10 Washita River #145
AGN015557	OKG010060	29	1035	1	1200000				14640	Murray	OK310800010240_00 Oil Creek

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, agricultural activities and domesticated animals, land application fields, urban runoff, failing onsite wastewater disposal (OSWD) systems and domestic pets. As previously stated, there are no NPDES-permitted facilities in the Sand Branch, Chigley Sandy Creek, Roaring Creek, Laflin Creek, and Willow Creek watersheds; therefore, nonsupport of PBCR use in these watersheds is caused by nonpoint sources of bacteria only.

Bacteria associated with urban runoff can emanate from humans, wildlife, livestock, 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. BMPs such as buffer strips and proper disposal of domestic animal waste 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 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 3-5 provides the estimated number of deer for each watershed.

Table 3-5 Estimated Deer Populations

Waterbody ID	Waterbody Name	Deer	Acre
OK310800010240_00	Oil Creek	296	31,776
OK310800020010_00	Washita River, US 177	2,135	285,325
OK310800020040_00	Sand Branch	77	10,373
OK310800020190_00	Chigley Sandy Creek	164	20,512
OK310810010010_10	Washita River, SH 19	915	171,190
OK310810020170_00	Roaring Creek	235	42,792
OK310810020200_00	Laflin Creek	106	19,755
OK310820010030_00	Bitter Creek	246	44,729
OK310830010010_00	Washita River, US 281	2,692	280,065
OK310830030010_00	Washita River, SH 152	1,403	332,185
OK310830030010_10	Washita River # 145	1,983	368,626
OK310830060030_00	Willow Creek	214	22,166
OK310840010010_00	Washita River, SH 33	477	69,908
OK310840010060_00	Quartermaster Creek	754	111,570

According to a livestock study conducted by ASAE (the American Society of Agricultural Engineers), deer release approximately $5x10^8$ 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 3-6 in cfu/day provides a relative magnitude of loading in each watershed.

Table 3-6 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
OK310800010240_00	Oil Creek	31,776	296	0.009	1,482
OK310800020010_00	Washita River, US 177	285,325	2135	0.007	10,676
OK310800020040_00	Sand Branch	10,373	77	0.007	384
OK310800020190_00	Chigley Sandy Creek	20,512	164	0.008	822
OK310810010010_10	Washita River, SH 19	171,190	915	0.005	4,576
OK310810020170_00	Roaring Creek	42,792	235	0.005	1,176
OK310810020200_00	Laflin Creek	19,755	106	0.005	531
OK310820010030_00	Bitter Creek	44,729	246	0.005	1,228
OK310830010010_00	Washita River, US 281	280,065	2692	0.010	13,460
OK310830030010_00	Washita River, SH 152	332,185	1403	0.004	7,015
OK310830030010_10	Washita River # 145	368,626	1983	0.005	9,915
OK310830060030_00	Willow Creek	22,166	214	0.010	1,070
OK310840010010_00	Washita River, SH 33	69,908	477	0.007	2,385
OK310840010060_00	Quartermaster Creek	111,570	754	0.007	3,768

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). Examples of livestock activities that can contribute to bacteria sources include:

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

Table 3-7 provides estimated numbers of selected livestock by watershed based on the 2002 U.S. Department of Agriculture (USDA) county agricultural census data (USDA 2002). The estimated livestock populations in Table 3-7 were derived by using the percentage of the watershed within each county. Because the watersheds are generally much smaller than the counties, and livestock are not evenly distributed across counties or constant with time, these are rough estimates only. Cattle are clearly the most abundant species of livestock in the Study Area 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 from livestock. The estimated acreage by watershed where manure was applied in 2002 is shown in Table 3-7. These estimates are also based on the county level reports from the 2002 USDA county agricultural census, and thus, represent approximations of the livestock populations in each watershed. Despite the lack of specific data, for the purpose of these TMDLs, land application of livestock manure is considered a potential source of bacteria loading to the watersheds in the Study Area.

According to a livestock study conducted by the ASAE, the daily fecal coliform production rates by livestock 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 livestock populations and the fecal coliform production rates from ASAE, an estimate of fecal coliform production from each group of livestock was calculated in each watershed of the Study Area in Table 3-8. 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 again appear to represent the most likely livestock source of fecal bacteria. For informational purposes, data on livestock operations provided by ODAFF are summarized in Table 3-9. Table 3-9 lists an estimated number of livestock within select watersheds for which data are available. These numbers are considered more representative since they are based on the number of permitted livestock within the selected watershed derived from an ODAFF GIS inventory. The general location of livestock operations are shown in Figure 3-1. However, for consistency, estimated fecal coliform production for the general category of livestock is based on USDA county agriculture census numbers as summarized in Table 3-8.

Table 3-7 Livestock and Manure 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
OK310800010240_00	Oil Creek	3,609	142	104	287	44	24	7	21	108
OK310800020010_00	Washita River, US 177	31,998	243	1,209	750	430	339	353	1,007	691
OK310800020040_00	Sand Branch	1,150	2	45	20	16	13	15	40	23
OK310800020190_00	Chigley Sandy Creek	2,506	141	73	173	31	24	1	7	119
OK310810010010_10	Washita River, SH 19	25,443	295	1,146	374	526	602	132	248	978
OK310810020170_00	Roaring Creek	7,904	1,035	158	71	212	1,133	16	100	178
OK310810020200_00	Laflin Creek	3,523	372	99	31	106	462	7	67	103
OK310820010030_00	Bitter Creek	8,255	1,081	165	74	222	1,184	17	104	186
OK310830010010_00	Washita River, US 281	45,698	114	699	62	467	8,067	43	257	971
OK310830030010_00	Washita River, SH 152	50,927	193	363	716	390	0	11	183	1,094
OK310830030010_10	Washita River # 145	44,977	297	530	293	739	17	50	268	1,395
OK310830060030_00	Willow Creek	3,614	8	55	5	37	643	3	20	77
OK310840010010_00	Washita River, SH 33	6,599	70	129	35	35	24	2	48	63
OK310840010060_00	Quartermaster Creek	10,829	107	195	50	88	33	6	82	151

Table 3-8 Fecal Coliform Production Estimates for Selected Livestock ($x10^9$ number/day)

Waterbody ID	Waterbody Name	Cattle & Calves-all	Dairy Cows	Horses & Ponies	Goats	Sheep & Lambs	Hogs & Pigs	Ducks & Geese	Chickens & Turkeys	Total
OK310800010240_00	Oil Creek	375,337	14,338	44	N/A	533	256	88	3	390,599
OK310800020010_00	Washita River, US 177	3,327,778	24,556	508	N/A	5,155	3,659	3,055	136	3,364,846
OK310800020040_00	Sand Branch	119,558	240	19	N/A	188	138	124	5	120,273
OK310800020190_00	Chigley Sandy Creek	260,655	14,283	31	N/A	375	257	4	1	275,605
OK310810010010_10	Washita River, SH 19	2,646,028	29,763	481	N/A	6,313	6,503	2,486	32	2,691,605
OK310810020170_00	Roaring Creek	822,060	104,566	66	N/A	2,548	12,239	300	13	941,792
OK310810020200_00	Laflin Creek	366,351	37,529	42	N/A	1,268	4,992	127	9	410,316
OK310820010030_00	Bitter Creek	858,566	109,209	69	N/A	2,661	12,783	313	14	983,615
OK310830010010_00	Washita River, US 281	4,752,559	11,506	294	N/A	5,604	87,120	408	34	4,857,524
OK310830030010_00	Washita River, SH 152	5,296,405	19,520	152	N/A	4,684	0	26	25	5,320,813
OK310830030010_10	Washita River # 145	4,677,634	30,047	223	N/A	8,873	179	150	36	4,717,142
OK310830060030_00	Willow Creek	375,894	853	23	N/A	438	6,946	31	3	384,187
OK310840010010_00	Washita River, SH 33	686,260	7,092	54	N/A	418	264	6	7	694,101
OK310840010060_00	Quartermaster Creek	1,126,252	10,798	82	N/A	1,058	355	22	11	1,138,577

Table 3-9 Estimated Number of Livestock for Animal Operations Inventoried by ODAFF

ODAFF Owner ID	ODAFF ID	ODAFF License Number	Maximum Number of Permitted Slaughter Feeder Cattle at Facility	Total # of Animal Units at Facility	County	Watershed
AGN031858	90	1388	450	450	Dewey	OK310830030010_10 Washita River #145

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 and 8 percent in the Texas Panhandle 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 3-10 summarizes estimates of sewered and unsewered households for each watershed in the Study Area.

Table 3-10 Estimates of Sewered and Unsewered Households

Waterbody ID	Waterbody Name	Public Sewer	Septic Tank	Other Means	Housing Units	% Sewered
OK310800010240_00	Oil Creek	58	157	5	220	26%
OK310800020010_00	Washita River, US 177	3,850	2,380	74	6,305	61%
OK310800020040_00	Sand Branch	97	239	2	338	29%
OK310800020190_00	Chigley Sandy Creek	303	167	5	474	64%
OK310810010010_10	Washita River, SH 19	1,916	1,177	39	3,131	61%
OK310810020170_00	Roaring Creek	129	301	9	440	29%
OK310810020200_00	Laflin Creek	52	130	4	186	28%
OK310820010030_00	Bitter Creek	79	351	4	434	18%
OK310830010010_00	Washita River, US 281	3,323	1,918	20	5,262	63%
OK310830030010_00	Washita River, SH 152	3,213	1,049	49	4,311	75%
OK310830030010_10	Washita River # 145	4,252	1,017	12	5,281	81%
OK310830060030_00	Willow Creek	105	123	4	232	45%
OK310840010010_00	Washita River, SH 33	474	116	1	591	80%
OK310840010060_00	Quartermaster Creek	91	151	1	243	37%

For the purpose of estimating fecal coliform loading in watersheds, an OSWD failure rate of 12 percent was used for Oil Creek (OK310800010240_00), Washita River at US 177 (OK310800020010_00), Sand Branch (OK310800020040_00), Chigley Sandy Creek (OK310800020190_00), Washita River at SH 19 (OK310810010010_10), Roaring Creek (OK310810020170_00), Laflin Creek (OK310810020200_00), and Bitter Creek (OK310820010030_00). The failure rate of 8 percent was used for Washita River at US 281 (OK310830010010_00), Washita River at SH 152 (OK310830030010_00), Washita River #145 (OK310830030010_10), Willow Creek (OK310830060030_00), Washita River at SH 33 (OK310840010010_00), and Quartermaster Creek (OK310840010060_00). Using both 12 and 8 percent failure rates, 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 3-11.

Table 3-11 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)
OK310800010240_00	Oil Creek	31,776	157	19	122
OK310800020010_00	Washita River, US 177	285,325	2,380	286	1,847
OK310800020040_00	Sand Branch	10,373	239	29	186
OK310800020190_00	Chigley Sandy Creek	20,512	167	20	129
OK310810010010_10	Washita River, SH 19	171,190	1,177	141	913
OK310810020170_00	Roaring Creek	42,792	301	36	234
OK310810020200_00	Laflin Creek	19,755	130	16	101
OK310820010030_00	Bitter Creek	44,729	351	42	272
OK310830010010_00	Washita River, US 281	280,065	1,918	153	992
OK310830030010_00	Washita River, SH 152	332,185	1,049	84	542
OK310830030010_10	Washita River # 145	368,626	1,017	81	526
OK310830060030_00	Willow Creek	22,166	123	10	64
OK310840010010_00	Washita River, SH 33	69,908	116	9	60
OK310840010060_00	Quartermaster Creek	111,570	151	12	78

3.2.4 Domestic Pets

Fecal matter from dogs and cats, which is transported to streams by runoff from urban and suburban areas 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 3-12 summarizes the estimated number of dogs and cats for the watersheds of the Study Area.

Table 3-12 Estimated Number of Pets

Waterbody ID	Waterbody Name	Dogs	Cats
OK310800010240_00	Oil Creek	123	145
OK310800020010_00	Washita River, US 177	3,531	4,161
OK310800020040_00	Sand Branch	189	223
OK310800020190_00	Chigley Sandy Creek	266	313
OK310810010010_10	Washita River, SH 19	1,753	2,066
OK310810020170_00	Roaring Creek	246	290
OK310810020200_00	Laflin Creek	104	122
OK310820010030_00	Bitter Creek	243	286
OK310830010010_00	Washita River, US 281	2,947	3,473
OK310830030010_00	Washita River, SH 152	2,414	2,846
OK310830030010_10	Washita River # 145	2,957	3,486
OK310830060030_00	Willow Creek	130	153
OK310840010010_00	Washita River, SH 33	331	390
OK310840010060_00	Quartermaster Creek	136	160

Table 3-13 provides an estimate of the fecal coliform load from pets. These estimates are based on estimated fecal coliform production rates of $5.4x10^8$ per day for cats and $3.3x10^9$ per day for dogs (Schueler 2000).

Table 3-13 Estimated Fecal Coliform Daily Production by Pets ($x10^9$)

Waterbody ID	Waterbody Name	Dogs	Cats	Total
OK310800010240_00	Oil Creek	407	79	486
OK310800020010_00	Washita River, US 177	11,651	2,247	13,898
OK310800020040_00	Sand Branch	625	121	745
OK310800020190_00	Chigley Sandy Creek	876	169	1,045
OK310810010010_10	Washita River, SH 19	5,786	1,116	6,902
OK310810020170_00	Roaring Creek	813	157	969
OK310810020200_00	Laflin Creek	343	66	409
OK310820010030_00	Bitter Creek	802	155	956
OK310830010010_00	Washita River, US 281	9,724	1,875	11,599
OK310830030010_00	Washita River, SH 152	7,968	1,537	9,504
OK310830030010_10	Washita River # 145	9,760	1,882	11,642
OK310830060030_00	Willow Creek	429	83	512
OK310840010010_00	Washita River, SH 33	1,092	211	1,303
OK310840010060_00	Quartermaster Creek	449	87	536

3.3 Summary of Bacteria Sources

Table 3-14 summarizes the suspected sources of bacteria loading in each impaired watershed. As indicated in the table there are no point sources in Sand Branch, Chigley Sandy Creek, Roaring Creek, Laflin Creek, and Willow Creek watersheds; therefore, nonsupport of PBCR use in these watersheds is caused by nonpoint sources of bacteria only. In watersheds with both point and nonpoint sources of bacteria, the available data suggests that the proportion of bacteria from point sources ranges from minor to moderate. Those waterbodies in which point sources are a minor contributor of bacteria include Oil Creek (OK310800010240_00), Bitter Creek (OK310820010030_00), Washita River at SH 19 (OK310810010010_10), Washita River #145 (OK310830030010_10), Washita River at SH 33 (OK310840010010_00), and Quartermaster Creek (OK310840010060_00). In the remaining three watersheds, Washita River at US 177 (OK310800020010_00), Washita River at US 281 (OK310830010010_00), and Washita River at SH 152 (OK310830030010_00), point sources such as WWTP, SSOs, and CAFOs, contribute moderate bacteria loads in proportion to nonpoint sources. However, overall nonpoint sources are considered to be the major source of bacteria loading in each watershed.

Table 3-14 Estimated Major Source of Bacteria Loading by Watershed

Waterbody ID	Waterbody Name	Point Sources	Nonpoint Sources	Major Source
OK310800010240_00	Oil Creek	Yes	Yes	Nonpoint
OK310800020010_00	Washita River, US 177	Yes	Yes	Nonpoint
OK310800020040_00	Sand Branch	No	Yes	Nonpoint
OK310800020190_00	Chigley Sandy Creek	No	Yes	Nonpoint
OK310810010010_10	Washita River, SH 19	Yes	Yes	Nonpoint
OK310810020170_00	Roaring Creek	No	Yes	Nonpoint
OK310810020200_00	Laflin Creek	No	Yes	Nonpoint
OK310820010030_00	Bitter Creek	Yes	Yes	Nonpoint
OK310830010010_00	Washita River, US 281	Yes	Yes	Nonpoint
OK310830030010_00	Washita River, SH 152	Yes	Yes	Nonpoint
OK310830030010_10	Washita River # 145	Yes	Yes	Nonpoint
OK310830060030_00	Willow Creek	No	Yes	Nonpoint
OK310840010010_00	Washita River, SH 33	Yes	Yes	Nonpoint
OK310840010060_00	Quartermaster Creek	Yes	Yes	Nonpoint

Table 3-15 below provides a summary of the estimated fecal coliform loads in cfu/day for the four major nonpoint source categories (livestock, pets, deer, and septic tanks) that are contributing to the elevated bacteria concentrations in each watershed. Livestock are estimated to be the largest 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 have quantified these effects, bacteria may die off or survive at different rates depending on the manure characteristics and a number of other environmental conditions. Also, the structural properties of some manures, such as cow patties, may limit their washoff into streams by runoff. In contrast, malfunctioning septic tank effluent may be present in standing water on the surface, or in shallow groundwater, which may enhance its conveyance to streams.

Table 3-15 Summary of Fecal Coliform Load Estimates from Nonpoint Sources to Land Surfaces (x10^9 counts/day)

Waterbody ID	Waterbody Name	All Livestock	Pets	Deer	Estimated Loads from Septic Tanks
OK310800010240_00	Oil Creek	390,599	486	148	122
OK310800020010_00	Washita River, US 177	3,364,846	13,898	1,068	1,847
OK310800020040_00	Sand Branch	120,273	745	38	186
OK310800020190_00	Chigley Sandy Creek	275,605	1,045	82	129
OK310810010010_10	Washita River, SH 19	2,691,605	6,902	458	913
OK310810020170_00	Roaring Creek	941,792	969	118	234
OK310810020200_00	Laflin Creek	410,316	409	53	101
OK310820010030_00	Bitter Creek	983,615	956	123	272
OK310830010010_00	Washita River, US 281	4,857,524	11,599	1,346	992
OK310830030010_00	Washita River, SH 152	5,320,813	9,504	701	542
OK310830030010_10	Washita River # 145	4,717,142	11,642	991	526
OK310830060030_00	Willow Creek	384,187	512	107	64
OK310840010010_00	Washita River, SH 33	694,101	1,303	238	60
OK310840010060_00	Quartermaster Creek	1,138,577	536	377	78

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.

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 4-14 are flow duration curves for each impaired waterbody. No flow gage exists on Oil Creek, segment OK310800010240_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07327550 (Little Washita River east of Ninnekah, OK). The flow period used for this station was 1992 through 2006.

The flow duration curve for Washita River at US 177, segment OK310800020010_00 was based on measured flows at USGS gage station 07331000 (Washita River near Dickson, OK). This gage is co-located with WQM station OK310800020010-001AT. The flow duration curve was based on measured flows from 1962 through 2006.

No flow gage exists on Sand Branch, segment OK310800020040_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07316500 (Washita River near Cheyenne, OK). The flow period used for this station was 1937 through 2006.

No flow gage exists on Chigley Sandy Creek , segment OK310800020190_00 Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07328180 (North Criner Creek near Criner, OK). The flow period used for this station was 1989 through 2006.

The flow duration curve for Washita River at SH 19, segment OK310810010010_10 was based on measured flows at USGS gage station 07328500 (Washita River near Pauls Valley, OK). This gage is co-located with WQM station OK310810010010-001AT. The flow duration curve was based on measured flows from 1962 through 2006.

No flow gage exists on Roaring Creek, segment OK310810020170_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07237550 (Little Washita River east of Ninnekah, OK). The flow period used for this station was 1992 through 2006.

No flow gage exists on Laflin Creek, segment OK310810020200_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07327550 (Little Washita River east of Ninnekah, OK). The flow period used for this station was 1992 through 2006.

No flow gage exists on Bitter Creek, segment OK310820010030_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07328180 (North Criner Creek near Criner, OK). The flow period used for this station was 1989 through 2006.

The flow duration curve for Washita River at US 281, segment OK310830010010_00 was based on measured flows at USGS gage station 07326500 (Washita River at Anadarko, OK). This gage is co-located with WQM station OK310830010010-001AT. The flow duration curve was based on measured flows from 1964 through 2006.

No flow gage exists on Washita River at SH 152, segment OK310830030010_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07325000 (Washita River near Clinton, OK). The flow period used for this station was 1962 through 2006.

The flow duration curve for Washita River #145, segment OK310830030010_10 was based on measured flows at USGS gage station 07325000 (Washita River near Clinton, OK). The flow period used for this station was 1962 through 2006.

The flow duration curve for Willow Creek, segment OK310830060030_00 was based on measured flows at USGS gage station 07325860 (Willow Creek near Albert, OK). The flow duration curve was based on measured flows from 1970 through 1979 and 2005 through 2006.

The flow duration curve for Washita River at SH 33, segment OK310840010010_00 was based on measured flows at USGS gage station 07324200 (Washita River near Hammon, OK). The flow duration curve was based on measured flows from 1970 through 2006.

No flow gage exists on Quartermaster Creek, segment OK310840010060_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07301420 (Sweetwater Creek near Sweetwater, OK). The flow period used for this station was 1986 through 2006.

Figure 4-1 Flow Duration Curve for Oil Creek (OK310800010240_00)

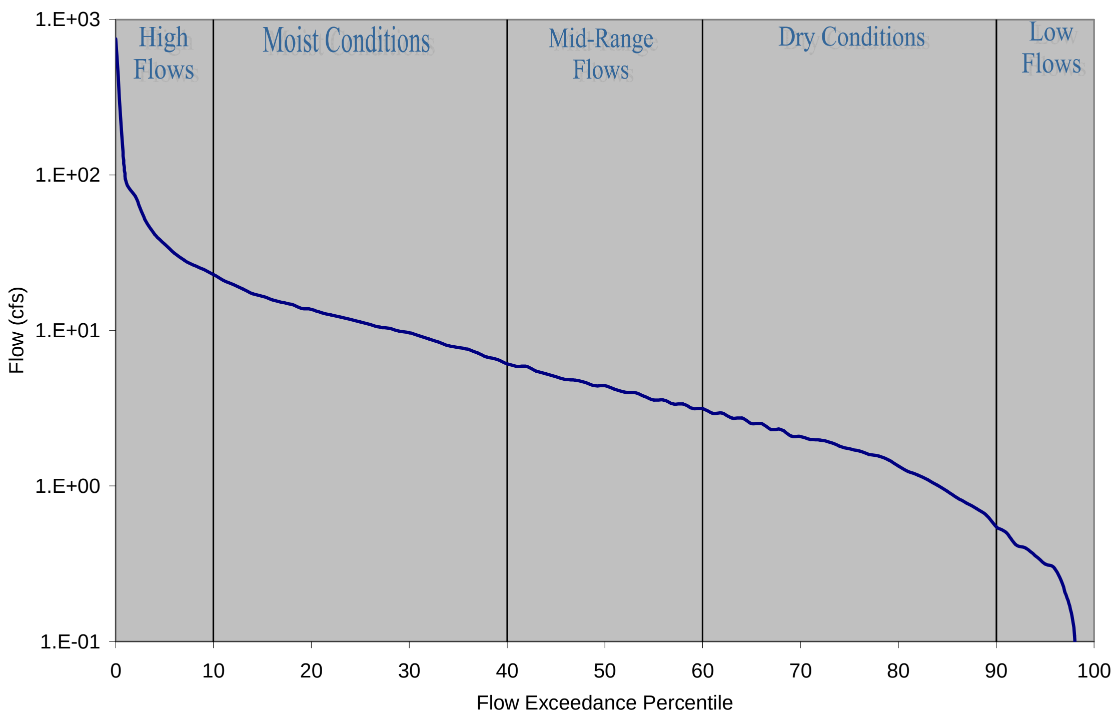


Figure 4-2 Flow Duration Curve for Washita River at US 177 (OK310800020010_00)

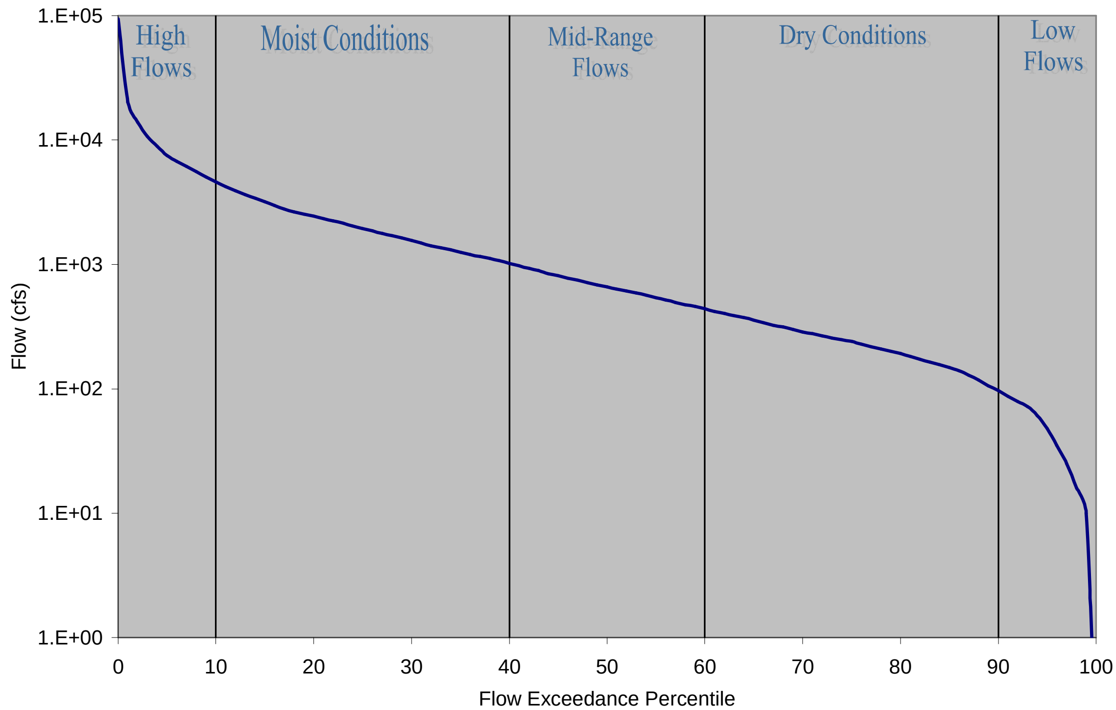


Figure 4-3 Flow Duration Curve for Sand Branch (OK310800020040_00)

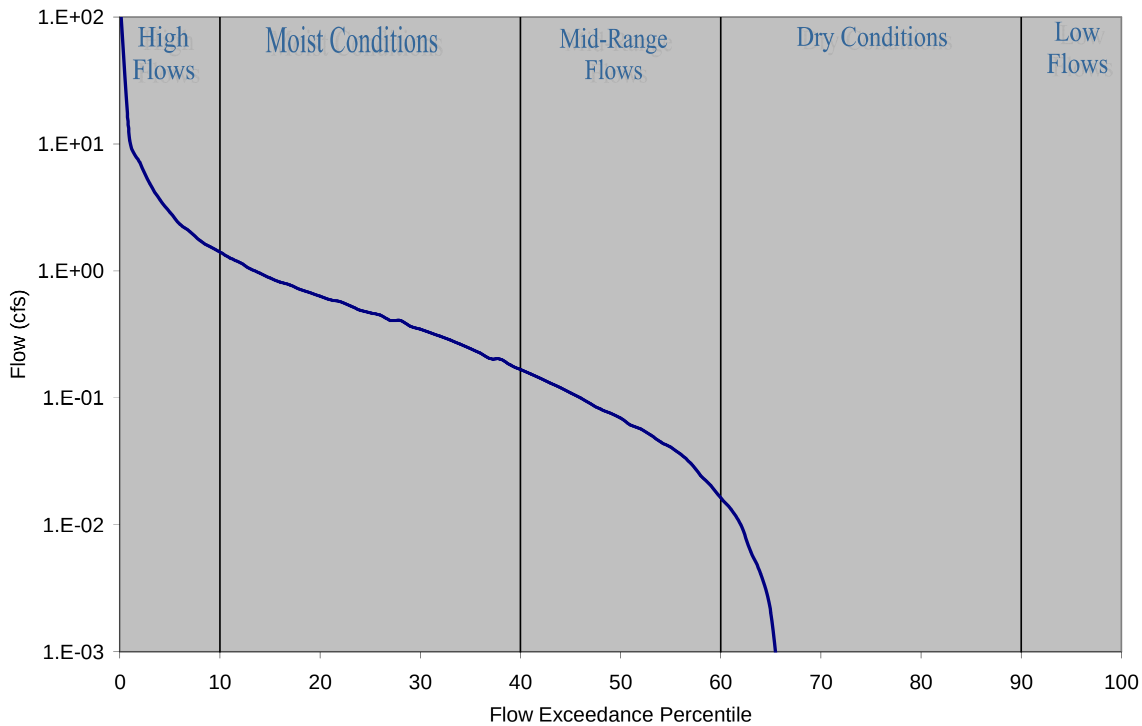
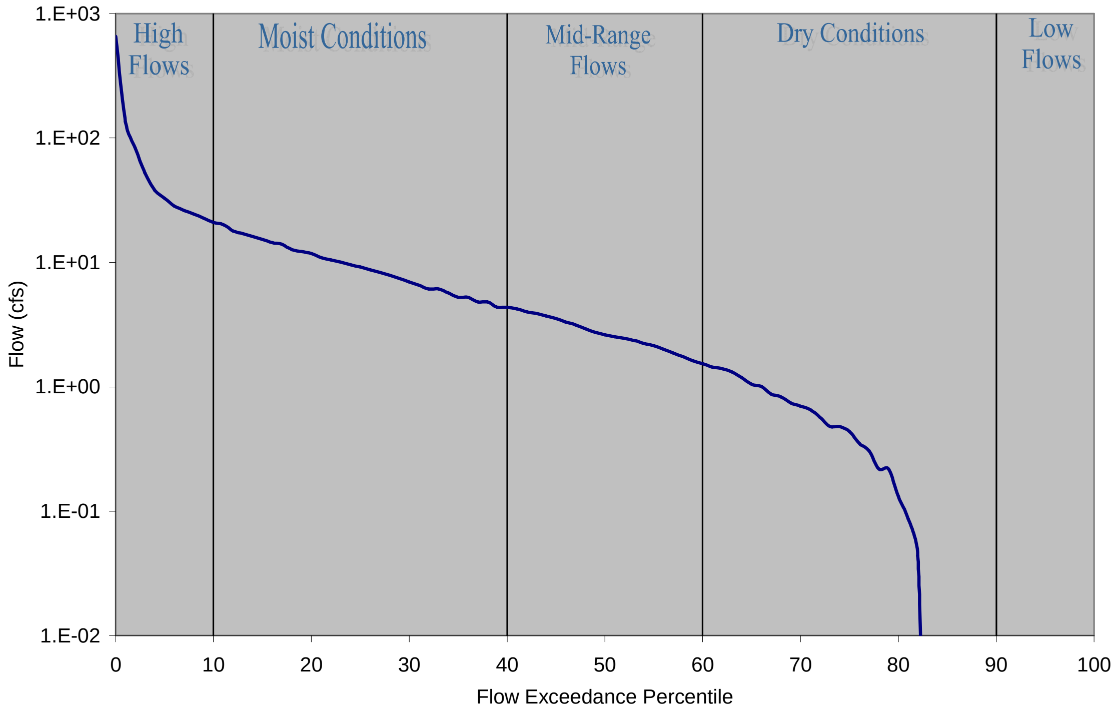


Figure 4-4 Flow Duration Curve for Chigley Sandy Creek (OK310800020190_00)



Note: The stepped curve is caused by extremely low flow conditions near the limit of quantitation, as well as data rounding conventions.

Figure 4-5 Flow Duration Curve for Washita River at SH 19 (OK310810010010_10)

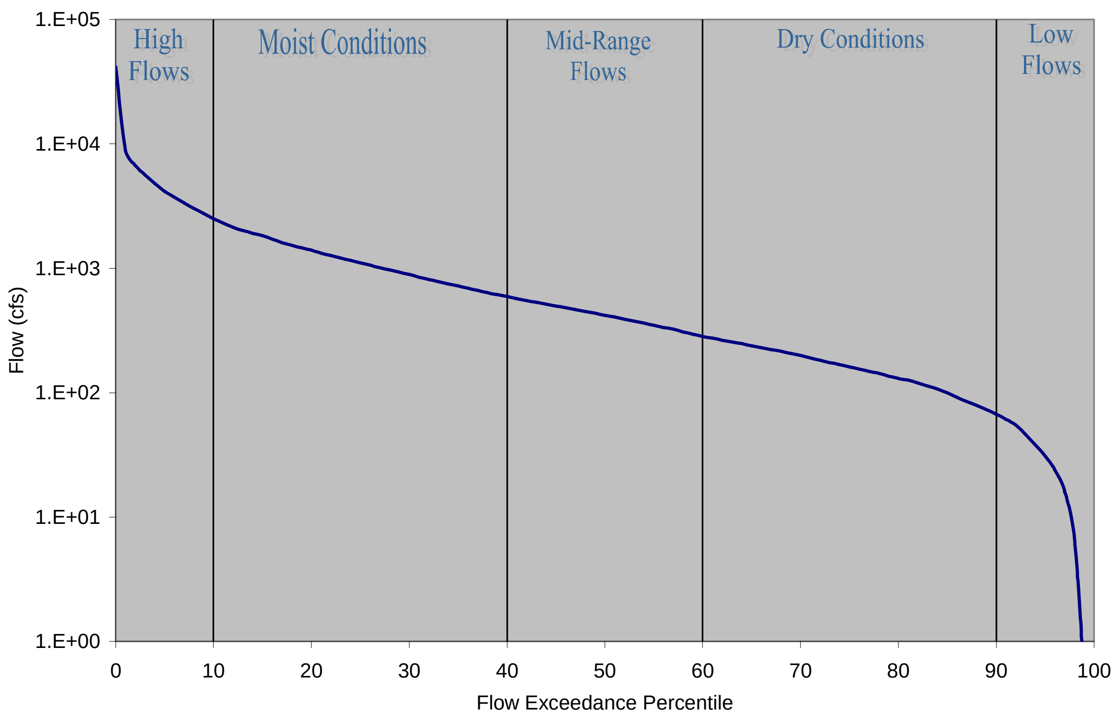


Figure 4-6 Flow Duration Curve for Roaring Creek (OK310810020170_00)

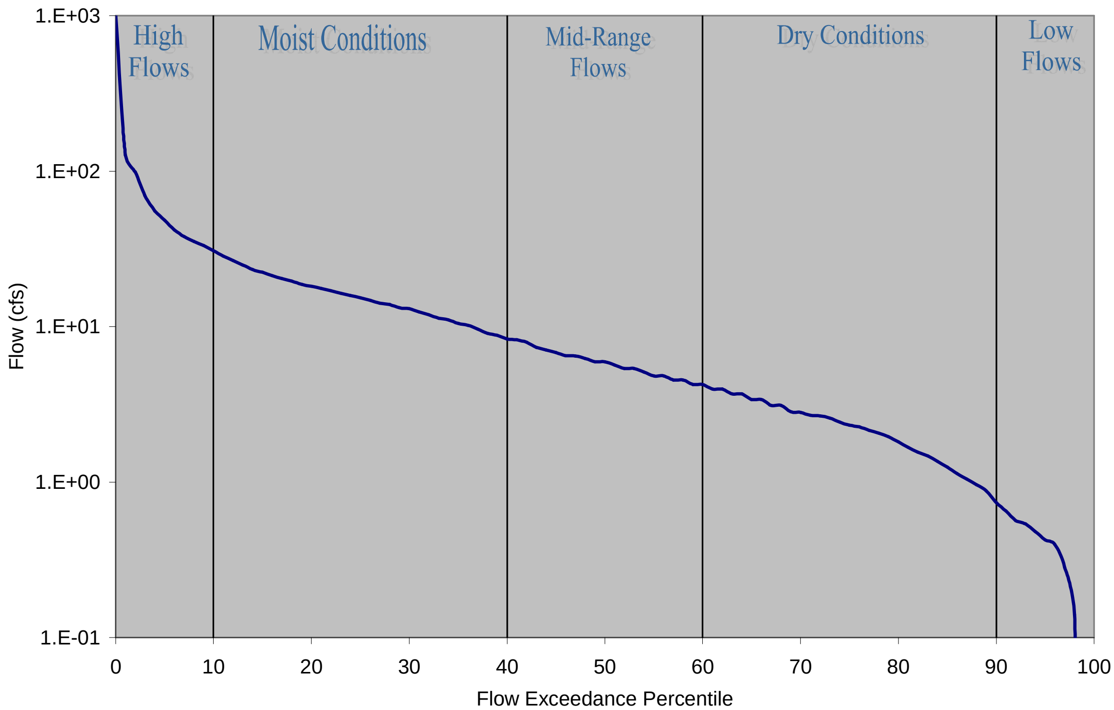


Figure 4-7 Flow Duration Curve for Laflin Creek (OK310810020200_00)

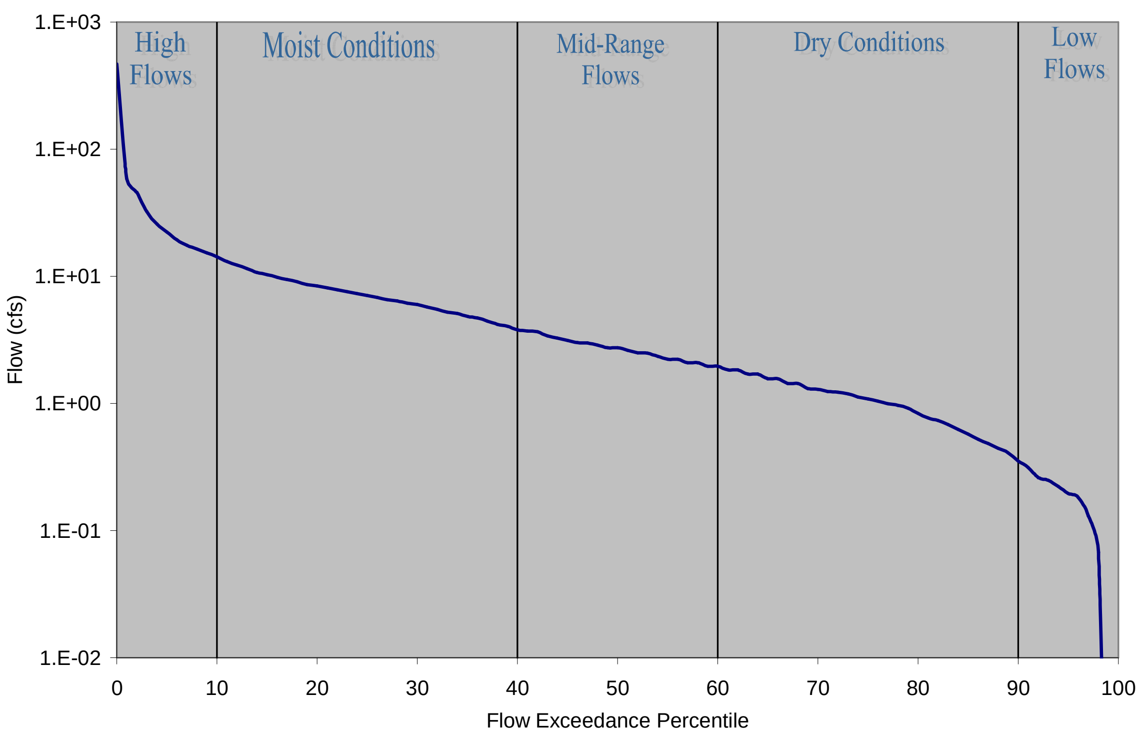
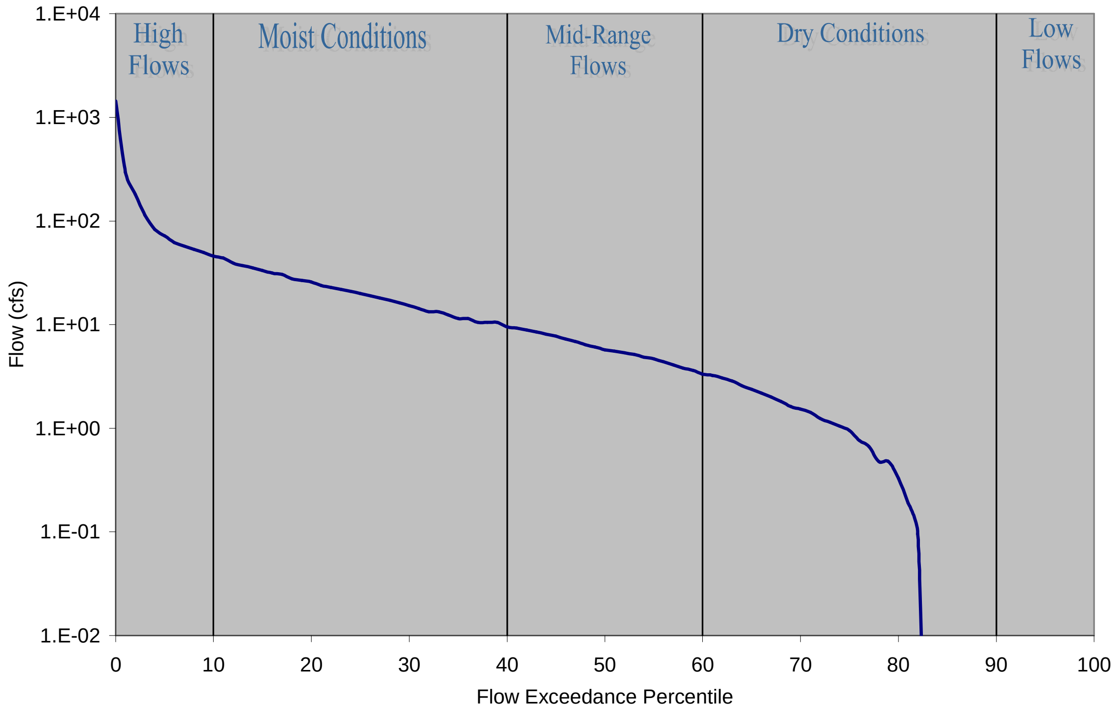


Figure 4-8 Flow Duration Curve for Bitter Creek (OK310820010030_00)



Note: The stepped curve is caused by extremely low flow conditions near the limit of quantitation, as well as data rounding conventions.

