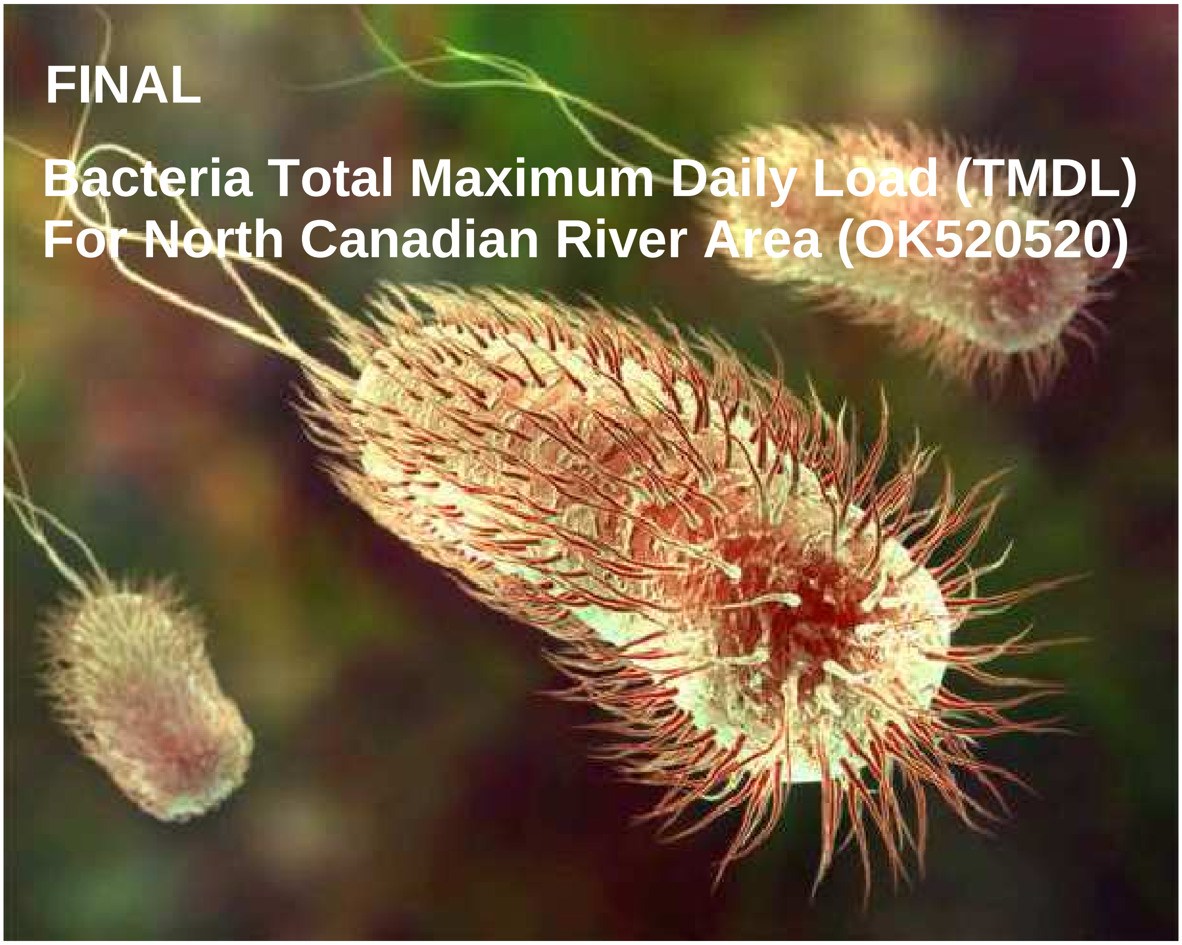

FINAL

Bacteria Total Maximum Daily Load (TMDL) For North Canadian River Area (OK520520)

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

WATER RESOURCES DIVISION

ASSOCIATION OF CENTRAL OKLAHOMA GOVERNMENTS

MARCH 2010

FINAL

Bacteria Total Maximum Daily Load (TMDL) For North Canadian River Area (OK520520)

OKWBID

OK520510000110_20, OK520520000010_00, OK520520000010_10
OK520520000010_20, OK520520000010_30, OK520520000010_40
OK520520000210_00, OK520520000250_00, OK520520000150_00
OK520520000240_00, OK520520000070_00

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

WATER RESOURCES DIVISION

ASSOCIATION OF CENTRAL OKLAHOMA GOVERNMENTS

MARCH 2010

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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
PS	Point source
SBCR	Secondary body contact recreation
SSO	Sanitary sewer overflow
TMDL	Total maximum daily load
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WLA	Wasteload allocation
WQM	Water quality monitoring
WQS	Water quality standard
WWTP	Wastewater treatment plant

Executive Summary

This report documents the data and assessment used to establish Total Maximum Daily Loads (TMDL) for the pathogen indicator bacteria fecal coliform, *Escherichia coli (E. coli),* or Enterococci for certain waterbodies in the North Canadian River Area. 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 lack of knowledge 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 2008 303(d) list because evidence of nonsupport of primary body contact recreation (PBCR) or secondary body contact recreation (SBCR) were 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 or secondary body contact recreation use designated for each waterbody.

Table ES-1 Excerpt from the 2008 Integrated Report – Comprehensive Waterbody Assessment Category List

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK520510000110_20	Canadian River, North	31.54	5	2010	N
OK520520000010_00	Canadian River, North	3.85	5	2010	N
OK520520000010_10	Canadian River, North	13.35	5	2010	N
OK520520000010_20	Canadian River, North	13.71	5	2010	N
OK520520000010_30	Canadian River, North	4.55	5	2010	N
OK520520000010_40	Canadian River, North	9.78	5	2010	N
OK520520000210_00	Canadian River, North	1.07	5	2019	N
OK520520000250_00	Canadian River, North	6.52	5	2019	N
OK520520000070_00	Crutcho Creek	3.85	5	2010	N
OK520520000150_00	Crooked Oak Creek	6.98	5	2010	N
OK520520000240_00	Mustang Creek	9.16	5	2019	N

N = Not Supporting; Source: 2008 Integrated Report, ODEQ 2008

For data collected between 1998 and 2008, evidence of nonsupport of the PBCR use based on fecal coliform concentrations was observed in nine stream segments: North Canadian River (OK520510000110_20, OK520520000010_00, OK520520000010_10, OK520520000010_20, OK520520000010_30, OK520520000010_40, OK520520000250_00), Crooked Oak Creek (OK520520000150_00), and Crutcho Creek (OK520520000070_00). Evidence of nonsupport of the PBCR use based on Enterococci concentrations was observed in seven stream segments: North Canadian River (OK520510000110_20, OK520520000010_00, OK520520000010_10, OK520520000010_20, OK520520000010_30, OK520520000010_40, OK520520000210_00). Evidence of nonsupport of the PBCR use based on E. coli concentrations were observed in three stream segments: North Canadian River (OK520520000010_30), Crooked Oak Creek (OK520520000150_00), and Mustang Creek (OK520520000150_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 as the Result of Re-assessment

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria		
			FC	E. coli	*ENT*
NC-08	OK520510000110_20	N. Canadian River	X		X
520510000110-001AT	OK520520000010_00	N. Canadian River	X		X
NC-07	OK520520000010_10	N. Canadian River	X		X
NC-06	OK520520000010_20	N. Canadian River	X		X
NC-05	OK520520000010_30	N. Canadian River	X	X	X
NC-04	OK520520000010_40	N. Canadian River	X		X
NC-03	OK520520000210_00	N. Canadian River			X
USGS07241000	OK520520000250_00	N. Canadian River	X		
OK520520-00-0070G OK520520-00-0070B	OK520520000070_00	Crutcho Creek	X		
OK520520-00-0150G WCNCE450	OK520520000150_00	Crooked Oak Creek	X	X	
WCNCW654 & OK520520-00-0240G	OK520520000240_00	Mustang Creek		X	
WCNCW617	OK520520000350_00	Airport Heights Creek			

ENT = enterococci; FC = fecal coliform

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

(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 2008). 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 2008).

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 stream segments 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 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 humans, warm-blooded animals; and sources may be point or nonpoint in nature.

There are no NPDES-permitted wastewater facilities in the contributing watersheds of North Canadian River (OK520520000010_00), Crutcho Creek (OK520520000070_00), North Canadian River (OK520520000010_40), North Canadian River (OK520520000210_00), and Mustang Creek (OK520520000240_00). Six of the watersheds in the Study Area, namely North Canadian River (OK520510000110_20, OK520520000010_10, OK520520000010_20, OK520520000010_30 and OK520520000250_00) and Crooked Oak Creek (OK520520000150_00) have NPDES-permitted wastewater facilities.

All sub-watersheds are located in urbanized areas designated as MS4s.