Figure 4-9 Flow Duration Curve for Washita River at US 281 (OK310830010010_00)

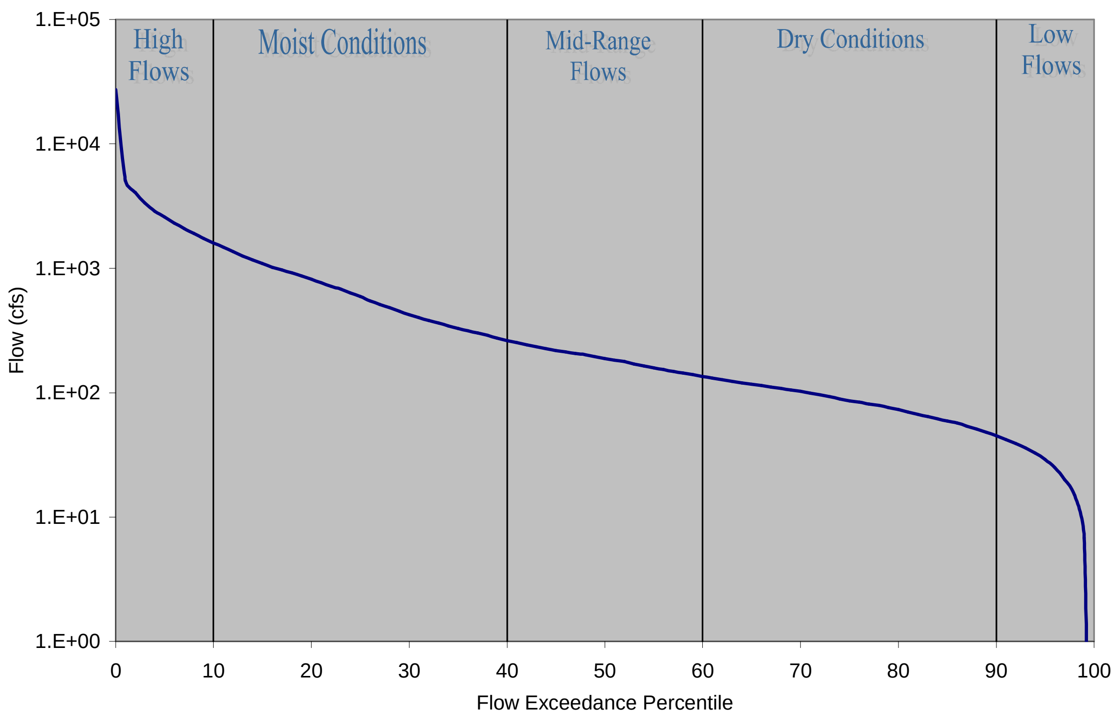


Figure 4-10 Flow Duration Curve for Washita River at SH 152 (OK310830030010_00)

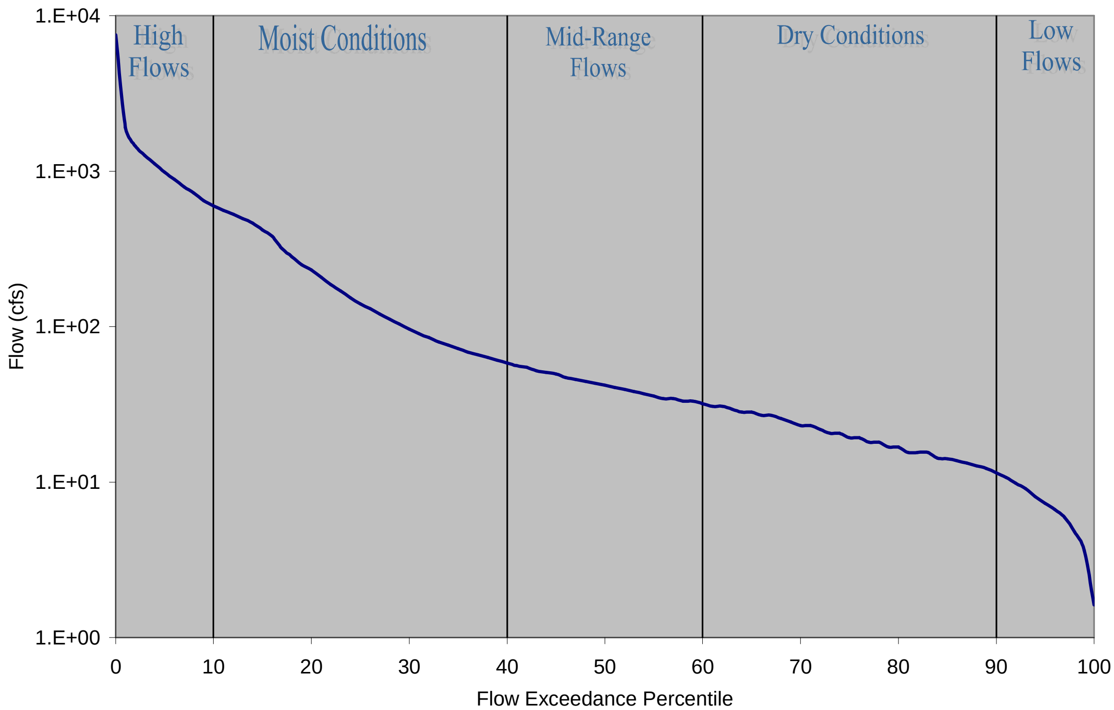


Figure 4-11 Flow Duration Curve for Washita River #145 (OK310830030010_10)

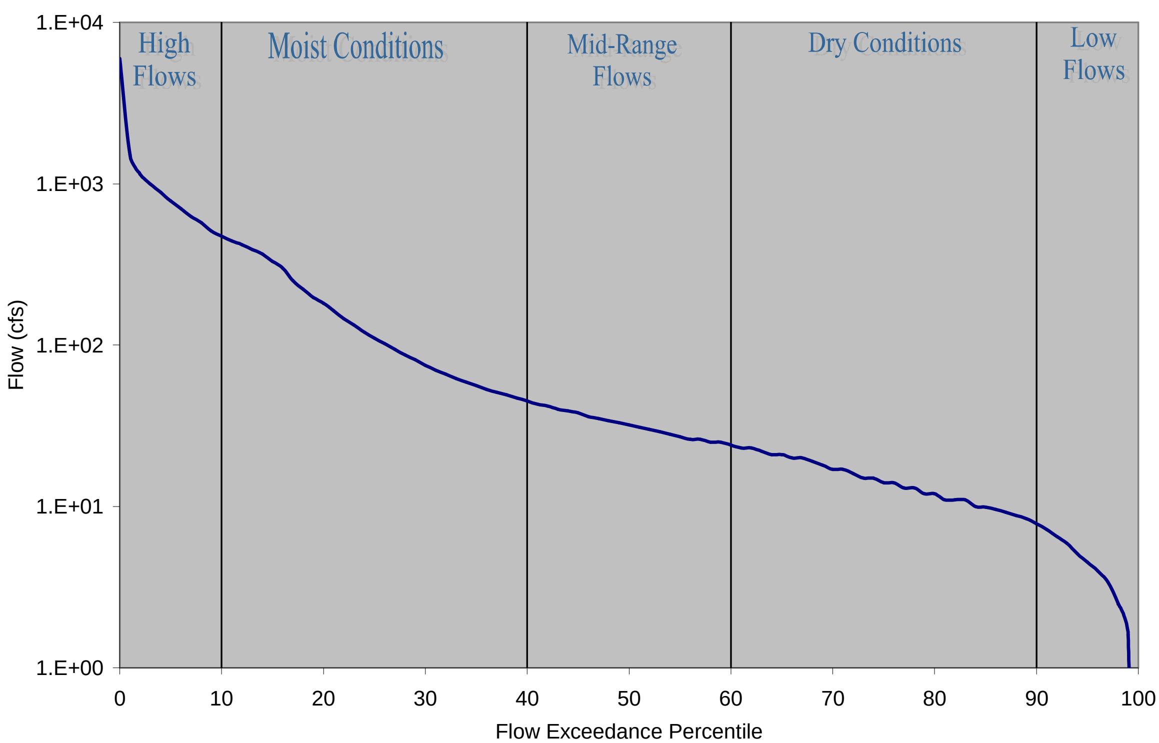


Figure 4-12 Flow Duration Curve for Willow Creek (OK310830060030_00)

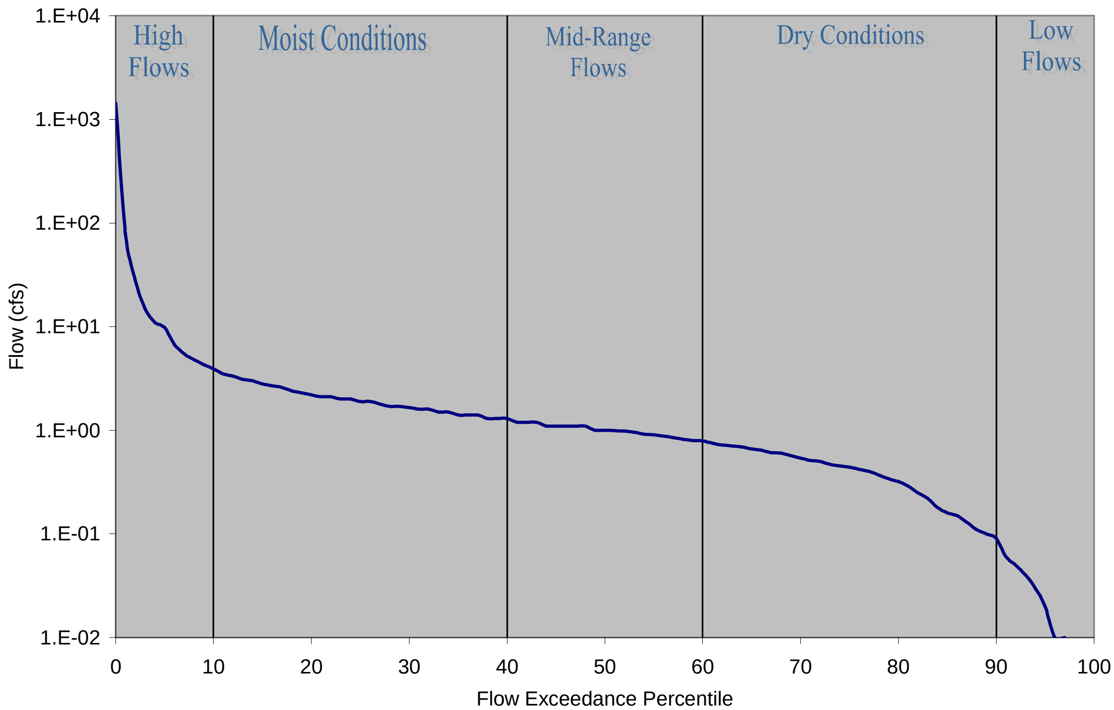


Figure 4-13 Flow Duration Curve for Washita River at SH 33 (OK310840010010_00)

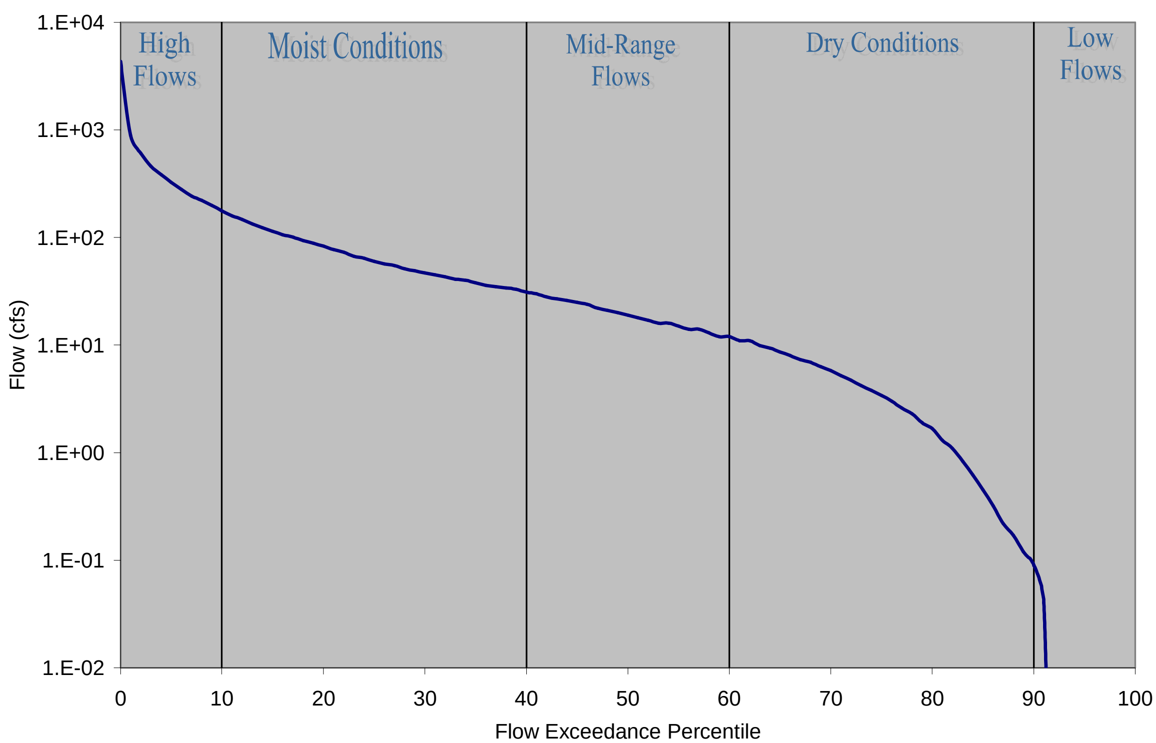
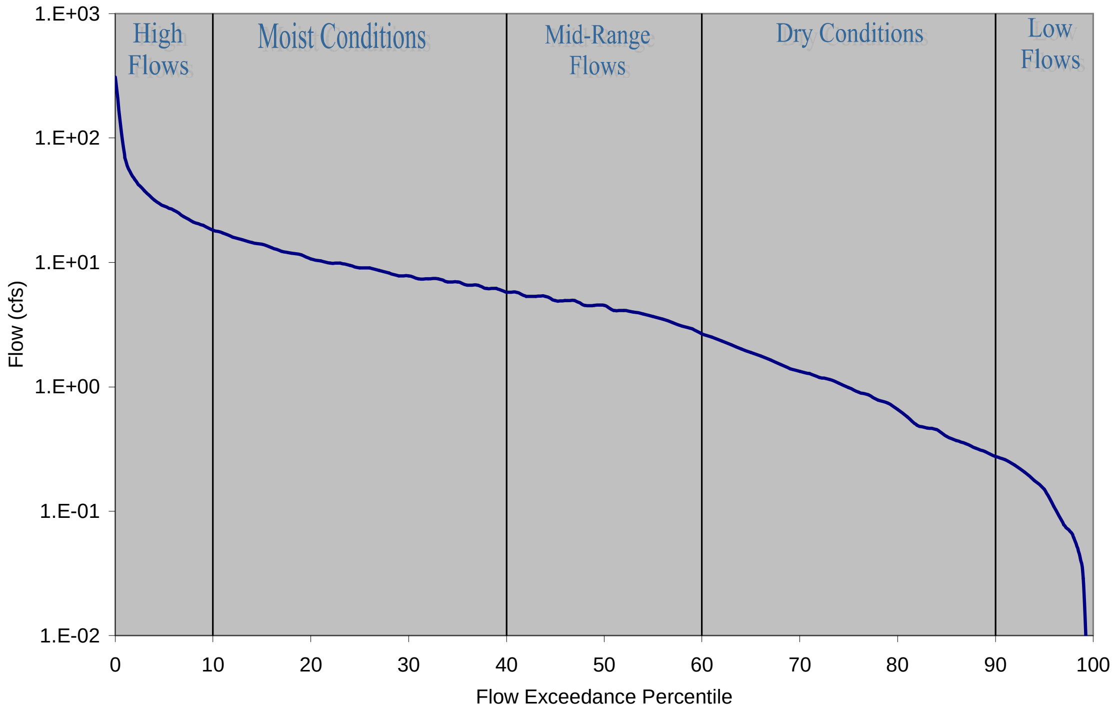


Figure 4-14 Flow Duration Curve for Quartermaster Creek (OK310840010060_00)



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. Where available, data necessary for this calculation were extracted from each point source's discharge monitoring reports from 1997 through 2006. The 90th percentile value of the monthly loads was used to express the estimated existing point source load in counts/day. 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 were used as a conservative surrogate for nonpoint loading. Existing instream loads were calculated as the 90th percentile of measured bacteria concentrations multiplied by the flow rate under various flow conditions.

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;
- displaying 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 (colonies/100 mL) by the instantaneous flow (cubic feet per second) 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 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 load allocation for point sources is defined by the WLA. A point source can be either a wastewater (continuous) or stormwater (MS4) discharge. Stormwater discharges 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 in cases of watersheds with no existing or planned continuous permitted point sources. For watersheds with permitted point sources, wasteloads 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: 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. 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 – MOS - ∑WLA

WLA for MS4s. When there are permitted MS4s in the watershed, WLAs for MS4s will be caluculated based on area prorated LA. 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. 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 bacterial 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 PRG 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 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 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 bacterial 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 mLs / ft^3 day*) and the criterion specific to each bacterial 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 1^{st} through September 30^{th}) 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 the unit conversion factor of *24,465,525 mLs / 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 so 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 bacterial indicator must be met in each impaired waterbody.

Table 5-1 presents the percent reductions necessary for each bacterial 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 these WQM stations. Based on this table, the TMDL PRGs for Washita River at US 177, Washita River at SH 19, Washita River at US 281, Washita River at SH 152, Washita River # 145 and Washita River at SH 33 will be based on Enterococci. The TMDL PRGs for Oil Creek, Sand Branch, Chigley Sandy Creek, Roaring Creek, Laflin Creek, Bitter Creek, Willow Creek, and Quartermaster Creek will be based on fecal coliform.

Table 5-1 TMDL Percent Reductions Required to Meet Water Quality Standards for Impaired Waterbodies in the Washita River Study Area

Waterbody ID	WQM Station	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instant-aneous	Instant-aneous	Geo-mean	Instant-aneous	Geo-mean
OK310800010240_00	OK310800010240P	Oil Creek	**91%**				
OK310800020010_00	OK310800020010-001AT	Washita River, US 177	40%			96%	**86%**
OK310800020040_00	OK310800020040C	Sand Branch	**85%**				
OK310800020190_00	OK310800020190K	Chigley Sandy Creek	**70%**				
OK310810010010_10	OK310810010010-001AT	Washita River, SH 19	51%			97%	**87%**
OK310810020170_00	OK310810020170G	Roaring Creek	**80%**				
OK310810020200_00	OK310810020200G	Laflin Creek	**82%**				
OK310820010030_00	OK310820010030G	Bitter Creek	**64%**				
OK310830010010_00	OK310830010010-001AT	Washita River, US 281				95%	**86%**
OK310830030010_00	OK310830030010-001AT	Washita River, SH 152	40%			97%	**94%**
OK310830030010_10	OK310830030010P	Washita River # 145	72%			95%	**88%**
OK310830060030_00	OK310830060030H	Willow Creek	**82%**				
OK310840010010_00	OK310840010010-001AT	Washita River, SH 33	49%	40%	34%	98%	**96%**
OK310840010060_00	OK310840010060G	Quartermaster Creek	**64%**				

A subset of the LDCs for each impaired waterbody (representing the primary contact recreation season from 1997 through 2003) are shown in Figures 5-1 through 5-14. While some waterbodies may be listed for multiple bacterial indicators, only one LDC for each waterbody is presented in Figures 5-1 through 5-14 – the LDC for the bacterial indicator that is highlighted by bold text in Table 5-1. In other words, Figures 5-1 through 5-14 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 Oil Creek (Figure 5-1) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310800010240P. Fecal coliform measurements collected during 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 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 fecal coliform levels exceed the instantaneous water quality criteria primarily under moist and moderately dry conditions, but not low flow conditions, indicative of nonpoint sources.

The LDC for Washita River at US 177 (Figure 5-2) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station

OOK310800020010-001AT. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria during moist through dry conditions, but especially under moist conditions, indicative of nonpoint sources.

The LDC for Sand Branch (Figure 5-3) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310800020040C. Fecal coliform measurements collected during 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 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 high flow and moist conditions, indicative of nonpoint sources.

The LDC for Chigley Sandy Creek (Figure 5-4) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310800020190K. Fecal coliform measurements collected during 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 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 wide range of hydrologic conditions, indicative of nonpoint sources.

The LDC for Washita River at SH 19 (Figure 5-5) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station OK310810010010-001AT. The LDC indicates that Enterococcus levels sometimes exceed the instantaneous water quality criteria under most hydrologic conditions, an indication of nonpoint sources or a combination of point and nonpoint sources.

The LDC for Roaring Creek (Figure 5-6) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310810020170G. Fecal coliform measurements collected during 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 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 fecal coliform levels exceed the instantaneous water quality criteria primarily under most flow conditions, indicative of nonpoint sources.

The LDC for Laflin Creek (Figure 5-7) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310810020200G. Fecal coliform measurements collected during 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 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 fecal coliform levels exceed the instantaneous water quality criteria primarily under a wide range of hydrologic conditions, indicative of nonpoint sources.

The LDC for Bitter Creek (Figure 5-8) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310820010030G. Fecal coliform measurements collected during 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 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 fecal coliform levels exceed the instantaneous water quality criteria primarily under moist conditions and mid-range flow conditions, indicative of nonpoint sources.

The LDC for Washita River at US 281 (Figure 5-9) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station OK310830010010-001AT. The LDC indicates that Enterococcus levels sometimes exceed the instantaneous water quality criteria under most hydrologic conditions, with the exceedance frequency and magnitude increasing at higher flow conditions, indicating the influence of nonpoint sources.

The LDC for Washita River at SH 152 (Figure 5-10) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station OK310830030010-001AT. The LDC indicates that Enterococcus levels sometimes exceed the instantaneous water quality criteria under high flows, moist conditions, mid-range conditions, and dry conditions, with the Enterococcus levels tending to increase with flow, indicating the impact of nonpoint sources.

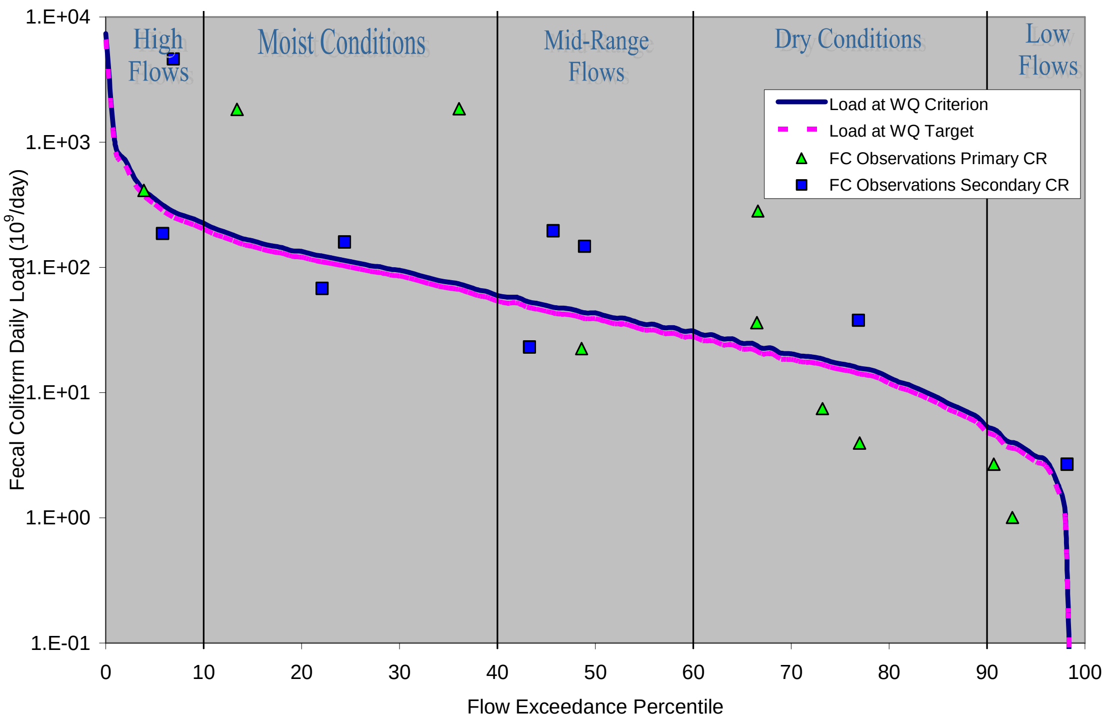
The LDC for Washita River #145 (Figure 5-11) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station OK310830030010P. Enterococcus measurements collected during secondary contact recreation season (October – April) are also displayed on the figure, although the load at the secondary contact recreation criterion is not shown. The PRG is calculated so the measurements under 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 sometimes exceed the primary contact recreation instantaneous water quality criteria under high flow, moist and dry conditions. Additionally, very elevated Enterococcus levels occurred under low flow conditions during non-primary contact recreation season. These factors indicate a combination of point and nonpoint sources contribute to the impairment.

The LDC for Willow Creek (Figure 5-12) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310830060030H. Fecal coliform measurements collected during 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 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 conditions, indicative of nonpoint sources.

The LDC for Washita River at SH 33 (Figure 5-13) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station OK310840010010-001AT. The LDC indicates that Enterococcus levels sometimes exceed the instantaneous water quality criteria under most hydrologic conditions, indicating nonpoint sources or a combination of point and nonpoint sources.

The LDC for Quartermaster Creek (Figure 5-14) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK310840010060G. Fecal coliform measurements collected during 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 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 high flow and dry conditions, indicative of nonpoint sources or a combination of point and nonpoint sources.

Figure 5-1 Load Duration Curve for Fecal Coliform in Oil Creek (OK310800010240_00)



* there is no wasteload allocation for this waterbody

Figure 5-2 Load Duration Curve for Enterococci in Washita River at US 177 (OK310800020010_00)

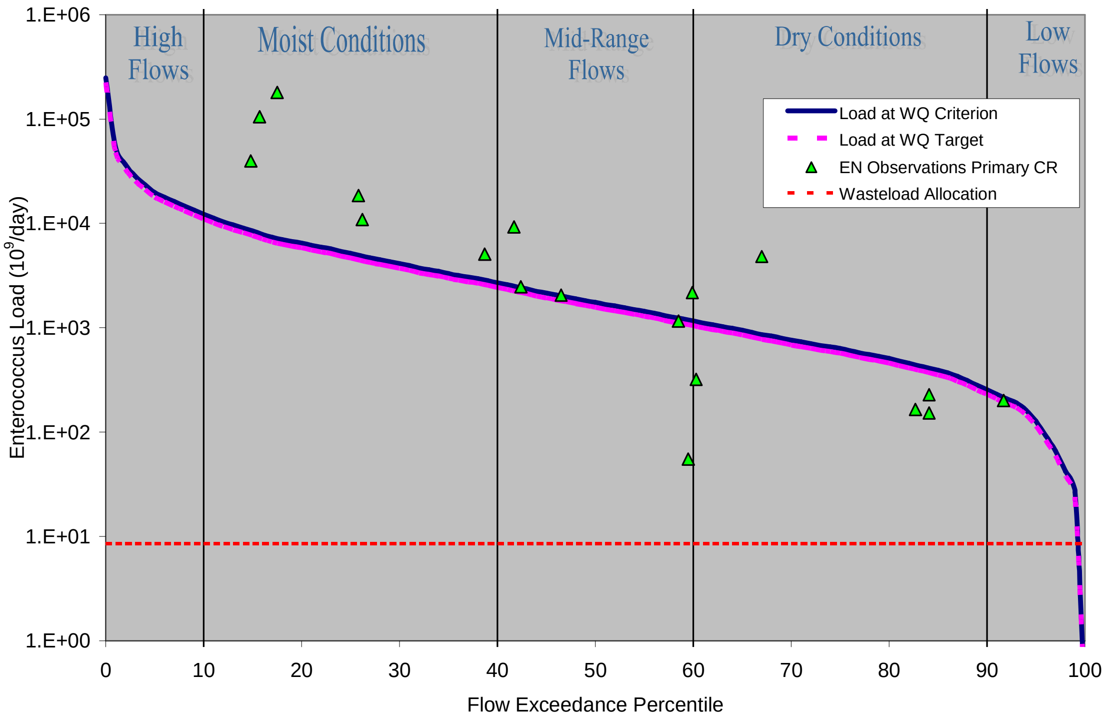
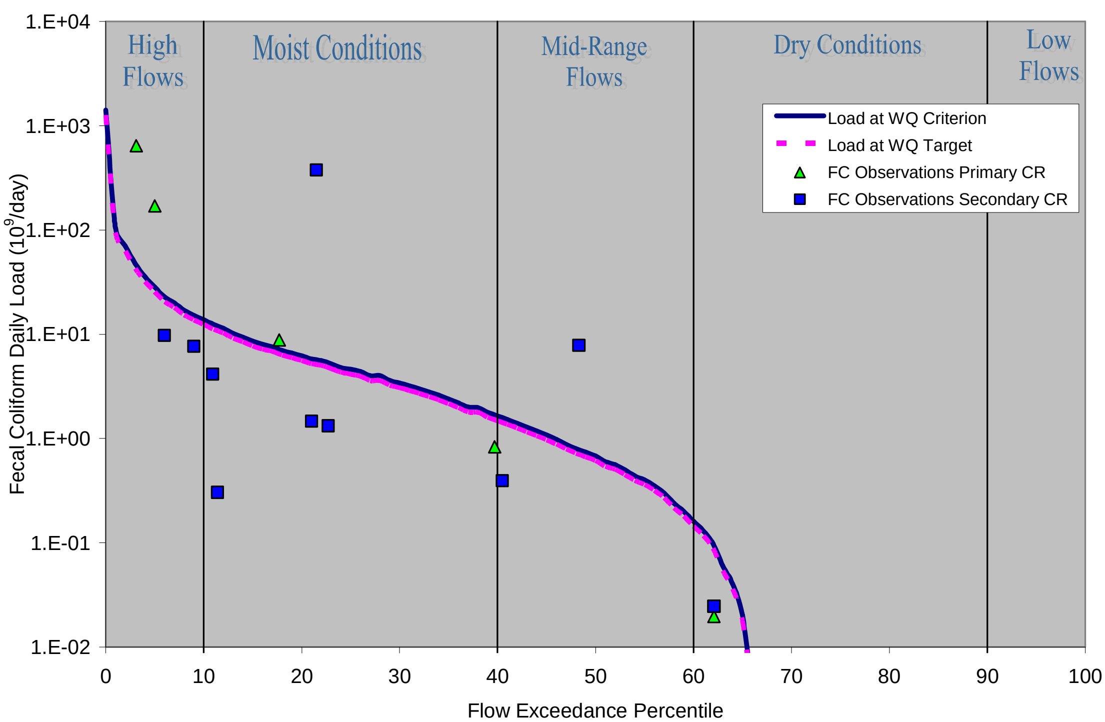
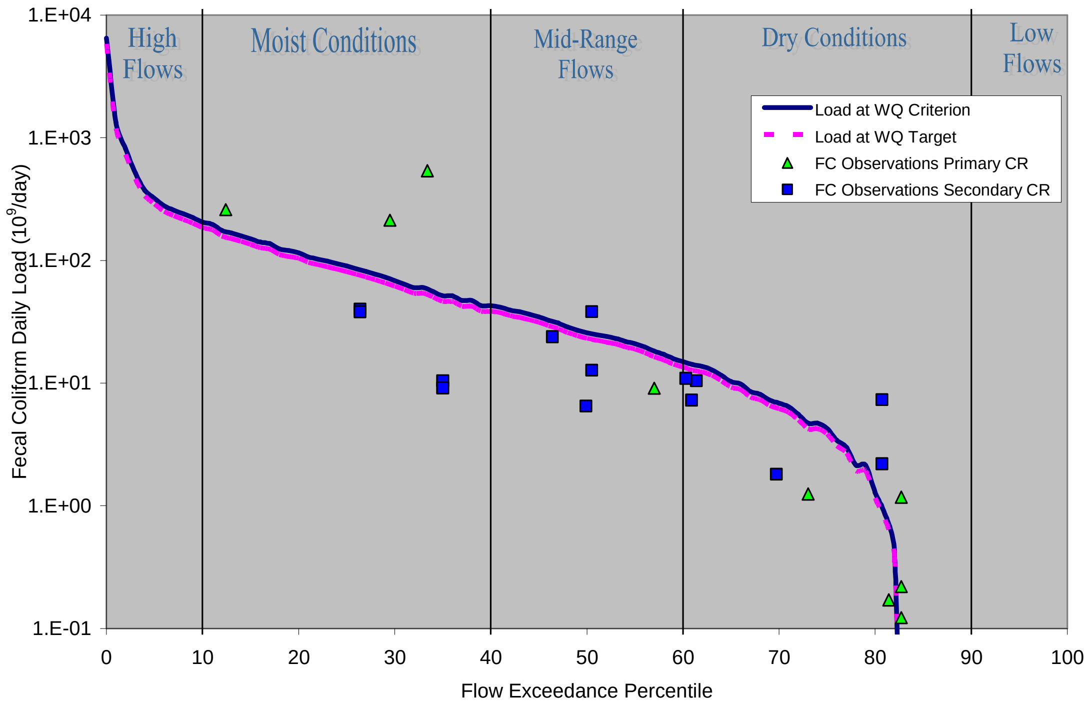


Figure 5-3 Load Duration Curve for Fecal Coliform in Sand Branch (OK310800020040_00)



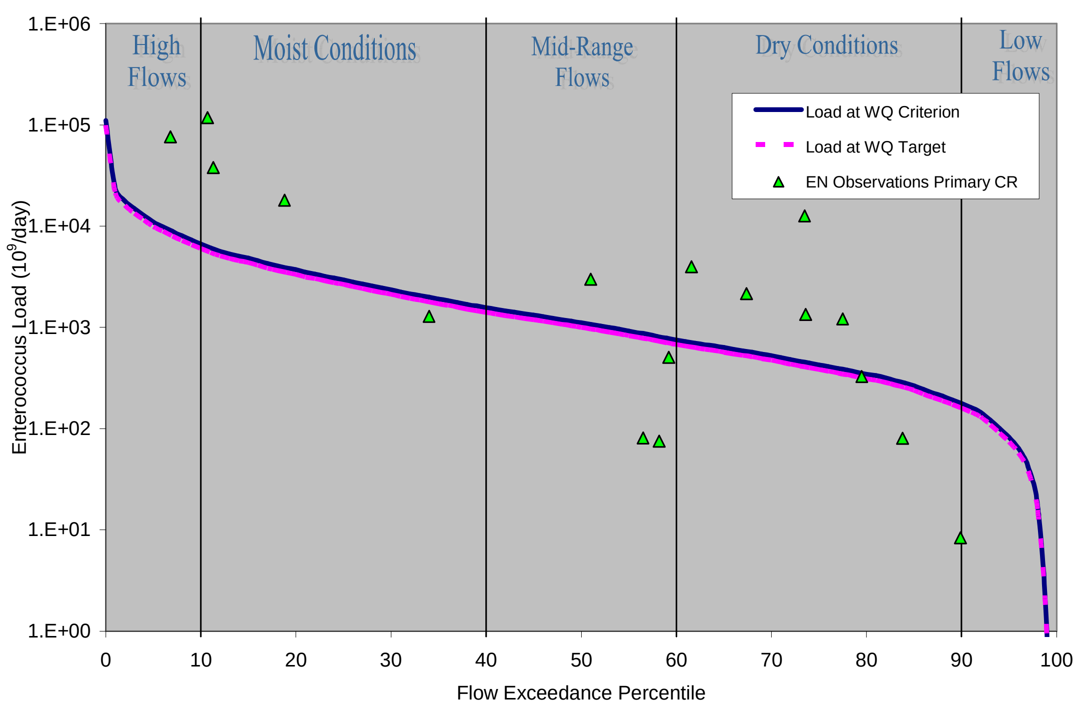
* there is no wasteload allocation for this waterbody