There are fifty-nine permitted NPDES facilities in the study area. Of these, 12 are classified with a SIC code of 4952 (Sewerage Systems). For the purposes of the pollutant source assessment only Sewerage Systems are assumed to contribute bacteria loads within the watersheds of the impaired waterbodies.

There are 18 no-discharge (total retention) facilities within the Study Area. It is assumed that no-discharge facilities do not contribute bacteria loading to streams in the study area. 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.

There were 1059 SSO occurrences, ranging from 0 gallon to 30 million gallons, reported for discharging or non-discharging sewage facilities within the watershed between January 2005 and July 2008. Given the significant number of occurrences and the size of overflows reported, SSOs could be a significant source of bacteria loading to streams in the study area.

The Municipal Separate Storm Sewer System (MS4) permit for small communities in Oklahoma became effective on February 8, 2005. Eleven entities have MS4 permits in the North Canadian River study area. Oklahoma City has a Phase I MS4 permit. Del City, Mustang, Yukon, Choctaw, Nicoma Park, Spencer, Midwest City, Moore, Oklahoma Department of Transportation (ODOT), and Tinker Air Force Base all have Phase II MS4 permit.

There are no CAFOs located in the Study Area. The Oklahoma National Stockyards Company is located in the study area. The animals processed through the stockyard can be found in ODAFF's Marketing Reports at http://www.oda.state.ok.us/mktdev-reports.htm. However, because of its proximity to the North Canadian River, it could be a significant source of bacteria.

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 and domestic pets 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 stream segments are the result of a variety of point and nonpoint source loading occurring during a range of flow conditions. Low flow exceedances are likely due to a combination of non-point sources, uncontrolled point sources and permit noncompliance.

E.3 Using Load Duration Curves to Develop TMDLs

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

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

The basic steps to generating an LDC involve:

- obtaining daily flow data for the site of interest from the U.S. Geological Survey ;
- sorting the flow data and calculating flow exceedance percentiles for the time period and season of interest;
- obtaining the water quality data from the primary contact recreation season (May 1 through September 30) for waterbodies not supporting the PBCR use;
- matching the water quality observations with the flow data from the same date;
- display a curve on a plot that represents the allowable load multiplied by 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 stream segments 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 lack of knowledge 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 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 stream segments. 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 WQS are considered to be met if, 1) either the geometric mean of all applicable recreation season data is less than the long-time geometric mean criteria, or 2) no samples exceed the instantaneous criteria.

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

WQM Station	Waterbody ID	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instant-aneous	Instant-aneous	Geo-mean	Instant-aneous	Geo-mean
NC-08	OK520510000110_20	N. Canadian River	**3.0%**			93.6%	**86.4%**
520510000110-001AT	OK520520000010_00	N. Canadian River	**53.0%**			96.6%	**91.6%**
NC-07	OK520520000010_10	N. Canadian River	**78.9%**			99.3%	**97.0%**
NC-06	OK520520000010_20	N. Canadian River	**48.6%**			99.97%	**98.9%**
NC-05	OK520520000010_30	N. Canadian River	**86.7%**	95.6%	**37.6%**	99.8%	**98.0%**
NC-04	OK520520000010_40	N. Canadian River	**48.6%**			99.9%	**98.1%**
NC-03	OK520520000210_00	N. Canadian River				99.7%	**92.9%**
USGS07241000	OK520520000250_00	N. Canadian River	**67.3%**				
OK520520-00-0070G OK520520-00-0070B	OK520520000070_00	Crutcho Creek	**28.1%**				
OK520520-00-0150G WCNCE450	OK520520000150_00	Crooked Oak Creek	**72.4%**	75.7%	**66.6%**		
WCNCW654 & OK520520-00-0240G	OK520520000240_00	Mustang Creek		88.8%	**42.6%**		

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 calculated for the median flow at each site are presented in Table ES-4. The WLA component of each TMDL is the sum of WLAs for all WWTPs within the contributing watershed of each stream segment. The sum of the WLAs for WWTPs can be represented as a single line below the LDC. The WLA for MS4s is estimated based on the percentage of study watershed which is under the MS4 coverage. The LDC and the simple equation of:

Average LA = average TMDL - MOS - WLA_WWTF - WLA_MS4

can provide an individual value for the LA in counts per day. For MS4s the load reduction will be the same as the PRG established for the LA (nonpoint sources). 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 lack of knowledge associated with calculating the allowable pollutant loading to ensure WQS 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 lack of knowledge, then the MOS is considered explicit.

An explicit Margin of Safety of 10% was selected in this TMDL report. This MOS was applied by setting the water quality target at 10 percent lower than the water quality criterion for each pathogen. For PBCR this 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.

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

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria Species	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4† (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
NC-08	OK520510000110_20	N. Canadian River	ENT	6.82E+11	2.06E+09	9.62E+10	5.15E+11	6.82E+10
520510000110-001AT	OK520520000010_00	N. Canadian River	FC	2.74E+12	0	0	2.47E+12	2.74E+11
NC-07	OK520520000010_10	N. Canadian River	ENT	7.40E+11	1.81E+09	4.46E+11	2.18E+11	7.40E+10
NC-06	OK520520000010_20	N. Canadian River	ENT	5.26E+11	1.01E+11	3.41E+11	3.13E+10	5.26E+10
NC-05	OK520520000010_30	N. Canadian River	ENT	1.51E+11	1.86E+10	1.17E+11	0	1.51E+10
NC-04	OK520520000010_40	N. Canadian River	ENT	1.51E+11	0	1.36E+11	0	1.51E+10
NC-03	OK520520000210_00	N. Canadian River	ENT	2.09E+11	0	1.88E+11	0	2.09E+10
USGS07241000	OK520520000250_00	N. Canadian River	FC	7.73E+11	4.73E+08	6.95E+11	0	7.73E+10
OK520520-00-0070G OK520520-00-0070B	OK520520000070_00	Crutcho Creek	FC	3.95E+10	0	3.55E+10	0	3.95E+09
OK520520-00-0150G WCNCE450	OK520520000150_00	Crooked Oak Creek	FC	4.00E+09	3.56E+09	4.13E+07	0	4.00E+08
WCNCW654 & OK520520-00-0240G	OK520520000240_00	Mustang Creek	EC	5.32E+09	0	4.79E+09	0	5.32E+08

† 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 North Canadian River area. 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 lack of knowledge 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 2008 Integrated Report [303(d) list] for nonsupport of primary or secondary body contact recreation:

- North Canadian River (OK520510000110_20)
- North Canadian River (OK520520000010_00)
- North Canadian River (OK520520000010_10)
- North Canadian River (OK520520000010_20)
- North Canadian River (OK520520000010_30)
- North Canadian River (OK520520000010_40)
- North Canadian River (OK520520000210_00)
- North Canadian River (OK520520000250_00)
- Crooked Oak Creek (OK520520000150_00)
- Mustang Creek (OK520520000240_00)
- Crutcho Creek (OK520520000070_00)
- Airport Heights Creek (OK520520000350_00)

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

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

Table 1-1 Water Quality Monitoring Stations used for 2008 303(d) Listing Decision

Waterbody Name	Waterbody ID	WQM Station	WQM Station Location Descriptions
Canadian River, North	OK520510000110_20	NC-08	
Canadian River, North	OK520520000010_00	520510000110-001AT	N Luther Rd bridge
Canadian River, North	OK520520000010_10	NC-07	
Canadian River, North	OK520520000010_20	NC-06	
Canadian River, North	OK520520000010_30	NC-05	
Canadian River, North	OK520520000010_40	NC-04	
Canadian River, North	OK520520000210_00	NC-03	
Canadian River, North	OK520520000250_00	USGS07241000	NW 10th St bridge
Crutcho Creek	OK520520000070_00	OK520520-00-0070G OK520520-00-0070B	
Crooked Oak Creek	OK520520000150_00	OK520520-00-0150G WCNCE450	
Airport Heights Creek	OK520520000350_00	WCNCW617	SW 15, E of Portland
Mustang Creek	OK520520000240_00	WCNCW654 & OK520520-00-0240G	S Morgan Rd, N of SW 29

1.2 Watershed Description

General. The North Canadian River study area is located in central Oklahoma. The waterbodies addressed in this report are located in Oklahoma, Canadian, Pottawatomie, Lincoln and Cleveland Counties.

Most of the study area is located in Oklahoma, Canadian and Pottawatomie counties. Table 1-2, derived from the 2000 U.S. Census, shows the population and population density of each county in the study area (U.S. Census Bureau 2000).

Table 1-2 County Population and Density

County Name	Population (2000 Census)	Population Density (per square mile)
Canadian	87,697	97
Cleveland	208,016	373
Lincoln	32,080	33
Oklahoma	660,448	919
Pottawatomie	65,521	83

Climate. Table 1-3 summarizes the average annual precipitation for each stream segment. Average annual precipitation values among the stream segments in this portion of Oklahoma range between 35.2 and 38.8 inches (Oklahoma Climate Survey 2007).