Figure 5-4 Load Duration Curve for Fecal Coliform in Chigley Sandy Creek (OK310800020190_00)



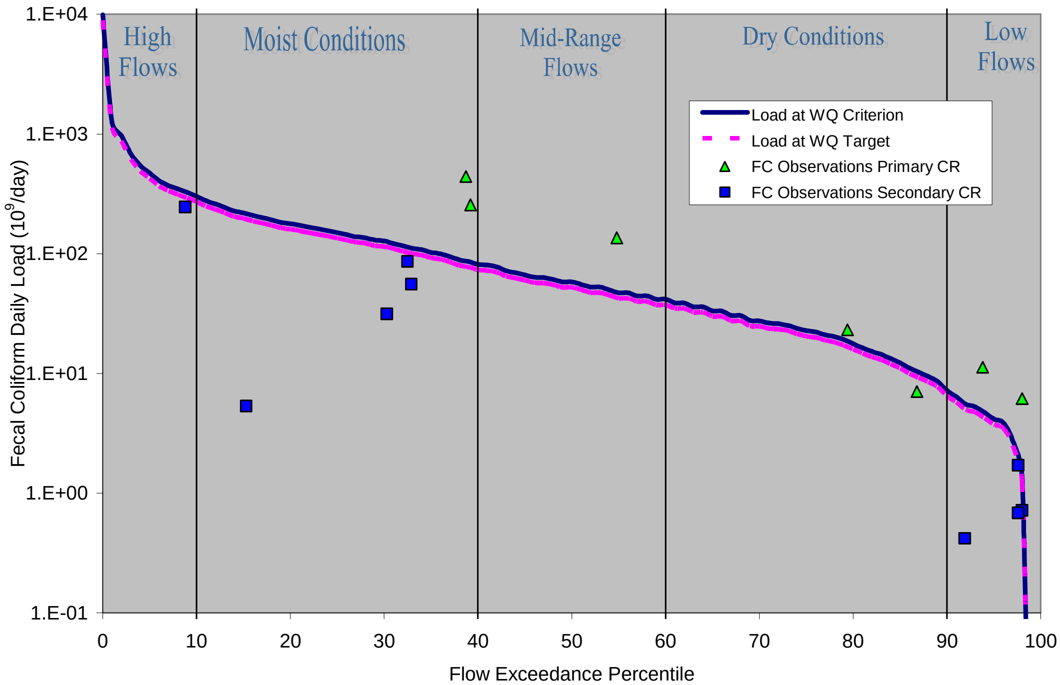
* there is no wasteload allocation for this waterbody

Figure 5-5 Load Duration Curve for Enterococci in Washita River at SH 19 (OK310810010010_10)



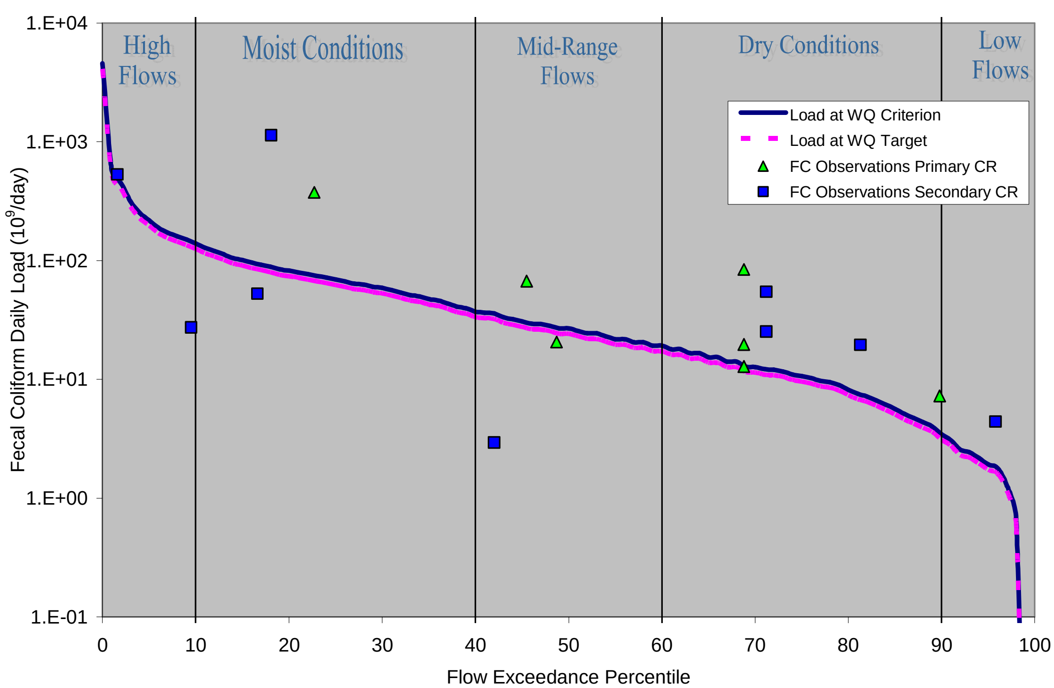
* there is no wasteload allocation for this waterbody

Figure 5-6 Load Duration Curve for Fecal Coliform in Roaring Creek (OK310810020170_00)



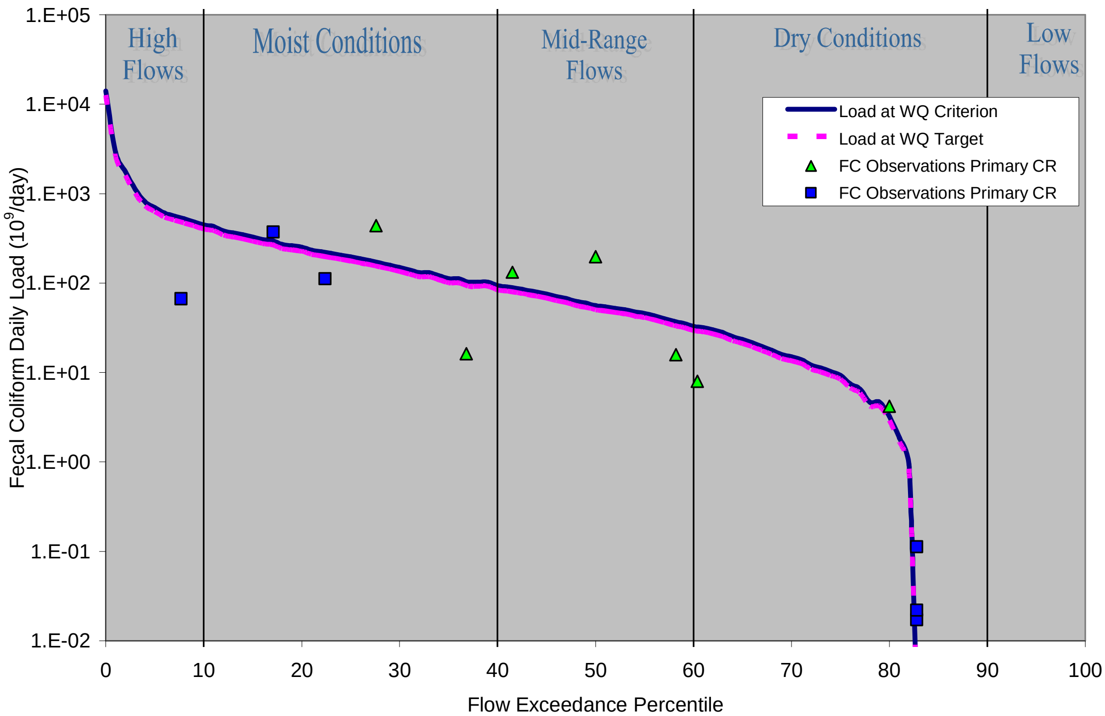
* there is no wasteload allocation for this waterbody

Figure 5-7 Load Duration Curve for Fecal Coliform in Laflin Creek (OK310810020200_00)



* there is no wasteload allocation for this waterbody

Figure 5-8 Load Duration Curve for Fecal Coliform in Bitter Creek (OK310820010030_00)



* there is no wasteload allocation for this waterbody

Figure 5-9 Load Duration Curve for Enterococci in Washita River at US 281 (OK310830010010_00)

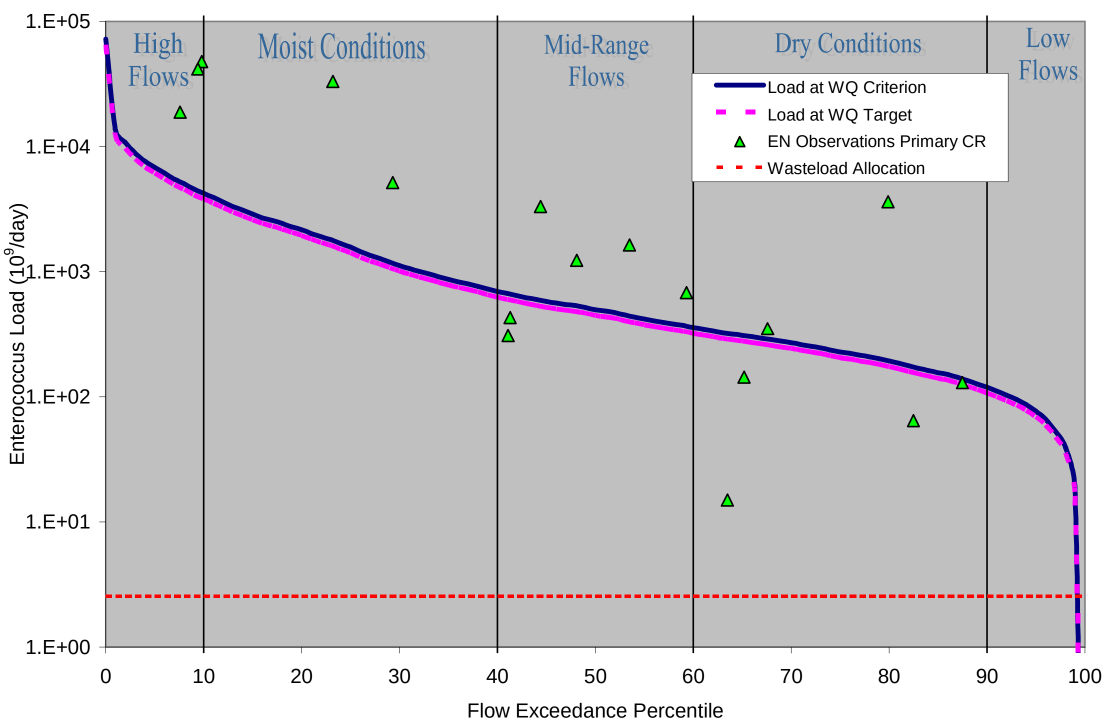


Figure 5-10 Load Duration Curve for Enterococci in Washita River at SH 152 (OK310830030010_00)

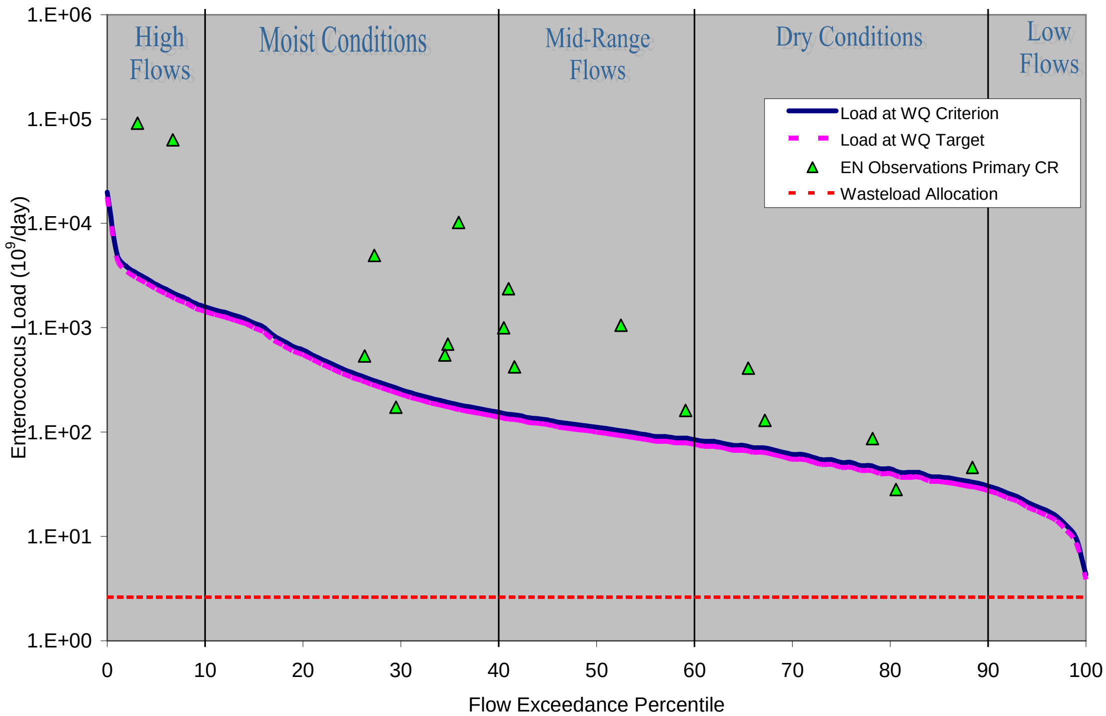
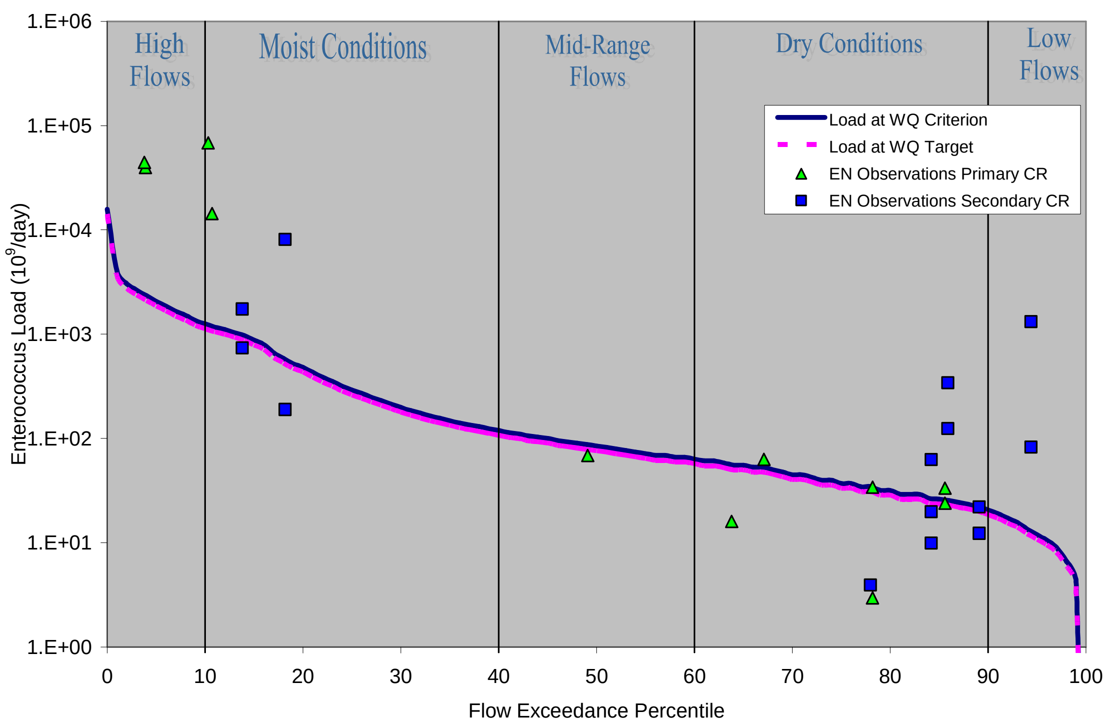
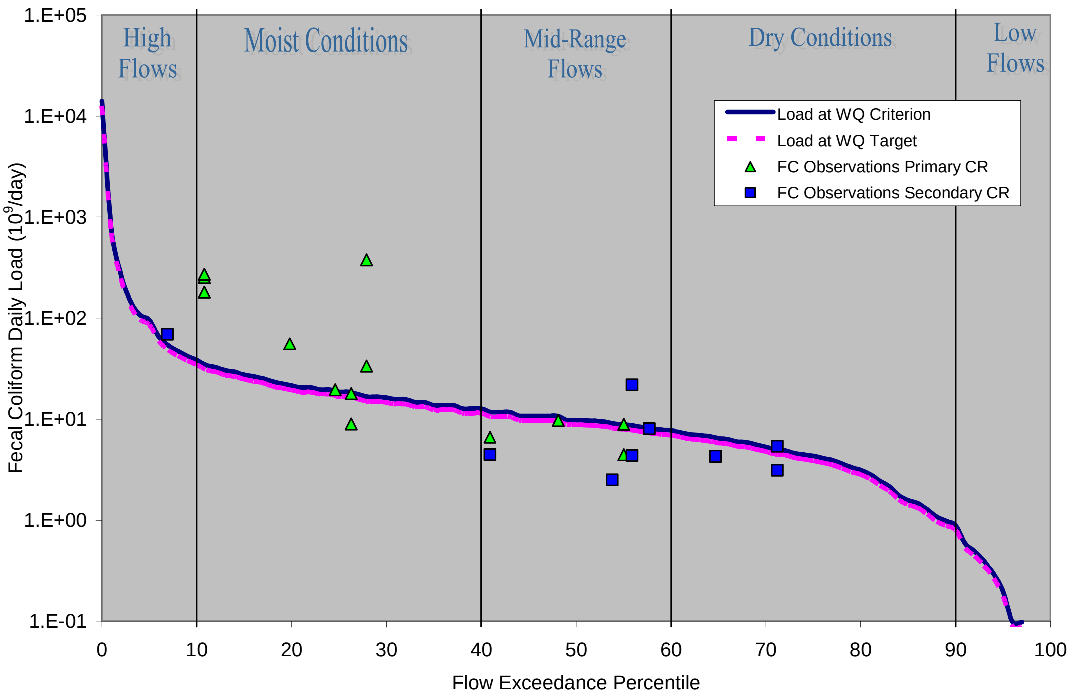


Figure 5-11 Load Duration Curve for Enterococci in Washita River #145 (OK310830030010_10)



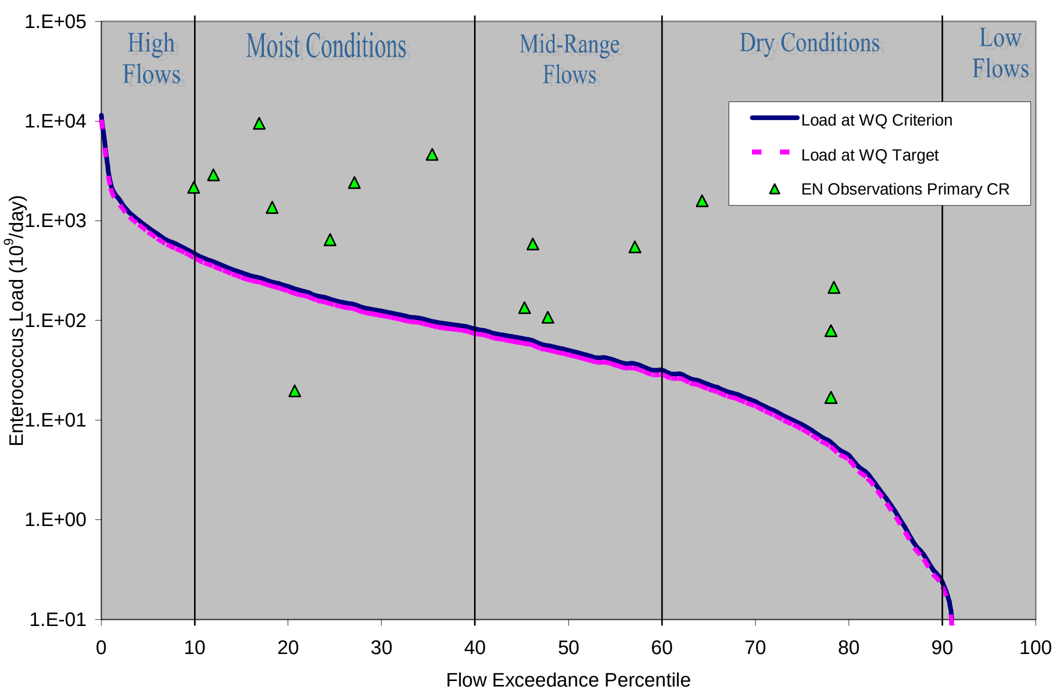
* there is no wasteload allocation for this waterbody

Figure 5-12 Load Duration Curve for Fecal Coliform in Willow Creek (OK310830060030_00)



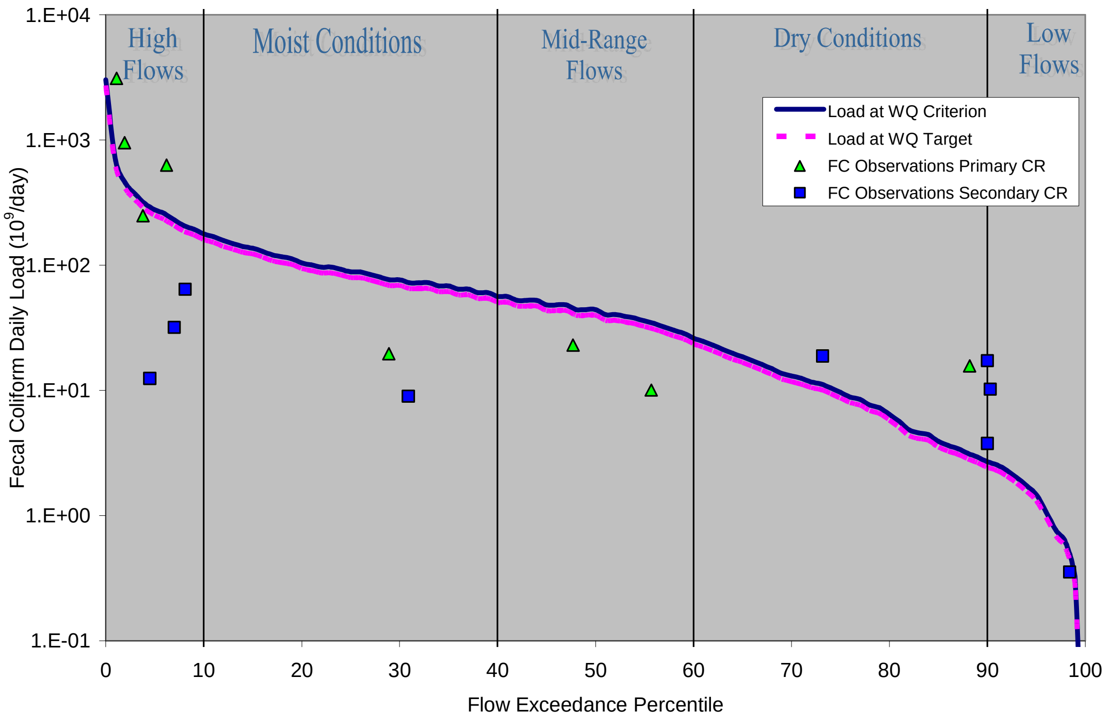
* there is no wasteload allocation for this waterbody

Figure 5-13 Load Duration Curve for Enterococci in Washita River at SH 33 (OK310840010010_00)



* there is no wasteload allocation for this waterbody

Figure 5-14 Load Duration Curve for Fecal Coliform in Quartermaster Creek (OK310840010060_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 Canadian 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 Wasteload Allocations for NPDES-Permitted Facilities

Waterbody ID	NPDES Permit No.	Name	Design Flow (mgd)	Wasteload Allocation (cfu/day)		
				Fecal Coliform	*E. Coli*	Enterococci
OK310800020010_00 Washita River, US 177	OK0030422	City of Ardmore-Industrial Park	0.130	9.84E+08	6.20E+08	1.62E+08
	OK0028282	Wynnewood Utilities Authority	0.750	5.68E+09	3.58E+09	9.37E+08
	OK0038440	City of Ardmore-Central	5.900	4.47E+10	2.81E+10	7.37E+09
OK310830010010_00 Washita River, US 281	OK0027766	Cement Public Works Authority	0.085	6.44E+08	4.05E+08	1.06E+08
	OK0028151	Anadarko Public Works Authority	1.940	1.47E+10	9.25E+09	2.42E+09
OK310830030010_00 Washita River, SH 152	OK0032379	City of Cordell	0.406	3.07E+09	1.94E+09	5.07E+08
	OK0031011	City of Clinton	1.700	1.29E+10	8.11E+09	2.12E+09

Permitted stormwater discharges are considered point sources. There are no permitted MS4s in the study area; therefore, a specific wasteload allocation is not calculated for MS4s. .

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, as follows:

$$LA = TMDL - \sum WLA - MOS$$

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:

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

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 5-14). 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:

$$Average\ LA = average\ TMDL - MOS - \sum WLA$$

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. LDCs do not display a specific percentage of the bacteria load assigned to MS4s. The allocation for MS4s will be expressed as a PRG. 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† (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
OK310800010240_00	OK310800010240P	Oil Creek	FC	4.32E+10	0	3.89E+10	4.32E+09
OK310800020010_00	OK310800020010-001AT	Washita River, US 177	ENT	1.74E+12	8.47E+09	1.56E+12	1.74E+11
OK310800020040_00	OK310800020040C	Sand Branch	FC	6.79E+08	0	6.11E+08	6.79E+07
OK310800020190_00	OK310800020190K	Chigley Sandy Creek	FC	2.57E+10	0	2.31E+10	2.57E+09
OK310810010010_10	OK310810010010-001AT	Washita River, SH 19	ENT	1.11E+12	0	9.96E+11	1.11E+11
OK310810020170_00	OK310810020170G	Roaring Creek	FC	5.82E+10	0	5.24E+10	5.82E+09
OK310810020200_00	OK310810020200G	Laflin Creek	FC	2.69E+10	0	2.42E+10	2.69E+09
OK310820010030_00	OK310820010030G	Bitter Creek	FC	5.60E+10	0	5.04E+10	5.60E+09
OK310830010010_00	OK310830010010-001AT	Washita River, US 281	ENT	4.97E+11	2.53E+09	4.45E+11	4.97E+10
OK310830030010_00	OK310830030010-001AT	Washita River, SH 152	ENT	1.11E+11	2.63E+09	9.73E+10	1.11E+10
OK310830030010_10	OK310830030010P	Washita River # 145	ENT	8.46E+10	0	7.61E+10	8.46E+09
OK310830060030_00	OK310830060030H	Willow Creek	FC	9.79E+09	0	8.81E+09	9.79E+08
OK310840010010_00	OK310840010010-001AT	Washita River, SH 33, Hammon	ENT	5.02E+10	0	4.52E+10	5.02E+09
OK310840010060_00	OK310840010060G	Quartermaster Creek	FC	4.43E+10	0	3.98E+10	4.43E+09

† Derived for illustrative purposes at the median flow value

Table 5-4 Fecal Coliform TMDL Calculations for Oil Creek (OK310800010240_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	751	7.35E+12	0	6.61E+12	7.35E+11
5	36	3.53E+11	0	3.17E+11	3.53E+10
10	23	2.24E+11	0	2.02E+11	2.24E+10
15	17	1.63E+11	0	1.46E+11	1.63E+10
20	14	1.34E+11	0	1.20E+11	1.34E+10
25	11	1.11E+11	0	1.00E+11	1.11E+10
30	9.7	9.47E+10	0	8.52E+10	9.47E+09
35	7.8	7.62E+10	0	6.86E+10	7.62E+09
40	6.1	5.97E+10	0	5.37E+10	5.97E+09
45	5.0	4.94E+10	0	4.45E+10	4.94E+09
50	4.4	4.32E+10	0	3.89E+10	4.32E+09
55	3.6	3.50E+10	0	3.15E+10	3.50E+09
60	3.2	3.09E+10	0	2.78E+10	3.09E+09
65	2.5	2.47E+10	0	2.22E+10	2.47E+09
70	2.1	2.04E+10	0	1.83E+10	2.04E+09
75	1.7	1.70E+10	0	1.53E+10	1.70E+09
80	1.3	1.32E+10	0	1.19E+10	1.32E+09
85	0.93	9.06E+09	0	8.15E+09	9.06E+08
90	0.55	5.35E+09	0	4.82E+09	5.35E+08
95	0.32	3.09E+09	0	2.78E+09	3.09E+08
100	0	0	0	0	0

Table 5-5 Enterococci TMDL Calculations for Washita River at US 177 (OK310800020010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	94,400	2.49E+14	8.47E+09	2.24E+14	2.49E+13
5	7,488	1.98E+13	8.47E+09	1.78E+13	1.98E+12
10	4,620	1.22E+13	8.47E+09	1.10E+13	1.22E+12
15	3,194	8.44E+12	8.47E+09	7.59E+12	8.44E+11
20	2,450	6.47E+12	8.47E+09	5.82E+12	6.47E+11
25	1,950	5.15E+12	8.47E+09	4.63E+12	5.15E+11
30	1,560	4.12E+12	8.47E+09	3.70E+12	4.12E+11
35	1,250	3.30E+12	8.47E+09	2.96E+12	3.30E+11
40	1,020	2.70E+12	8.47E+09	2.42E+12	2.70E+11
45	812	2.15E+12	8.47E+09	1.92E+12	2.15E+11
50	660	1.74E+12	8.47E+09	1.56E+12	1.74E+11
55	542	1.43E+12	8.47E+09	1.28E+12	1.43E+11
60	440	1.16E+12	8.47E+09	1.04E+12	1.16E+11
65	357	9.43E+11	8.47E+09	8.40E+11	9.43E+10
70	287	7.59E+11	8.47E+09	6.75E+11	7.59E+10
75	240	6.34E+11	8.47E+09	5.62E+11	6.34E+10
80	192	5.07E+11	8.47E+09	4.48E+11	5.07E+10
85	148	3.91E+11	8.47E+09	3.43E+11	3.91E+10
90	96	2.55E+11	8.47E+09	2.21E+11	2.55E+10
95	48	1.27E+11	8.47E+09	1.06E+11	1.27E+10
100	0.10	9.41E+09	8.47E+09	0.00E+00	9.41E+08

Table 5-6 Fecal Coliform TMDL Calculations for Sand Branch (OK310800020040_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	144	1.41E+12	0	1.27E+12	1.41E+11
5	2.9	2.84E+10	0	2.55E+10	2.84E+09
10	1.4	1.38E+10	0	1.24E+10	1.38E+09
15	0.88	8.59E+09	0	7.73E+09	8.59E+08
20	0.63	6.19E+09	0	5.57E+09	6.19E+08
25	0.47	4.59E+09	0	4.14E+09	4.59E+08
30	0.35	3.40E+09	0	3.06E+09	3.40E+08
35	0.24	2.40E+09	0	2.16E+09	2.40E+08
40	0.17	1.64E+09	0	1.47E+09	1.64E+08
45	0.11	1.08E+09	0	9.71E+08	1.08E+08
50	0.07	6.79E+08	0	6.11E+08	6.79E+07
55	0.04	4.00E+08	0	3.60E+08	4.00E+07
60	0.02	1.60E+08	0	1.44E+08	1.60E+07
65	0.00	2.00E+07	0	1.80E+07	2.00E+06
70	0.00	9.79E+05	0	8.81E+05	9.79E+04
75	0.00	9.79E+05	0	8.81E+05	9.79E+04
80	0	0	0	0	0
85	0	0	0	0	0
90	0	0	0	0	0
95	0	0	0	0	0
100	0	0	0	0	0

Table 5-7 Fecal Coliform TMDL Calculations for Chigley Sandy Creek (OK310800020190_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	660	6.46E+12	0	5.81E+12	6.46E+11
5	33	3.21E+11	0	2.89E+11	3.21E+10
10	21	2.05E+11	0	1.85E+11	2.05E+10
15	15	1.50E+11	0	1.35E+11	1.50E+10
20	12	1.16E+11	0	1.04E+11	1.16E+10
25	9.2	8.99E+10	0	8.09E+10	8.99E+09
30	7.0	6.85E+10	0	6.16E+10	6.85E+09
35	5.2	5.13E+10	0	4.62E+10	5.13E+09
40	4.4	4.28E+10	0	3.85E+10	4.28E+09
45	3.5	3.47E+10	0	3.12E+10	3.47E+09
50	2.6	2.57E+10	0	2.31E+10	2.57E+09
55	2.1	2.10E+10	0	1.89E+10	2.10E+09
60	1.5	1.50E+10	0	1.35E+10	1.50E+09
65	1.0	1.03E+10	0	9.24E+09	1.03E+09
70	0.70	6.85E+09	0	6.16E+09	6.85E+08
75	0.44	4.28E+09	0	3.85E+09	4.28E+08
80	0.13	1.28E+09	0	1.16E+09	1.28E+08
85	0	0	0	0	0
90	0	0	0	0	0
95	0	0	0	0	0
100	0	0	0	0	0

Table 5-8 Enterococci TMDL Calculations for Washita River at SH 19 (OK310810010010_10)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	41,700	1.10E+14	0	9.92E+13	1.10E+13
5	4,150	1.10E+13	0	9.87E+12	1.10E+12
10	2,516	6.65E+12	0	5.98E+12	6.65E+11
15	1,830	4.84E+12	0	4.35E+12	4.84E+11
20	1,400	3.70E+12	0	3.33E+12	3.70E+11
25	1,110	2.93E+12	0	2.64E+12	2.93E+11
30	892	2.36E+12	0	2.12E+12	2.36E+11
35	719	1.90E+12	0	1.71E+12	1.90E+11
40	592	1.56E+12	0	1.41E+12	1.56E+11
45	498	1.32E+12	0	1.18E+12	1.32E+11
50	419	1.11E+12	0	9.96E+11	1.11E+11
55	348	9.20E+11	0	8.28E+11	9.20E+10
60	284	7.50E+11	0	6.75E+11	7.50E+10
65	239	6.32E+11	0	5.68E+11	6.32E+10
70	199	5.26E+11	0	4.73E+11	5.26E+10
75	161	4.25E+11	0	3.83E+11	4.25E+10
80	130	3.43E+11	0	3.09E+11	3.43E+10
85	100	2.64E+11	0	2.38E+11	2.64E+10
90	67	1.77E+11	0	1.59E+11	1.77E+10
95	31	8.19E+10	0	7.37E+10	8.19E+09
100	0	0	0	0	0

Table 5-9 Fecal Coliform TMDL Calculations for Roaring Creek (OK310810020170_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1,011	9.90E+12	0	8.91E+12	9.90E+11
5	48	4.72E+11	0	4.25E+11	4.72E+10
10	31	3.02E+11	0	2.72E+11	3.02E+10
15	22	2.19E+11	0	1.97E+11	2.19E+10
20	18	1.78E+11	0	1.60E+11	1.78E+10
25	15	1.50E+11	0	1.35E+11	1.50E+10
30	13	1.28E+11	0	1.15E+11	1.28E+10
35	10	1.03E+11	0	9.23E+10	1.03E+10
40	8.3	8.15E+10	0	7.34E+10	8.15E+09
45	6.8	6.65E+10	0	5.99E+10	6.65E+09
50	5.9	5.82E+10	0	5.24E+10	5.82E+09
55	4.8	4.71E+10	0	4.24E+10	4.71E+09
60	4.2	4.16E+10	0	3.74E+10	4.16E+09
65	3.4	3.33E+10	0	2.99E+10	3.33E+09
70	2.8	2.74E+10	0	2.47E+10	2.74E+09
75	2.3	2.27E+10	0	2.05E+10	2.27E+09
80	1.8	1.77E+10	0	1.60E+10	1.77E+09
85	1.2	1.22E+10	0	1.10E+10	1.22E+09
90	0.74	7.21E+09	0	6.49E+09	7.21E+08
95	0.42	4.16E+09	0	3.74E+09	4.16E+08
100	0	0	0	0	0

Table 5-10 Fecal Coliform TMDL Calculations for Laflin Creek (OK310810020200_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	467	4.57E+12	0	4.11E+12	4.57E+11
5	22	2.18E+11	0	1.96E+11	2.18E+10
10	14	1.40E+11	0	1.26E+11	1.40E+10
15	10	1.01E+11	0	9.09E+10	1.01E+10
20	8.4	8.22E+10	0	7.40E+10	8.22E+09
25	7.1	6.91E+10	0	6.22E+10	6.91E+09
30	6.0	5.89E+10	0	5.30E+10	5.89E+09
35	4.8	4.74E+10	0	4.26E+10	4.74E+09
40	3.8	3.71E+10	0	3.34E+10	3.71E+09
45	3.1	3.07E+10	0	2.76E+10	3.07E+09
50	2.7	2.69E+10	0	2.42E+10	2.69E+09
55	2.2	2.18E+10	0	1.96E+10	2.18E+09
60	2.0	1.92E+10	0	1.73E+10	1.92E+09
65	1.6	1.54E+10	0	1.38E+10	1.54E+09
70	1.3	1.27E+10	0	1.14E+10	1.27E+09
75	1.1	1.06E+10	0	9.56E+09	1.06E+09
80	0.8	8.19E+09	0	7.37E+09	8.19E+08
85	0.6	5.63E+09	0	5.07E+09	5.63E+08
90	0.35	3.46E+09	0	3.11E+09	3.46E+08
95	0.20	1.92E+09	0	1.73E+09	1.92E+08
100	0	0	0	0	0

Table 5-11 Fecal Coliform TMDL Calculations for Bitter Creek (OK310820010030_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1,440	1.41E+13	0	1.27E+13	1.41E+12
5	72	7.00E+11	0	6.30E+11	7.00E+10
10	46	4.48E+11	0	4.03E+11	4.48E+10
15	33	3.27E+11	0	2.94E+11	3.27E+10
20	26	2.52E+11	0	2.27E+11	2.52E+10
25	20	1.96E+11	0	1.76E+11	1.96E+10
30	15	1.49E+11	0	1.34E+11	1.49E+10
35	11	1.12E+11	0	1.01E+11	1.12E+10
40	10	9.33E+10	0	8.40E+10	9.33E+09
45	8	7.56E+10	0	6.80E+10	7.56E+09
50	5.7	5.60E+10	0	5.04E+10	5.60E+09
55	4.7	4.57E+10	0	4.11E+10	4.57E+09
60	3.3	3.27E+10	0	2.94E+10	3.27E+09
65	2.4	2.33E+10	0	2.10E+10	2.33E+09
70	1.5	1.49E+10	0	1.34E+10	1.49E+09
75	1.0	9.33E+09	0	8.40E+09	9.33E+08
80	0.3	3.23E+09	0	2.91E+09	3.23E+08
85	0.00	9.79E+05	0	8.81E+05	9.79E+04
90	0.00	9.79E+05	0	8.81E+05	9.79E+04
95	0	0	0	0	0
100	0	0	0	0	0

Table 5-12 Enterococci TMDL Calculations for Washita River at US 281 (OK310830010010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	27,400	7.24E+13	2.53E+09	6.52E+13	7.24E+12
5	2,580	6.82E+12	2.53E+09	6.13E+12	6.82E+11
10	1,600	4.23E+12	2.53E+09	3.80E+12	4.23E+11
15	1,090	2.88E+12	2.53E+09	2.59E+12	2.88E+11
20	818	2.16E+12	2.53E+09	1.94E+12	2.16E+11
25	594	1.57E+12	2.53E+09	1.41E+12	1.57E+11
30	424	1.12E+12	2.53E+09	1.01E+12	1.12E+11
35	328	8.67E+11	2.53E+09	7.77E+11	8.67E+10
40	262	6.92E+11	2.53E+09	6.21E+11	6.92E+10
45	218	5.76E+11	2.53E+09	5.16E+11	5.76E+10
50	188	4.97E+11	2.53E+09	4.45E+11	4.97E+10
55	158	4.17E+11	2.53E+09	3.73E+11	4.17E+10
60	135	3.57E+11	2.53E+09	3.19E+11	3.57E+10
65	117	3.09E+11	2.53E+09	2.76E+11	3.09E+10
70	102	2.71E+11	2.53E+09	2.41E+11	2.71E+10
75	86	2.27E+11	2.53E+09	2.02E+11	2.27E+10
80	73	1.93E+11	2.53E+09	1.71E+11	1.93E+10
85	59	1.56E+11	2.53E+09	1.38E+11	1.56E+10
90	45	1.19E+11	2.53E+09	1.04E+11	1.19E+10
95	29	7.66E+10	2.53E+09	6.64E+10	7.66E+09
100	0	2.81E+09	2.53E+09	0.00E+00	2.81E+08

Table 5-13 Enterococci TMDL Calculations for Washita River at SH 152 (OK310830030010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	7,539	1.99E+13	2.63E+09	1.79E+13	1.99E+12
5	982	2.60E+12	2.63E+09	2.33E+12	2.60E+11
10	600	1.58E+12	2.63E+09	1.42E+12	1.58E+11
15	420	1.11E+12	2.63E+09	9.95E+11	1.11E+11
20	231	6.11E+11	2.63E+09	5.48E+11	6.11E+10
25	141	3.71E+11	2.63E+09	3.32E+11	3.71E+10
30	96	2.55E+11	2.63E+09	2.26E+11	2.55E+10
35	72	1.91E+11	2.63E+09	1.69E+11	1.91E+10
40	58	1.54E+11	2.63E+09	1.36E+11	1.54E+10
45	50	1.31E+11	2.63E+09	1.15E+11	1.31E+10
50	42	1.11E+11	2.63E+09	9.73E+10	1.11E+10
55	36	9.44E+10	2.63E+09	8.23E+10	9.44E+09
60	32	8.44E+10	2.63E+09	7.33E+10	8.44E+09
65	28	7.44E+10	2.63E+09	6.43E+10	7.44E+09
70	23	6.10E+10	2.63E+09	5.23E+10	6.10E+09
75	19	5.10E+10	2.63E+09	4.33E+10	5.10E+09
80	17	4.43E+10	2.63E+09	3.73E+10	4.43E+09
85	14	3.73E+10	2.63E+09	3.10E+10	3.73E+09
90	11	3.03E+10	2.63E+09	2.47E+10	3.03E+09
95	7.3	1.93E+10	2.63E+09	1.48E+10	1.93E+09
100	1.6	4.30E+09	2.63E+09	1.24E+09	4.30E+08

Table 5-14 Enterococci TMDL Calculations for Washita River #145 (OK310830030010_10)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	5,970	1.58E+13	0	1.42E+13	1.58E+12
5	781	2.06E+12	0	1.86E+12	2.06E+11
10	473	1.25E+12	0	1.12E+12	1.25E+11
15	331	8.75E+11	0	7.87E+11	8.75E+10
20	182	4.81E+11	0	4.33E+11	4.81E+10
25	110	2.91E+11	0	2.62E+11	2.91E+10
30	75	1.98E+11	0	1.78E+11	1.98E+10
35	56	1.48E+11	0	1.33E+11	1.48E+10
40	45	1.19E+11	0	1.07E+11	1.19E+10
45	38	1.00E+11	0	9.04E+10	1.00E+10
50	32	8.46E+10	0	7.61E+10	8.46E+09
55	27	7.13E+10	0	6.42E+10	7.13E+09
60	24	6.34E+10	0	5.71E+10	6.34E+09
65	21	5.55E+10	0	4.99E+10	5.55E+09
70	17	4.49E+10	0	4.04E+10	4.49E+09
75	14	3.70E+10	0	3.33E+10	3.70E+09
80	12	3.17E+10	0	2.85E+10	3.17E+09
85	10	2.62E+10	0	2.35E+10	2.62E+09
90	7.8	2.06E+10	0	1.85E+10	2.06E+09
95	4.5	1.19E+10	0	1.07E+10	1.19E+09
100	0	0	0	0	0

Table 5-15 Fecal Coliform TMDL Calculations for Willow Creek (OK310830060030_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1,440	1.41E+13	0	1.27E+13	1.41E+12
5	9.8	9.55E+10	0	8.60E+10	9.55E+09
10	3.9	3.84E+10	0	3.45E+10	3.84E+09
15	2.8	2.74E+10	0	2.47E+10	2.74E+09
20	2.2	2.15E+10	0	1.94E+10	2.15E+09
25	1.9	1.86E+10	0	1.67E+10	1.86E+09
30	1.7	1.62E+10	0	1.46E+10	1.62E+09
35	1.4	1.37E+10	0	1.23E+10	1.37E+09
40	1.3	1.27E+10	0	1.14E+10	1.27E+09
45	1.1	1.08E+10	0	9.69E+09	1.08E+09
50	1.0	9.79E+09	0	8.81E+09	9.79E+08
55	0.90	8.81E+09	0	7.93E+09	8.81E+08
60	0.79	7.73E+09	0	6.96E+09	7.73E+08
65	0.66	6.46E+09	0	5.81E+09	6.46E+08
70	0.54	5.28E+09	0	4.76E+09	5.28E+08
75	0.44	4.31E+09	0	3.88E+09	4.31E+08
80	0.32	3.13E+09	0	2.82E+09	3.13E+08
85	0.16	1.57E+09	0	1.41E+09	1.57E+08
90	0.09	8.81E+08	0	7.93E+08	8.81E+07
95	0.02	1.96E+08	0	1.76E+08	1.96E+07
100	0	0	0	0	0

Table 5-16 Enterococci TMDL Calculations for Washita River at SH 33 (OK310840010010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	4,340	1.15E+13	0	1.03E+13	1.15E+12
5	325	8.60E+11	0	7.74E+11	8.60E+10
10	177	4.68E+11	0	4.21E+11	4.68E+10
15	114	3.01E+11	0	2.71E+11	3.01E+10
20	83	2.19E+11	0	1.97E+11	2.19E+10
25	60	1.59E+11	0	1.43E+11	1.59E+10
30	47	1.24E+11	0	1.12E+11	1.24E+10
35	38	1.00E+11	0	9.04E+10	1.00E+10
40	31	8.19E+10	0	7.37E+10	8.19E+09
45	25	6.61E+10	0	5.95E+10	6.61E+09
50	19	5.02E+10	0	4.52E+10	5.02E+09
55	15	3.96E+10	0	3.57E+10	3.96E+09
60	12	3.17E+10	0	2.85E+10	3.17E+09
65	8.6	2.27E+10	0	2.05E+10	2.27E+09
70	5.8	1.53E+10	0	1.38E+10	1.53E+09
75	3.4	8.98E+09	0	8.09E+09	8.98E+08
80	1.7	4.44E+09	0	4.00E+09	4.44E+08
85	0.45	1.19E+09	0	1.07E+09	1.19E+08
90	0.09	2.38E+08	0	2.14E+08	2.38E+07
95	0	0	0	0	0
100	0	0	0	0	0

Table 5-17 Fecal Coliform TMDL Calculations for Quartermaster Creek (OK310840010060_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	310	3.04E+12	0	2.73E+12	3.04E+11
5	28	2.78E+11	0	2.50E+11	2.78E+10
10	18	1.78E+11	0	1.60E+11	1.78E+10
15	14	1.37E+11	0	1.23E+11	1.37E+10
20	11	1.05E+11	0	9.42E+10	1.05E+10
25	9.0	8.85E+10	0	7.97E+10	8.85E+09
30	7.8	7.64E+10	0	6.88E+10	7.64E+09
35	7.0	6.84E+10	0	6.16E+10	6.84E+09
40	5.8	5.63E+10	0	5.07E+10	5.63E+09
45	4.9	4.83E+10	0	4.35E+10	4.83E+09
50	4.5	4.43E+10	0	3.98E+10	4.43E+09
55	3.7	3.58E+10	0	3.22E+10	3.58E+09
60	2.7	2.62E+10	0	2.35E+10	2.62E+09
65	1.9	1.85E+10	0	1.67E+10	1.85E+09
70	1.3	1.30E+10	0	1.17E+10	1.30E+09
75	1.0	9.66E+09	0	8.69E+09	9.66E+08
80	0.66	6.44E+09	0	5.79E+09	6.44E+08
85	0.40	3.91E+09	0	3.52E+09	3.91E+08
90	0.28	2.70E+09	0	2.43E+09	2.70E+08
95	0.15	1.46E+09	0	1.32E+09	1.46E+08
100	0	0	0	0	0

5.7 LDCs and TMDL Calculations for Additional Bacterial Indicators

As mentioned previously in Subsection 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 5-15 through 5-20 and Tables 5-18 through 5-23, respectively.

Figure 5-15 Load Duration Curve for Fecal Coliform in Washita River at US 177 (OK310800020010_00)

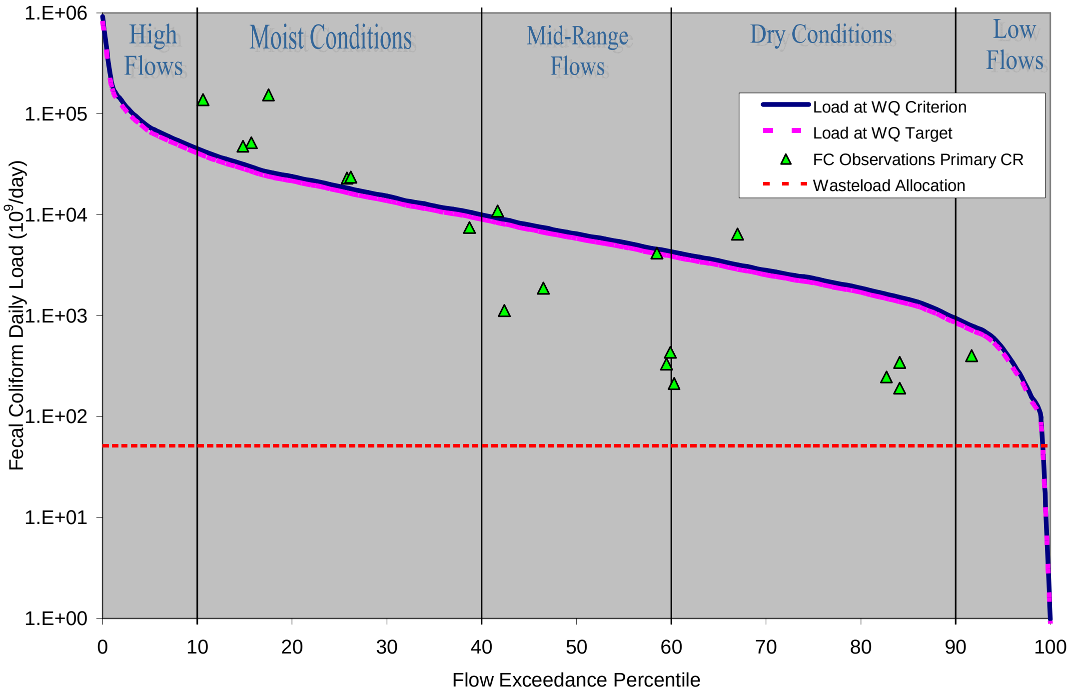
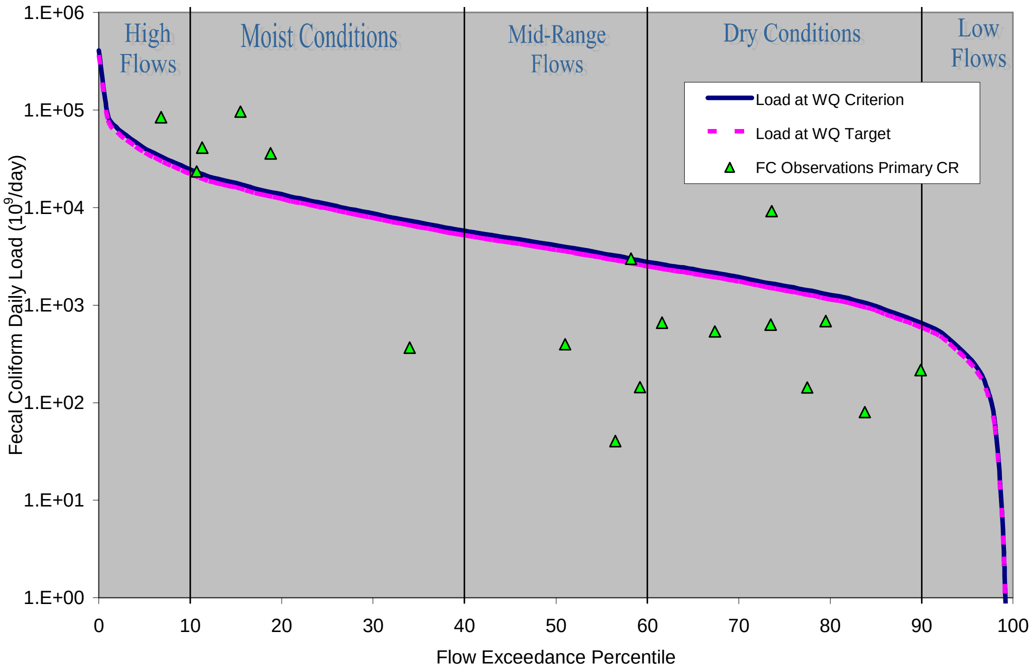


Table 5-18 Fecal Coliform TMDL Calculations for Washita River at US 177 (OK310800020010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	94,400	9.24E+14	5.13E+10	8.31E+14	9.24E+13
5	7,488	7.33E+13	5.13E+10	6.59E+13	7.33E+12
10	4,620	4.52E+13	5.13E+10	4.06E+13	4.52E+12
15	3,194	3.13E+13	5.13E+10	2.81E+13	3.13E+12
20	2,450	2.40E+13	5.13E+10	2.15E+13	2.40E+12
25	1,950	1.91E+13	5.13E+10	1.71E+13	1.91E+12
30	1,560	1.53E+13	5.13E+10	1.37E+13	1.53E+12
35	1,250	1.22E+13	5.13E+10	1.10E+13	1.22E+12
40	1,020	9.98E+12	5.13E+10	8.93E+12	9.98E+11
45	812	7.95E+12	5.13E+10	7.10E+12	7.95E+11
50	660	6.46E+12	5.13E+10	5.76E+12	6.46E+11
55	542	5.30E+12	5.13E+10	4.72E+12	5.30E+11
60	440	4.31E+12	5.13E+10	3.82E+12	4.31E+11
65	357	3.49E+12	5.13E+10	3.09E+12	3.49E+11
70	287	2.81E+12	5.13E+10	2.48E+12	2.81E+11
75	240	2.35E+12	5.13E+10	2.06E+12	2.35E+11
80	192	1.88E+12	5.13E+10	1.64E+12	1.88E+11
85	148	1.45E+12	5.13E+10	1.25E+12	1.45E+11
90	96	9.43E+11	5.13E+10	7.98E+11	9.43E+10
95	48	4.70E+11	5.13E+10	3.71E+11	4.70E+10
100	0.10	5.70E+10	5.13E+10	0.00E+00	5.70E+09

Figure 5-16 Load Duration Curve for Fecal Coliform in Washita River at SH 19 (OK310810010010_10)



* there is no wasteload allocation for this waterbody

Table 5-19 Fecal Coliform TMDL Calculations for Washita River at SH 19 (OK310810010010_10)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	41,700	4.08E+14	0	3.67E+14	4.08E+13
5	4,150	4.06E+13	0	3.66E+13	4.06E+12
10	2,516	2.46E+13	0	2.22E+13	2.46E+12
15	1,830	1.79E+13	0	1.61E+13	1.79E+12
20	1,400	1.37E+13	0	1.23E+13	1.37E+12
25	1,110	1.09E+13	0	9.78E+12	1.09E+12
30	892	8.73E+12	0	7.85E+12	8.73E+11
35	719	7.04E+12	0	6.33E+12	7.04E+11
40	592	5.79E+12	0	5.21E+12	5.79E+11
45	498	4.87E+12	0	4.39E+12	4.87E+11
50	419	4.10E+12	0	3.69E+12	4.10E+11
55	348	3.41E+12	0	3.07E+12	3.41E+11
60	284	2.78E+12	0	2.50E+12	2.78E+11
65	239	2.34E+12	0	2.11E+12	2.34E+11
70	199	1.95E+12	0	1.75E+12	1.95E+11
75	161	1.58E+12	0	1.42E+12	1.58E+11
80	130	1.27E+12	0	1.14E+12	1.27E+11
85	100	9.79E+11	0	8.81E+11	9.79E+10
90	67	6.56E+11	0	5.90E+11	6.56E+10
95	31	3.03E+11	0	2.73E+11	3.03E+10
100	0	0	0	0	0

Figure 5-17 Load Duration Curve for Fecal Coliform in Washita River at SH 152 (OK310830030010_00)

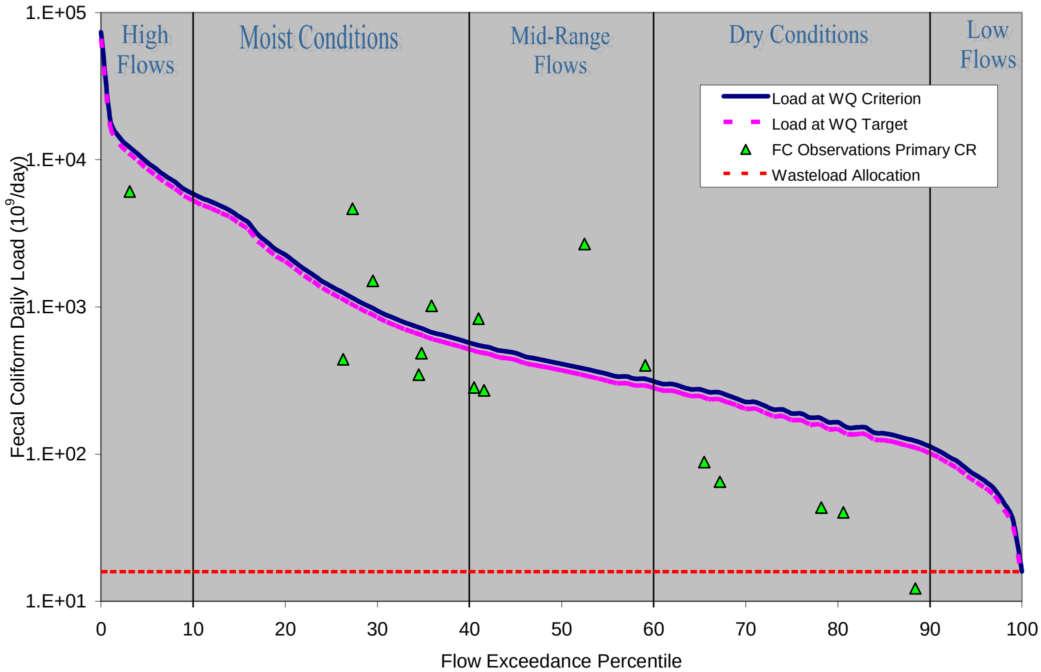
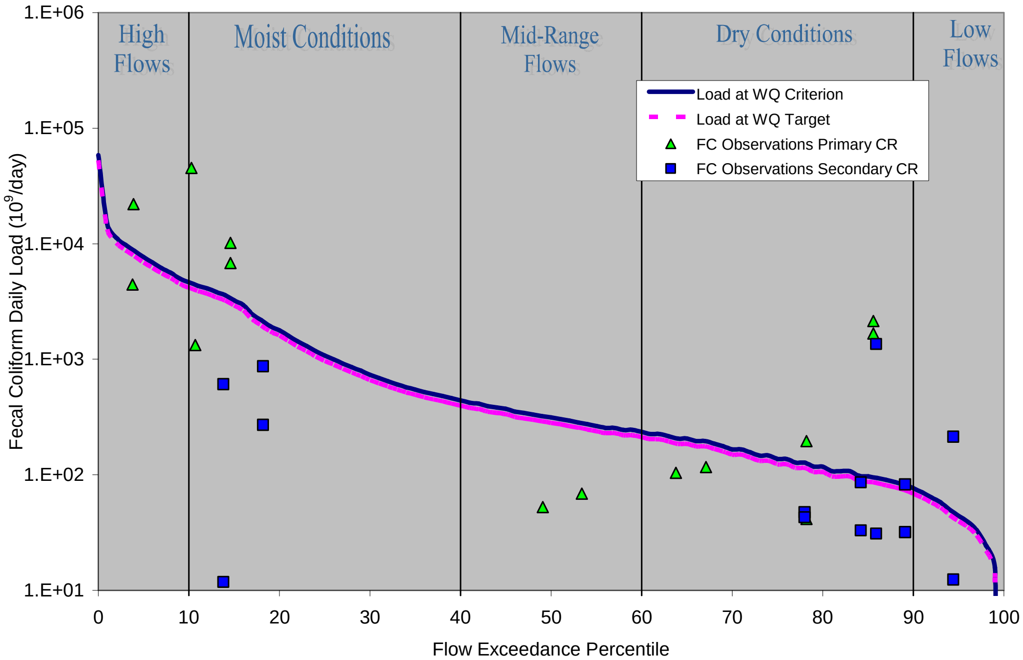


Table 5-20 Fecal Coliform TMDL Calculations for Washita River at SH 152 (OK310830030010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	7539	7.38E+13	1.59E+10	6.64E+13	7.38E+12
5	982	9.61E+12	1.59E+10	8.64E+12	9.61E+11
10	600	5.87E+12	1.59E+10	5.26E+12	5.87E+11
15	420	4.11E+12	1.59E+10	3.68E+12	4.11E+11
20	231	2.26E+12	1.59E+10	2.02E+12	2.26E+11
25	141	1.38E+12	1.59E+10	1.22E+12	1.38E+11
30	96	9.43E+11	1.59E+10	8.32E+11	9.43E+10
35	72	7.08E+11	1.59E+10	6.21E+11	7.08E+10
40	58	5.72E+11	1.59E+10	4.99E+11	5.72E+10
45	50	4.85E+11	1.59E+10	4.21E+11	4.85E+10
50	42	4.11E+11	1.59E+10	3.54E+11	4.11E+10
55	36	3.50E+11	1.59E+10	2.99E+11	3.50E+10
60	32	3.12E+11	1.59E+10	2.65E+11	3.12E+10
65	28	2.75E+11	1.59E+10	2.32E+11	2.75E+10
70	23	2.26E+11	1.59E+10	1.87E+11	2.26E+10
75	19	1.89E+11	1.59E+10	1.54E+11	1.89E+10
80	17	1.64E+11	1.59E+10	1.32E+11	1.64E+10
85	14	1.38E+11	1.59E+10	1.08E+11	1.38E+10
90	11	1.12E+11	1.59E+10	8.51E+10	1.12E+10
95	7.3	7.15E+10	1.59E+10	4.84E+10	7.15E+09
100	1.6	1.59E+10	1.43E+10	0.00E+00	1.59E+09

Figure 5-18 Load Duration Curve for Fecal Coliform in Washita River #145 (OK310830030010_10)

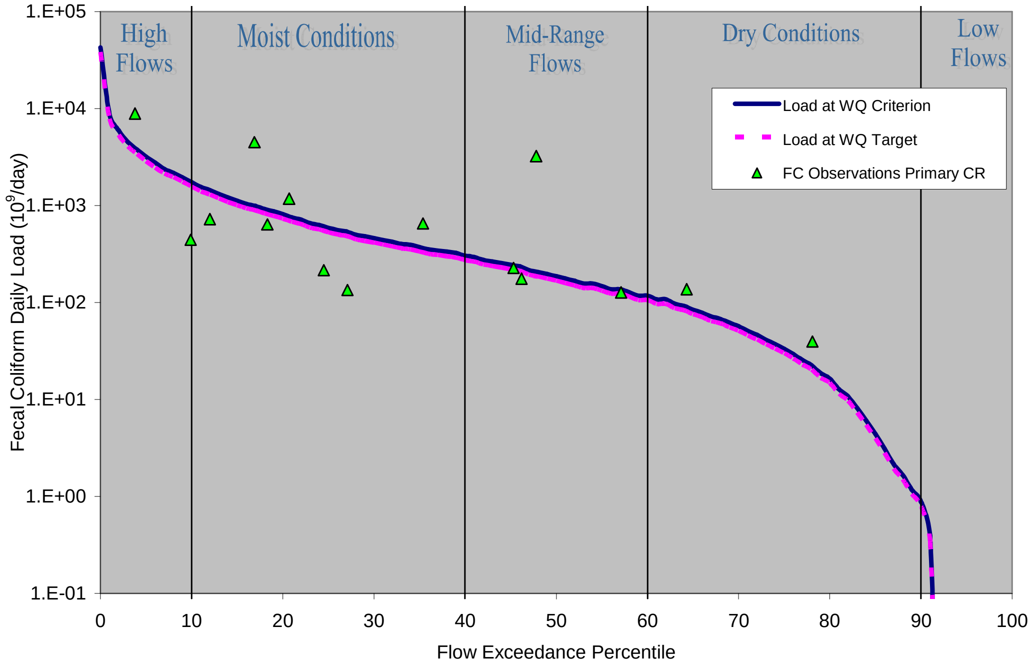


* there is no wasteload allocation for this waterbody

Table 5-21 Fecal Coliform TMDL Calculations for Washita River #145 (OK310830030010_10)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	5,970	5.84E+13	0	5.26E+13	5.84E+12
5	781	7.64E+12	0	6.88E+12	7.64E+11
10	473	4.63E+12	0	4.17E+12	4.63E+11
15	331	3.24E+12	0	2.92E+12	3.24E+11
20	182	1.78E+12	0	1.60E+12	1.78E+11
25	110	1.08E+12	0	9.69E+11	1.08E+11
30	75	7.34E+11	0	6.61E+11	7.34E+10
35	56	5.48E+11	0	4.93E+11	5.48E+10
40	45	4.40E+11	0	3.96E+11	4.40E+10
45	38	3.72E+11	0	3.35E+11	3.72E+10
50	32	3.13E+11	0	2.82E+11	3.13E+10
55	27	2.64E+11	0	2.38E+11	2.64E+10
60	24	2.35E+11	0	2.11E+11	2.35E+10
65	21	2.06E+11	0	1.85E+11	2.06E+10
70	17	1.66E+11	0	1.50E+11	1.66E+10
75	14	1.37E+11	0	1.23E+11	1.37E+10
80	12	1.17E+11	0	1.06E+11	1.17E+10
85	10	9.69E+10	0	8.72E+10	9.69E+09
90	7.8	7.63E+10	0	6.87E+10	7.63E+09
95	4.5	4.40E+10	0	3.96E+10	4.40E+09
100	0	0	0	0	0

Figure 5-19 Load Duration Curve for Fecal Coliform in Washita River at SH 33 (OK310840010010_00)

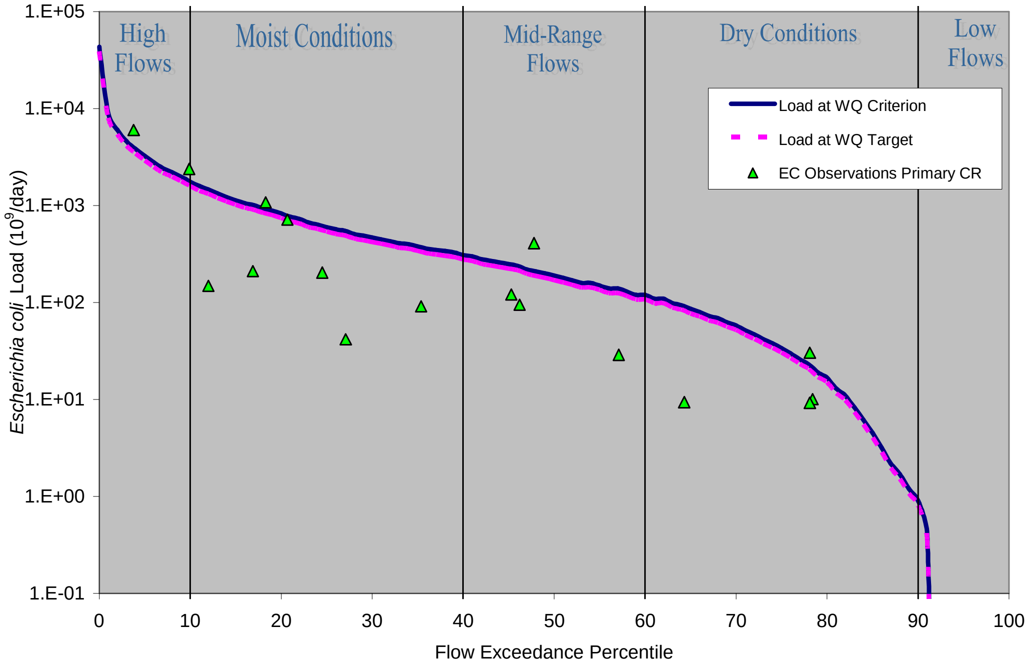


* there is no wasteload allocation for this waterbody

Table 5-22 Fecal Coliform TMDL Calculations for Washita River at SH 33 (OK310840010010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	4,340	4.25E+13	0	3.82E+13	4.25E+12
5	325	3.18E+12	0	2.87E+12	3.18E+11
10	177	1.73E+12	0	1.56E+12	1.73E+11
15	114	1.11E+12	0	1.00E+12	1.11E+11
20	83	8.12E+11	0	7.31E+11	8.12E+10
25	60	5.87E+11	0	5.28E+11	5.87E+10
30	47	4.60E+11	0	4.14E+11	4.60E+10
35	38	3.72E+11	0	3.35E+11	3.72E+10
40	31	3.03E+11	0	2.73E+11	3.03E+10
45	25	2.45E+11	0	2.20E+11	2.45E+10
50	19	1.86E+11	0	1.67E+11	1.86E+10
55	15	1.47E+11	0	1.32E+11	1.47E+10
60	12	1.17E+11	0	1.06E+11	1.17E+10
65	8.6	8.42E+10	0	7.57E+10	8.42E+09
70	5.8	5.68E+10	0	5.11E+10	5.68E+09
75	3.4	3.33E+10	0	2.99E+10	3.33E+09
80	1.7	1.64E+10	0	1.48E+10	1.64E+09
85	0.45	4.41E+09	0	3.97E+09	4.41E+08
90	0.09	8.81E+08	0	7.93E+08	8.81E+07
95	0	0	0	0	0
100	0	0	0	0	0

Figure 5-20 Load Duration Curve for *E. Coli* in Washita River at SH 33 (OK310840010010_00)



* there is no wasteload allocation for this waterbody

Table 5-23 *E. Coli* TMDL Calculations for Washita River at SH 33 (OK310840010010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	4,340	4.31E+13	0	3.88E+13	4.31E+12
5	325	3.23E+12	0	2.91E+12	3.23E+11
10	177	1.76E+12	0	1.58E+12	1.76E+11
15	114	1.13E+12	0	1.02E+12	1.13E+11
20	83	8.24E+11	0	7.42E+11	8.24E+10
25	60	5.96E+11	0	5.36E+11	5.96E+10
30	47	4.67E+11	0	4.20E+11	4.67E+10
35	38	3.77E+11	0	3.40E+11	3.77E+10
40	31	3.08E+11	0	2.77E+11	3.08E+10
45	25	2.48E+11	0	2.23E+11	2.48E+10
50	19	1.89E+11	0	1.70E+11	1.89E+10
55	15	1.49E+11	0	1.34E+11	1.49E+10
60	12	1.19E+11	0	1.07E+11	1.19E+10
65	8.6	8.54E+10	0	7.69E+10	8.54E+09
70	5.8	5.76E+10	0	5.19E+10	5.76E+09
75	3.4	3.38E+10	0	3.04E+10	3.38E+09
80	1.7	1.67E+10	0	1.50E+10	1.67E+09
85	0.45	4.48E+09	0	4.03E+09	4.48E+08
90	0.09	8.94E+08	0	8.05E+08	8.94E+07
95	0	0	0	0	0
100	0	0	0	0	0

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 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 5-24 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 5-24 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 regulated 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.

The reduction rates called for in this TMDL report are as high as 96 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 this segment of the river, 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 and was also submitted to the EPA for technical review. No comments were received from peer review. The report was technically approved by the EPA on July 19, 2007 with one comment on priority ranking of impaired stream segment. After updating the report according to the EPA's comment, the TMDL report was made available for public from August 2, 2007 through September 17, 2007. A public meeting was held in the auditorium of the Visitor's Center at the Wichita Mountains Wildlife Refuge, Oklahoma on September 6, 2007. Six people attended the public meeting.

At the end of public comment period, one comment was received. The response to the comment was prepared and included as part of this TMDL report. No change was made to the report due to the comment.