Table 1-3 Average Annual Precipitation by Watershed

North Canadian River Precipitation Summary		
Waterbody Name	Waterbody ID	Average Annual (Inches)
N. Canadian River	OK520510000110_20	38.8
N. Canadian River	OK520520000010_00	37.6
N. Canadian River	OK520520000010_10	36.8
N. Canadian River	OK520520000010_20	36.6
N. Canadian River	OK520520000010_30	36.7
N. Canadian River	OK520520000010_40	36.3
N. Canadian River	OK520520000210_00	35.3
N. Canadian River	OK520520000250_00	35.2
Crutcho Creek	OK520520000070_00	36.9
Crooked Oak Creek	OK520520000150_00	36.6
Airport Heights Creek	OK520520000350_00	36.1
Mustang Creek	OK520520000240_00	35.5

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 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.

Table 1-4a Land Use Summaries by Watershed

Landuse Category	Stream segment					
	N Canadian River	N Canadian River	N Canadian River	N Canadian River	N Canadian River	N Canadian River
Waterbody ID	520510000110_20	520520000010_00	520520000010_10	520520000010_20	520520000010_30	520520000010_40
Open Water	10.09%	1.61%	1.97%	2.75%	14.27%	28.57%
Low Intensity Residential	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Medium Intensity Residential	2.35%	1.63%	6.30%	4.79%	20.42%	27.56%
High Intensity Residential	0.12%	0.02%	0.24%	0.32%	5.01%	19.51%
Commercial/Industrial/Transportation	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Bare Rock/Sand/Clay	0.01%	0.00%	0.06%	0.14%	0.01%	0.00%
Quarries/Strip Mines/Gravel Pits	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Deciduous Forest	22.85%	18.40%	23.93%	16.91%	11.94%	0.62%
Evergreen Forest	0.03%	0.00%	0.16%	0.05%	0.04%	0.00%
Mixed Forest	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Grasslands/Herbaceous	38.82%	43.11%	36.09%	36.96%	24.67%	3.91%
Pasture/Hay	8.57%	9.05%	5.17%	5.88%	2.15%	0.27%
Row Crops	8.96%	19.09%	8.58%	18.05%	3.72%	1.42%
Urban/Recreational Grasses	8.18%	7.05%	17.50%	14.14%	17.77%	18.13%
Woody Wetlands	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Emergent Herbaceous Wetlands	0.00%	0.04%	0.01%	0.02%	0.00%	0.00%
Open Water	11564	102	764	569.5	2587	8913
Low Intensity Residential	0	0	0	0.0	0	0
Medium Intensity Residential	2699	103	2442	991.5	3703	8596
High Intensity Residential	139	1	93	65.2	909	6086
Commercial/Industrial/Transportation	0	0	0	0.0	0	0
Bare Rock/Sand/Clay	11	0	23	29.8	2	0
Quarries/Strip Mines/Gravel Pits	0	0	0	0.0	0	0
Deciduous Forest	26188	1157	9280	3497.2	2164	195
Evergreen Forest	39	0	63	9.5	8	0
Mixed Forest	0	0	0	0.0	0	0
Grasslands/Herbaceous	44497	2711	13994	7644.1	4473	1220

Landuse Category	Stream segment					
	N Canadian River	N Canadian River	N Canadian River	N Canadian River	N Canadian River	N Canadian River
Waterbody ID	**520510000110_20**	**520520000010_00**	**520520000010_10**	**520520000010_20**	**520520000010_30**	**520520000010_40**
Pasture/Hay	9825	569	2005	1216.4	389	85
Row Crops	10272	1201	3327	3732.9	674	442
Urban/Recreational Grasses	9379	443	6788	2924.0	3223	5657
Woody Wetlands	0	0	0	0.0	0	0
Emergent Herbaceous Wetlands	5	3	3	3.7	0	0
Total (Acres)	114617	6289	38781	20684	18132	31195

Table 1-4b Land Use Summaries by Watershed

Landuse Category	Stream segment					
	N Canadian River	N Canadian River	Crutcho Creek	Crooked Oak Creek	Mustang Creek	Airport Heights Creek
Waterbody ID	520520000210_00	520520000250_00	520520000070_00	520520000150_00	520520000240_00	520520000350_00
Open Water	24.24%	22.61%	21.36%	18.81%	6.35%	23.67%
Low Intensity Residential	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Medium Intensity Residential	12.45%	12.64%	20.82%	14.68%	10.56%	24.76%
High Intensity Residential	17.99%	3.06%	14.87%	14.25%	0.93%	21.41%
Commercial/Industrial/Transportation	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Bare Rock/Sand/Clay	0.50%	0.06%	0.05%	0.00%	0.00%	0.00%
Quarries/Strip Mines/Gravel Pits	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Deciduous Forest	4.56%	4.34%	3.80%	5.74%	5.70%	1.15%
Evergreen Forest	0.00%	0.08%	0.01%	0.00%	0.38%	0.00%
Mixed Forest	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Grasslands/Herbaceous	10.71%	20.24%	22.06%	16.46%	35.28%	6.53%
Pasture/Hay	0.00%	0.55%	1.62%	2.46%	1.69%	0.50%
Row Crops	8.49%	23.77%	1.18%	2.43%	30.22%	2.04%
Urban/Recreational Grasses	21.05%	12.64%	14.24%	25.17%	8.90%	19.93%
Woody Wetlands	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Emergent Herbaceous Wetlands	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
Open Water	248	1638.5	3058	1165	1282	417
Low Intensity Residential	0	0.0	0	0	0	0
Medium Intensity Residential	127	915.9	2982	909	2132	436
High Intensity Residential	184	221.7	2129	882	187	377
Commercial/Industrial/Transportation	0	0.0	0	0	0	0
Bare Rock/Sand/Clay	5	4.7	8	0	0	0
Quarries/Strip Mines/Gravel Pits	0	0.0	0	0	0	0
Deciduous Forest	47	314.3	544	355	1151	20
Evergreen Forest	0	5.8	1	0	76	0
Mixed Forest	0	0.0	0	0	0	0
Grasslands/Herbaceous	110	1466.5	3158	1019	7123	115

Landuse Category	Stream segment					
	N Canadian River	N Canadian River	Crutcho Creek	Crooked Oak Creek	Mustang Creek	Airport Heights Creek
Waterbody ID	520520000210_00	520520000250_00	520520000070_00	520520000150_00	520520000240_00	520520000350_00
Pasture/Hay	0	40.1	231	152	340	9
Row Crops	87	1722.3	168	151	6100	36
Urban/Recreational Grasses	216	915.8	2039	1559	1796	351
Woody Wetlands	0	0.0	0	0	0	0
Emergent Herbaceous Wetlands	0	0.0	0	0	0	0
Total (Acres)	1024	7246	14319	6194	20186	1760

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

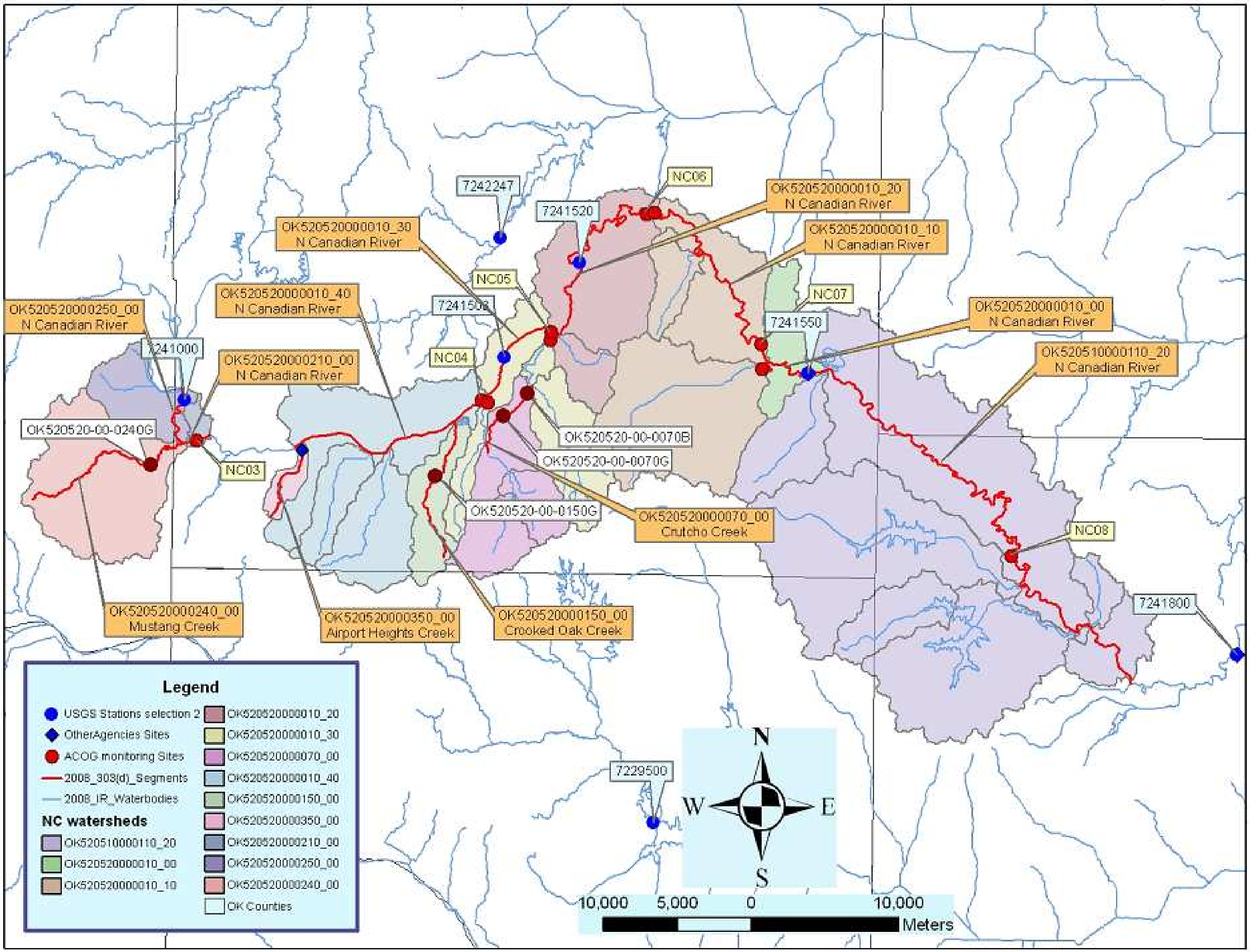
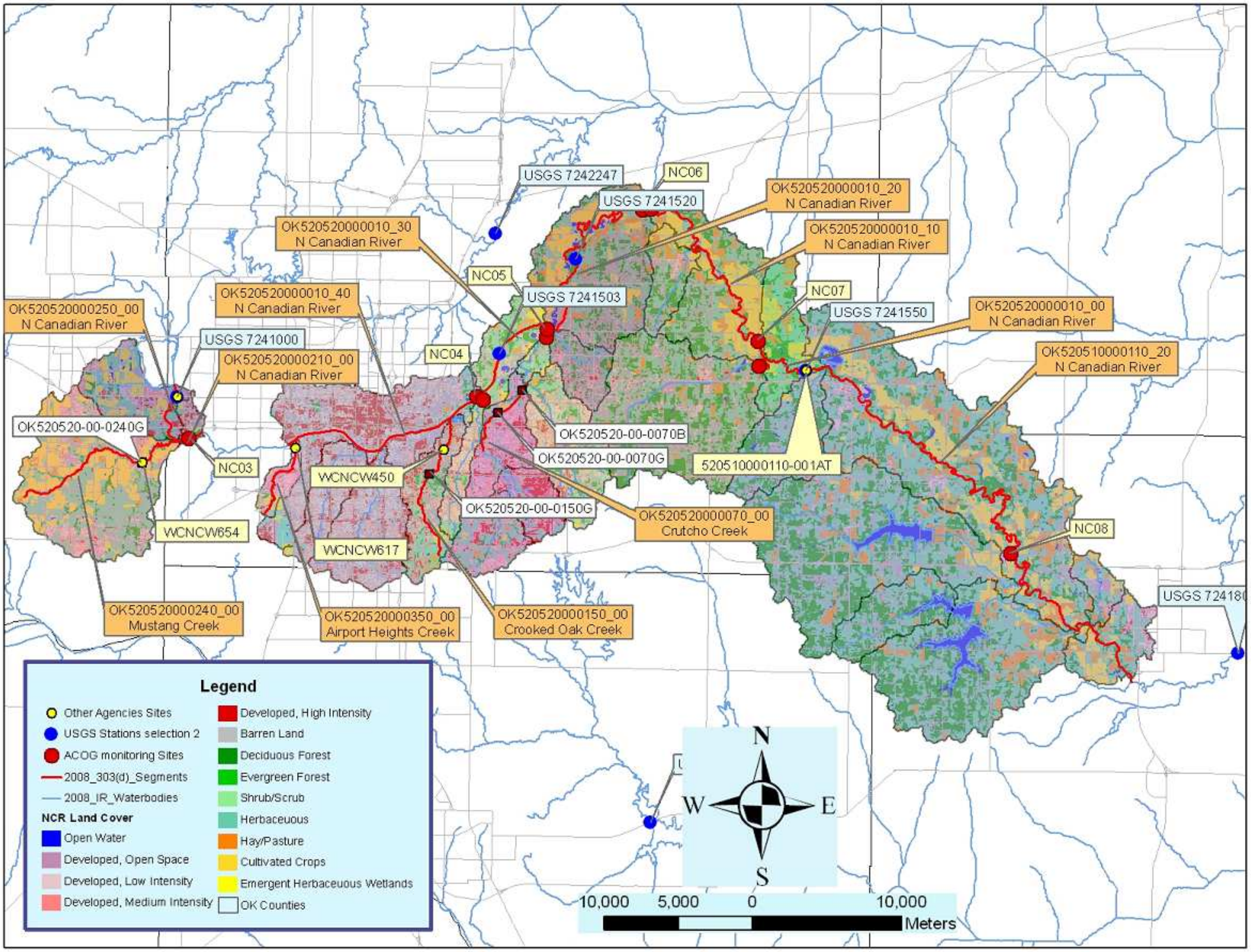


Figure 1-2 Land Use Map by Watershed



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 2008). 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 2008). The beneficial uses designated for North Canadian River (OK520510000110_20, OK520520000010_00, OK520520000010_10, OK520520000010_20, OK520520000010_30, OK520520000010_40, OK520520000210_00, & OK520520000250_00), Crutcho Creek, Crooked Oak Creek, and Mustang Creek include PBCR, public/private water supply, warm water aquatic community, agricultural water supply, fish consumption, and aesthetics. The TMDLs in this report address the PBCR use for all of the waterbodies. Table 2-1, an excerpt from Appendix B of the 2008 Integrated Report (ODEQ 2008), 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.

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

(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.

Table 2-1 Excerpt from the 2008 Integrated Report – Comprehensive Waterbody Assessment Category List

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK520510000110_20	Canadian River, North	31.54	5	2010	N
OK520520000010_00	Canadian River, North	3.85	5	2010	N
OK520520000010_10	Canadian River, North	13.35	5	2010	N
OK520520000010_20	Canadian River, North	13.71	5	2010	N
OK520520000010_30	Canadian River, North	4.55	5	2010	N
OK520520000010_40	Canadian River, North	9.78	5	2010	N
OK520520000210_00	Canadian River, North	1.07	5	2019	N
OK520520000250_00	Canadian River, North	6.52	5	2019	N
OK520520000070_00	Crutcho Creek	3.85	5	2010	N
OK520520000150_00	Crooked Oak Creek	6.98	5	2010	N
OK520520000240_00	Mustang Creek	9.16	5	2019	N

N = Not Supporting; Source: 2008 Integrated Report, ODEQ 2008

To implement Oklahoma's WQS for PBCR, OWRB promulgated Chapter 46, *Implementation of Oklahoma's Water Quality Standards* (OWRB 2008). 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 2008).

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 stream segments 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 2008 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 between 1998 and 2008 for each indicator bacteria. All the data collected during the primary recreation season was used to support the decision to place specific waterbodies within the Study Area on the ODEQ 2008 303(d) list (ODEQ 2008). 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.

Tables 2-3 summarizes the bacteria impairment status for each waterbody based on further data analysis. A TMDL will be developed for each bacteria indicator. Airport Heights Creek (OK520510000350_00) is not impaired for bacteria. Therefore, a TMDL will not be developed for the creek. Instead, the TMDL for North Canadian River (OK520520000010_40) watershed will include the Airport Heights Creek sub-watershed.

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 stream segments 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 criteria for determining attainment of PBCR use as defined in the Oklahoma WQS. 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 2008). 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 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, for PBCR, 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.

For data collected between 1998 and 2008, evidence of nonsupport of the PBCR use based on fecal coliform concentrations was observed in nine stream segments: North Canadian River (OK520510000110_20, OK520520000010_00, OK520520000010_10, OK520520000010_20, OK520520000010_30, OK520520000010_40, OK520520000250_00), Crooked Oak Creek (OK520520000150_00), and Crutcho Creek (OK520520000070_00). Evidence of nonsupport of the PBCR use based on Enterococci concentrations was observed in Seven stream segments: North Canadian River (OK520510000110_20, OK520520000010_00, OK520520000010_10, OK520520000010_20, OK520520000010_30, OK520520000010_40, OK520520000210_00). Evidence of nonsupport of the PBCR use based on E. coli concentrations were observed in three stream segments: North Canadian River (OK520520000010_30), Crooked Oak Creek

(OK520520000150_00), and Mustang Creek (OK520520000150_00). Table 2-3 summarizes the waterbodies requiring TMDLs for not supporting PBCR.