SECTION 7
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APPENDIX A
AMBIENT WATER QUALITY BACTERIA DATA – 1999 TO 2002

Appendix A

Ambient Water Quality Bacteria Data – 1999 to 2002

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310800010240P	Oil Creek	5/18/1999	FC	400	400
OK310800010240P	Oil Creek	6/15/1999	FC	10000	400
OK310800010240P	Oil Creek	7/13/1999	FC	100	400
OK310800010240P	Oil Creek	8/17/1999	FC	100	400
OK310800010240P	Oil Creek	9/28/1999	FC	200	400
OK310800010240P	Oil Creek	12/7/1999	FC	100	2000
OK310800010240P	Oil Creek	1/11/2000	FC	100	2000
OK310800010240P	Oil Creek	2/15/2000	FC	400	2000
OK310800010240P	Oil Creek	3/21/2000	FC	500	2000
OK310800010240P	Oil Creek	5/2/2000	FC	4200	400
OK310800010240P	Oil Creek	6/6/2000	FC	600	400
OK310800010240P	Oil Creek	7/11/2000	FC	4700	400
OK310800010240P	Oil Creek	8/15/2000	FC	160	400
OK310800010240P	Oil Creek	9/19/2000	FC	210	400
OK310800010240P	Oil Creek	10/24/2000	FC	6000	2000
OK310800010240P	Oil Creek	11/28/2000	FC	230	2000
OK310800010240P	Oil Creek	1/9/2001	FC	200	2000
OK310800010240P	Oil Creek	2/13/2001	FC	700	2000
OK310800010240P	Oil Creek	3/20/2001	FC	900	2000
OK310800010240P	Oil Creek	8/15/2000	EC	110	406
OK310800010240P	Oil Creek	9/19/2000	EC	132	406
OK310800010240P	Oil Creek	10/24/2000	EC	5475	2030
OK310800010240P	Oil Creek	11/28/2000	EC	122	2030
OK310800010240P	Oil Creek	1/9/2001	EC	262	2030
OK310800010240P	Oil Creek	2/13/2001	EC	504	2030
OK310800010240P	Oil Creek	3/20/2001	EC	624	2030
OK310800010240P	Oil Creek	9/19/2000	ENT	700	108
OK310800010240P	Oil Creek	10/24/2000	ENT	44000	540
OK310800010240P	Oil Creek	11/28/2000	ENT	200	540
OK310800010240P	Oil Creek	1/9/2001	ENT	30	540
OK310800010240P	Oil Creek	2/13/2001	ENT	200	540
OK310800010240P	Oil Creek	3/20/2001	ENT	100	540
OK310800020010-001AT	Washita River, US 177, Durwood	6/2/1999	FC	1290	400
OK310800020010-001AT	Washita River, US 177, Durwood	6/29/1999	FC	2300	400
OK310800020010-001AT	Washita River, US 177, Durwood	7/27/1999	FC	30	400
OK310800020010-001AT	Washita River, US 177, Durwood	9/28/1999	FC	40	400
OK310800020010-001AT	Washita River, US 177, Durwood	5/10/2000	FC	690	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310800020010-001AT	Washita River, US 177, Durwood	6/14/2000	FC	280	400
OK310800020010-001AT	Washita River, US 177, Durwood	7/19/2000	FC	50	400
OK310800020010-001AT	Washita River, US 177, Durwood	8/16/2000	FC	90	400
OK310800020010-001AT	Washita River, US 177, Durwood	9/13/2000	FC	200	400
OK310800020010-001AT	Washita River, US 177, Durwood	5/15/2001	FC	500	400
OK310800020010-001AT	Washita River, US 177, Durwood	6/11/2001	FC	600	400
OK310800020010-001AT	Washita River, US 177, Durwood	7/17/2001	FC	20	400
OK310800020010-001AT	Washita River, US 177, Durwood	8/14/2001	FC	50	400
OK310800020010-001AT	Washita River, US 177, Durwood	9/5/2001	FC	800	400
OK310800020010-001AT	Washita River, US 177, Durwood	5/22/2002	FC	100	400
OK310800020010-001AT	Washita River, US 177, Durwood	6/18/2002	FC	520	400
OK310800020010-001AT	Washita River, US 177, Durwood	7/24/2002	FC	60	400
OK310800020010-001AT	Washita River, US 177, Durwood	8/19/2002	FC	470	400
OK310800020010-001AT	Washita River, US 177, Durwood	9/23/2002	FC	360	400
OK310800020010-001AT	Washita River, US 177, Durwood	6/2/1999	EC	2419	406
OK310800020010-001AT	Washita River, US 177, Durwood	6/29/1999	EC	1046	406
OK310800020010-001AT	Washita River, US 177, Durwood	7/27/1999	EC	20	406
OK310800020010-001AT	Washita River, US 177, Durwood	9/28/1999	EC	805	406
OK310800020010-001AT	Washita River, US 177, Durwood	5/10/2000	EC	301	406
OK310800020010-001AT	Washita River, US 177, Durwood	6/14/2000	EC	175	406
OK310800020010-001AT	Washita River, US 177, Durwood	7/19/2000	EC	20	406
OK310800020010-001AT	Washita River, US 177, Durwood	8/16/2000	EC	5	406
OK310800020010-001AT	Washita River, US 177, Durwood	9/13/2000	EC	74	406
OK310800020010-001AT	Washita River, US 177, Durwood	5/15/2001	EC	598	406
OK310800020010-001AT	Washita River, US 177, Durwood	6/11/2001	EC	354	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310800020010-001AT	Washita River, US 177, Durwood	7/17/2001	EC	5	406
OK310800020010-001AT	Washita River, US 177, Durwood	8/14/2001	EC	5	406
OK310800020010-001AT	Washita River, US 177, Durwood	9/5/2001	EC	84	406
OK310800020010-001AT	Washita River, US 177, Durwood	5/22/2002	EC	158	406
OK310800020010-001AT	Washita River, US 177, Durwood	6/18/2002	EC	143	406
OK310800020010-001AT	Washita River, US 177, Durwood	7/24/2002	EC	10	406
OK310800020010-001AT	Washita River, US 177, Durwood	8/19/2002	EC	41	406
OK310800020010-001AT	Washita River, US 177, Durwood	9/23/2002	EC	20	406
OK310800020010-001AT	Washita River, US 177, Durwood	6/2/1999	ENT	75000	108
OK310800020010-001AT	Washita River, US 177, Durwood	6/29/1999	ENT	2700	108
OK310800020010-001AT	Washita River, US 177, Durwood	7/27/1999	ENT	5	108
OK310800020010-001AT	Washita River, US 177, Durwood	9/28/1999	ENT	200	108
OK310800020010-001AT	Washita River, US 177, Durwood	5/10/2000	ENT	1400	108
OK310800020010-001AT	Washita River, US 177, Durwood	6/14/2000	ENT	190	108
OK310800020010-001AT	Washita River, US 177, Durwood	7/19/2000	ENT	110	108
OK310800020010-001AT	Washita River, US 177, Durwood	8/16/2000	ENT	40	108
OK310800020010-001AT	Washita River, US 177, Durwood	9/13/2000	ENT	100	108
OK310800020010-001AT	Washita River, US 177, Durwood	5/15/2001	ENT	400	108
OK310800020010-001AT	Washita River, US 177, Durwood	6/11/2001	ENT	500	108
OK310800020010-001AT	Washita River, US 177, Durwood	7/17/2001	ENT	30	108
OK310800020010-001AT	Washita River, US 177, Durwood	8/14/2001	ENT	60	108
OK310800020010-001AT	Washita River, US 177, Durwood	9/5/2001	ENT	600	108
OK310800020010-001AT	Washita River, US 177, Durwood	5/22/2002	ENT	110	108
OK310800020010-001AT	Washita River, US 177, Durwood	6/18/2002	ENT	240	108
OK310800020010-001AT	Washita River, US 177, Durwood	7/24/2002	ENT	40	108

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310800020010-001AT	Washita River, US 177, Durwood	8/19/2002	ENT	400	108
OK310800020010-001AT	Washita River, US 177, Durwood	9/23/2002	ENT	100	108
OK310800020040C	Sand Branch Creek	4/19/1999	FC	26200	2000
OK310800020040C	Sand Branch Creek	5/17/1999	FC	2400	400
OK310800020040C	Sand Branch Creek	6/14/1999	FC	200	400
OK310800020040C	Sand Branch Creek	8/16/1999	FC	100	400
OK310800020040C	Sand Branch Creek	9/27/1999	FC	100	400
OK310800020040C	Sand Branch Creek	11/1/1999	FC	100	2000
OK310800020040C	Sand Branch Creek	12/6/1999	FC	100	2000
OK310800020040C	Sand Branch Creek	1/10/2000	FC	100	2000
OK310800020040C	Sand Branch Creek	2/14/2000	FC	100	2000
OK310800020040C	Sand Branch Creek	3/20/2000	FC	100	2000
OK310800020040C	Sand Branch Creek	5/1/2000	FC	5500	400
OK310800020040C	Sand Branch Creek	6/5/2000	FC	500	400
OK310800020040C	Sand Branch Creek	7/10/2000	FC	80	400
OK310800020040C	Sand Branch Creek	10/23/2000	FC	4000	2000
OK310800020040C	Sand Branch Creek	11/27/2000	FC	170	2000
OK310800020040C	Sand Branch Creek	1/8/2001	FC	10	2000
OK310800020040C	Sand Branch Creek	2/12/2001	FC	200	2000
OK310800020040C	Sand Branch Creek	3/19/2001	FC	130	2000
OK310800020040C	Sand Branch Creek	10/23/2000	EC	1050	2030
OK310800020040C	Sand Branch Creek	11/27/2000	EC	189	2030
OK310800020040C	Sand Branch Creek	1/8/2001	EC	52	2030
OK310800020040C	Sand Branch Creek	2/12/2001	EC	132	2030
OK310800020040C	Sand Branch Creek	3/19/2001	EC	134	2030
OK310800020040C	Sand Branch Creek	10/23/2000	ENT	10000	540
OK310800020040C	Sand Branch Creek	11/27/2000	ENT	900	540
OK310800020040C	Sand Branch Creek	1/8/2001	ENT	900	540
OK310800020040C	Sand Branch Creek	2/12/2001	ENT	130	540
OK310800020040C	Sand Branch Creek	3/19/2001	ENT	110	540
OK310800020190K	Chigley Sandy Creek	5/18/1999	FC	600	400
OK310800020190K	Chigley Sandy Creek	6/15/1999	FC	1200	400
OK310800020190K	Chigley Sandy Creek	7/13/1999	FC	200	400
OK310800020190K	Chigley Sandy Creek	8/17/1999	FC	1200	400
OK310800020190K	Chigley Sandy Creek	9/28/1999	FC	100	400
OK310800020190K	Chigley Sandy Creek	11/2/1999	FC	300	2000
OK310800020190K	Chigley Sandy Creek	12/7/1999	FC	200	2000
OK310800020190K	Chigley Sandy Creek	1/11/2000	FC	100	2000
OK310800020190K	Chigley Sandy Creek	2/15/2000	FC	100	2000
OK310800020190K	Chigley Sandy Creek	3/21/2000	FC	300	2000
OK310800020190K	Chigley Sandy Creek	5/2/2000	FC	3800	400
OK310800020190K	Chigley Sandy Creek	6/6/2000	FC	100	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310800020190K	Chigley Sandy Creek	7/11/2000	FC	500	400
OK310800020190K	Chigley Sandy Creek	8/15/2000	FC	40	400
OK310800020190K	Chigley Sandy Creek	9/19/2000	FC	900	400
OK310800020190K	Chigley Sandy Creek	10/24/2000	FC	3000	2000
OK310800020190K	Chigley Sandy Creek	10/24/2000	FC	900	2000
OK310800020190K	Chigley Sandy Creek	11/28/2000	FC	190	2000
OK310800020190K	Chigley Sandy Creek	11/28/2000	FC	180	2000
OK310800020190K	Chigley Sandy Creek	1/9/2001	FC	80	2000
OK310800020190K	Chigley Sandy Creek	1/9/2001	FC	70	2000
OK310800020190K	Chigley Sandy Creek	2/13/2001	FC	600	2000
OK310800020190K	Chigley Sandy Creek	2/13/2001	FC	200	2000
OK310800020190K	Chigley Sandy Creek	3/20/2001	FC	300	2000
OK310800020190K	Chigley Sandy Creek	8/15/2000	EC	20	406
OK310800020190K	Chigley Sandy Creek	9/19/2000	EC	213	406
OK310800020190K	Chigley Sandy Creek	10/24/2000	EC	2098	2030
OK310800020190K	Chigley Sandy Creek	11/28/2000	EC	201	2030
OK310800020190K	Chigley Sandy Creek	1/9/2001	EC	97	2030
OK310800020190K	Chigley Sandy Creek	2/13/2001	EC	305	2030
OK310800020190K	Chigley Sandy Creek	3/20/2001	EC	269	2030
OK310800020190K	Chigley Sandy Creek	9/19/2000	ENT	210	108
OK310800020190K	Chigley Sandy Creek	10/24/2000	ENT	20000	540
OK310800020190K	Chigley Sandy Creek	10/24/2000	ENT	42000	540
OK310800020190K	Chigley Sandy Creek	11/28/2000	ENT	1200	540
OK310800020190K	Chigley Sandy Creek	11/28/2000	ENT	800	540
OK310800020190K	Chigley Sandy Creek	1/9/2001	ENT	600	540
OK310800020190K	Chigley Sandy Creek	1/9/2001	ENT	300	540
OK310800020190K	Chigley Sandy Creek	2/13/2001	ENT	600	540
OK310800020190K	Chigley Sandy Creek	2/13/2001	ENT	400	540
OK310800020190K	Chigley Sandy Creek	3/20/2001	ENT	70	540
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/2/1999	FC	1000	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/29/1999	FC	2200	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/27/1999	FC	5	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/28/1999	FC	2200	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/10/2000	FC	740	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/14/2000	FC	40	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/19/2000	FC	20	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/16/2000	FC	210	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/13/2000	FC	130	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/15/2001	FC	1000	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/11/2001	FC	400	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/16/2001	FC	20	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/13/2001	FC	30	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/4/2001	FC	100	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/22/2002	FC	400	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/24/2002	FC	40	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/19/2002	FC	150	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/23/2002	FC	100	400
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/2/1999	EC	226	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/29/1999	EC	727	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/27/1999	EC	5	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/28/1999	EC	341	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/10/2000	EC	341	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/14/2000	EC	52	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/19/2000	EC	10	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/16/2000	EC	5	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/13/2000	EC	5	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/15/2001	EC	581	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/11/2001	EC	143	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/16/2001	EC	5	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/13/2001	EC	5	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/4/2001	EC	5	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/22/2002	EC	52	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/24/2002	EC	10	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/19/2002	EC	10	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/23/2002	EC	10	406
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/2/1999	ENT	900	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/29/1999	ENT	41000	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/27/1999	ENT	10	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/28/1999	ENT	320	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/10/2000	ENT	680	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/14/2000	ENT	300	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/19/2000	ENT	70	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/16/2000	ENT	100	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/13/2000	ENT	5	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/15/2001	ENT	500	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	6/11/2001	ENT	2000	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/16/2001	ENT	70	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/13/2001	ENT	30	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/4/2001	ENT	400	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	5/22/2002	ENT	10	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	7/24/2002	ENT	340	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	8/19/2002	ENT	3000	108
OK310810010010-001AT	Washita River, SH 19, Pauls Valley	9/23/2002	ENT	600	108
OK310810020170G	Roaring Creek	5/22/2000	FC	500	400
OK310810020170G	Roaring Creek	6/26/2000	FC	1200	400
OK310810020170G	Roaring Creek	9/5/2000	FC	1800	400
OK310810020170G	Roaring Creek	10/9/2000	FC	30	2000
OK310810020170G	Roaring Creek	11/13/2000	FC	300	2000
OK310810020170G	Roaring Creek	12/18/2000	FC	200	2000
OK310810020170G	Roaring Creek	1/30/2001	FC	300	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310810020170G	Roaring Creek	3/5/2001	FC	10	2000
OK310810020170G	Roaring Creek	4/9/2001	FC	100	2000
OK310810020170G	Roaring Creek	5/14/2001	FC	2000	400
OK310810020170G	Roaring Creek	6/18/2001	FC	1100	400
OK310810020170G	Roaring Creek	7/23/2001	FC	270	400
OK310810020170G	Roaring Creek	8/27/2001	FC	920	400
OK310810020170G	Roaring Creek	10/1/2001	FC	210	2000
OK310810020170G	Roaring Creek	11/5/2001	FC	350	2000
OK310810020170G	Roaring Creek	11/5/2001	FC	140	2000
OK310810020170G	Roaring Creek	9/5/2000	EC	395	406
OK310810020170G	Roaring Creek	10/9/2000	EC	20	2030
OK310810020170G	Roaring Creek	11/13/2000	EC	262	2030
OK310810020170G	Roaring Creek	12/18/2000	EC	309	2030
OK310810020170G	Roaring Creek	1/30/2001	EC	233	2030
OK310810020170G	Roaring Creek	3/5/2001	EC	10	2030
OK310810020170G	Roaring Creek	4/9/2001	EC	323	2030
OK310810020170G	Roaring Creek	5/14/2001	EC	467	406
OK310810020170G	Roaring Creek	6/18/2001	EC	311	406
OK310810020170G	Roaring Creek	7/23/2001	EC	5	406
OK310810020170G	Roaring Creek	8/27/2001	EC	360	406
OK310810020170G	Roaring Creek	10/1/2001	EC	190	2030
OK310810020170G	Roaring Creek	11/5/2001	EC	160	2030
OK310810020170G	Roaring Creek	9/5/2000	ENT	10000	108
OK310810020170G	Roaring Creek	10/9/2000	ENT	600	540
OK310810020170G	Roaring Creek	11/13/2000	ENT	4000	540
OK310810020170G	Roaring Creek	12/18/2000	ENT	4000	540
OK310810020170G	Roaring Creek	1/30/2001	ENT	16000	540
OK310810020170G	Roaring Creek	3/5/2001	ENT	70	540
OK310810020170G	Roaring Creek	4/9/2001	ENT	70	540
OK310810020170G	Roaring Creek	5/14/2001	ENT	1600	108
OK310810020170G	Roaring Creek	6/18/2001	ENT	3000	108
OK310810020170G	Roaring Creek	7/23/2001	ENT	85	108
OK310810020170G	Roaring Creek	8/27/2001	ENT	240	108
OK310810020170G	Roaring Creek	10/1/2001	ENT	210	540
OK310810020170G	Roaring Creek	11/5/2001	ENT	170	540
OK310810020170G	Roaring Creek	11/5/2001	ENT	50	540
OK310810020200G	Laflin Creek	5/22/2000	FC	2500	400
OK310810020200G	Laflin Creek	6/26/2000	FC	900	400
OK310810020200G	Laflin Creek	7/31/2000	FC	400	400
OK310810020200G	Laflin Creek	9/5/2000	FC	800	400
OK310810020200G	Laflin Creek	10/9/2000	FC	200	2000
OK310810020200G	Laflin Creek	11/13/2000	FC	200	2000
OK310810020200G	Laflin Creek	12/18/2000	FC	20	2000
OK310810020200G	Laflin Creek	1/30/2001	FC	500	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310810020200G	Laflin Creek	3/5/2001	FC	70	2000
OK310810020200G	Laflin Creek	4/9/2001	FC	4611	2000
OK310810020200G	Laflin Creek	5/14/2001	FC	2000	400
OK310810020200G	Laflin Creek	6/18/2001	FC	300	400
OK310810020200G	Laflin Creek	8/27/2001	FC	600	400
OK310810020200G	Laflin Creek	10/1/2001	FC	390	2000
OK310810020200G	Laflin Creek	11/5/2001	FC	760	2000
OK310810020200G	Laflin Creek	11/5/2001	FC	350	2000
OK310810020200G	Laflin Creek	7/31/2000	EC	171	406
OK310810020200G	Laflin Creek	9/5/2000	EC	259	406
OK310810020200G	Laflin Creek	10/9/2000	EC	52	2030
OK310810020200G	Laflin Creek	11/13/2000	EC	122	2030
OK310810020200G	Laflin Creek	12/18/2000	EC	41	2030
OK310810020200G	Laflin Creek	1/30/2001	EC	243	2030
OK310810020200G	Laflin Creek	3/5/2001	EC	132	2030
OK310810020200G	Laflin Creek	4/9/2001	EC	6000	2030
OK310810020200G	Laflin Creek	5/14/2001	EC	419	406
OK310810020200G	Laflin Creek	6/18/2001	EC	169	406
OK310810020200G	Laflin Creek	7/23/2001	EC	75	406
OK310810020200G	Laflin Creek	8/27/2001	EC	590	406
OK310810020200G	Laflin Creek	10/1/2001	EC	550	2030
OK310810020200G	Laflin Creek	11/5/2001	EC	550	2030
OK310810020200G	Laflin Creek	7/31/2000	ENT	1100	108
OK310810020200G	Laflin Creek	9/5/2000	ENT	8000	108
OK310810020200G	Laflin Creek	10/9/2000	ENT	1000	540
OK310810020200G	Laflin Creek	11/13/2000	ENT	2000	540
OK310810020200G	Laflin Creek	12/18/2000	ENT	5000	540
OK310810020200G	Laflin Creek	1/30/2001	ENT	9000	540
OK310810020200G	Laflin Creek	3/5/2001	ENT	90	540
OK310810020200G	Laflin Creek	4/9/2001	ENT	300	540
OK310810020200G	Laflin Creek	5/14/2001	ENT	4000	108
OK310810020200G	Laflin Creek	6/18/2001	ENT	300	108
OK310810020200G	Laflin Creek	7/23/2001	ENT	300	108
OK310810020200G	Laflin Creek	8/27/2001	ENT	510	108
OK310810020200G	Laflin Creek	10/1/2001	ENT	180	540
OK310810020200G	Laflin Creek	11/5/2001	ENT	300	540
OK310810020200G	Laflin Creek	11/5/2001	ENT	170	540
OK310820010030G	Bitter Creek	5/22/2000	FC	100	400
OK310820010030G	Bitter Creek	6/26/2000	FC	1400	400
OK310820010030G	Bitter Creek	9/5/2000	FC	520	400
OK310820010030G	Bitter Creek	12/18/2000	FC	200	2000
OK310820010030G	Bitter Creek	3/5/2001	FC	50	2000
OK310820010030G	Bitter Creek	4/9/2001	FC	500	2000
OK310820010030G	Bitter Creek	5/14/2001	FC	1000	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310820010030G	Bitter Creek	6/18/2001	FC	60	400
OK310820010030G	Bitter Creek	7/23/2001	FC	170	400
OK310820010030G	Bitter Creek	8/27/2001	FC	600	400
OK310820010030G	Bitter Creek	10/1/2001	FC	70	2000
OK310820010030G	Bitter Creek	11/5/2001	FC	90	2000
OK310820010030G	Bitter Creek	11/5/2001	FC	460	2000
OK310820010030G	Bitter Creek	9/5/2000	EC	30	406
OK310820010030G	Bitter Creek	12/18/2000	EC	275	2030
OK310820010030G	Bitter Creek	3/5/2001	EC	52	2030
OK310820010030G	Bitter Creek	4/9/2001	EC	295	2030
OK310820010030G	Bitter Creek	5/14/2001	EC	345	406
OK310820010030G	Bitter Creek	6/18/2001	EC	20	406
OK310820010030G	Bitter Creek	7/23/2001	EC	100	406
OK310820010030G	Bitter Creek	8/27/2001	EC	800	406
OK310820010030G	Bitter Creek	10/1/2001	EC	90	2030
OK310820010030G	Bitter Creek	11/5/2001	EC	70	2030
OK310820010030G	Bitter Creek	9/5/2000	ENT	180	108
OK310820010030G	Bitter Creek	12/18/2000	ENT	5000	540
OK310820010030G	Bitter Creek	3/5/2001	ENT	500	540
OK310820010030G	Bitter Creek	4/9/2001	ENT	90	540
OK310820010030G	Bitter Creek	5/14/2001	ENT	500	108
OK310820010030G	Bitter Creek	6/18/2001	ENT	30	108
OK310820010030G	Bitter Creek	7/23/2001	ENT	130	108
OK310820010030G	Bitter Creek	8/27/2001	ENT	800	108
OK310820010030G	Bitter Creek	10/1/2001	ENT	160	540
OK310820010030G	Bitter Creek	11/5/2001	ENT	110	540
OK310820010030G	Bitter Creek	11/5/2001	ENT	170	540
OK310820020010B	Little Washita River	5/22/2000	FC	100	400
OK310820020010B	Little Washita River	6/26/2000	FC	1100	400
OK310820020010B	Little Washita River	9/5/2000	FC	6200	400
OK310820020010B	Little Washita River	10/9/2000	FC	70	2000
OK310820020010B	Little Washita River	11/14/2000	FC	300	2000
OK310820020010B	Little Washita River	12/19/2000	FC	80	2000
OK310820020010B	Little Washita River	1/31/2001	FC	200	2000
OK310820020010B	Little Washita River	3/6/2001	FC	400	2000
OK310820020010B	Little Washita River	4/10/2001	FC	1000	2000
OK310820020010B	Little Washita River	5/15/2001	FC	400	400
OK310820020010B	Little Washita River	6/19/2001	FC	200	400
OK310820020010B	Little Washita River	7/24/2001	FC	105	400
OK310820020010B	Little Washita River	7/24/2001	FC	50	400
OK310820020010B	Little Washita River	8/28/2001	FC	290	400
OK310820020010B	Little Washita River	8/28/2001	FC	210	400
OK310820020010B	Little Washita River	10/2/2001	FC	40	2000
OK310820020010B	Little Washita River	10/2/2001	FC	50	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310820020010B	Little Washita River	11/6/2001	FC	550	2000
OK310820020010B	Little Washita River	11/6/2001	FC	160	2000
OK310820020010B	Little Washita River	11/6/2001	FC	720	2000
OK310820020010B	Little Washita River	9/5/2000	EC	62	406
OK310820020010B	Little Washita River	10/9/2000	EC	63	2030
OK310820020010B	Little Washita River	11/14/2000	EC	122	2030
OK310820020010B	Little Washita River	12/19/2000	EC	86	2030
OK310820020010B	Little Washita River	1/31/2001	EC	63	2030
OK310820020010B	Little Washita River	3/6/2001	EC	85	2030
OK310820020010B	Little Washita River	4/10/2001	EC	1236	2030
OK310820020010B	Little Washita River	5/15/2001	EC	74	406
OK310820020010B	Little Washita River	6/19/2001	EC	41	406
OK310820020010B	Little Washita River	7/24/2001	EC	5	406
OK310820020010B	Little Washita River	8/28/2001	EC	20	406
OK310820020010B	Little Washita River	10/2/2001	EC	60	2030
OK310820020010B	Little Washita River	11/6/2001	EC	220	2030
OK310820020010B	Little Washita River	9/5/2000	ENT	1000	108
OK310820020010B	Little Washita River	10/9/2000	ENT	14000	540
OK310820020010B	Little Washita River	11/14/2000	ENT	800	540
OK310820020010B	Little Washita River	12/19/2000	ENT	11000	540
OK310820020010B	Little Washita River	1/31/2001	ENT	5000	540
OK310820020010B	Little Washita River	3/6/2001	ENT	500	540
OK310820020010B	Little Washita River	4/10/2001	ENT	500	540
OK310820020010B	Little Washita River	5/15/2001	ENT	700	108
OK310820020010B	Little Washita River	6/19/2001	ENT	300	108
OK310820020010B	Little Washita River	7/24/2001	ENT	65	108
OK310820020010B	Little Washita River	7/24/2001	ENT	40	108
OK310820020010B	Little Washita River	8/28/2001	ENT	80	108
OK310820020010B	Little Washita River	8/28/2001	ENT	90	108
OK310820020010B	Little Washita River	10/2/2001	ENT	30	540
OK310820020010B	Little Washita River	10/2/2001	ENT	350	540
OK310820020010B	Little Washita River	11/6/2001	ENT	50	540
OK310820020010B	Little Washita River	11/6/2001	ENT	110	540
OK310830010010-001AT	Washita River, US 281, Anadarko	6/16/1999	FC	150	400
OK310830010010-001AT	Washita River, US 281, Anadarko	7/12/1999	FC	51000	400
OK310830010010-001AT	Washita River, US 281, Anadarko	8/18/1999	FC	10	400
OK310830010010-001AT	Washita River, US 281, Anadarko	5/9/2000	FC	280	400
OK310830010010-001AT	Washita River, US 281, Anadarko	6/13/2000	FC	150	400
OK310830010010-001AT	Washita River, US 281, Anadarko	7/19/2000	FC	30	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830010010-001AT	Washita River, US 281, Anadarko	8/16/2000	FC	80	400
OK310830010010-001AT	Washita River, US 281, Anadarko	9/13/2000	FC	30	400
OK310830010010-001AT	Washita River, US 281, Anadarko	5/16/2001	FC	4000	400
OK310830010010-001AT	Washita River, US 281, Anadarko	6/12/2001	FC	200	400
OK310830010010-001AT	Washita River, US 281, Anadarko	7/17/2001	FC	300	400
OK310830010010-001AT	Washita River, US 281, Anadarko	8/14/2001	FC	3000	400
OK310830010010-001AT	Washita River, US 281, Anadarko	9/4/2001	FC	30	400
OK310830010010-001AT	Washita River, US 281, Anadarko	5/21/2002	FC	200	400
OK310830010010-001AT	Washita River, US 281, Anadarko	7/23/2002	FC	70	400
OK310830010010-001AT	Washita River, US 281, Anadarko	8/19/2002	FC	80	400
OK310830010010-001AT	Washita River, US 281, Anadarko	9/23/2002	FC	200	400
OK310830010010-001AT	Washita River, US 281, Anadarko	6/16/1999	EC	145	406
OK310830010010-001AT	Washita River, US 281, Anadarko	7/12/1999	EC	4352	406
OK310830010010-001AT	Washita River, US 281, Anadarko	8/18/1999	EC	20	406
OK310830010010-001AT	Washita River, US 281, Anadarko	5/9/2000	EC	771	406
OK310830010010-001AT	Washita River, US 281, Anadarko	6/13/2000	EC	62	406
OK310830010010-001AT	Washita River, US 281, Anadarko	7/19/2000	EC	5	406
OK310830010010-001AT	Washita River, US 281, Anadarko	8/16/2000	EC	5	406
OK310830010010-001AT	Washita River, US 281, Anadarko	9/13/2000	EC	5	406
OK310830010010-001AT	Washita River, US 281, Anadarko	5/16/2001	EC	743	406
OK310830010010-001AT	Washita River, US 281, Anadarko	6/12/2001	EC	97	406
OK310830010010-001AT	Washita River, US 281, Anadarko	7/17/2001	EC	41	406
OK310830010010-001AT	Washita River, US 281, Anadarko	8/14/2001	EC	233	406
OK310830010010-001AT	Washita River, US 281, Anadarko	9/4/2001	EC	10	406
OK310830010010-001AT	Washita River, US 281, Anadarko	5/21/2002	EC	382	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830010010-001AT	Washita River, US 281, Anadarko	7/23/2002	EC	10	406
OK310830010010-001AT	Washita River, US 281, Anadarko	8/19/2002	EC	10	406
OK310830010010-001AT	Washita River, US 281, Anadarko	9/23/2002	EC	52	406
OK310830010010-001AT	Washita River, US 281, Anadarko	6/16/1999	ENT	470	108
OK310830010010-001AT	Washita River, US 281, Anadarko	7/12/1999	ENT	390	108
OK310830010010-001AT	Washita River, US 281, Anadarko	8/18/1999	ENT	5	108
OK310830010010-001AT	Washita River, US 281, Anadarko	5/9/2000	ENT	1200	108
OK310830010010-001AT	Washita River, US 281, Anadarko	6/13/2000	ENT	50	108
OK310830010010-001AT	Washita River, US 281, Anadarko	7/19/2000	ENT	70	108
OK310830010010-001AT	Washita River, US 281, Anadarko	8/16/2000	ENT	50	108
OK310830010010-001AT	Washita River, US 281, Anadarko	9/13/2000	ENT	40	108
OK310830010010-001AT	Washita River, US 281, Anadarko	5/16/2001	ENT	2000	108
OK310830010010-001AT	Washita River, US 281, Anadarko	6/12/2001	ENT	1000	108
OK310830010010-001AT	Washita River, US 281, Anadarko	7/17/2001	ENT	250	108
OK310830010010-001AT	Washita River, US 281, Anadarko	8/14/2001	ENT	600	108
OK310830010010-001AT	Washita River, US 281, Anadarko	9/4/2001	ENT	130	108
OK310830010010-001AT	Washita River, US 281, Anadarko	5/21/2002	ENT	400	108
OK310830010010-001AT	Washita River, US 281, Anadarko	7/23/2002	ENT	2000	108
OK310830010010-001AT	Washita River, US 281, Anadarko	8/19/2002	ENT	100	108
OK310830010010-001AT	Washita River, US 281, Anadarko	9/23/2002	ENT	200	108
OK310830030010-001AT	Washita River, SH 152, Cordell	6/16/1999	FC	140	400
OK310830030010-001AT	Washita River, SH 152, Cordell	7/12/1999	FC	610	400
OK310830030010-001AT	Washita River, SH 152, Cordell	8/18/1999	FC	2800	400
OK310830030010-001AT	Washita River, SH 152, Cordell	5/9/2000	FC	1600	400
OK310830030010-001AT	Washita River, SH 152, Cordell	6/13/2000	FC	270	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830030010-001AT	Washita River, SH 152, Cordell	7/19/2000	FC	200	400
OK310830030010-001AT	Washita River, SH 152, Cordell	8/16/2000	FC	100	400
OK310830030010-001AT	Washita River, SH 152, Cordell	9/13/2000	FC	100	400
OK310830030010-001AT	Washita River, SH 152, Cordell	6/12/2001	FC	200	400
OK310830030010-001AT	Washita River, SH 152, Cordell	7/17/2001	FC	200	400
OK310830030010-001AT	Washita River, SH 152, Cordell	8/14/2001	FC	500	400
OK310830030010-001AT	Washita River, SH 152, Cordell	9/4/2001	FC	190	400
OK310830030010-001AT	Washita River, SH 152, Cordell	5/21/2002	FC	600	400
OK310830030010-001AT	Washita River, SH 152, Cordell	6/18/2002	FC	600	400
OK310830030010-001AT	Washita River, SH 152, Cordell	7/23/2002	FC	130	400
OK310830030010-001AT	Washita River, SH 152, Cordell	8/21/2002	FC	40	400
OK310830030010-001AT	Washita River, SH 152, Cordell	9/25/2002	FC	100	400
OK310830030010-001AT	Washita River, SH 152, Cordell	6/16/1999	EC	134	406
OK310830030010-001AT	Washita River, SH 152, Cordell	7/12/1999	EC	650	406
OK310830030010-001AT	Washita River, SH 152, Cordell	8/18/1999	EC	703	406
OK310830030010-001AT	Washita River, SH 152, Cordell	5/9/2000	EC	203	406
OK310830030010-001AT	Washita River, SH 152, Cordell	6/13/2000	EC	63	406
OK310830030010-001AT	Washita River, SH 152, Cordell	7/19/2000	EC	31	406
OK310830030010-001AT	Washita River, SH 152, Cordell	8/16/2000	EC	62	406
OK310830030010-001AT	Washita River, SH 152, Cordell	9/13/2000	EC	30	406
OK310830030010-001AT	Washita River, SH 152, Cordell	5/16/2001	EC	3448	406
OK310830030010-001AT	Washita River, SH 152, Cordell	6/12/2001	EC	240	406
OK310830030010-001AT	Washita River, SH 152, Cordell	7/17/2001	EC	41	406
OK310830030010-001AT	Washita River, SH 152, Cordell	8/14/2001	EC	41	406
OK310830030010-001AT	Washita River, SH 152, Cordell	9/4/2001	EC	5	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830030010-001AT	Washita River, SH 152, Cordell	5/21/2002	EC	644	406
OK310830030010-001AT	Washita River, SH 152, Cordell	6/18/2002	EC	373	406
OK310830030010-001AT	Washita River, SH 152, Cordell	7/23/2002	EC	10	406
OK310830030010-001AT	Washita River, SH 152, Cordell	8/21/2002	EC	10	406
OK310830030010-001AT	Washita River, SH 152, Cordell	9/25/2002	EC	20	406
OK310830030010-001AT	Washita River, SH 152, Cordell	6/16/1999	ENT	170	108
OK310830030010-001AT	Washita River, SH 152, Cordell	7/12/1999	ENT	70	108
OK310830030010-001AT	Washita River, SH 152, Cordell	8/18/1999	ENT	1100	108
OK310830030010-001AT	Washita River, SH 152, Cordell	5/9/2000	ENT	1700	108
OK310830030010-001AT	Washita River, SH 152, Cordell	6/13/2000	ENT	390	108
OK310830030010-001AT	Washita River, SH 152, Cordell	7/19/2000	ENT	700	108
OK310830030010-001AT	Washita River, SH 152, Cordell	8/16/2000	ENT	200	108
OK310830030010-001AT	Washita River, SH 152, Cordell	9/13/2000	ENT	70	108
OK310830030010-001AT	Washita River, SH 152, Cordell	5/16/2001	ENT	3100	108
OK310830030010-001AT	Washita River, SH 152, Cordell	6/12/2001	ENT	3000	108
OK310830030010-001AT	Washita River, SH 152, Cordell	7/17/2001	ENT	310	108
OK310830030010-001AT	Washita River, SH 152, Cordell	8/14/2001	ENT	200	108
OK310830030010-001AT	Washita River, SH 152, Cordell	9/4/2001	ENT	300	108
OK310830030010-001AT	Washita River, SH 152, Cordell	5/21/2002	ENT	1700	108
OK310830030010-001AT	Washita River, SH 152, Cordell	6/18/2002	ENT	6000	108
OK310830030010-001AT	Washita River, SH 152, Cordell	7/23/2002	ENT	600	108
OK310830030010-001AT	Washita River, SH 152, Cordell	8/21/2002	ENT	150	108
OK310830030010-001AT	Washita River, SH 152, Cordell	9/25/2002	ENT	200	108
OK310830030010G	Washita River # 466	5/22/2000	FC	100	400
OK310830030010G	Washita River # 466	9/5/2000	FC	9000	400
OK310830030010G	Washita River # 466	10/9/2000	FC	130	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830030010G	Washita River # 466	11/13/2000	FC	1300	2000
OK310830030010G	Washita River # 466	12/18/2000	FC	100	2000
OK310830030010G	Washita River # 466	3/5/2001	FC	100	2000
OK310830030010G	Washita River # 466	4/9/2001	FC	140	2000
OK310830030010G	Washita River # 466	5/14/2001	FC	4000	400
OK310830030010G	Washita River # 466	6/18/2001	FC	200	400
OK310830030010G	Washita River # 466	7/23/2001	FC	65	400
OK310830030010G	Washita River # 466	8/27/2001	FC	660	400
OK310830030010G	Washita River # 466	10/1/2001	FC	120	2000
OK310830030010G	Washita River # 466	11/5/2001	FC	100	2000
OK310830030010G	Washita River # 466	11/5/2001	FC	430	2000
OK310830030010G	Washita River # 466	9/5/2000	EC	51	406
OK310830030010G	Washita River # 466	10/9/2000	EC	131	2030
OK310830030010G	Washita River # 466	11/13/2000	EC	644	2030
OK310830030010G	Washita River # 466	12/18/2000	EC	161	2030
OK310830030010G	Washita River # 466	3/5/2001	EC	73	2030
OK310830030010G	Washita River # 466	4/9/2001	EC	86	2030
OK310830030010G	Washita River # 466	5/14/2001	EC	2143	406
OK310830030010G	Washita River # 466	6/18/2001	EC	119	406
OK310830030010G	Washita River # 466	7/23/2001	EC	40	406
OK310830030010G	Washita River # 466	8/27/2001	EC	630	406
OK310830030010G	Washita River # 466	10/1/2001	EC	30	2030
OK310830030010G	Washita River # 466	11/5/2001	EC	110	2030
OK310830030010G	Washita River # 466	9/5/2000	ENT	100	108
OK310830030010G	Washita River # 466	10/9/2000	ENT	90	540
OK310830030010G	Washita River # 466	11/13/2000	ENT	8000	540
OK310830030010G	Washita River # 466	12/18/2000	ENT	1100	540
OK310830030010G	Washita River # 466	3/5/2001	ENT	3000	540
OK310830030010G	Washita River # 466	4/9/2001	ENT	400	540
OK310830030010G	Washita River # 466	5/14/2001	ENT	6000	108
OK310830030010G	Washita River # 466	6/18/2001	ENT	2000	108
OK310830030010G	Washita River # 466	7/23/2001	ENT	85	108
OK310830030010G	Washita River # 466	8/27/2001	ENT	115	108
OK310830030010G	Washita River # 466	10/1/2001	ENT	10	540
OK310830030010G	Washita River # 466	11/5/2001	ENT	30	540
OK310830030010G	Washita River # 466	11/5/2001	ENT	250	540
OK310830030010P	Washita River # 145	5/22/2000	FC	100	400
OK310830030010P	Washita River # 145	6/26/2000	FC	800	400
OK310830030010P	Washita River # 145	6/26/2000	FC	1200	400
OK310830030010P	Washita River # 145	7/31/2000	FC	240	400
OK310830030010P	Washita River # 145	9/5/2000	FC	7000	400
OK310830030010P	Washita River # 145	9/5/2000	FC	9000	400
OK310830030010P	Washita River # 145	10/9/2000	FC	50	2000
OK310830030010P	Washita River # 145	10/9/2000	FC	130	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830030010P	Washita River # 145	11/13/2000	FC	500	2000
OK310830030010P	Washita River # 145	11/13/2000	FC	1300	2000
OK310830030010P	Washita River # 145	12/18/2000	FC	40	2000
OK310830030010P	Washita River # 145	12/18/2000	FC	100	2000
OK310830030010P	Washita River # 145	3/5/2001	FC	500	2000
OK310830030010P	Washita River # 145	3/5/2001	FC	100	2000
OK310830030010P	Washita River # 145	4/9/2001	FC	200	2000
OK310830030010P	Washita River # 145	4/9/2001	FC	140	2000
OK310830030010P	Washita River # 145	5/14/2001	FC	4000	400
OK310830030010P	Washita River # 145	5/15/2001	FC	1000	400
OK310830030010P	Washita River # 145	6/18/2001	FC	200	400
OK310830030010P	Washita River # 145	6/19/2001	FC	120	400
OK310830030010P	Washita River # 145	7/23/2001	FC	65	400
OK310830030010P	Washita River # 145	7/24/2001	FC	195	400
OK310830030010P	Washita River # 145	8/27/2001	FC	140	400
OK310830030010P	Washita River # 145	8/27/2001	FC	660	400
OK310830030010P	Washita River # 145	10/1/2001	FC	30	2000
OK310830030010P	Washita River # 145	10/1/2001	FC	120	2000
OK310830030010P	Washita River # 145	11/5/2001	FC	130	2000
OK310830030010P	Washita River # 145	11/5/2001	FC	100	2000
OK310830030010P	Washita River # 145	11/5/2001	FC	260	2000
OK310830030010P	Washita River # 145	7/31/2000	EC	52	406
OK310830030010P	Washita River # 145	9/5/2000	EC	10	406
OK310830030010P	Washita River # 145	9/5/2000	EC	51	406
OK310830030010P	Washita River # 145	10/9/2000	EC	41	2030
OK310830030010P	Washita River # 145	10/9/2000	EC	131	2030
OK310830030010P	Washita River # 145	11/13/2000	EC	350	2030
OK310830030010P	Washita River # 145	11/13/2000	EC	644	2030
OK310830030010P	Washita River # 145	12/18/2000	EC	41	2030
OK310830030010P	Washita River # 145	12/18/2000	EC	161	2030
OK310830030010P	Washita River # 145	3/5/2001	EC	74	2030
OK310830030010P	Washita River # 145	3/5/2001	EC	73	2030
OK310830030010P	Washita River # 145	4/9/2001	EC	332	2030
OK310830030010P	Washita River # 145	4/9/2001	EC	86	2030
OK310830030010P	Washita River # 145	5/14/2001	EC	2143	406
OK310830030010P	Washita River # 145	5/15/2001	EC	520	406
OK310830030010P	Washita River # 145	6/18/2001	EC	119	406
OK310830030010P	Washita River # 145	6/19/2001	EC	121	406
OK310830030010P	Washita River # 145	7/23/2001	EC	40	406
OK310830030010P	Washita River # 145	7/24/2001	EC	110	406
OK310830030010P	Washita River # 145	8/27/2001	EC	40	406
OK310830030010P	Washita River # 145	8/27/2001	EC	630	406
OK310830030010P	Washita River # 145	10/1/2001	EC	40	2030
OK310830030010P	Washita River # 145	10/1/2001	EC	30	2030

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830030010P	Washita River # 145	11/5/2001	EC	60	2030
OK310830030010P	Washita River # 145	11/5/2001	EC	110	2030
OK310830030010P	Washita River # 145	7/31/2000	ENT	130	108
OK310830030010P	Washita River # 145	9/5/2000	ENT	140	108
OK310830030010P	Washita River # 145	9/5/2000	ENT	100	108
OK310830030010P	Washita River # 145	10/9/2000	ENT	50	540
OK310830030010P	Washita River # 145	10/9/2000	ENT	90	540
OK310830030010P	Washita River # 145	11/13/2000	ENT	500	540
OK310830030010P	Washita River # 145	11/13/2000	ENT	8000	540
OK310830030010P	Washita River # 145	12/18/2000	ENT	400	540
OK310830030010P	Washita River # 145	12/18/2000	ENT	1100	540
OK310830030010P	Washita River # 145	3/5/2001	ENT	70	540
OK310830030010P	Washita River # 145	3/5/2001	ENT	3000	540
OK310830030010P	Washita River # 145	4/9/2001	ENT	170	540
OK310830030010P	Washita River # 145	4/9/2001	ENT	400	540
OK310830030010P	Washita River # 145	5/14/2001	ENT	6000	108
OK310830030010P	Washita River # 145	5/15/2001	ENT	1800	108
OK310830030010P	Washita River # 145	6/18/2001	ENT	2000	108
OK310830030010P	Washita River # 145	6/19/2001	ENT	1300	108
OK310830030010P	Washita River # 145	7/23/2001	ENT	85	108
OK310830030010P	Washita River # 145	7/24/2001	ENT	30	108
OK310830030010P	Washita River # 145	8/27/2001	ENT	10	108
OK310830030010P	Washita River # 145	8/27/2001	ENT	115	108
OK310830030010P	Washita River # 145	10/1/2001	ENT	10	540
OK310830030010P	Washita River # 145	11/5/2001	ENT	60	540
OK310830030010P	Washita River # 145	11/5/2001	ENT	30	540
OK310830030010P	Washita River # 145	11/5/2001	ENT	190	540
OK310830030230G	West Barnitz Creek	5/22/2000	FC	100	400
OK310830030230G	West Barnitz Creek	6/26/2000	FC	800	400
OK310830030230G	West Barnitz Creek	7/31/2000	FC	100	400
OK310830030230G	West Barnitz Creek	9/5/2000	FC	3060	400
OK310830030230G	West Barnitz Creek	10/9/2000	FC	1100	2000
OK310830030230G	West Barnitz Creek	11/13/2000	FC	100	2000
OK310830030230G	West Barnitz Creek	12/18/2000	FC	100	2000
OK310830030230G	West Barnitz Creek	12/18/2000	FC	40	2000
OK310830030230G	West Barnitz Creek	1/30/2001	FC	10	2000
OK310830030230G	West Barnitz Creek	3/5/2001	FC	10	2000
OK310830030230G	West Barnitz Creek	4/9/2001	FC	180	2000
OK310830030230G	West Barnitz Creek	5/15/2001	FC	400	400
OK310830030230G	West Barnitz Creek	6/19/2001	FC	150	400
OK310830030230G	West Barnitz Creek	7/24/2001	FC	330	400
OK310830030230G	West Barnitz Creek	8/27/2001	FC	160	400
OK310830030230G	West Barnitz Creek	10/1/2001	FC	200	2000
OK310830030230G	West Barnitz Creek	11/5/2001	FC	230	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830030230G	West Barnitz Creek	11/5/2001	FC	130	2000
OK310830030230G	West Barnitz Creek	7/31/2000	EC	10	406
OK310830030230G	West Barnitz Creek	9/5/2000	EC	226	406
OK310830030230G	West Barnitz Creek	10/9/2000	EC	2098	2030
OK310830030230G	West Barnitz Creek	11/13/2000	EC	121	2030
OK310830030230G	West Barnitz Creek	12/18/2000	EC	98	2030
OK310830030230G	West Barnitz Creek	1/30/2001	EC	30	2030
OK310830030230G	West Barnitz Creek	3/5/2001	EC	20	2030
OK310830030230G	West Barnitz Creek	4/9/2001	EC	146	2030
OK310830030230G	West Barnitz Creek	5/15/2001	EC	327	406
OK310830030230G	West Barnitz Creek	6/19/2001	EC	121	406
OK310830030230G	West Barnitz Creek	7/24/2001	EC	130	406
OK310830030230G	West Barnitz Creek	8/27/2001	EC	120	406
OK310830030230G	West Barnitz Creek	10/1/2001	EC	90	2030
OK310830030230G	West Barnitz Creek	11/5/2001	EC	160	2030
OK310830030230G	West Barnitz Creek	7/31/2000	ENT	250	108
OK310830030230G	West Barnitz Creek	9/5/2000	ENT	1400	108
OK310830030230G	West Barnitz Creek	10/9/2000	ENT	3000	540
OK310830030230G	West Barnitz Creek	11/13/2000	ENT	1100	540
OK310830030230G	West Barnitz Creek	12/18/2000	ENT	10000	540
OK310830030230G	West Barnitz Creek	12/18/2000	ENT	7000	540
OK310830030230G	West Barnitz Creek	1/30/2001	ENT	900	540
OK310830030230G	West Barnitz Creek	3/5/2001	ENT	300	540
OK310830030230G	West Barnitz Creek	4/9/2001	ENT	210	540
OK310830030230G	West Barnitz Creek	5/15/2001	ENT	1200	108
OK310830030230G	West Barnitz Creek	6/19/2001	ENT	1600	108
OK310830030230G	West Barnitz Creek	7/24/2001	ENT	340	108
OK310830030230G	West Barnitz Creek	8/27/2001	ENT	160	108
OK310830030230G	West Barnitz Creek	10/1/2001	ENT	245	540
OK310830030230G	West Barnitz Creek	11/5/2001	ENT	330	540
OK310830030230G	West Barnitz Creek	11/5/2001	ENT	60	540
OK310830060030H	Willow Creek	5/16/2000	FC	200	400
OK310830060030H	Willow Creek	5/16/2000	FC	400	400
OK310830060030H	Willow Creek	6/20/2000	FC	2800	400
OK310830060030H	Willow Creek	6/20/2000	FC	3000	400
OK310830060030H	Willow Creek	6/20/2000	FC	2000	400
OK310830060030H	Willow Creek	7/25/2000	FC	9000	400
OK310830060030H	Willow Creek	7/25/2000	FC	800	400
OK310830060030H	Willow Creek	8/29/2000	FC	200	400
OK310830060030H	Willow Creek	8/29/2000	FC	400	400
OK310830060030H	Willow Creek	10/3/2000	FC	1000	2000
OK310830060030H	Willow Creek	10/3/2000	FC	200	2000
OK310830060030H	Willow Creek	11/14/2000	FC	260	2000
OK310830060030H	Willow Creek	12/18/2000	FC	110	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310830060030H	Willow Creek	1/29/2001	FC	500	2000
OK310830060030H	Willow Creek	3/5/2001	FC	150	2000
OK310830060030H	Willow Creek	5/14/2001	FC	1000	400
OK310830060030H	Willow Creek	6/18/2001	FC	400	400
OK310830060030H	Willow Creek	7/23/2001	FC	220	400
OK310830060030H	Willow Creek	8/27/2001	FC	370	400
OK310830060030H	Willow Creek	10/1/2001	FC	390	2000
OK310830060030H	Willow Creek	11/5/2001	FC	430	2000
OK310830060030H	Willow Creek	11/5/2001	FC	250	2000
OK310830060030H	Willow Creek	8/29/2000	EC	20	406
OK310830060030H	Willow Creek	10/3/2000	EC	41	2030
OK310830060030H	Willow Creek	11/14/2000	EC	213	2030
OK310830060030H	Willow Creek	12/18/2000	EC	249	2030
OK310830060030H	Willow Creek	1/29/2001	EC	1019	2030
OK310830060030H	Willow Creek	3/5/2001	EC	471	2030
OK310830060030H	Willow Creek	5/14/2001	EC	723	406
OK310830060030H	Willow Creek	6/18/2001	EC	354	406
OK310830060030H	Willow Creek	7/23/2001	EC	70	406
OK310830060030H	Willow Creek	8/27/2001	EC	280	406
OK310830060030H	Willow Creek	10/1/2001	EC	120	2030
OK310830060030H	Willow Creek	11/5/2001	EC	400	2030
OK310830060030H	Willow Creek	8/29/2000	ENT	2000	108
OK310830060030H	Willow Creek	8/29/2000	ENT	1400	108
OK310830060030H	Willow Creek	10/3/2000	ENT	900	540
OK310830060030H	Willow Creek	10/3/2000	ENT	1100	540
OK310830060030H	Willow Creek	11/14/2000	ENT	700	540
OK310830060030H	Willow Creek	12/18/2000	ENT	600	540
OK310830060030H	Willow Creek	1/29/2001	ENT	25000	540
OK310830060030H	Willow Creek	3/5/2001	ENT	400	540
OK310830060030H	Willow Creek	5/14/2001	ENT	4000	108
OK310830060030H	Willow Creek	6/18/2001	ENT	2000	108
OK310830060030H	Willow Creek	7/23/2001	ENT	135	108
OK310830060030H	Willow Creek	8/27/2001	ENT	370	108
OK310830060030H	Willow Creek	10/1/2001	ENT	180	540
OK310830060030H	Willow Creek	11/5/2001	ENT	250	540
OK310830060030H	Willow Creek	11/5/2001	ENT	380	540
OK310840010010-001AT	Washita River, SH 33, Hammon	6/22/1999	FC	100	400
OK310840010010-001AT	Washita River, SH 33, Hammon	7/20/1999	FC	140	400
OK310840010010-001AT	Washita River, SH 33, Hammon	8/17/1999	FC	370	400
OK310840010010-001AT	Washita River, SH 33, Hammon	5/9/2000	FC	280	400

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310840010010-001AT	Washita River, SH 33, Hammon	6/13/2000	FC	1800	400
OK310840010010-001AT	Washita River, SH 33, Hammon	7/19/2000	FC	100	400
OK310840010010-001AT	Washita River, SH 33, Hammon	8/16/2000	FC	370	400
OK310840010010-001AT	Washita River, SH 33, Hammon	9/13/2000	FC	700	400
OK310840010010-001AT	Washita River, SH 33, Hammon	5/22/2001	FC	900	400
OK310840010010-001AT	Washita River, SH 33, Hammon	6/19/2001	FC	200	400
OK310840010010-001AT	Washita River, SH 33, Hammon	7/24/2001	FC	300	400
OK310840010010-001AT	Washita River, SH 33, Hammon	8/21/2001	FC	600	400
OK310840010010-001AT	Washita River, SH 33, Hammon	5/21/2002	FC	600	400
OK310840010010-001AT	Washita River, SH 33, Hammon	6/18/2002	FC	700	400
OK310840010010-001AT	Washita River, SH 33, Hammon	7/23/2002	FC	6000	400
OK310840010010-001AT	Washita River, SH 33, Hammon	8/21/2002	FC	200	400
OK310840010010-001AT	Washita River, SH 33, Hammon	9/25/2002	FC	270	400
OK310840010010-001AT	Washita River, SH 33, Hammon	6/22/1999	EC	538	406
OK310840010010-001AT	Washita River, SH 33, Hammon	7/20/1999	EC	132	406
OK310840010010-001AT	Washita River, SH 33, Hammon	8/17/1999	EC	197	406
OK310840010010-001AT	Washita River, SH 33, Hammon	5/9/2000	EC	472	406
OK310840010010-001AT	Washita River, SH 33, Hammon	6/13/2000	EC	84	406
OK310840010010-001AT	Washita River, SH 33, Hammon	7/19/2000	EC	31	406
OK310840010010-001AT	Washita River, SH 33, Hammon	8/16/2000	EC	84	406
OK310840010010-001AT	Washita River, SH 33, Hammon	9/13/2000	EC	538	406
OK310840010010-001AT	Washita River, SH 33, Hammon	5/22/2001	EC	608	406
OK310840010010-001AT	Washita River, SH 33, Hammon	6/19/2001	EC	41	406
OK310840010010-001AT	Washita River, SH 33, Hammon	7/24/2001	EC	161	406
OK310840010010-001AT	Washita River, SH 33, Hammon	8/21/2001	EC	41	406

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310840010010-001AT	Washita River, SH 33, Hammon	5/21/2002	EC	364	406
OK310840010010-001AT	Washita River, SH 33, Hammon	6/18/2002	EC	98	406
OK310840010010-001AT	Washita River, SH 33, Hammon	7/23/2002	EC	759	406
OK310840010010-001AT	Washita River, SH 33, Hammon	8/21/2002	EC	187	406
OK310840010010-001AT	Washita River, SH 33, Hammon	9/25/2002	EC	164	406
OK310840010010-001AT	Washita River, SH 33, Hammon	6/22/1999	ENT	490	108
OK310840010010-001AT	Washita River, SH 33, Hammon	7/20/1999	ENT	420	108
OK310840010010-001AT	Washita River, SH 33, Hammon	8/17/1999	ENT	220	108
OK310840010010-001AT	Washita River, SH 33, Hammon	5/9/2000	ENT	600	108
OK310840010010-001AT	Washita River, SH 33, Hammon	6/13/2000	ENT	3800	108
OK310840010010-001AT	Washita River, SH 33, Hammon	7/19/2000	ENT	1800	108
OK310840010010-001AT	Washita River, SH 33, Hammon	8/16/2000	ENT	1600	108
OK310840010010-001AT	Washita River, SH 33, Hammon	9/13/2000	ENT	1400	108
OK310840010010-001AT	Washita River, SH 33, Hammon	6/19/2001	ENT	800	108
OK310840010010-001AT	Washita River, SH 33, Hammon	7/24/2001	ENT	1000	108
OK310840010010-001AT	Washita River, SH 33, Hammon	8/21/2001	ENT	7000	108
OK310840010010-001AT	Washita River, SH 33, Hammon	5/21/2002	ENT	10	108
OK310840010010-001AT	Washita River, SH 33, Hammon	6/18/2002	ENT	5000	108
OK310840010010-001AT	Washita River, SH 33, Hammon	7/23/2002	ENT	200	108
OK310840010010-001AT	Washita River, SH 33, Hammon	8/21/2002	ENT	4000	108
OK310840010010-001AT	Washita River, SH 33, Hammon	9/25/2002	ENT	300	108
OK310840010060G	Quartermaster Creek	5/22/2000	FC	1000	400
OK310840010060G	Quartermaster Creek	6/26/2000	FC	800	400
OK310840010060G	Quartermaster Creek	7/31/2000	FC	190	400
OK310840010060G	Quartermaster Creek	9/5/2000	FC	2010	400
OK310840010060G	Quartermaster Creek	10/9/2000	FC	30	2000
OK310840010060G	Quartermaster Creek	11/13/2000	FC	110	2000
OK310840010060G	Quartermaster Creek	12/18/2000	FC	30	2000

WQM Station	Water Body Name	Date	Bacteria Concentration (#/100ml)	Bacteria Indicator	Single Sample Criteria * (#/100)
OK310840010060G	Quartermaster Creek	1/30/2001	FC	20	2000
OK310840010060G	Quartermaster Creek	3/5/2001	FC	60	2000
OK310840010060G	Quartermaster Creek	4/9/2001	FC	130	2000
OK310840010060G	Quartermaster Creek	5/15/2001	FC	2000	400
OK310840010060G	Quartermaster Creek	6/19/2001	FC	300	400
OK310840010060G	Quartermaster Creek	7/24/2001	FC	100	400
OK310840010060G	Quartermaster Creek	8/27/2001	FC	115	400
OK310840010060G	Quartermaster Creek	10/2/2001	FC	140	2000
OK310840010060G	Quartermaster Creek	11/5/2001	FC	50	2000
OK310840010060G	Quartermaster Creek	11/5/2001	FC	230	2000
OK310840010060G	Quartermaster Creek	7/31/2000	EC	51	406
OK310840010060G	Quartermaster Creek	9/5/2000	EC	10	406
OK310840010060G	Quartermaster Creek	10/9/2000	EC	52	2030
OK310840010060G	Quartermaster Creek	11/13/2000	EC	74	2030
OK310840010060G	Quartermaster Creek	12/18/2000	EC	146	2030
OK310840010060G	Quartermaster Creek	1/30/2001	EC	41	2030
OK310840010060G	Quartermaster Creek	3/5/2001	EC	52	2030
OK310840010060G	Quartermaster Creek	4/9/2001	EC	145	2030
OK310840010060G	Quartermaster Creek	5/15/2001	EC	823	406
OK310840010060G	Quartermaster Creek	6/19/2001	EC	171	406
OK310840010060G	Quartermaster Creek	7/24/2001	EC	35	406
OK310840010060G	Quartermaster Creek	8/27/2001	EC	65	406
OK310840010060G	Quartermaster Creek	10/2/2001	EC	50	2030
OK310840010060G	Quartermaster Creek	11/5/2001	EC	30	2030
OK310840010060G	Quartermaster Creek	7/31/2000	ENT	360	108
OK310840010060G	Quartermaster Creek	9/5/2000	ENT	300	108
OK310840010060G	Quartermaster Creek	10/9/2000	ENT	290	540
OK310840010060G	Quartermaster Creek	11/13/2000	ENT	900	540
OK310840010060G	Quartermaster Creek	12/18/2000	ENT	4000	540
OK310840010060G	Quartermaster Creek	1/30/2001	ENT	6000	540
OK310840010060G	Quartermaster Creek	3/5/2001	ENT	500	540
OK310840010060G	Quartermaster Creek	4/9/2001	ENT	220	540
OK310840010060G	Quartermaster Creek	5/15/2001	ENT	6000	108
OK310840010060G	Quartermaster Creek	6/19/2001	ENT	1600	108
OK310840010060G	Quartermaster Creek	7/24/2001	ENT	160	108
OK310840010060G	Quartermaster Creek	8/27/2001	ENT	50	108
OK310840010060G	Quartermaster Creek	10/2/2001	ENT	140	540
OK310840010060G	Quartermaster Creek	11/5/2001	ENT	80	540
OK310840010060G	Quartermaster Creek	11/5/2001	ENT	330	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 1998-2006

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
OK0028151	1	1	001	6/30/1998	74055	FC	1.188	1.629	50050	Flow
OK0028151	1	1	001	8/31/1998	74055	FC	1.117	1.455	50050	Flow
OK0028151	1	1	001	8/31/1999	74055	FC	0.786	1.501	50050	Flow
OK0028151	1.2	2	001	7/31/1999	74055	FC	1.418	1.654	50050	Flow
OK0028151	1.3	3	001	5/31/1999	74055	FC	1.163	1.484	50050	Flow
OK0028151	1.4	3	001	7/31/2004	74055	FC	0.474	0.846	50050	Flow
OK0028151	1.8	11	001	6/30/2000	74055	FC	1.355	1.732	50050	Flow
OK0028151	2	8	001	7/31/1998	74055	FC	1.171	1.417	50050	Flow
OK0028151	2	3	001	5/31/2000	74055	FC	0.697	1.578	50050	Flow
OK0028151	2.6	23	001	9/30/2002	74055	FC	0.697	0.889	50050	Flow
OK0028151	3	42	001	6/30/1999	74055	FC	1.481	1.706	50050	Flow
OK0028151	3.3	1	001	5/31/2004	74055	FC	0.681	0.769	50050	Flow
OK0028151	3.5	12	001	7/31/2000	74055	FC	1.214	1.51	50050	Flow
OK0028151	3.5	11	001	7/31/2002	74055	FC	0.809	0.896	50050	Flow
OK0028151	3.5	10	001	6/30/2004	74055	FC	0.659	0.854	50050	Flow
OK0028151	3.7	7	001	6/30/2002	74055	FC	0.889	1.386	50050	Flow
OK0028151	3.7	13	001	8/31/2002	74055	FC	0.737	0.832	50050	Flow
OK0028151	3.8	14	001	5/31/2002	74055	FC	0.821	0.994	50050	Flow
OK0028151	4.1	45	001	8/31/2003	74055	FC	0.711	0.912	50050	Flow
OK0028151	5.1	16	001	9/30/2003	74055	FC	0.682	0.748	50050	Flow
OK0028151	5.5	59	001	8/31/2000	74055	FC	1.016	1.361	50050	Flow
OK0028151	6.9	16	001	9/30/2004	74055	FC	0.241	0.68	50050	Flow
OK0028151	8.7	290	001	9/30/2000	74055	FC	0.773	1.154	50050	Flow
OK0028151	12	8800	001	5/31/1998	74055	FC	1.2	1.606	50050	Flow
OK0028151	12.4	46	001	7/31/2001	74055	FC	0.751	0.818	50050	Flow
OK0028151	16	45	001	6/30/2001	74055	FC	0.844	0.964	50050	Flow
OK0028151	16.3	350	001	5/31/2001	74055	FC	0.902	1.209	50050	Flow
OK0028151	17.9	68	001	9/30/2001	74055	FC	0.74	0.807	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
OK0028151	18.2	270	001	8/31/2001	74055	FC	0.753	1.071	50050	Flow
OK0028151	25	25	001	7/31/2003	74055	FC	0.089	0.743	50050	Flow
OK0028151	382.4	4300	001	5/31/2005	74055	FC	0.416	0.769	50050	Flow
OK0028282	0	< 1	002	7/31/1998	74055	FC	0.323	0.359	50050	Flow
OK0028282	0	1	002	8/31/1998	74055	FC	0.249	0.319	50050	Flow
OK0028282	0	1	002	9/30/1998	74055	FC	0.253	0.35	50050	Flow
OK0028282	0	0	002	5/31/1999	74055	FC	0.401	0.805	50050	Flow
OK0028282	0	0	002	9/30/2000	74055	FC	0.246	0.32	50050	Flow
OK0028282	1	2	001	5/31/2003	74055	FC	0.417	0.681	50050	Flow
OK0028282	1.2	6	001	6/30/2006	74055	FC	0.234	0.272	50050	Flow
OK0028282	1.3	3	002	6/30/1999	74055	FC	0.443	0.644	50050	Flow
OK0028282	1.4	6.3	001	8/31/2004	74055	FC	0.399	0.458	50050	Flow
OK0028282	1.4	4	001	7/31/2005	74055	FC	0.321	0.48	50050	Flow
OK0028282	1.4	7	001	8/31/2005	74055	FC	0.334	0.893	50050	Flow
OK0028282	1.48	5	002	8/31/1999	74055	FC	0.263	0.379	50050	Flow
OK0028282	1.6	7.3	001	6/30/2003	74055	FC	0.456	0.707	50050	Flow
OK0028282	1.6	8	001	6/30/2005	74055	FC	0.274	0.419	50050	Flow
OK0028282	1.6	6	001	9/30/2006	74055	FC	0.26	0.315	50050	Flow
OK0028282	1.8	11	001	9/30/2004	74055	FC	0.304	0.36	50050	Flow
OK0028282	1.9	1.4	002	7/31/1999	74055	FC	0.364	0.888	50050	Flow
OK0028282	1.9	2	002	5/31/2000	74055	FC	0.246	0.479	50050	Flow
OK0028282	1.9	5	002	6/30/2001	74055	FC	0.241	0.351	50050	Flow
OK0028282	2.5	47	001	5/31/2006	74055	FC	0.246	0.35	50050	Flow
OK0028282	2.8	6	002	8/31/2001	74055	FC	0.188	0.265	50050	Flow
OK0028282	2.89	14	002	5/31/1998	74055	FC	0.335	0.452	50050	Flow
OK0028282	2.9	20	002	7/31/2001	74055	FC	0.226	0.379	50050	Flow
OK0028282	2.9	45	001	9/30/2005	74055	FC	0.32	0.456	50050	Flow
OK0028282	3.2	24	001	8/31/2006	74055	FC	0.299	0.357	50050	Flow
OK0028282	3.35	32	002	6/30/1998	74055	FC	0.283	0.522	50050	Flow
OK0028282	3.5	16	001	9/30/2003	74055	FC	0.369	0.668	50050	Flow
OK0028282	4.1	42	002	7/31/2000	74055	FC	0.255	0.361	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
OK0028282	4.2	69	001	7/31/2003	74055	FC	0.373	0.455	50050	Flow
OK0028282	4.2	390	001	8/31/2003	74055	FC	0.247	0.494	50050	Flow
OK0028282	4.6	520	001	5/31/2005	74055	FC	0.354	0.412	50050	Flow
OK0028282	5	18	001	7/31/2006	74055	FC	0.302	0.345	50050	Flow
OK0028282	5.7	4900	002	5/31/2001	74055	FC	0.238	0.432	50050	Flow
OK0028282	7.9	410	002	9/30/1999	74055	FC	0.255	0.454	50050	Flow
OK0028282	9.7	5	002	6/30/2000	74055	FC	0.295	0.8	50050	Flow
OK0028282	9.7	5	001	9/30/2002	74055	FC	0.279	0.4	50050	Flow
OK0028282	10	1	002	8/31/2000	74055	FC	0.214	0.234	50050	Flow
OK0028282	10	39	001	5/31/2002	74055	FC	0.44	0.615	50050	Flow
OK0028282	12.5	9900	001	5/31/2004	74055	FC	0.282	0.458	50050	Flow
OK0028282	12.6	260	001	7/31/2004	74055	FC	0.5	0.832	50050	Flow
OK0028282	31.6	8900	001	9/30/2001	74055	FC	0.274	0.707	50050	Flow
OK0028282	158	18600	001	7/31/2002	74055	FC	0.282	0.297	50050	Flow
OK0028282	158	22000	001	8/31/2002	74055	FC	0.308	0.578	50050	Flow
OK0028282	199	12600	001	6/30/2002	74055	FC	0.399	0.461	50050	Flow
OK0031011	0	0	001	5/31/1998	74055	FC	1.332	1.543	50050	Flow
OK0031011	0	0	001	6/30/1998	74055	FC	1.149	1.383	50050	Flow
OK0031011	1.2	3.6	001	8/31/1998	74055	FC	1.003	1.183	50050	Flow
OK0031011	6.9	27.7	001	7/31/1998	74055	FC	1.057	1.159	50050	Flow
OK0031011	10	11.8	001	8/31/2000	74055	FC	1.29	1.411	50050	Flow
OK0031011	10.5	18.2	001	5/31/1999	74055	FC	1.292	2.143	50050	Flow
OK0031011	10.5	12.7	001	6/30/2002	74055	FC	1.221	1.473	50050	Flow
OK0031011	10.9	12.7	001	8/31/2001	74055	FC	1.069	1.196	50050	Flow
OK0031011	11.6	23.6	001	9/30/1998	74055	FC	1.002	1.155	50050	Flow
OK0031011	11.8	14.5	001	9/30/2001	74055	FC	1.071	1.211	50050	Flow
OK0031011	12.1	16.4	001	6/30/1999	74055	FC	1.224	1.403	50050	Flow
OK0031011	12.3	15.5	001	7/31/2001	74055	FC	1.063	1.165	50050	Flow
OK0031011	13.2	16.4	001	9/30/2000	74055	FC	1.36	1.539	50050	Flow
OK0031011	14.1	18.2	001	7/31/2002	74055	FC	1.203	1.357	50050	Flow
OK0031011	14.2	20.9	001	8/31/1999	74055	FC	1.002	1.192	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
OK0031011	15.5	22.7	001	9/30/2002	74055	FC	1.199	1.363	50050	Flow
OK0031011	17.7	21.8	001	5/31/2002	74055	FC	1.222	1.454	50050	Flow
OK0031011	18.2	20	001	5/31/2000	74055	FC	1.617	1.987	50050	Flow
OK0031011	18.2	22.7	001	6/30/2000	74055	FC	1.66	2.015	50050	Flow
OK0031011	18.4	24.5	001	7/31/1999	74055	FC	1.096	1.305	50050	Flow
OK0031011	19.1	24.5	001	5/31/2001	74055	FC	1.324	1.828	50050	Flow
OK0031011	20.4	23.5	001	9/30/2004	74055	FC	1.207	1.273	50050	Flow
OK0031011	20.5	26.4	001	8/31/2002	74055	FC	1.182	1.485	50050	Flow
OK0031011	20.6	21.2	001	9/30/2003	74055	FC	1.168		50050	Flow
OK0031011	20.9	23.6	001	6/30/2001	74055	FC	1.296	1.634	50050	Flow
OK0031011	23	25.7	001	8/31/2004	74055	FC	1.131	1.346	50050	Flow
OK0031011	24.6	29.1	001	7/31/2000	74055	FC	1.486	1.813	50050	Flow
OK0031011	24.8	31	001	5/31/2005	74055	FC	1.231	1.553	50050	Flow
OK0031011	25	29	001	6/30/2005	74055	FC	1.26	1.543	50050	Flow
OK0031011	29	33.5	001	6/30/2003	74055	FC	1.313	1.922	50050	Flow
OK0031011	30	67.3	001	9/30/1999	74055	FC	1.049	1.172	50050	Flow
OK0031011	30	35.5	001	8/31/2005	74055	FC	1.275	1.723	50050	Flow
OK0031011	30.4	35.5	001	7/31/2005	74055	FC	1.129	1.331	50050	Flow
OK0031011	31.1	39.3	001	7/31/2003	74055	FC	1.158	1.312	50050	Flow
OK0031011	31.4	38.3	001	7/31/2004	74055	FC	1.184	1.313	50050	Flow
OK0031011	33.5	30.7	001	6/30/2004	74055	FC	1.298	1.366	50050	Flow
OK0031011	38	45.8	001	6/30/2006	74055	FC	1.157	1.344	50050	Flow
OK0031011	39.1	42.4	001	9/30/2006	74055	FC	1.492	1.681	50050	Flow
OK0031011	41	50	001	5/31/2006	74055	FC	1.227	1.518	50050	Flow
OK0031011	41.8	45.6	001	9/30/2005	74055	FC	1.196	1.427	50050	Flow
OK0031011	42.7	53.8	001	5/31/2004	74055	FC	1.211	1.63	50050	Flow
OK0031011	48	70.7	001	8/31/2006	74055	FC	1.4	1.931	50050	Flow
OK0031011	48.4	53.9	001	7/31/2006	74055	FC	1.4	1.563	50050	Flow
OK0031011	54.9	62.9	001	8/31/2003	74055	FC	1.141	1.311	50050	Flow
OK0031011	65.8	99.2	001	5/31/2003	74055	FC	1.165	1.314	50050	Flow
OK0038440	0	140	001	7/31/2003	74055	FC	2.98	5.717	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
OK0038440	6.5	40	001	7/31/2006	74055	FC	2.839	4.774	50050	Flow
OK0038440	8	100	001	6/30/2004	74055	FC	3.856	6.459	50050	Flow
OK0038440	12	100	001	5/31/2005	74055	FC	2.211	4.998	50050	Flow
OK0038440	16	78	001	6/30/2005	74055	FC	2.108	2.352	50050	Flow
OK0038440	17.8	71	001	8/31/2006	74055	FC	2.814	3.325	50050	Flow
OK0038440	22	144	001	5/31/2003	74055	FC	3.938	5.414	50050	Flow
OK0038440	27	200	001	6/30/2003	74055	FC	3.471	5.921	50050	Flow
OK0038440	46.9	310	001	7/31/2005	74055	FC	1.729	2.514	50050	Flow
OK0038440	86.883	53786.8	001	5/31/2002	74055	FC	5.189	9.18	50050	Flow
OK0038440	92	457	001	5/31/2004	74055	FC	2.378	4.933	50050	Flow
OK0038440	100.9	479	001	8/31/2005	74055	FC	2.268	3.902	50050	Flow
OK0038440	116	834	001	7/31/2004	74055	FC	3.192	4.204	50050	Flow
OK0038440	118.8	375	001	9/30/2006	74055	FC	2.869	4.275	50050	Flow
OK0038440	172.5	978	001	9/30/2005	74055	FC	2.326	3.402	50050	Flow
OK0038440	197	698	001	8/31/2004	74055	FC	3.163	3.799	50050	Flow
OK0038440	278	1266	001	9/30/2004	74055	FC	2.136	2.651	50050	Flow
OK0038440	409.3	4820	001	6/30/2006	74055	FC	3.331	4.062	50050	Flow
OK0038440	554	5039	001	5/31/2006	74055	FC	3.771	5.169	50050	Flow
OK0038440	909	5000	001	9/30/2002	74055	FC	2.782	3.749	50050	Flow
OK0038440	1909	4000	001	8/31/2003	74055	FC	2.709	4.873	50050	Flow
OK0038440	9093	4000	001	9/30/2003	74055	FC	4.345	7.002	50050	Flow
OK0038440	20165	15130	001	8/31/2002	74055	FC	3.159	5.473	50050	Flow
OK0038440	68681	176161	001	7/31/2002	74055	FC	4.427	6.981	50050	Flow
OK0038440	100782	162468	001	6/30/2002	74055	FC	4.393	7.335	50050	Flow

ODEQ Summary of Available Reports of Sanitary Sewer Overflows

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
CANUTE	3/16/1994	S10803	LAGOONS		HYDROLIC OVERLOAD WITH HIGH WINDS	
CANUTE	3/9/1998	S10803	LAGOONS S.E. OF TOWN		RAINS	
CLINTON	11/17/1994	S10804	20TH AND MODELLE	200	GREASE BLOCKAGE	
CLINTON	3/6/1997	S10804	WWTP	5	BLOCKAGE	
CLINTON	5/28/1998	S10804	MH N. OF PLANT 1/2 MILE	5,000	L.S. PUMP FAILURE	
CLINTON	7/12/1999	S10804	WWTP	1,500	VALVE FAILURE	
CLINTON	1/24/2001	S10804	WWP	185,000	SLUDGE IMPACTED FILTERS	
CLINTON	7/23/2001	S10804	IN THE FIELD ON HARRY SPURLEY'S PROERTY N. OF WWP	3,000	MALFUNTIONS	MANHOLE
CLINTON	9/5/2001	S10804	WWTP	10,000	PUMP FAILURE	LIFT STATION
CLINTON	5/7/2002	S10804	WWTP	500	STOPPED UP FLOW	CLARIFIER
CLINTON	12/15/2003	S10804	CUSTER & 21ST	2,000	GREASE	MANHOLE
CLINTON	5/17/2004	S10804	WWP	100	CLARIFIER BROKE	CLARIFIER
CLINTON	11/13/2004	S10804	WWTP - 1100 E. COMMERCE	10,000	PUMP LEFT ON CAUSING OVERFLOW	DIGESTER
CLINTON	3/21/2005	S10804	PLANT	20,000	MECHANICAL PROBLEMS	CLARIFIER
CLINTON	7/29/2006	S10804	ROY BROOKS WAY/ JIM ROBBINS DR.	100,000	BROKEN LINE	
CLINTON		S10804				
CLINTON		S10804			PUMP FAILURE	
CORDELL	5/18/1994	S10811	AT PLANT	10000	REPLACING EQUIPMENT	
CORDELL	6/4/1995	S10811	41 MOTEL 719 E MAIN STREET	0	SEWER MAIN OVERFLOWED DUE TO RIAN WATER	
CORDELL	6/5/1995	S10811	LIFT STATION	0	RAIN I/I	
CORDELL	8/22/1996	S10811	N. CALVARY CREEK	3000	MALFUNTIONS IN SYSTEM	
CORDELL	9/4/1996	S10811	41 MOTEL AT 719 E. MAIN ST.	0	HEAVY RAINFALL	
CORDELL	9/5/1996	S10811	41 MOTEL; 719 E. MAIN		RAINWATER	
CORDELL	2/20/1997	S10811	LIFT STATION	350	RAIN	
CORDELL	3/14/1997	S10811	LIFT STATION	400	NO PUMPS, BEING REPAIRED	
CORDELL	4/25/1998	S10811	MH BEHIND TRAILER PARK AT 1ST & MAGNOLIA		STOPPED MAIN	
CORDELL	11/1/1998	S10811	LIFT STATION	200,000	RAINS	
CORDELL	5/27/1999	S10811	L.S.	200,000	RAINS	
CORDELL	4/23/2003	S10811	900 NORTH MARKET IN CREEK	10	BROKEN MAIN	PIPE
CORDELL	10/18/2005	S10811	LIFT STATION	150	PUMP FAILURE	LIFT STATION