Table 2-2 Summary of Indicator Bacteria Samples from Primary Body Contact Recreation Season, 1998-2008

Waterbody ID	Waterbody Name	Indicator Bacteria	Single Sample Criterion (#/100ml)	Geometric Mean Concentration (count/100ml)	Number of Samples	Number of Samples Exceeding Criterion	% of Samples Exceeding Criterion	Reason for Listing Change
OK520510000110_20	N. Canadian River	FC	400	165.52	20	6	30.0%	
		EC	406	46.81	20	0	0.0%	delist: Geomean < 126
		ENT	108	219.07	20	15	75.0%	
OK520520000010_00	N. Canadian River	FC	400	351.37	28	11	39.3%	
		EC	406	93.37	27	3	11.1%	delist: Geomean < 126
		ENT	108	355.67	27	18	66.7%	
OK520520000010_10	N. Canadian River	FC	400	834.66	20	14	70.0%	
		EC	406	118.24	20	2	10.0%	delist: Geomean < 126
		ENT	108	991.08	20	18	90.0%	
OK520520000010_20	N. Canadian River	FC	400	227.72	20	11	55.0%	
		EC	406	61.14	20	2	10.0%	delist: Geomean < 126
		ENT	108	2753.74	20	16	80.0%	
OK520520000010_30	N. Canadian River	FC	400	976.76	18	14	77.8%	
		EC	406	154.32	18	4	22.2%	
		ENT	108	1493.88	18	18	100.0%	
OK520520000010_40	N. Canadian River (Oklahoma River)	FC	400	464.33	18	8	44.4%	
		EC	406	92.10	18	1	5.6%	delist: Geomean < 126
		ENT	108	1589.74	18	16	88.9%	
OK520520000210_00	N. Canadian River	FC	400	281.62	20	5	25.0%	delist: 25% or less
		EC	406	75.55	20	2	10.0%	delist: Geomean < 126
		ENT	108	420.23	20	15	75.0%	
OK520520000250_00	N. Canadian River	FC	400	536.87	26	10	38.5%	
		EC	406					
		ENT	108					
OK520520000070_00	Crutcho Creek	FC	400	335.03	11	3	27.3%	added
		EC	406	114.96	7	1	14.3%	delist: not enough samples
		ENT	108	90.65	5	1	20.0%	delist: not enough samples

Waterbody ID	Waterbody Name	Indicator Bacteria	Single Sample Criterion (#/100ml)	Geometric Mean Concentration (count/100ml)	Number of Samples	Number of Samples Exceeding Criterion	% of Samples Exceeding Criterion	Reason for Listing Change
OK520520000150_00	Crooked Oak Creek	FC	400	503.47	18	6	33.3%	
		EC	406	339.78	15	6	40.0%	
		ENT	108	545.26	6	5	83.3%	delist: not enough samples
OK520520000240_00	Mustang Creek	FC	400	169.68	13	3	23.1%	
		EC	406	197.40	12	3	25.0%	
		ENT	108					
OK520520000350_00	Airport Heights Creek	FC	400	339.80	7	2	28.6%	delist: not enough samples
		EC	406	339.51	7	2	28.6%	not enough samples
		ENT	108					

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	E. coli	*ENT*
NC-08	OK520510000110_20	N. Canadian River	X		X
520510000110-001AT	OK520520000010_00	N. Canadian River	X		X
NC-07	OK520520000010_10	N. Canadian River	X		X
NC-06	OK520520000010_20	N. Canadian River	X		X
NC-05	OK520520000010_30	N. Canadian River	X	X	X
NC-04	OK520520000010_40	N. Canadian River	X		X
NC-03	OK520520000210_00	N. Canadian River			X
USGS07241000	OK520520000250_00	N. Canadian River	X		
OK520520-00-0070G OK520520-00-0070B	OK520520000070_00	Crutcho Creek	X		
OK520520-00-0150G WCNCE450	OK520520000150_00	Crooked Oak Creek	X	X	
WCNCW654 & OK520520-00-0240G	OK520520000240_00	Mustang Creek		X	
WCNCW617	OK520520000350_00	Airport Heights Creek			

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 humans and warm-blooded animals; and sources may be point or nonpoint in nature.

Point sources are permitted through the NPDES program. NPDES-permitted facilities that discharge treated wastewater are required to monitor for one of the three bacteria indicators (fecal coliform, *E coli*, or Enterococci) in accordance with its permit. Nonpoint sources are diffuse sources that typically cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources may involve land activities that contribute bacteria to surface water as a result of rainfall runoff. For the TMDLs in this report, all sources of pollutant loading not regulated by NPDES are considered nonpoint sources. The following discussion describes what is known regarding point and nonpoint sources of bacteria in the impaired watersheds.

3.1 NPDES-Permitted Facilities

Under 40CFR, §122.2, a point source is described as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Certain 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);
- 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 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 bacteria concentrations. There are eleven urbanized areas designated as MS4s within this 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 wastewater facilities in the contributing watersheds of North Canadian River (OK520520000010_00), Crutcho Creek (OK520520000070_00), North Canadian River (OK520520000010_40), North Canadian River (OK520520000210_00), and Mustang Creek (OK520520000240_00). Six of the watersheds in the Study Area, namely North Canadian River (OK520510000110_20, OK520520000010_10, OK520520000010_20, OK520520000010_30 and OK520520000250_00) and Crooked Oak Creek (OK520520000150_00) have NPDES-permitted wastewater facilities.

All sub-watersheds are located in urbanized areas designated as MS4s.

3.1.1 Continuous Point Source Discharges

There are fifty-nine permitted NPDES facilities in the study area. Of these, 12 are classified with a SIC code of 4952 (Sewerage Systems). The locations of these sewerage systems are listed in Table 3-1 and displayed in Figure 3-1. For the purposes of the pollutant source assessment only Sewerage Systems are assumed to contribute bacteria loads within the watersheds of the impaired waterbodies.

Table 3-1 Permitted Sewer Discharges in the Study Area

NPDES Permit No.	Name	Receiving Water	Facility ID	Bacteria Limits	County Name	Design Flow (mgd)	Active/ Inactive
OK0022535	SPENCER, CITY OF	N Canadian River	S20542	Y	Okla	0.48	Active
OK0026085	DEL CITY MUNICIPAL SVCS AUTH	Cherry Creek	S20536	Y	Okla	2.86	Active
OK0026841	MIDWEST CITY, CITY OF (NORTHSI	Crutcho Creek	S20541	Y	Okla	12	Active
OK0029009	MCLOUD PUB WORKS AUTH	N Canadian River	S20547	Y	Pottawa	0.7	Inactive
OK0030520	OK CITY, CITY OF - DUNJEE PARK	Untrib, Choctaw Creek	S20544	Y	Okla	0.195	Active
OK0030996	JONES PUB WORKS AUTH, TOWN OF	N Canadian River	S20543	Y	Okla	0.252	Active
OK0032239	VALLEY BROOK,TOWN OF	Crooked Oak Creek	S20535	Y	Okla	0.47	Active
OK0036978	OK CITY, CITY OF-NORTH CANADIA	N Canadian River	S20580	Y	Okla	80	Active
OK0037834	CHOCTAW UTILITIES AUTHORITY	Choctaw Creek	S20592	Y	Okla	1	Active
OK0038482	HARRAH PUBLIC WORKS AUTHORITY	N Canadian River	S20546	Y	Okla	0.95	Active
OK0039136	HOLLIDAY OUTT MHP	N Canadian River	S20585	N	Okla	0.0125	Active
OKG580019	LAKEVIEW TERRACE MHP	Untrib, N Canadian R	S20586	N	Okla	0.05	Active

N/A = not available

3.1.2 No-Discharge Facilities and SSOs

There are 18 no-discharge (total retention) facilities within the Study Area. The locations of these facilities are listed in Table 3-2 and displayed in Figure 3-2. For the purposes of these TMDLs, it is assumed that no-discharge facilities do not contribute bacteria loading to the

North Canadian River and its tributaries. However, it is possible the wastewater collection systems associated with those WWTPs could be a source of bacteria loading, or that discharges may occur during large rainfall events that exceed the systems' storage capacities.

Sanitary sewer overflows (SSO) from wastewater collection systems, although infrequent, can be a major source of bacteria loading to streams. SSOs have existed since the introduction of separate sanitary sewers, and most are caused by blockage of sewer pipes by grease, tree roots, and other debris that clog sewer lines, by sewer line breaks and leaks, cross connections with storm sewers, and inflow and infiltration of groundwater into sanitary sewers. SSOs are permit violations that must be addressed by the responsible NPDES permittee. The reporting of SSOs has been strongly encouraged by USEPA, primarily through enforcement and fines. While not all sewer overflows are reported, ODEQ has some data on SSOs available. There were 1059 SSO occurrences, ranging from 0 gallon to 30 million gallons, reported for discharging or non-discharging facilities within the watershed between January 2005 and July 2008 which are summarized in Table 3-3. Additional data on each individual SSO event are provided in Appendix B. Given the significant number of occurrences and the size of overflows reported, SSOs could be a significant source of bacteria loading to streams in the study area.

Figure 3-1 Locations of NPDES Sewer Discharges in the Study Area

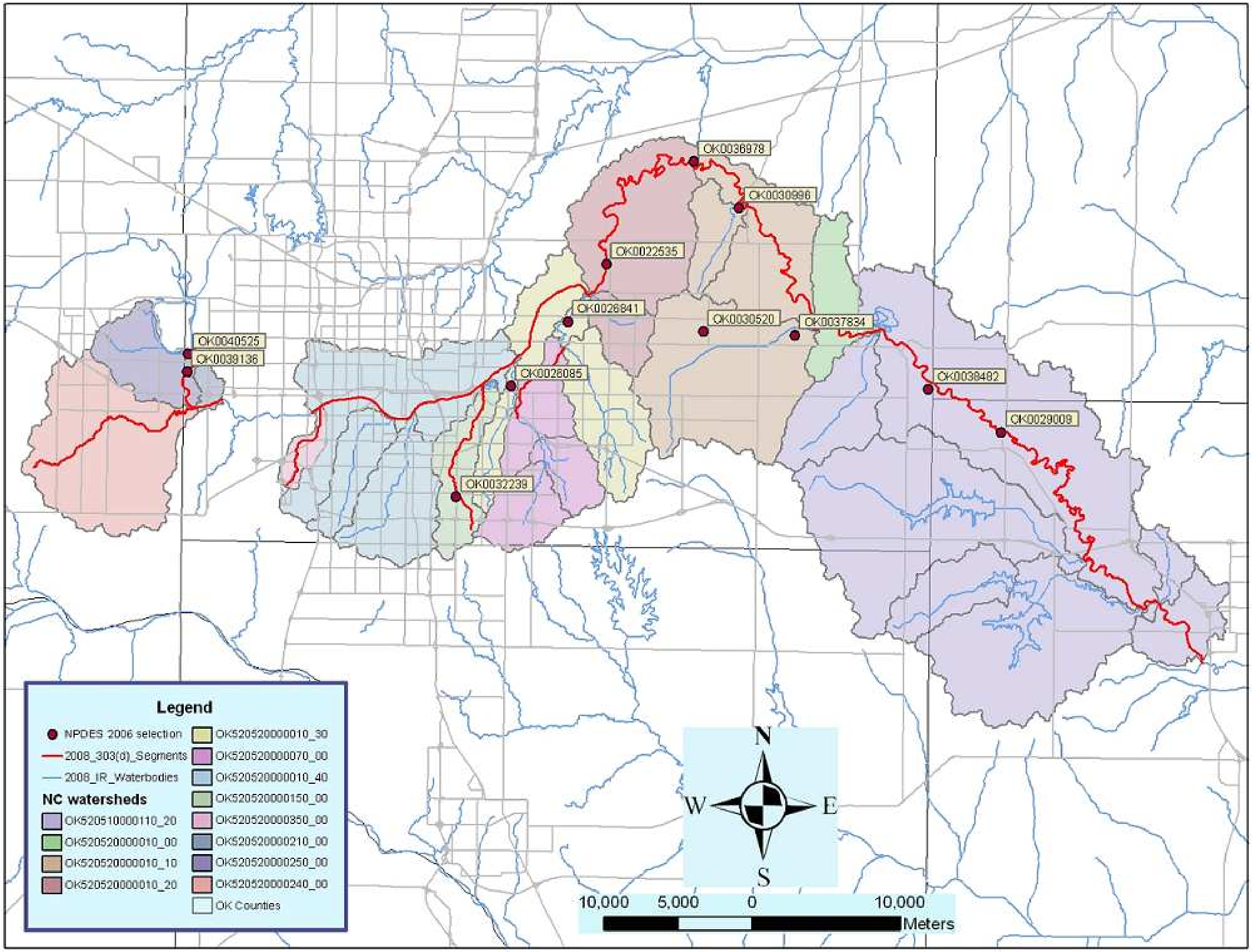


Figure 3-2 Locations of Total Retention Facilities in the Study Area

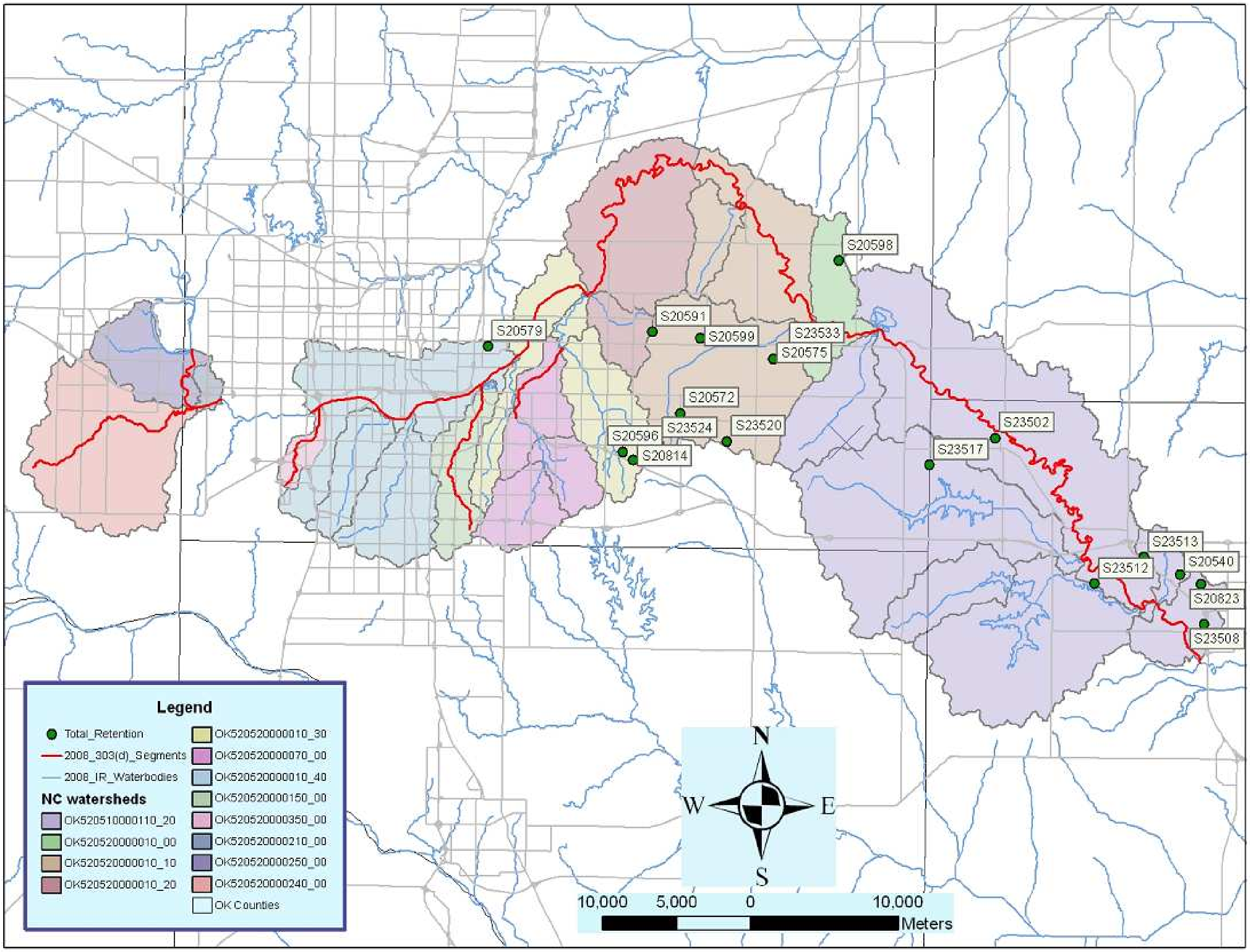


Table 3-2 No-Discharge Facilities in the Study Area

Facility	Facility ID	County	Stream Names	Watershed (waterbody ID)
PEACHTREE APARTMENTS	S23533	OKLAHOMA	N Canadian River	OK520520000010_10
PONDEROSA MHP	S23524	OKLAHOMA	N Canadian River	OK520520000010_10
TIMBERLAND MHP	S23520	OKLAHOMA	N Canadian River	OK520520000010_10
COUNTRY HAVEN MHP	S23517	OKLAHOMA	N Canadian River	OK520510000110_20
ABSENTEE SHAWNEE (LAGOON)	S23513	POTTAWATOMIE	N Canadian River	OK520510000110_20
STEELMAN ESTATES	S23512	POTTAWATOMIE	N Canadian River	OK520510000110_20
TERREL HEIGHTS MHP WWT	S23508	POTTAWATOMIE	N Canadian River	OK520510000110_20
SHADY VALLEY MHP	S23502	POTTAWATOMIE	N Canadian River	OK520510000110_20
POTTAWATOMIE CO SEWER DIST #1 WWT	S20823	POTTAWATOMIE	N Canadian River	OK520510000110_20
IMPERIAL OAKS MHP	S20814	OKLAHOMA	N Canadian River	OK520510000110_30
TOLAND ACRES MHP	S20599	OKLAHOMA	N Canadian River	OK520520000010_10
SUMMIT RIDGE	S20598	OKLAHOMA	N Canadian River	OK520520000010_00
HILLSIDE #1 MHP WWT	S20596	OKLAHOMA	N Canadian River	OK520510000110_30
GARDEN ACRES MHP	S20591	OKLAHOMA	N Canadian River	OK520520000010_20
APPLEWOOD MHP WWT	S20579	OKLAHOMA	N Canadian River	OK520520000010_40
CHOCTAW-WATERFRONT ACRES WWT	S20575	OKLAHOMA	N Canadian River	OK520520000010_10
POINTONS REDWOOD MANOR	S20572	OKLAHOMA	N Canadian River	OK520520000010_10
A-ROLLING ACRES MHP	S20540	POTTAWATOMIE	N Canadian River	OK520510000110_20

Table 3-3 Sanitary Sewer Overflows Summary

Facility Name	Facility ID	Number of Occurrences	Date Range		Amount (Gallons)	
			From	To	Min	Max
YUKON	S23533	1	11/18/05	11/18/05	50	50
SPENCER	S20542	166	01/03/05	06/03/08	0	500000
OKC - N. CAN	S20580	591	01/03/05	07/15/08	0	30000000