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ANADARKO	2/14/1992	S10817	SOUTH SIDE OF TREATMENT LANT	2000	PUMP SEAL FAILURE	
ANADARKO	2/19/1992	S10817	FACILITY ENTERED WASHITA RIVER	0	PUMP SWITCHES MESSED UP CAUSING PUMP TO SHUT DOWN	
ANADARKO	2/19/1992	S10817	SOUTH SIDE OF TREATMENT LANT	103415	PUMP SWITCH FAILURE	
ANADARKO	3/19/1992	S10817	7TH & EAST CENTRAL &SHW 62 E &2HW 8 INTERSECTION		LINE PROBLEM	
ANADARKO	4/28/1992	S10817	FARMER'S WHEAT FIELD	0	POP OFF VAVLE IN COLLECTION SYSTEM	
ANADARKO	1/26/1993	S10817	HOLLEY TEX CARPET LINE	2000	PUMP FAILURE	
ANADARKO	2/17/1993	S10817	LIFT STATION ON PLANT GROUNDS	75000	SWITCH FAILURE	
ANADARKO	10/23/1995	S10817	N. OF CARPET MILL ON 7TH & KANSAS	0	COLLAPSED SEWER MAIN	
ANADARKO	1/26/1996	S10817	7TH & E. CENTRAL	5000	BROKEN SEWER MAIN	
ANADARKO	1/26/1996	S10817	7TH & E. CENTRAL	2000	BREAK IN LINE	
ANADARKO	2/2/1996	S10817	N 7TH AND KANSAS	150	RUPTURED HOSES ON PUMP	
ANADARKO	2/11/1996	S10817	E. CENTRAL & 7TH	2000	BREAKER TRIPPED AT LIFT STATION CAUSING BACKUP	
ANADARKO	2/13/1996	S10817	408 & 410 W. MARKET	50	BROKEN LINE	
ANADARKO	2/15/1996	S10817	408 & 410 W. MARKET		BROKEN MAIN	
ANADARKO	2/27/1996	S10817	7TH & E. CENTRAL	75	PUMP FAILURE TO LIFT STATION	
ANADARKO	3/6/1996	S10817	600 BLK. OF MISSION & W. VIRGINIA	100	COLLAPSED MANHOLE	
ANADARKO	3/24/1996	S10817	N. 7TH & KANSAS	200	POWER FAILURE AT LIFT STATION DURING STORM.	
ANADARKO	6/24/1996	S10817	N. 7TH & E. KANSAS	5000	POWER OFF AT LIFT STATION	
ANADARKO	7/7/1996	S10817	7 & E. CENTRAL	250	PUMPS WENT DOWN IN FIBERGLASS	
ANADARKO	7/26/1996	S10817	7TH & E. CENTRAL	5000	LIFT STATION FAILURE	
ANADARKO	8/1/1996	S10817	7TH & E. CENTRAL		PUMP FAILURE	
ANADARKO	11/17/1996	S10817	7TH & E. CENTRAL		PUMP FAILURE	
ANADARKO	5/16/1997	S10817	7TH & EAST CENTRAL	500	PUMP FAILURE AT L.S.	
ANADARKO	8/3/1997	S10817	N.E. 7TH & E. CENTRAL		PUMP FAILURE	
ANADARKO	3/12/1998	S10817	RANDELETT PARK		STOPPED MAIN	
ANADARKO	3/16/1998	S10817	E. 7TH & HWY 8		RAIN	
ANADARKO	3/17/1998	S10817	ALLEY BETWEEN E. 7TH & KENTUCKY ST.		RAINS	
ANADARKO	6/11/1998	S10817	N.E. CORNER OF 7TH & E. CENTRAL	1,500	POWER FAILURE	
ANADARKO	4/26/2001	S10817	1200 S. MISSION	100	SEWER STOPPAGE	
ANADARKO	4/25/2004	S10817	S.W. CORNER OF 7TH & E ST.	25	PUMP FAILURE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ANADARKO	6/28/2004	S10817	ALLEY AT 1ST & E. GEORGIA	60	BAD FLOAT	
ANADARKO		S10817	100 BLK E. GEORGIA IN ALLEY	45	RAIN	
CEMENT	3/28/1995	S10821	LAGOON	5000	HYDROLIC OVERLOAD	
CEMENT	12/6/2000	S10821	PRIMARY CELL		LEAKING IN CREEK	
CEMENT	4/3/2001	S10821	1ST & F		COLLAPSED LINE	PIPE
CEMENT	2/3/2003	S10821	ALLEY AT 4TH & 5TH, MAIN & B ST.		STOPPAGE	PIPE
CEMENT	9/3/2004	S10821	LAGOONS	30	BROKEN CONCRETE IN MH	MANHOLE
CEMENT	9/25/2006	S10821	112 SOUTH MAIN IN ALLEY	27	BLOCKAGE	LIFT STATION
PAOLI	3/30/1993	S10828	LAGOONS		VANDALISM AT OUTLET	
PAOLI	2/5/2002	S10828	LAGOON	1,000	BROKE BOARD	
PAOLI	9/29/2003	S10828	200 DULIN IN ALLEY	1,000	BROKEN MAIN	
PAOLI	12/31/2003	S10828	402 CHURCH ST.	3,000	BLOCKAGE	
PAOLI	1/1/2004	S10828	402 CHURCH IN FIELD	2,000	GREASE	
PAOLI	1/7/2004	S10828	ACROSS FROM 402 CHURCH ST.	500	GREASE & ROOTS	
PAOLI	4/13/2004	S10828		<500		
PAOLI	7/13/2004	S10828	108 SOUTH IN PASTURE	500	PLUGGED	
PAOLI	8/19/2004	S10828	301 MAIN AR PIG PENS	500	LINE PLUGGED	MANHOLE
PAOLI	10/28/2004	S10828	301 E. MAIN IN PIG PEN	1,00	RAIN	MANHOLE
PAOLI	11/3/2004	S10828	301 E. MAIN	1,000	RAINS	MANHOLE
PAOLI	11/21/2004	S10828	301 E. MAIN	1,000	RAIN	MANHOLE
PAOLI	11/21/2004	S10828	E. OF 302 E. CHURCH	1,000	RAIN	MANHOLE
PAOLI	1/2/2005	S10828	FIELD	250	PLUGGED LINE	PIPE
PAOLI	4/18/2005	S10828	107 W. SOUTH	300	BROKEN LINE & ROOTS	PIPE
PAOLI	6/12/2005	S10828	S. SIDE OF CHURCH ST BY RR TRACKS	100	ROOT SEWER LINE	MANHOLE
PAOLI	3/2/2006	S10828	100 BLK. OF N. CRABTREE	200	BLOCKAGE	PIPE
PAOLI	5/10/2006	S10828	MAIN & CRABTREE	200	BLOCKAGE	MANHOLE
PAOLI	8/16/2006	S10828	701 S. OKLAHOMA ST.	800	CLEAN OUT IS BROKEN	
PAOLI	10/20/2006	S10828	103 E. DAVIS	300	BLOCKAGE	PIPE
PAOLI	12/13/2006	S10828	CHURCH & CRABTREE ST.	500	CLOGGED LINE	MANHOLE
PAOLI	2/9/2007	S10828	CHURCH ST. BY RAILROAD TRACKS	400	BLOCKAGE	PIPE
PAOLI	2/15/2007	S10828	LAGOON & DOGPENS		STOPPED UP	MANHOLE
PAOLI	2/21/2007	S10828	CHURCH ST. AT RAILROAD TRACKS	200	BLOCKAGE	MANHOLE
PAOLI	4/12/2007	S10828	109 & 111 FUTREAL FAIRWAY	300	STOPPED UP	MANHOLE

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
WYNNEWOOD	3/15/1990	S10832	WATEWATER TREATMENT PLANT		FAILURE OF 5HP & 7HP SLUDGE WELL PUMPS, CLARIFIERS & AEREATO	
WYNNEWOOD	4/30/1990	S10832	MANHOLE IN THE WYNNEWOOOD SEWER SYSTEM	10	HEAVY RAINFALL HAS CAUSED DIFFICULTY WITHIN THE SYSTEM	
WYNNEWOOD	3/7/1996	S10832	SCHMEIDT LIFT STATION	20000	ELECTRICAL SHORT	
WYNNEWOOD	2/20/1997	S10832	CITY PARK - CRUMP ST.		RAIN	
WYNNEWOOD	7/16/2001	S10832	L.S. ON SMITH ST.	2,500	TRIPPED CIRCUIT BREAKER	LIFT STATION
ARDMORE	4/25/1995	S10840	HI LEWIS LEASING	200	LINE STOPPAGE	
ARDMORE	11/2/2004	S10840	INDUSTRIAL AIRPARK	65,000	LOWERED WATER LEVEL	LAGOON/BASIN
ARDMORE	11/3/2004	S10840	INDUSTRIAL AIRPARK LAGOON	73,000	LOWERED LEVEL OF WATER IN LAGOON	LAGOON/BASIN
ARDMORE	11/4/2004	S10840	INDUSTRIAL AIRPARK	73,000	OVERFLOW	
ARDMORE	11/5/2004	S10840	GENE AUTRY	68,500	LOWERED WATER LEVEL	LAGOON/BASIN
ARDMORE	11/8/2004	S10840	GENE AUTRY INDUSTRIAL AIRPARK	73,000	WATER LEVEL LOWERED	LAGOON/BASIN
ARDMORE	11/10/2004	S10840	INDUSTRIAL AIRPARK	73,000	LOWER LEVEL OF WATER IN LAGOONS	LAGOON/BASIN
ARDMORE	11/15/2004	S10840	INDUSTRIAL AIRPARK	73,000	WATER LEVEL LOWERED	LAGOON/BASIN
ARDMORE	11/16/2004	S10840	INDUSTRIAL AIRPARK	63,000	WATER LEVEL LOWERED	LAGOON/BASIN
ARDMORE	1/11/2005	S10840	INDUSTRIAL AIRPARK	72,000	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/12/2005	S10840	INDUSTRIAL AIRPARK	41,040	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/13/2005	S10840	GENE AUTRY AIRPORT	63,500	LOWER LEVEL IN DYKES	LAGOON/BASIN
ARDMORE	1/14/2005	S10840	INDUSTRIAL AIRPARK	75,000	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/18/2005	S10840	GENE AUTRY AIRPARK	60,500	LOWER LEVELS	LAGOON/BASIN
ARDMORE	1/19/2005	S10840	GENE AUTRY AIRPARK	36,500	LOWER LEVEL	LAGOON/BASIN
ARDMORE	1/20/2005	S10840	GENE AUTRY AIRPARK	68,500	LOWER LEVEL	LAGOON/BASIN
ARDMORE	3/14/2005	S10840	INDUSTRIAL AIRPARK	137,940	LOWER LEVEL	LAGOON/BASIN
ARDMORE	3/15/2005	S10840	INDUSTRIAL AIRPARK	30,780	LOWER LEVEL	LAGOON/BASIN
ARDMORE	3/16/2005	S10840	INDUSTRIAL AIRPARK	30,780	LOWER LEVEL	LAGOON/BASIN
ARDMORE	3/21/2005	S10840	INDUSTRIAL AIRPARK	71,820	LOWER LEVEL	LAGOON/BASIN
ARDMORE	3/22/2005	S10840	GENE AUTRY PARK	44,460	LOWER LEVEL	LAGOON/BASIN
ARDMORE	3/23/2005	S10840	GENE AUTRY INDUSTRIAL PARK	27,360	LOWER LEVEL	LAGOON/BASIN
ARDMORE	4/22/2005	S10840	INDUSTRIAL AIRPARK	2,000	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	4/29/2005	S10840	GENE AUTRY INDUSTRIAL PARK	589	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	7/18/2005	S10840	INDUSTRIAL AIRPARK	245,520	LOWER LEVEL IN LAGOONS	LAGOON/BASIN
ARDMORE	8/22/2005	S10840	INDUSTRIAL AIRPARK	239,000	RUN SPRINKLER SYSTEM	LAGOON/BASIN

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	9/6/2005	S10840	INDUSTRIAL AIRPARK	12,540	LOWER WATER LEVEL IN LAGOON	LAGOON/BASIN
ARDMORE	10/25/2005	S10840	INDUSTRIAL AIRPARK	36,480	LOWER LAGOONS	LAGOON/BASIN
ARDMORE	10/26/2005	S10840	INDUSTRIAL AIRPARK	34,200	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	12/15/2005	S10840	INDUSTRIAL AIRPARK	64,980	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	12/16/2005	S10840	INDUSTRIAL AIRPARK	53,580	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	12/19/2005	S10840	INDUSTRIAL AIRPARK	28,500	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/5/2006	S10840	INDUSTRIAL AIRPARK	200	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/11/2006	S10840	INDUSTRIAL AIRPARK	55,860	LOWER WATER WELL	LAGOON/BASIN
ARDMORE	1/13/2006	S10840	GENE AUTRY AIRPARK	44,460	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/17/2006	S10840	GENE AUTRY AIRPARK	26,220	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/23/2006	S10840	GENE AUTRY AIRPARK	35,340	LOWER WATER LEVELS	LAGOON/BASIN
ARDMORE	2/6/2006	S10840	GENE AUTRY AIRPARK	42,180	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/8/2006	S10840	GENE AUTRY AIRPARK	68,400	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/9/2006	S10840	GENE AUTRY AIRPARK	37,620	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/15/2006	S10840	GENE AUTRY AIRPARK	28,500	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/27/2006	S10840	GENE AUTRY AIRPARK	41,040	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	3/15/2006	S10840	AIRPARK PLANT	75,240	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	3/16/2006	S10840	AIRPARK PLANT	55,860	LOWER WATER PLANT	LAGOON/BASIN
ARDMORE	3/17/2006	S10840	AIRPARK	30,400	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	3/27/2006	S10840	GENE AUTRY AIRPARK	76,380	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	3/28/2006	S10840	GENE AUTRY AIRPARK	41,040	LOWER LEVEL	LAGOON/BASIN
ARDMORE	3/31/2006	S10840	GENE AUTRY AIRPARK	71,820	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	5/5/2006	S10840	GENE AUTRY AIRPARK	68,400	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	5/9/2006	S10840	GENE AUTRY AIRPARK	68,400	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	5/10/2006	S10840	GENE AUTRY AIRPARK	45,600	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	5/11/2006	S10840	GENE AUTRY AIRPARK	72,960	WATER LEVEL	LAGOON/BASIN
ARDMORE	5/19/2006	S10840	GENE AUTRY AIRPARK	84,360	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	6/9/2006	S10840	GENE AUTRY AIRPARK	70,680	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	6/21/2006	S10840	GENE AUTRY AIRPARK	79,800	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	6/26/2006	S10840	GENE AUTRY INDUSTRIAL AIRPARK	69,540	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	10/19/2006	S10840	GENE AUTRY AIRPARK	67,260	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	10/27/2006	S10840	GENE AUTRY AIRPARK	69,540	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	10/30/2006	S10840	GENE AUTRY AIRPARK	58,150	LOWER WATER LEVEL	LAGOON/BASIN

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	12/6/2006	S10840	INDUSTRIAL AIRPARK	62,700	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	12/7/2006	S10840	INDUSTRIAL AIRPARK	50,160	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	12/27/2006	S10840	GENE AUTRY AIRPARK	68,400	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	12/28/2006	S10840	INDUSTRIAL AIRPARK	72,960	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/3/2007	S10840	GENE AUTRY AIRPARK	69,540	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/9/2007	S10840	GENE AUTRY AIRPARK	66,120	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/10/2007	S10840	GENE AUTRY AIRPARK	71,820	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/11/2007	S10840	GENE AUTRY AIRPARK	63,840	LOWER LEVEL	LAGOON/BASIN
ARDMORE	1/18/2007	S10840	GENE AUTRY AIRPARK	58,140	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/19/2007	S10840	GENE AUTRY AIRPARK	64,980	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/22/2007	S10840	GENE AUTRY AIRPARK	98,040	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/23/2007	S10840	GENE AUTRY AIRPARK	74,100	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/24/2007	S10840	GENE AUTRY AIRPARK	67,260	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/24/2007	S10840	GENE AUTRY AIRPARK	<200	CONTRACTOR ERROR	LAGOON/BASIN
ARDMORE	1/26/2007	S10840	GENE AUTRY AIRPARK	60,420	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/2/2007	S10840	GENE AUTRY AIRPARK	69,540	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/7/2007	S10840	GENE AUTRY AIRPARK	66,120	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/21/2007	S10840	GENE AUTRY AIRPARK	70,680	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	2/22/2007	S10840	GENE AUTRY AIRPARK	68,400	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	3/13/2007	S10840	GENE AUTRY AIRPARK	69,430	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	4/3/2007	S10840	GENE AUTRY AIRPARK	68,240	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	4/4/2007	S10840	GENE AUTRY AIRPARK	75,240	LOWER WATER LEVEL	LAGOON/BASIN
ARDMORE	1/17/1990	S30804	LIFT STATION #5	9400	HEAVY RAINS	
ARDMORE	2/1/1990	S30804	LIFT STATION #3	7099	HEAVY RAINFALL	
ARDMORE	2/20/1990	S30804	ARDMORE INDUSTRIAL AIRPARK LIFT STATION	76885	PUMP FAILURE	
ARDMORE	2/26/1990	S30804	LIFT STATION #5	23663	HEAVY RAINFALL	
ARDMORE	2/26/1990	S30804	LIFT STATION #3	14917	HEAVY RAINFALL	
ARDMORE	3/6/1990	S30804	EAST SIDE PUMPING STATION	74000	HEAVY RAINFALL	
ARDMORE	4/19/1990	S30804	EAST SIDE PUMPING STATION(LS#3)	177600	BYPASS DUE TO HEAVY RAINFALL	
ARDMORE	4/19/1990	S30804	LAKE MURRAY LIFT STATION(LS#5)	1128000	BYPASS DUE TO HEAVY RAINFALL	
ARDMORE	4/29/1990	S30804	LAKE MURRAY PUMPING STATION(LS#5)	188000	BYPASS DUE TO HEAVY RAINFALL	
ARDMORE	4/30/1990	S30804	EAST SIDE PUMPING STATION(LS#3)	74000	BYPASS DUE TO HEAVY RAINFALL	
ARDMORE	11/28/1990	S30804	LAKE MURRY LIFT	100000	RAIN	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	12/30/1990	S30804	LIFT STA	37600	FUSE BOX	
ARDMORE	12/31/1990	S30804	LIFT STA	56400	FUSE BOX	
ARDMORE	1/2/1991	S30804	LIFT STA	28200	SE BOX	
ARDMORE	2/6/1991	S30804		16450	CHANICAL PROBLEMS	
ARDMORE	3/22/1991	S30804	DOG POUND	15864	RAIN	
ARDMORE	3/28/1991	S30804	ANDERSON	47592	PUMP DOWN	
ARDMORE	3/30/1991	S30804	LAKE MURRAY	112800	CONSTRUCTION	
ARDMORE	3/31/1991	S30804	LAKE MURRAY	112800	CONSTRUCTION	
ARDMORE	4/8/1991	S30804	LAKE MURRAY	56400	CONSTRUCTION	
ARDMORE	4/14/1991	S30804	LAKE MURRAYN	376000	STOPPAGES DUE TO CONSTUCTION	
ARDMORE	4/15/1991	S30804	CHICKASAW HOUSING	282000	STOPPAGES DUE TO CONSTRUCTION	
ARDMORE	6/4/1991	S30804	AIR PARK	225608	PUMP FAILURE	
ARDMORE	6/8/1991	S30804	DOG POUND	56402	HEAVY RAIN	
ARDMORE	6/8/1991	S30804	LAKE MURRAY	75203	HEAVY RAIN	
ARDMORE	6/10/1991	S30804	AIR PARK	225608	PUMP FAILURE	
ARDMORE	7/8/1991	S30804	CHICKASAW HOUSING L.S.	37600	ELECTRICAL SERVICE INTERUPTION	
ARDMORE	8/7/1991	S30804	ANDERSON LIFT STATION	32900	MECHANICAL FAILURE	
ARDMORE	9/7/1991	S30804	LAKE MURRAY PUMP STATION	214210	FLOODING CONDITIONS	
ARDMORE	9/16/1991	S30804	DOG POUND LIFT STATION	112804	EXCESSIVE RAINFALL	
ARDMORE	9/18/1991	S30804	LAKE MURRAY LIFT STATION	97400	EXCESSIVE RAINFALL	
ARDMORE	10/15/1991	S30804	LAKE MURRAY LIFT STATION	67800	PUMP FAILURE	
ARDMORE	10/28/1991	S30804	CHICKASAW LIFT STATION	282000	EXCESSIVE RAINFALL	
ARDMORE	12/16/1993	S30804	MYALL ROAD	5000	LINE STOPPAGE	
ARDMORE	12/28/1993	S30804	MOUNT WASHINGTON ROAD	0	LINE BLOCKAGE	
ARDMORE	12/28/1993	S30804	HEATHER ROAD	0	OBSTRUCTION IN THE MANHOLE	
ARDMORE	2/4/1994	S30804	BY DAKOTA'S RESTURANT	0	LINE BLOCKAGE	
ARDMORE	2/14/1994	S30804	BURGER KING ON BROADWAY36	0	GREASE STOPPAGE	
ARDMORE	2/23/1994	S30804	T C LEASING	0	LINE BLOCKAGE	
ARDMORE	3/15/1994	S30804	MOUNT WASHINGTON AND CAMPELL	0	LINE BLOCKAGE	
ARDMORE	3/21/1994	S30804	1015 SOUTH COMMERCE	500	LINE BLOCKAGE	
ARDMORE	4/6/1994	S30804	1722 WILDWOOD	0	LINE STOPPAGE	
ARDMORE	4/13/1994	S30804	115 H N W	13000	LINE BLOCKAGE	
ARDMORE	4/13/1994	S30804	F STREET S W	100	LINE BLOCKAGE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	5/16/1994	S30804	EAST OF REFINERY	40000	ROOT STOPPAGE	
ARDMORE	6/13/1994	S30804	'A' LIFT STATION DISCHARGE LINE	0	BREAK IN THE LINE'S CREEK CROSSING	
ARDMORE	10/6/1994	S30804	BEHIND BOY SCOUT OFFICE IN FIELD	1500	LINE STOPPAGE	
ARDMORE	10/11/1994	S30804	COUNTRY WOODS LANE	0	LINE BLOCKAGE	
ARDMORE	11/17/1994	S30804	PRETREATMENT AREA	0	OPPAGE	
ARDMORE	11/20/1994	S30804	1OTH AND E STREET SE	0	LINE BLOCKAGE	
ARDMORE	12/2/1994	S30804	101 H WEST	0	GREASE STOPPAGE	
ARDMORE	12/6/1994	S30804	101 H S W	0	LINE STOPPAGE(DEBRIS)	
ARDMORE	12/21/1994	S30804	BEHIND COUNTY JAIL	0	DEBRIS BLOCKAGE	
ARDMORE	12/23/1994	S30804	101 H NW	0	ROOT STPPAGE	
ARDMORE	1/4/1995	S30804	SUNSET AND MYALL	0	LINE BLOCKAGE	
ARDMORE	1/25/1995	S30804	COUNTRYWOOD LANE	0	LINE BLOCKAGE	
ARDMORE	2/1/1995	S30804	K AND WHITE STREET	1000	LINE BLOCKAGEN THE LINE	
ARDMORE	2/6/1995	S30804	MOUNT WASHINGTON ROAD	1500	ROOT BLOCKAGE	
ARDMORE	2/14/1995	S30804	519 NORTH DRIVE	500	LINE BLOCKAGE	
ARDMORE	2/26/1995	S30804	9TH AND CARTER	1000	LINE STOPPAGE	
ARDMORE	3/1/1995	S30804	110 H NW	0	LINE BLOCKAGE	
ARDMORE	3/10/1995	S30804	500 D STREET SE	500	LINE BLOCKAGE	
ARDMORE	3/20/1995	S30804	GRAVES ROAD	0	FAULTY CHECK VALVE	
ARDMORE	3/24/1995	S30804	2ND AND I NORTH EAST	500	LINE STOPPAGE	
ARDMORE	4/9/1995	S30804	SUNSET AND MAYALL	500	LINE BLOCKAGE	
ARDMORE	5/8/1995	S30804	LIFT STATION 'A'	0	RAIN I/I	
ARDMORE	5/18/1995	S30804	BEHIND TERRACE INN	0	LINE BROKEN	
ARDMORE	5/18/1995	S30804	BEHIND TERRACE INN	0	LINE BLOCKAGE	
ARDMORE	6/7/1995	S30804	2000 VETRANS BLVD	0	COLLASPED LINE	
ARDMORE	6/26/1995	S30804	101 H NORTHWEST	300	LINE STOPPAGE	
ARDMORE	8/3/1995	S30804	I40 AND HIWAY 142 BEHIND DAKOTA'S RESTURANT	0	LINE BLOCKAGE	
ARDMORE	8/26/1995	S30804	MT WASHINGTON RD 1 MILE NORTH OF 142 BYPASS	0	DAMAGED LINE	
ARDMORE	9/11/1995	S30804	TOWN & COUNTRY LIFT STATION	0	PUMP FAILURE	
ARDMORE	10/12/1995	S30804	14 FREEMAN	3000	UNK	
ARDMORE	10/17/1995	S30804	101 H NW	500	BLOCKAGE	
ARDMORE	11/6/1995	S30804	OVERLAND ROUTE	150	BLOCKAGE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	11/13/1995	S30804	100 'H' NORTHWEST	500	LINE BLOCKAGE	
ARDMORE	11/15/1995	S30804	#10 OVERLAND	50	LINE STOPPAGE	
ARDMORE	11/19/1995	S30804	B & MONROE NE	200	LINE STOPPAGE	
ARDMORE	12/13/1995	S30804	'P'STREET SOTHWEST	0	LINE BLOCKAGE	
ARDMORE	12/29/1995	S30804	BEHIND A GYMNASIUM	500	BLOCKAGE IN LINE	
ARDMORE	1/7/1996	S30804	101 8TH ST. NW	500	BLOCKAGE IN THE LINE	
ARDMORE	1/29/1996	S30804	DAKOTAS RESTAURANT	500	BLOCKAGE IN THE LINE	
ARDMORE	2/11/1996	S30804	ROCKFORD & MYALL RD.	500	BLOCKAGE IN SYSTEM	
ARDMORE	2/13/1996	S30804	801 N S. WEST		ROOTS IN THE LINE	
ARDMORE	2/20/1996	S30804	MILL ST. & STANLEY	0	LINE SEPARATION	
ARDMORE	3/3/1996	S30804	1206 OAKRIDGE			
ARDMORE	3/7/1996	S30804	1206 OAKRIDGE	500	ROOTS IN LINE	
ARDMORE	3/12/1996	S30804	115 MONROE	14	LINE BLOCKAGE	
ARDMORE	3/13/1996	S30804	913 4 ST. N.E.	500	BLOCKAGE IN LINES	
ARDMORE	3/15/1996	S30804	CORNER OF K & 6TH ST. NW	500		
ARDMORE	3/21/1996	S30804	TACO BUENO	500	GREASE STOP UP	
ARDMORE	3/25/1996	S30804	VICINITY OF 6TH & K N.W.	500	BLOCKAGE IN LINES	
ARDMORE	4/19/1996	S30804	101 H N.W.	300	BLOCKAGE IN LINES	
ARDMORE	4/21/1996	S30804	STANLEY & S. WASHINGTON		BLOCKAGE	
ARDMORE	4/23/1996	S30804	8TH N.W. & N. COMMERCE	250	BLOCKAGE IN LINES	
ARDMORE	5/8/1996	S30804	I & 3RD ST.	1000	BLOCKAGE IN LINES	
ARDMORE	5/10/1996	S30804	BROOKHAVEN & MILE SW	500	ROOTS	
ARDMORE	5/16/1996	S30804	K ST. & E. MAIN		BLOCKAGE	
ARDMORE	5/22/1996	S30804	F S.W. & MCKLISH		BLOCKAGE	
ARDMORE	6/11/1996	S30804	602 N. COMMERCE	200		
ARDMORE	7/18/1996	S30804	COMMERCE & MCCOLLOUGH		BLOCKAGE IN LINES	
ARDMORE	7/25/1996	S30804	114 H N.W.	200	BLOCKAGE IN SYSTEM	
ARDMORE	7/29/1996	S30804	HOLIDAY DR. & BROADWAY	200	LINE BLOCKAGE	
ARDMORE	8/6/1996	S30804	6TH ST. NW & COMMERCE	100	LINE BLOCKAGE	
ARDMORE	8/19/1996	S30804	REMINGTON CT. & SUNSET DR.		ROOTS	
ARDMORE	8/22/1996	S30804	WASHINGTON & STANLEY	500	BLOCKAGE	
ARDMORE	9/5/1996	S30804	13TH & C S.E.	200	BLOCKAGE IN LINE	
ARDMORE	9/13/1996	S30804	MILL & STANLEY S.E.		LINE BLOCKAGE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	9/20/1996	S30804	1000 A N.E.		LINE BLOCKAGE	
ARDMORE	9/29/1996	S30804	6TH & N S.W.			
ARDMORE	10/16/1996	S30804	MELODY & MYALL S.W.		BLOCKAGE	
ARDMORE	10/17/1996	S30804	118 I N.E.		ROOTS	
ARDMORE	10/24/1996	S30804	HEDGES RD.		PRESSURE RELEASE VALVE FAILURE	
ARDMORE	11/19/1996	S30804	10TH & F S.E.	0	LINE BLOCKAGE	
ARDMORE	11/25/1996	S30804	LIFT STATION A	4	BREAKER FAILURE	
ARDMORE	12/2/1996	S30804	MAYO MOBILE HOME		BLOCKAGE	
ARDMORE	12/4/1996	S30804	TERRACE INN		GREASE & ROOTS	
ARDMORE	1/9/1997	S30804	7TH & S AVE.	0	LINE BLOCKAGE	
ARDMORE	1/10/1997	S30804	13TH & A N.E.	0	LINE BLOCKAGE	
ARDMORE	1/15/1997	S30804	MOUNTAIN VIEW MALL	500	BLOCKAGE	
ARDMORE	1/16/1997	S30804	MT WASHINGTON RD. & VETERANS BLVD.		ROOTS	
ARDMORE	1/24/1997	S30804	STANLEY & S. WASHINGTON		BLOCKAGE	
ARDMORE	2/11/1997	S30804	WILKINSON'S NURSERY		LINE BLOCKAGE	
ARDMORE	2/14/1997	S30804	2ND. & A N.E.	250	LINE BLOCKAGE	
ARDMORE	2/18/1997	S30804	15 & HARDROVE	500	BLOCKAGE	
ARDMORE	3/11/1997	S30804	110 H NW		LINE BLOCKAGE	
ARDMORE	3/19/1997	S30804	118 I ST. NE		ROOTS	
ARDMORE	3/21/1997	S30804	MT. WASHINGTON RD. BEHIND CHURCH			
ARDMORE	3/27/1997	S30804	D S.E. & LAKE MURRAY		GREASE	
ARDMORE	3/28/1997	S30804	FREEMAN & MT. WASHINGTON RD.	<1,000	CLOGGED	
ARDMORE	3/31/1997	S30804	BROADWAY & A N.E.		BLOCKAGE	
ARDMORE	4/2/1997	S30804	K & 2ND N.W.		BLOCKAGE	
ARDMORE	4/9/1997	S30804	BURGER KING AT HOLIDAY DR.		LINE BLOCKAGE	
ARDMORE	4/18/1997	S30804	KNOX ROAD		LINE BLOCKAGE	
ARDMORE	4/22/1997	S30804	PLAINVIEW SCHOOL		LINE BLOCKAGE	
ARDMORE	4/23/1997	S30804	F & 10TH S.E.	<250	LINE BLOCKAGE	
ARDMORE	4/28/1997	S30804	1600 P S.E.		LINE BLOCKAGE	
ARDMORE	4/28/1997	S30804	ELMBROOK NURSING HOME		LINE BLOCKAGE	
ARDMORE	5/9/1997	S30804	F & 10TH ST. S.E.	250	BLOCKAGE	
ARDMORE	6/13/1997	S30804	6TH & WOLVERTON		LINE STOPPAGE	
ARDMORE	8/26/1997	S30804	HOLIDAY DR.		LINE BLOCKAGE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	9/11/1997	S30804	F ST. S.W.	>1,000	LINE BLOCKAGE	
ARDMORE	10/20/1997	S30804	DREW ST. S.W.		BLOCKAGE	
ARDMORE	11/18/1997	S30804	6TH & O ST. SW		LINE BLOCKAGE	
ARDMORE	11/24/1997	S30804	101 H NW		LINE BLOCKAGE	
ARDMORE	12/15/1997	S30804	100 FREEMAN	<500	BLOCKAGE	
ARDMORE	12/15/1997	S30804	629 2ND S.E.		BLOCKAGE	
ARDMORE	12/19/1997	S30804	10TH S.E. & LAKE MURRAY DR.	<500	LINE BLOCKAGE	
ARDMORE	1/5/1998	S30804	C S.E. & BOYD		LINE BLOCKAGE	
ARDMORE	1/5/1998	S30804	224 F S.E.		BLOCKAGE	
ARDMORE	1/29/1998	S30804	300 SUNSET	<500	BLOCKAGE	
ARDMORE	3/30/1998	S30804	3RD N.E.		BLOCKAGE	
ARDMORE	4/7/1998	S30804	PLAINVIEW RD.		BLOCKAGE	
ARDMORE	4/14/1998	S30804	418 FIRST S.E.		BLOCKAGE IN LINE	
ARDMORE	8/17/1998	S30804	BROADWAY & A N.W.	1,000	BLOCKAGE	
ARDMORE	10/8/1998	S30804	118 I N.E.	1,000	BLOCKAGE	
ARDMORE	10/8/1998	S30804	MT. WASHINGTON RD. 1/4 MILE N. OF VETERANS BLVD.		LEAKING RELEASE VALVE	
ARDMORE	10/9/1998	S30804	S. OF CHATANOOGA LOOP		RELEASE VALVE ON MAIN FAILED	
ARDMORE	11/9/1998	S30804	7TH & N S.W.	>1,000	BLOCKAGE	
ARDMORE	12/28/1998	S30804	#8 CHAMPION STATION	500	BLOCKAGE	
ARDMORE	2/2/1999	S30804	101 H N.W.	1,000	BLOCKAGE	
ARDMORE	2/12/1999	S30804	MT. WASHINGTON & 142	1,000	BLOCKAGE	
ARDMORE	2/24/1999	S30804	3RD & A N.E.		BLOCKAGE	
ARDMORE	2/24/1999	S30804	3RD & A N.E.		BLOCKAGE	
ARDMORE	3/5/1999	S30804	MONROE & REFINERY RD.		BLOCKAGE	
ARDMORE	3/9/1999	S30804	CHICKASAW TOWERS	1,000	BLOCKAGE	
ARDMORE	3/22/1999	S30804	COUNTRY WOODS ESTATES		BLOCKAGE	
ARDMORE	3/23/1999	S30804	1ST & C ST. S.E.		BLOCKAGE	
ARDMORE	5/9/1999	S30804	HOLLINGSWORTH BETWEEN COMMERCIAL & SUNSET		BLOCKAGE	
ARDMORE	5/12/1999	S30804	D N.E. & MAIN ST		BLOCKAGE	
ARDMORE	7/8/1999	S30804	100 BLK H ST N.W.		BLOCKAGE	
ARDMORE	7/13/1999	S30804	CHICKASAW TOWERS		BLOCKAGE	
ARDMORE	7/20/1999	S30804	4TH ST N.W. & NORTH DR.		BLOCKAGE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	8/2/1999	S30804	EASTWOOD CIRLE & WOODSIDE DR.		BLOCKAGE	
ARDMORE	9/9/1999	S30804	RR AT 3RD & MAIN N.E.		BLOCKAGE	
ARDMORE	9/28/1999	S30804	ROSS RD. & INDUSTRIAL VILLAGE RD.		BLOCKAGE	
ARDMORE	10/27/1999	S30804	EAST OF MELODY LN ON MYALL RD.		BLOCKAGE	
ARDMORE	11/9/1999	S30804	HOLIDAY DR. & ROCKFORD RD.		BLOCKAGE	
ARDMORE	11/29/1999	S30804	SUNSET & W. MAIN		BLOCKED MAIN	
ARDMORE	12/14/1999	S30804	2ND & K N.W./1811 9TH N.W.		BLOCKAGE/ODOR	
ARDMORE	12/22/1999	S30804	K & EAST BROADWAY		BLOCKAGE	
ARDMORE	1/20/2000	S30804	PLAINVIEW & MYALL		BLOCKAGE	
ARDMORE	2/10/2000	S30804	2ND & K N.W.		BLOCKAGE	
ARDMORE	3/3/2000	S30804	ROCKFORD & 12TH N.W.	12,000	VALVE FAILURE	
ARDMORE	3/8/2000	S30804	12TH N.W. & N. ROCKFORD RD.	8,000	VALVE FAILURE	
ARDMORE	3/21/2000	S30804	VETERANS BLVD. & SOFTBALL COMPLEX RD.	135,000	RUPTURED MAIN	
ARDMORE	4/17/2000	S30804	SUNSET & BROADWAY		BLOCKAGE	
ARDMORE	5/15/2000	S30804	511 G S.W.	500	GREASE	
ARDMORE	5/15/2000	S30804	101 H N.W.		BLOCKAGE	
ARDMORE	5/15/2000	S30804	101 H N.W.		BLOCKAGE	
ARDMORE	6/12/2000	S30804	101 H N.W.		BLOCKAGE	
ARDMORE	8/22/2000	S30804	E. OF COMMERCE & S. OF MYALL		TREE ROOTS & GREASE	
ARDMORE	9/9/2000	S30804	816 FREEMAN		BUCKET IN LINE	
ARDMORE	11/13/2000	S30804	7TH & S		BLOCKAGE	
ARDMORE	12/1/2000	S30804	E. OF COMMERCE & S. OF MYALL		ROOTS	
ARDMORE	12/11/2000	S30804	1115 COUNTRY WOOD ESTATES	750	HOLE IN LINE	
ARDMORE	12/21/2000	S30804	COUNTRY WOOD ESTATES	2,000	VALVE STUCK	
ARDMORE	1/11/2001	S30804	E. SIDE OF TRUCK BYPASS	3,000	ROOTS	
ARDMORE	1/11/2001	S30804	AT 3RD S ST	20,000	ROOTS	
ARDMORE	1/11/2001	S30804	SUTTON RD	20,000	ROOTS	
ARDMORE	1/30/2001	S30804	1323 S. COMMERCE	5,000	GREASE	
ARDMORE	3/5/2001	S30804				
ARDMORE	4/11/2001	S30804	920 ISABELL	500	OBSTRUCTION	
ARDMORE	4/27/2001	S30804	DORNICK HILLS L.S.	20,000	HOLE IN LINE	PIPE
ARDMORE	5/1/2001	S30804				
ARDMORE	5/3/2001	S30804	SUTTON RD.	8,000	BLOCKAGE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	5/6/2001	S30804	CHAMPION STATION	7,000	MAIN VALVE FAILURE	
ARDMORE	5/6/2001	S30804	PINE & ASH	150	BLOCKAGE	
ARDMORE	5/30/2001	S30804	L.S. A AT HEDGES RD	30,000	POWER OUTAGE	LIFT STATION
ARDMORE	9/13/2001	S30804	1219 SOUTH ROCKFORD RD.	350	ROOTS	
ARDMORE	9/20/2001	S30804	PETROLEUM LAND TREATMENT UNIT ON SUTTON RD.	1,000	ROOTS	
ARDMORE	10/4/2001	S30804	L.S. D ON 1610 MCLAINE RD	5,000	MAIN BREAK	
ARDMORE	10/8/2001	S30804	244 EAST WOOD LN.	4,800	HOLE IN LINE	
ARDMORE	10/23/2001	S30804	MYALL RD BETWEEN MELODY & WESTERN HEIGHTS	2,500	ROOTS	
ARDMORE	11/6/2001	S30804	1902 KNOX RD.	200	BLOCKAGE	
ARDMORE	11/8/2001	S30804	109 H ST	75	BLOCKAGE	
ARDMORE	11/9/2001	S30804	1902 KNOX RD	75	BLOCKAGE	
ARDMORE	11/13/2001	S30804	DORNICK HILLS L.S.	35,000	AIR LOCKED FORCE MAIN	
ARDMORE	11/19/2001	S30804	MESA & MT. WASHINGTON RD.	500	TRYING TO REPAIR MAIN	
ARDMORE	1/29/2002	S30804	2605 W. BROADWAY			
ARDMORE	2/7/2002	S30804	2302 KNOX RD.	7,000	PLUGGED LINE	MANHOLE
ARDMORE	3/15/2002	S30804	115 MONROE N.E.	1,000	ROOTS	MANHOLE
ARDMORE	3/18/2002	S30804	10TH & MYAH S.E.	500	OBSTRUCTION	PIPE
ARDMORE	3/27/2002	S30804	H ST & 2ND N.W.	<500	BROKEN MAIN	PIPE
ARDMORE	3/28/2002	S30804	DORNICK HILLS L.S.	<500	MALFUNCTION	MANHOLE
ARDMORE	4/12/2002	S30804	LAKE MURRAY DR. & D ST	>500	OBSTRUCTION	MANHOLE
ARDMORE	4/15/2002	S30804	CHATANOOGA RD.	1,500	OBSTRUCTION	MANHOLE
ARDMORE	4/19/2002	S30804	W. OF MT. WASHINGTON RD.	5,000	OBSTRUCTION	MANHOLE
ARDMORE	5/8/2002	S30804	MT. WASHINGTON 1 BLK S. OF 142 BYPASS	3,500	OBSTRUCTION	MANHOLE
ARDMORE	5/15/2002	S30804	H & N.W. BEHIND CHICKASAW TOWERS	<500	LINE BLOCKAGE	MANHOLE
ARDMORE	7/8/2002	S30804	MYALL & S. PLAINVIEW RD.	<500	BUSTED LINE	PIPE
ARDMORE	7/9/2002	S30804	500 E. OF HWY 142 BYPASS	20,000	OBSTRUCTION	MANHOLE
ARDMORE	8/22/2002	S30804	S.E. FENCE OF PLAINVIEW SCHOOL	<500	BROKEN PIPE	PIPE
ARDMORE	8/26/2002	S30804	2ND & H	<500	BLOCKAGE	MANHOLE
ARDMORE	9/24/2002	S30804	DREW ST. & COMMERCE	1,000	BLOCKAGE	PIPE
ARDMORE	10/4/2002	S30804	E. OF MIDDLE SCHOOL ON HWY 142	100	PLUGGED LINE	MANHOLE
ARDMORE	11/16/2002	S30804	1000 BLK OF S. COMMERCE	80,000	DEBRIS	MANHOLE
ARDMORE	12/8/2002	S30804	CHATTANOOGA RD. & RAILHEAD ST.	<1,000	DEBRIS	PIPE

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	12/17/2002	S30804	CLOVERLEAF DR. & ROCKFORD RD.	<100	BROKEN PIPE	PIPE
ARDMORE	12/24/2002	S30804	1219 S. ROCKFORD RD.	3,000	BLOCKAGE	MANHOLE
ARDMORE	12/31/2002	S30804	DEAD END OF CHATANOOGA RD.	<250	BLOCKAGE	MANHOLE
ARDMORE	1/2/2003	S30804	AUGUSTA & ROCKFORD RD.	<1,000	DEBRIS	MANHOLE
ARDMORE	1/10/2003	S30804	312 ASH	<1,000	OBSTRUCTION	MANHOLE
ARDMORE	1/24/2003	S30804	C & BOYD	500	OBSTRUCTION	MANHOLE
ARDMORE	1/24/2003	S30804	CARTER & 9TH	<1,000	OBSTRUCTION	MANHOLE
ARDMORE	1/27/2003	S30804	S. OF 110 S ST N.E.	6,000	OBSTRUCTION	MANHOLE
ARDMORE	2/13/2003	S30804	CHAMPION STATION N.W.	150	DEBRIS	MANHOLE
ARDMORE	2/15/2003	S30804	ISABEL RD. & MYALL RD.	1,000	OBSTRUCTION	PIPE
ARDMORE	2/19/2003	S30804	MESA RD. - 1/2 MILE WEST OF REFINERY RD.	40,000	CRACK IN PIPE	PIPE
ARDMORE	3/17/2003	S30804	ROCKFORD RD. & 12TH	500	BLOCKAGE	MANHOLE
ARDMORE	3/24/2003	S30804	FLOYD & ALLEN	200	BLOCKAGE	MANHOLE
ARDMORE	3/26/2003	S30804	1806 W. MAIN	2,500	BLOCKAGE	MANHOLE
ARDMORE	4/7/2003	S30804	110 H ST.	<200	BLOCKAGE	MANHOLE
ARDMORE	4/11/2003	S30804	25 ROCKFORD RD.	12,000	ROOTS	MANHOLE
ARDMORE	4/14/2003	S30804	25 ROCKFORD RD.	10,000	BLOCKAGE	MANHOLE
ARDMORE	5/31/2003	S30804	CHATTANOOGA & RAILWAY RD.	<1,000	BLOCKAGE	MANHOLE
ARDMORE	6/2/2003	S30804	518 D S.E.	1,000	OBSTRUCTION	MANHOLE
ARDMORE	6/3/2003	S30804	6TH & D S.E.	<250	OBSTRUCTION	PIPE
ARDMORE	6/5/2003	S30804	RAILHEAD EXPRESS & STATION RD.	<500	OBSTRUCTION	MANHOLE
ARDMORE	6/10/2003	S30804	L & SAM NOBLE PKWY	4,000	BROKEN LINE	PIPE
ARDMORE	6/10/2003	S30804	118 8TH ST. S.E.	500	OBSTRUCTION	MANHOLE
ARDMORE	6/24/2003	S30804	3RD & L N.E.	<250	OBSTRUCTION	MANHOLE
ARDMORE	6/24/2003	S30804	K & 2ND	<500	OBSTRUCTION	MANHOLE
ARDMORE	6/30/2003	S30804	104 H ST. N.W.	500	BLOCKAGE	MANHOLE
ARDMORE	7/12/2003	S30804	1570 CHICKASAW LAKE CLUB	200	BLOCKAGE	MANHOLE
ARDMORE	8/14/2003	S30804	918 3RD N.E.	1,000	BLOCKAGE	MANHOLE
ARDMORE	8/21/2003	S30804	1201 L N.E.	1,500	BROKEN PIPE	PIPE
ARDMORE	9/8/2003	S30804	9TH & CARTER S.E.	<1,000	OBSTRUCTION	MANHOLE
ARDMORE	9/15/2003	S30804	H ST. N.W.	<500	BLOCKAGE	MANHOLE
ARDMORE	9/16/2003	S30804	ROCKFORD RD. & WOOD-N-CREEK	200	OBSTRUCTION	PIPE
ARDMORE	9/19/2003	S30804	12TH & ROCKFORD RD.	30,000	BLOCKAGE	PIPE

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	10/1/2003	S30804	CAMPBELL & MT. WASHINGTON	2,000	BLOCKAGE	MANHOLE
ARDMORE	10/9/2003	S30804	4 N.W. & NORTH DR.	3,500	OBSTRUCTION	PIPE
ARDMORE	10/27/2003	S30804	H & 1ST	<300	OBSTRUCTION	MANHOLE
ARDMORE	11/6/2003	S30804	DORNICK HILLS	1,000	MALFUNCTION	LIFT STATION
ARDMORE	11/11/2003	S30804	513 ECHOL HOLLOW TR.	75	ROOTS	
ARDMORE	11/15/2003	S30804	STANLEY & WASHINGTON	500	OBSTRUCTION	PIPE
ARDMORE	11/19/2003	S30804	12TH & ROCKFORD RD.	<300	OBSTRUCTION	MANHOLE
ARDMORE	11/21/2003	S30804	N. COMMERCE & MERRICK AVE	<500	OSTRUCTION	MANHOLE
ARDMORE	11/28/2003	S30804	S. OF 3600 SUTTON RD.	3,000	BLOCKAGE	MANHOLE
ARDMORE	12/19/2003	S30804	2ND & H ST	100	BLOCKAGE	MANHOLE
ARDMORE	12/26/2003	S30804	2701 12TH N.W.	700	OBSTRUCTION	MANHOLE
ARDMORE	1/7/2004	S30804	1024 S. COMMERCE	1,000	BLOCKAGE	MANHOLE
ARDMORE	1/12/2004	S30804	800 BLK. MYALL ST. S.W.	1,000	BLOCKAGE	MANHOLE
ARDMORE	2/18/2004	S30804	1107 FRANKLIN	200	OBSTRUCTION	MANHOLE
ARDMORE	2/24/2004	S30804	S. OF 3600 SUTTON RD.	1,000	FLOODING	MANHOLE
ARDMORE	3/4/2004	S30804	CAMPBELL & MT. WASHINGTON RD.	500	RAINS	MANHOLE
ARDMORE	3/4/2004	S30804	S. OF 3600 SUTTON RD.	1,000	RAIN	MANHOLE
ARDMORE	3/7/2004	S30804	S. OF BROADWAY & COMMERCE	500	OBSTRUCTION	MANHOLE
ARDMORE	3/8/2004	S30804	S. SIDE OF LOWES STORE	1,500	OBSTRUCTION	MANHOLE
ARDMORE	3/9/2004	S30804	W. OF ASHBROOK APTS. ON KNOX RD.	1,000	OBSTRUCTION	MANHOLE
ARDMORE	3/18/2004	S30804	6TH & FRISCO	500	BLOCKAGE	PIPE
ARDMORE	4/5/2004	S30804	10TH & A ST. S.E.	500	BLOCKAGE	PIPE
ARDMORE	4/6/2004	S30804	BEHIND ATLAS ROOFING CO. - 142 BYPASS	1,500	BLOCKAGE	MANHOLE
ARDMORE	4/13/2004	S30804	W. MAIN	500	BLOCKAGE	PIPE
ARDMORE	4/27/2004	S30804	EAST SIDE OF 2605 W. BROADWAY	1,000	BLOCKAGE	MANHOLE
ARDMORE	5/10/2004	S30804	CHICKASAW CLUB LAKE RD.	1,500	BLOCKAGE	MANHOLE
ARDMORE	5/25/2004	S30804	601 ANDERSON ST. S.E.	100	BLOCKAGE	PIPE
ARDMORE	5/30/2004	S30804		1,000	BLOCKED LINE	MANHOLE
ARDMORE	6/6/2004	S30804	ATLAS ROOFING NEAR RR	5,000	BLOCKAGE	MANHOLE
ARDMORE	6/9/2004	S30804	3600 SUTTON RD.	4,000	RAIN	MANHOLE
ARDMORE	6/13/2004	S30804	402 PARK ST.	5,000	BLOCKED LINE	MANHOLE
ARDMORE	6/16/2004	S30804	H ST. N.W.	500	BLOCKAGE	MANHOLE
ARDMORE	6/30/2004	S30804	1522 MT. WASHINGTON		RAINS	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	6/30/2004	S30804	1522 BLK. MT WASHINGTON RD.	750	RAINS	MANHOLE
ARDMORE	6/30/2004	S30804	S. OF 3600 SUTTON	5,000	FLOOD WATERS	MANHOLE
ARDMORE	7/1/2004	S30804	E. OF REFINERY RD. ON DEAD END OF MONROE	>1,000	RAINS	MANHOLE
ARDMORE	7/23/2004	S30804	MYALL & MELODY DR.	500	OBSTRUCTION	MANHOLE
ARDMORE	9/13/2004	S30804	GENE AUTRY , OKLA	50,000	LAGOON DOWN FOR REPAIRS	LAGOON/BASIN
ARDMORE	9/14/2004	S30804	402 PARK	5,000	BLOCKAGE	MANHOLE
ARDMORE	9/17/2004	S30804	N. 142 BYPASS, E. OF MT. WASHINGTON	1,000	BLOCKAGE	MANHOLE
ARDMORE	9/27/2004	S30804	1809 W. MAIN	2,000	BLOCKAGE	PIPE
ARDMORE	9/29/2004	S30804	1809 W. MAIN	500	BLOCKAGE	PIPE
ARDMORE	10/3/2004	S30804	H ST. N.W.	500	LINE BLOCKAGE	MANHOLE
ARDMORE	10/6/2004	S30804	MELODY & MYALL	500	BLOCKAGE	MANHOLE
ARDMORE	10/6/2004	S30804	1401 MONROE	1,000	BLOCKAGE	PIPE
ARDMORE	10/11/2004	S30804	S. OF 3600 SUTTON RD.	5,000	FLOODING	MANHOLE
ARDMORE	10/27/2004	S30804	Q & I ST. S.W.	300	BLOCKAGE	MANHOLE
ARDMORE	10/27/2004	S30804	1401 MONROE	1,000	BLOCKAGE	MANHOLE
ARDMORE	11/1/2004	S30804	1401 MONROE	2,000	BLOCKAGE	MANHOLE
ARDMORE	11/3/2004	S30804	S. OF 3600 SUTTON RD.	3,000	FLOODING	MANHOLE
ARDMORE	11/12/2004	S30804	2605 W. BROADWAY	1,000	BLOCKAGE	MANHOLE
ARDMORE	11/12/2004	S30804	400 CAMERON AVE.		DAMAGED PIPE	PIPE
ARDMORE	11/17/2004	S30804	S. OF 3600 SUTTON RD.	5,000	RAIN	MANHOLE
ARDMORE	11/18/2004	S30804	E & 9TH S.E.	500	BLOCKAGE	MANHOLE
ARDMORE	11/23/2004	S30804	400 CAMERON AVE	2,000	DAMAGED PIPE	PIPE
ARDMORE	12/3/2004	S30804	24TH & MONROE N.E.	500	BROKEN PIPE	PIPE
ARDMORE	12/7/2004	S30804	N. OF DOWNTOWN AIRPARK	1,000	BLOCKAGE	MANHOLE
ARDMORE	12/9/2004	S30804	N.E. OF BURGER KING ON BROADWAY	2,000	BLOCKAGE	MANHOLE
ARDMORE	12/10/2004	S30804	400 LOCUST	800	BLOCKAGE	MANHOLE
ARDMORE	12/20/2004	S30804	715 VIRGINIA LN.	300	BLOCKAGE	MANHOLE
ARDMORE	12/23/2004	S30804	1217 ROCKFORD RD.	<1,000	BLOCKAGE	MANHOLE
ARDMORE	12/27/2004	S30804	H ST. N.W.	1,000	BLOCKAGE	MANHOLE
ARDMORE	1/4/2005	S30804	AUGUSTA RD.	100	BLOCKAGE	MANHOLE
ARDMORE	1/5/2005	S30804	S. OF 3600 SUTTON RD.	5,000	RAINS	MANHOLE
ARDMORE	1/24/2005	S30804	402 PARK ST. S.E.	300	BLOCKAGE	MANHOLE
ARDMORE	1/29/2005	S30804	MT. WASHINGTON & COTTONWOOD	1,000	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	2/9/2005	S30804	3600 SUTTON RD.	4,500	OVERFLOW	MANHOLE
ARDMORE	2/12/2005	S30804	S. OF 36TH & SUTTON RD.	2,000	RAIN	MANHOLE
ARDMORE	2/18/2005	S30804	1315 SUNSET DR.	50	BLOCKAGE	PIPE
ARDMORE	2/25/2005	S30804	6TH & FRISCO S.W.	2,000	BLOCKAGE	PIPE
ARDMORE	3/1/2005	S30804	1809 W. MAIN	700	BLOCKAGE	PIPE
ARDMORE	3/2/2005	S30804	W. OF ASHBROOK APTS.	1,500	BLOCKAGE	MANHOLE
ARDMORE	3/4/2005	S30804	118 I ST N.E.	100	BLOCKAGE	MANHOLE
ARDMORE	3/10/2005	S30804	3 & K N.W.	300	BLOCKAGE	MANHOLE
ARDMORE	3/31/2005	S30804	2701 12TH ST. N.W. IN FRONT OF LOWES	200	BLOCKAGE	MANHOLE
ARDMORE	4/1/2005	S30804	N. OF ROSS ST. N.E.	5,000	BLOCKAGE	MANHOLE
ARDMORE	4/4/2005	S30804	E. OF 142 BYPASS BRIDGE	1,200	BLOCKAGE	MANHOLE
ARDMORE	4/13/2005	S30804	2423 W. VETERANS BLVD.	500	BLOCKAGE	MANHOLE
ARDMORE	5/2/2005	S30804	ARDMORE H.S. ON PRACTICE FIELD	50	BLOCKAGE	MANHOLE
ARDMORE	5/3/2005	S30804	PETTIT & MCCULLOH	1,000	BROKEN PIPE	PIPE
ARDMORE	6/5/2005	S30804	S. OF 3600 SUTTON RD.	5,000	RAIN	MANHOLE
ARDMORE	6/8/2005	S30804	1708 9TH N.W.	1,500	BLOCKAGE	MANHOLE
ARDMORE	7/2/2005	S30804	11TH & K N.E.	2,000	BLOCKAGE	MANHOLE
ARDMORE	7/11/2005	S30804	118 I ST. N.E.		BLOCKAGE	MANHOLE
ARDMORE	8/15/2005	S30804	3600 SUTTON RD.	10,000	RAIN	MANHOLE
ARDMORE	9/1/2005	S30804	1807	20	BLOCKAGE	MANHOLE
ARDMORE	9/9/2005	S30804	COTTONWOOD & ASH N.W.	500	BLOCKED LINE	MANHOLE
ARDMORE	9/24/2005	S30804	S. OF POLO'S RESTAURANT	500	BLOCKAGE	MANHOLE
ARDMORE	9/30/2005	S30804	BEHIND TIFFANY'S PLAZA MALL IN WOODED AREA		LINE BLOCKAGE	PIPE
ARDMORE	12/9/2005	S30804	STANLEY & S. WASHINGTON	500	BLOCKAGE	MANHOLE
ARDMORE	12/14/2005	S30804	402 PARK ST. S.E.	500	BLOCKAGE	MANHOLE
ARDMORE	12/15/2005	S30804	2215 REMINGTON CT.	200	BLOCKAGE	MANHOLE
ARDMORE	12/22/2005	S30804	RAILWAY EXPRESS S.W. BEHIND 2 FROGS	1,000	BLOCKAGE	MANHOLE
ARDMORE	12/22/2005	S30804	1900 4TH N.W.	500	BLOCKAGE	MANHOLE
ARDMORE	12/27/2005	S30804	9TH & CARTER	200	BLOCKAGE	
ARDMORE	1/4/2006	S30804	1302 3RD S.W.	200	BLOCKAGE	MANHOLE
ARDMORE	1/18/2006	S30804	2605 W. BROADWAY		AIR RELEASE VALVE WAS OPENED	PIPE
ARDMORE	2/7/2006	S30804	1204 S. ROCKFORD	300	BLOCKAGE	MANHOLE
ARDMORE	2/16/2006	S30804	9TH & CARTER	200	BLOCKAGE	

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	3/16/2006	S30804	CAMPBELL & WASHINGTON	200	BLOCKAGE	MANHOLE
ARDMORE	3/19/2006	S30804	3600 SUTTON RD.	500	RAIN	MANHOLE
ARDMORE	3/27/2006	S30804	1809 7TH N.W.	700	BLOCKAGE	PIPE
ARDMORE	4/3/2006	S30804	2ND & I ST. N.E.	600	BLOCKAGE	PIPE
ARDMORE	4/3/2006	S30804	101 H ST. N.W.	250	BLOCKAGE	PIPE
ARDMORE	4/3/2006	S30804	1409 OAK RIDGE	1,500	BLOCKAGE	PIPE
ARDMORE	5/7/2006	S30804	2605 W. BROADWAY		BLOCKAGE	LIFT STATION
ARDMORE	5/8/2006	S30804	2831 HEDGES RD	500	PUMP FAILURE	LIFT STATION
ARDMORE	5/8/2006	S30804	2ND & K N.W.	200	LINE BLOCKAGE	MANHOLE
ARDMORE	5/12/2006	S30804	403 LOCUST ST.	500	BLOCKAGE	MANHOLE
ARDMORE	6/12/2006	S30804	WILLOW PARK APTS. - MONROE N.E.	1,500	BLOCKAGE	MANHOLE
ARDMORE	6/28/2006	S30804	MONROE & B N.W.		LINE BLOCKAGE	MANHOLE
ARDMORE	8/9/2006	S30804	110 H ST. N.W.	<200	BLOCKAGE	MANHOLE
ARDMORE	8/10/2006	S30804	2ND & I ST N.E.	<1,000	BLOCKAGE	MANHOLE
ARDMORE	9/1/2006	S30804	3600 SUTTON RD.	200	BLOCKAGE	HEAD WORKS
ARDMORE	9/5/2006	S30804	MT. WASHINGTON RD.	<1,000	BLOCKAGE	MANHOLE
ARDMORE	9/7/2006	S30804	BURGER KING ON BROADWAY		BLOCKAGE	MANHOLE
ARDMORE	11/20/2006	S30804	701 ROSEWOOD	200	BLOCKAGE	MANHOLE
ARDMORE	11/27/2006	S30804	ASH & PINE N.W.	750	BLOCKAGE	MANHOLE
ARDMORE	12/12/2006	S30804	GRACE BAPTIST TEMPLE- MT. WASHINGTON RD.		BLOCKAGE	PIPE
ARDMORE	12/15/2006	S30804	WILLOWBROOK APTS.		LINE BREAK	PIPE
ARDMORE	12/18/2006	S30804	811 ROCKFORD PL.	<100	BLOCKAGE	PIPE
ARDMORE	12/20/2006	S30804	118 I ST. N.E.		BLOCKAGE	PIPE
ARDMORE	1/17/2007	S30804	1115 8TH N.W.	<100	BLOCKAGE	MANHOLE
ARDMORE	1/22/2007	S30804	2702 CROSSROADS	1,000	BLOCKAGE	MANHOLE
ARDMORE	2/1/2007	S30804	110 H ST. N.W.	500	BLOCKAGE	
ARDMORE	2/5/2007	S30804	N. OF OAK HALL SCHOOL		BLOCKAGE	PIPE
ARDMORE	2/8/2007	S30804	SOUTH OF MAYO TRAILER PARK		BLOCKAGE	PIPE
ARDMORE	2/21/2007	S30804	MT. WASHINGTON RD.		BLOCKAGE	PIPE
ARDMORE	2/28/2007	S30804	13TH & A ST. N.E.	<200	BLOCKAGE	PIPE
ARDMORE	3/7/2007	S30804	O ST. & 1ST ST. N.W.	200	PLUG LEAKING	MANHOLE
ARDMORE	3/12/2007	S30804	A & MONROE	300	BLOCKAGE	PIPE
ARDMORE	3/15/2007	S30804	W. OF VETERANS CENTER		BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	Amount (Gal)	Cause	Type of Source
ARDMORE	3/28/2007	S30804	300 ASH N.W.	<1,000	BLOCKAGE	MANHOLE
ARDMORE		S30804	800 BLK MILES ST. S.W.	1,000	OBSTRUCTION	MANHOLE
ARDMORE		S30804	CHICKASAW HILLS HOUSING ADDITION	1,000	BLOCKAGE	MANHOLE
ARDMORE		S30804	400 LOCUST	800	BLOCKAGE	MANHOLE
ARDMORE		S30804	MT. WASHINGTON RD.		BLOCKAGE	
ARDMORE		S30804	3600 SUTTON RD.	2,000	RAIN	MANHOLE
ARDMORE		S30804				
ARDMORE		S30804		150		
ARDMORE		S30804	KNOX RD. - ASTERICK PL. APTS	75	BLOCKAGE	

APPENDIX C
ESTIMATED FLOW EXCEEDANCE PERCENTILES

Appendix C

Estimated Flow Exceedance Percentiles

WQ Station	OK310800010240P	OK310800020010-001AT	OK310800020040C	OK310800020190K	OK310810010010-001AT	OK310810020170G	OK310810020200G	OK310820010030G	OK310830010010-001AT	OK310830030010-001AT	OK310830030010P	OK310830060030H	OK310840010010-001AT	OK310840010060G
	Oil Creek	**Washita River, US 177**	**Sand Branch**	**Chigley Sandy Creek**	**Washita River, SH 19**	**Roaring Creek**	**Laflin Creek**	**Bitter Creek**	**Washita River, US 281**	**Washita River, SH 152**	**Washita River # 145**	**Willow Creek**	**Washita River, SH 33**	**Quartermaster Creek**
WBID Segment	OK310800010240_00	OK310800020010_00	OK310800020040_00	OK310800020190_00	OK310810010010_10	OK310810020170_00	OK310810020200_00	OK310820010030_00	OK310830010010_00	OK310830030010_00	OK310830030010_10	OK310830060030_00	OK310840010010_00	OK310840010060_00
USGS Gage Reference	07327550	07331000	07316500	07328180	07328500	07237550	07327550	07328180	07326500	07325000	07325000	07325860	07324200	07301420
Watershed Area (sq. mile)	49.6	445.8	16.2	32.0	267.5	66.9	30.9	69.9	437.6	519.0	576.0	34.6	109.2	174.3
NRCS Curve Number	71.5	67.5	63.7	72.0	71.9	65.3	64.4	69.1	67.8	74.9	69.6	71.6	66.2	64.6
Average Annual Rainfall (inch)	41.1	38.7	39.3	40.3	39.0	36.1	36.0	34.1	32.6	30.3	29.0	32.0	27.4	27.0
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)**
0	751	94,400	144	660	41,700	1,011	467	1,440	27,400	7,539	5,970	1,440	4,340	310
1	95	20,164	11	136	8,910	127	59	296	5,072	1,910	1,512	79	890	70
2	73	13,932	7.1	83	6,723	99	46	181	4,074	1,454	1,150	28	607	46
3	52	10,700	4.9	52	5,625	70	32	114	3,340	1,263	999	15	460	38
4	41	8,892	3.6	38	4,816	56	26	83	2,880	1,117	885	11	385	32
5	36	7,488	2.9	33	4,150	48	22	72	2,580	982	781	9.8	325	28
6	31	6,750	2.3	28	3,730	42	19	62	2,313	885	701	6.7	281	26
7	28	6,121	2.0	26	3,350	38	18	57	2,080	793	626	5.5	243	23
8	26	5,563	1.7	24	3,030	35	16	53	1,908	724	572	4.8	222	21
9	25	5,059	1.6	23	2,764	33	15	50	1,730	646	509	4.3	199	20
10	23	4,620	1.4	21	2,516	31	14	46	1,600	600	473	3.9	177	18
11	21	4,240	1.3	20	2,308	28	13	44	1,480	560	442	3.5	159	17
12	20	3,920	1.2	18	2,130	27	12	39	1,360	531	419	3.3	147	16
13	19	3,650	1.0	17	2,010	25	12	37	1,250	495	391	3.1	134	15
14	17	3,420	0.96	16	1,910	23	11	35	1,170	464	366	3.0	123	14
15	17	3,194	0.88	15	1,830	22	10	33	1,090	420	331	2.8	114	14
16	16	2,976	0.82	14	1,720	21	9.8	31	1,020	381	301	2.7	106	13
17	15	2,780	0.78	14	1,610	20	9.4	31	970	318	251	2.6	101	12
18	15	2,650	0.71	13	1,530	20	9.0	28	917	282	222	2.4	94	12
19	14	2,540	0.67	12	1,460	19	8.6	27	865	250	197	2.3	89	12
20	14	2,450	0.63	12	1,400	18	8.4	26	818	231	182	2.2	83	11
21	13	2,334	0.59	11	1,320	18	8.1	24	764	207	163	2.1	77	10
22	13	2,240	0.57	10	1,270	17	7.8	23	717	186	146	2.1	73	9.9
23	12	2,150	0.53	10	1,210	16	7.6	22	679	170	133	2.0	67	9.9
24	12	2,040	0.49	9.6	1,160	16	7.3	21	634	153	120	2.0	64	9.5
25	11	1,950	0.47	9.2	1,110	15	7.1	20	594	141	110	1.9	60	9.0
26	11	1,860	0.45	8.7	1,060	15	6.8	19	548	130	102	1.9	57	9.0
27	11	1,770	0.41	8.3	1,010	14	6.5	18	511	120	94	1.8	55	8.6
28	10	1,700	0.41	7.9	968	14	6.4	17	482	111	87	1.7	51	8.2
29	9.9	1,630	0.37	7.4	928	13	6.1	16	451	104	81	1.7	49	7.8
30	9.7	1,560	0.35	7.0	892	13	6.0	15	424	96	75	1.7	47	7.8
31	9.3	1,490	0.33	6.6	848	12	5.8	14	400	90	70	1.6	45	7.4
32	8.8	1,410	0.31	6.1	811	12	5.5	13	380	85	66	1.6	43	7.4
33	8.4	1,360	0.29	6.1	782	11	5.2	13	363	80	62	1.5	41	7.4

WQ Station	OK310800010240P Oil Creek	OK310800020010-001AT Washita River, US 177	OK310800020040C Sand Branch	OK310800020190K Chigley Sandy Creek	OK310810010010-001AT Washita River, SH 19	OK310810020170G Roaring Creek	OK310810020200G Laflin Creek	OK310820010030G Bitter Creek	OK310830010010-001AT Washita River, US 281	OK310830030010-001AT Washita River, SH 152	OK310830030010P Washita River # 145	OK310830060030H Willow Creek	OK310840010010-001AT Washita River, SH 33	OK310840010060G Quartermaster Creek
WBID Segment	OK310800010240_00	OK310800020010_00	OK310800020040_00	OK310800020190_00	OK310810010010_10	OK310810020170_00	OK310810020200_00	OK310820010030_00	OK310830010010_00	OK310830030010_00	OK310830030010_10	OK310830060030_00	OK310840010010_00	OK310840010060_00
USGS Gage Reference	07327550	07331000	07316500	07328180	07328500	07237550	07327550	07328180	07326500	07325000	07325000	07325860	07324200	07301420
Watershed Area (sq. mile)	49.6	445.8	16.2	32.0	267.5	66.9	30.9	69.9	437.6	519.0	576.0	34.6	109.2	174.3
NRCS Curve Number	71.5	67.5	63.7	72.0	71.9	65.3	64.4	69.1	67.8	74.9	69.6	71.6	66.2	64.6
Average Annual Rainfall (inch)	41.1	38.7	39.3	40.3	39.0	36.1	36.0	34.1	32.6	30.3	29.0	32.0	27.4	27.0
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)**
34	8.0	1,310	0.27	5.7	749	11	5.1	12	344	76	59	1.5	40	7.0
35	7.8	1,250	0.24	5.2	719	10	4.8	11	328	72	56	1.4	38	7.0
36	7.6	1,200	0.22	5.2	693	10	4.7	11	314	69	53	1.4	36	6.6
37	7.2	1,160	0.20	4.8	663	9.6	4.4	10	302	66	51	1.4	35	6.6
38	6.7	1,120	0.20	4.8	636	9.1	4.2	10	289	63	49	1.3	34	6.2
39	6.5	1,070	0.18	4.4	614	8.8	4.1	10.5	274	61	47	1.3	33	6.2
40	6.1	1,020	0.17	4.4	592	8.3	3.8	9.5	262	58	45	1.3	31	5.8
41	5.9	976	0.16	4.2	571	8.2	3.7	9.2	252	56	43	1.2	30	5.8
42	5.9	929	0.14	4.0	550	7.9	3.7	8.9	242	55	42	1.2	28	5.3
43	5.5	891	0.13	3.9	532	7.4	3.4	8.5	233	52	40	1.2	27	5.3
44	5.3	843	0.12	3.7	515	7.1	3.3	8.1	226	51	39	1.1	26	5.3
45	5.0	812	0.11	3.5	498	6.8	3.1	7.7	218	50	38	1.1	25	4.9
46	4.8	777	0.10	3.3	483	6.5	3.0	7.2	212	47	36	1.1	24	4.9
47	4.8	747	0.09	3.1	466	6.5	3.0	6.9	206	46	35	1.1	22	4.9
48	4.6	714	0.08	2.9	450	6.2	2.9	6.4	202	45	34	1.1	21	4.5
49	4.4	686	0.08	2.8	435	5.9	2.7	6.1	195	43	33	1.0	20	4.5
50	4.4	660	0.07	2.6	419	5.9	2.7	5.7	188	42	32	1.0	19	4.5
51	4.2	633	0.06	2.5	405	5.7	2.6	5.5	183	41	31	0.99	18	4.1
52	4.0	611	0.06	2.4	390	5.4	2.5	5.3	178	40	30	0.98	17	4.1
53	4.0	589	0.05	2.4	376	5.4	2.5	5.1	170	38	29	0.96	16	4.0
54	3.8	566	0.04	2.2	363	5.1	2.4	4.9	164	37	28	0.92	16	3.9
55	3.6	542	0.04	2.1	348	4.8	2.2	4.7	158	36	27	0.90	15	3.7
56	3.6	520	0.04	2.0	334	4.8	2.2	4.4	153	34	26	0.88	14	3.5
57	3.4	495	0.03	1.9	323	4.5	2.1	4.1	148	34	26	0.85	14	3.3
58	3.4	475	0.02	1.7	308	4.5	2.1	3.8	144	33	25	0.82	13	3.1
59	3.2	459	0.02	1.6	296	4.2	2.0	3.6	140	33	25	0.80	12	2.9
60	3.2	440	0.02	1.5	284	4.2	2.0	3.3	135	32	24	0.79	12	2.7
61	2.9	419	0.01	1.4	274	4.0	1.8	3.2	131	31	23	0.75	11	2.5
62	2.9	404	0.01	1.4	264	4.0	1.8	3.1	127	31	23	0.72	11	2.3
63	2.7	387	0.01	1.3	255	3.7	1.7	2.9	123	29	22	0.71	9.9	2.2
64	2.7	374	0	1.2	248	3.7	1.7	2.6	120	28	21	0.69	9.4	2.0
65	2.5	357	0	1.0	239	3.4	1.6	2.4	117	28	21	0.66	8.6	1.9
66	2.5	341	0	1.0	230	3.4	1.6	2.2	114	27	20	0.64	8.0	1.8
67	2.3	325	0	0.87	222	3.1	1.4	2.0	111	27	20	0.61	7.3	1.6
68	2.3	314	0	0.83	215	3.1	1.4	1.8	108	26	19	0.60	6.9	1.5
69	2.1	300	0	0.74	206	2.8	1.3	1.6	105	24	18	0.57	6.3	1.4
70	2.1	287	0	0.70	199	2.8	1.3	1.5	102	23	17	0.54	5.8	1.3

WQ Station	OK310800010240P	OK310800020010-001AT	OK310800020040C	OK310800020190K	OK310810010010-001AT	OK310810020170G	OK310810020200G	OK310820010030G	OK310830010010-001AT	OK310830030010-001AT	OK310830030010P	OK310830060030H	OK310840010010-001AT	OK310840010060G
	Oil Creek	**Washita River, US 177**	**Sand Branch**	**Chigley Sandy Creek**	**Washita River, SH 19**	**Roaring Creek**	**Laflin Creek**	**Bitter Creek**	**Washita River, US 281**	**Washita River, SH 152**	**Washita River # 145**	**Willow Creek**	**Washita River, SH 33**	**Quartermaster Creek**
WBID Segment	OK310800010240_00	OK310800020010_00	OK310800020040_00	OK310800020190_00	OK310810010010_10	OK310810020170_00	OK310810020200_00	OK310820010030_00	OK310830010010_00	OK310830030010_00	OK310830030010_10	OK310830060030_00	OK310840010010_00	OK310840010060_00
USGS Gage Reference	07327550	07331000	07316500	07328180	07328500	07237550	07327550	07328180	07326500	07325000	07325000	07325860	07324200	07301420
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Average Annual Rainfall (inch)	41.1	38.7	39.3	40.3	39.0	36.1	36.0	34.1	32.6	30.3	29.0	32.0	27.4	27.0
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)**
71	2.0	277	0	0.66	190	2.7	1.2	1.4	99	23	17	0.51	5.2	1.3
72	2.0	267	0	0.57	182	2.7	1.2	1.2	96	22	16	0.50	4.7	1.2
73	1.9	256	0	0.48	174	2.6	1.2	1.1	93	21	15	0.47	4.2	1.2
74	1.8	248	0	0.48	168	2.4	1.1	1.0	89	21	15	0.45	3.8	1.1
75	1.7	240	0	0.44	161	2.3	1.1	0.95	86	19	14	0.44	3.4	0.99
76	1.7	228	0	0.35	155	2.3	1.0	0.76	84	19	14	0.42	3.0	0.90
77	1.6	218	0	0.31	148	2.2	0.99	0.67	81	18	13	0.40	2.6	0.86
78	1.6	209	0	0.22	143	2.1	0.97	0.48	79	18	13	0.37	2.3	0.78
79	1.5	201	0	0.22	136	2.0	0.92	0.48	76	17	12	0.34	1.9	0.74
80	1.3	192	0	0.13	130	1.8	0.84	0.33	73	17	12	0.32	1.7	0.66
81	1.2	182	0	0.09	126	1.7	0.77	0.19	70	16	11	0.29	1.3	0.58
82	1.2	173	0	0.04	120	1.6	0.73	0.10	67	16	11	0.25	1.1	0.49
83	1.1	164	0	0	113	1.5	0.68	0	64	16	11	0.22	0.83	0.47
84	1.0	156	0	0	107	1.4	0.63	0	61	14	10	0.18	0.62	0.45
85	0.93	148	0	0	100	1.2	0.58	0	59	14	9.9	0.16	0.45	0.40
86	0.84	140	0	0	92	1.1	0.52	0	57	14	9.6	0.15	0.32	0.37
87	0.78	129	0	0	85	1.0	0.48	0	54	13	9.2	0.13	0.22	0.35
88	0.72	118	0	0	79	0.96	0.44	0	51	13	8.8	0.11	0.17	0.32
89	0.65	106	0	0	73	0.88	0.41	0	48	12	8.4	0.10	0.12	0.30
90	0.55	96	0	0	67	0.74	0.35	0	45	11	7.8	0.09	0.09	0.28
91	0.50	87	0	0	61	0.65	0.31	0	42	11	7.2	0.06	0.04	0.26
92	0.42	79	0	0	55	0.57	0.26	0	39	9.8	6.5	0.05	0	0.23
93	0.40	72	0	0	46	0.54	0.25	0	36	9.1	5.9	0.04	0	0.21
94	0.36	61	0	0	38	0.48	0.22	0	33	8.1	5.1	0.03	0	0.18
95	0.32	48	0	0	31	0.42	0.20	0	29	7.3	4.5	0.02	0	0.15
96	0.29	35	0	0	24	0.40	0.18	0	25	6.7	4.0	0.01	0	0.11
97	0.21	25	0	0	16	0.28	0.13	0	20	5.9	3.4	0.01	0	0.08
98	0.11	16	0	0	6.6	0.14	0.07	0	15	4.8	2.5	0	0	0.06
99	0	10	0	0	0.30	0	0	0	7	3.6	1.6	0	0	0.03
100	0	0.10	0	0	0	0	0	0	0	1.6	0	0	0	0

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.