OKC – DUNJEE	S20544	1	08/26/05	08/26/05	50	50
MIDWEST CITY	S20541	212	01/03/05	07/11/08	0	200000
MCLOUD	S20547	5	07/07/05	12/24/05	0	862000
HARRAH	S20546	29	01/10/05	05/05/08	0	20000
DEL CITY	S20536	52	01/06/05	06/30/08	0	4000000
CHOCTAW	S20592	2	06/25/07	12/11/07	0	0

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

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

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

DEQ has taken aggressive enforcement action to curtail SSOs within the study area in recent years. Consent Orders have been signed with the City of Spencer (August, 2007) and the City of Midwest City (May, 2004) to address SSOs. In addition, DEQ and the City of Oklahoma City have entered into a comprehensive Consent Order (September, 2008) to address SSOs city-wide.

3.1.3 NPDES Municipal Separate Storm Sewer Discharge (MS4)

Phase I MS4

In 1990 the USEPA developed rules establishing Phase I of the NPDES Stormwater Program, designed to prevent harmful pollutants from being washed by stormwater runoff into MS4s (or from being dumped directly into the MS4) and then discharged into local water bodies (USEPA 2005). Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or greater) to implement a stormwater management program as a means to control polluted discharges. Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipal-owned operations, and hazardous waste treatment. Oklahoma City has a Phase I MS4 permit in the Study Area.

Phase II MS4s

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

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

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

The small MS4 General Permit for communities in Oklahoma became effective on February 8, 2005. Table 3-4 lists the entities with a Phase II MS4 permit in the study area:

Table 3-4 MS4 Entities in the Study Area

ENTITIES	PHASE 1 / PHASE 2 MS4	DATE ISSUED
Oklahoma City [1]	Phase 1 MS4	01/19/2007
Choctaw	Phase 2 MS4	01/18/2006
Del City	Phase 2 MS4	12/29/2005
Midwest City	Phase 2 MS4	11/07/2005
Moore	Phase 2 MS4	12/1/2005
Mustang	Phase 2 MS4	02/15/2006
Nicoma Park	Phase 2 MS4	01/05/2006
ODOT	Phase 2 MS4	Pending
Spencer	Phase 2 MS4	10/13/2005
Tinker Air Force Base	Phase 2 MS4	11/08/2005
Yukon	Phase 2 MS4	11/14/2005

[1] Co-permittee with ODOT and OTA

Figure 3-3 shows the municipal boundaries for each entity in the study area. Table 3-4 shows the percentage of MS4 area for each sub-watershed.

Table 3-5 Percentage of MS4 Area for Each Sub-watershed

Waterbody ID	Stream Name	MS4 area/watershed size (%)
OK520510000110_20	N. Canadian River	15.7%
OK520520000010_00	N. Canadian River	0.0%
OK520520000010_10	N. Canadian River	67.2%
OK520520000010_20	N. Canadian River	91.6%
OK520520000010_30	N. Canadian River	100%
OK520520000010_40	N. Canadian River	100%
OK520520000210_00	N. Canadian River	100%
OK520520000250_00	N. Canadian River	100%
OK520520000070_00	Crutcho Creek	100%
OK520520000150_00	Crooked Oak Creek	100%
OK520520000240_00	Mustang Creek	100%

ODEQ provides information on the current status of the MS4 program on its website, which can be found at:

Oklahoma Department of Environmental Quality

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

Figure 3-3 MS4 Boundaries in the Study Area

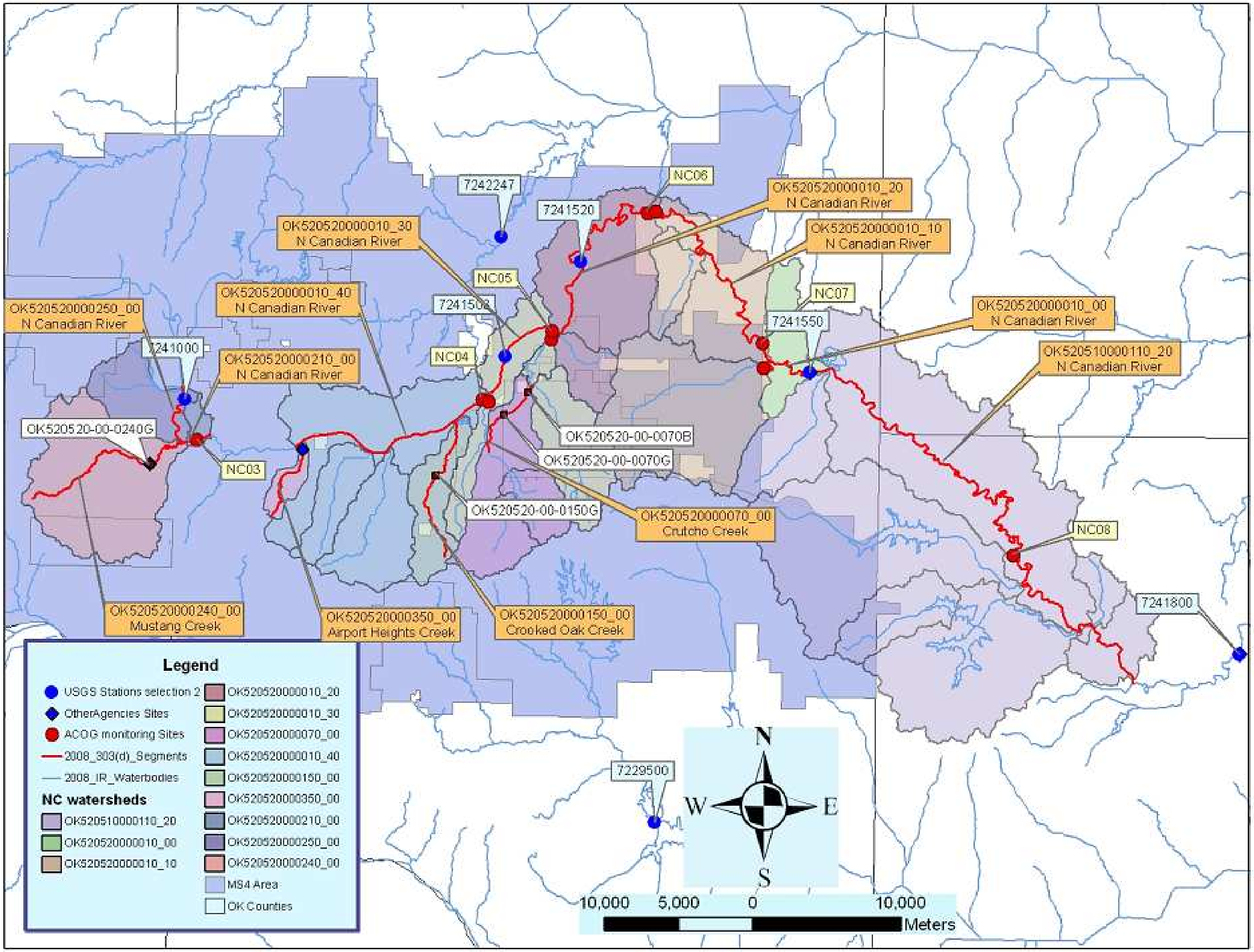


Figure 3-4 Land Application Sites in the Study Area

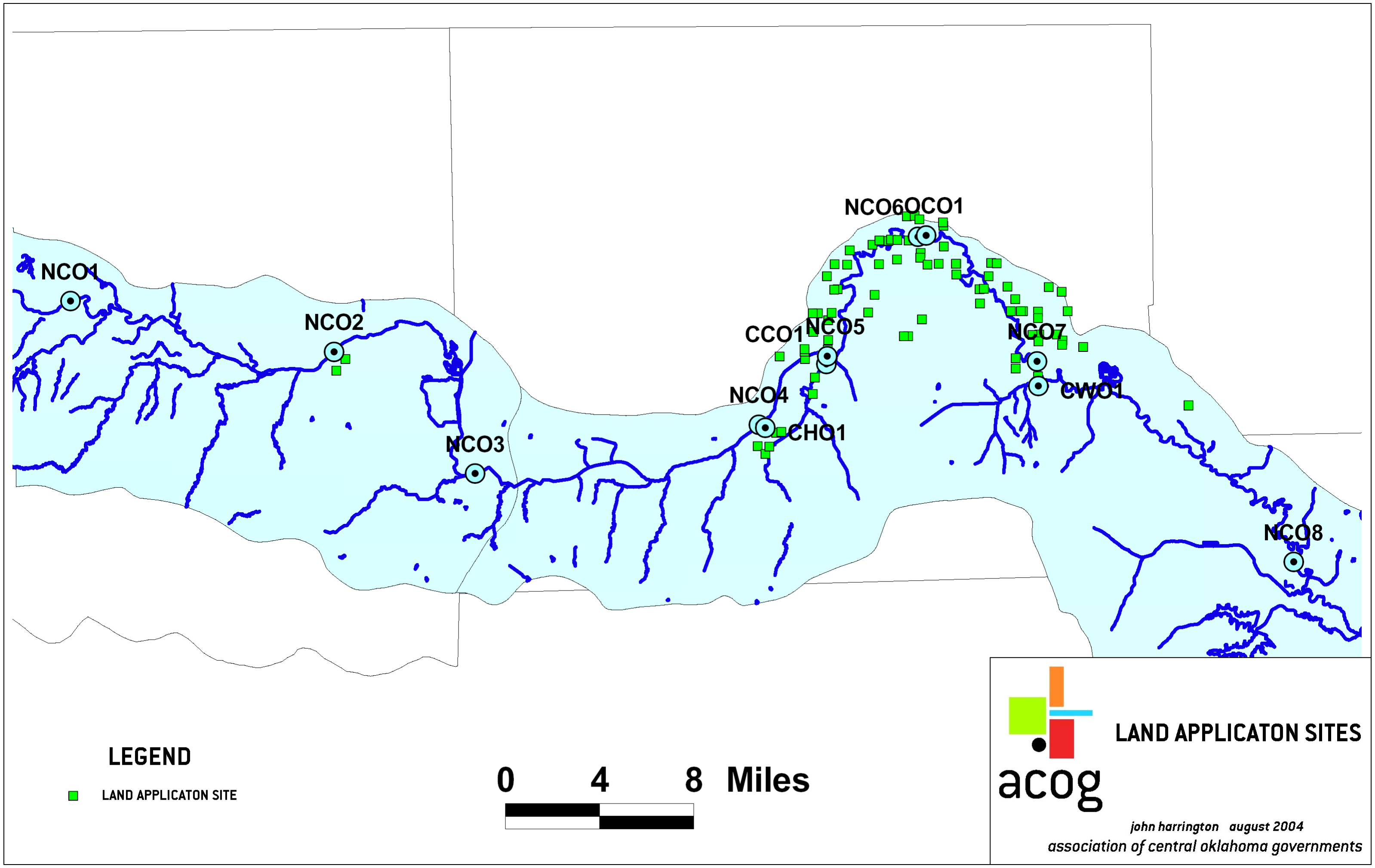


Figure 3-5 Other Potential Bacteria Sources in the Study Area

3.1.4 Concentrated Animal Feeding Operations

There are no CAFOs located in the study area.

3.1.5 Land Application Sites

Land application of municipal sludge is common in Oklahoma County. In central Oklahoma, a principal cause of soil erosion is heavy rains that fall on sloping soils with thin vegetative cover. Municipal sewage sludge can be an important restorative for abused land and it can be substantially more effective than treatment of eroded areas that involves only grading and one-time fertilizing at planting. Sludge can improve soil condition, restore fertility, and maintain gentle contour while simultaneously solving the problem of disposal (Kessler, et al. 1985).

One of the potential hazards associated with the application of sewage sludge to land is the possibility of human exposure to pathogens. Because of this hazard, sewage sludge must undergo additional treatment to reduce pathogens before it can be used for land application (Krogmann, et. al., 2003). The treatment, management and disposal of sewage sludge is regulated by DEQ to minimize environmental effects.

As shown in Figure 3-4, land application in the study area is concentrated in an area around the Oklahoma City Northside Plant near Jones, Oklahoma.

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 bacteria loading within the Study Area.

These sources include wildlife, various agricultural activities and domesticated animals, urban runoff, failing onsite wastewater disposal (OSWD) systems, and domestic pets.

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 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 bacteria. Water quality data collected from streams draining many of the nonpermitted communities show existing loads of fecal coliform bacteria at levels greater than the State’s instantaneous standards. The specific requirements for bacteria control in a MS4 permit can be found in Appendix E. Appendix E also includes information on a list of BMPs and their effectiveness. Best management practices (BMP) such as buffer strips, repair of leaking sewage collection systems, elimination of illicit discharges, and proper disposal of domestic animal waste can reduce bacteria loading to waterbodies.

3.2.1 Wildlife

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

However, adequate data are available by county to estimate the number of deer by watershed. This report assumes that deer habitat includes forests, croplands, and pastures. Using Oklahoma Department of Wildlife and Conservation county data, the population of deer can be roughly estimated from the actual number of deer harvested and harvest rate estimates. Because harvest success varies from year to year based on weather and other factors, the average harvest from 1999 to 2003 was combined with an estimated annual harvest rate of 20 percent to predict deer population by county. Using the estimated deer population by county and the percentage of the watershed area within each county, a wild deer population can be calculated for each watershed. Table 3-6 provides the estimated number of deer for each watershed. Due to the urban nature of the study area, the actual number of resident deer is probably less than these estimates.

According to information from the Oklahoma Department of Agriculture, Food and Forestry, there is a large, active heron/egret/cormorant rookery along the North Canadian River at NW 10th & Council Road. There is also a large active roost of pigeons and starlings underneath the river bridge at I-40, with their waste dropping directly into the river on a continuous basis (Figure 3-5). The bacteria production by these birds may be small compared to other animals. Since their dropping is directly into the river or on the river banks, it may be a significant bacteria source to the river.

Table 3-6 Estimated Deer Populations

Waterbody ID	Waterbody Name	Deer	Acre
OK520510000110_20	N. Canadian River	969	116,399
OK520520000010_00	N. Canadian River	36	6,290
OK520520000010_10	N. Canadian River	221	38,781
OK520520000010_20	N. Canadian River	118	20,684
OK520520000010_30	N. Canadian River	103	18,132
OK520520000010_40	N. Canadian River	193	32,955
OK520520000210_00	N. Canadian River	6	1,024
OK520520000250_00	N. Canadian River	48	7,246
OK520520000070_00	Crutcho Creek	83	14,319
OK520520000150_00	Crooked Oak Creek	37	6,194
OK520520000240_00	Mustang Creek	134	20,186

According to a livestock study conducted by ASAE (the American Society of Agricultural Engineers), deer release approximately 5×10^8 fecal coliform units per animal per day (ASAE 1999). Although only a fraction of the total fecal coliform loading produced by the deer population may actually enter a waterbody, the estimated fecal coliform production for deer provided in Table 3-7 in cfu/day provides a relative magnitude of loading in each watershed.

Table 3-7 Estimated Fecal Coliform Production for Deer

Waterbody ID	Waterbody Name	Watershed Area (acres)	Wild Deer Population	Estimated Wild Deer per acre	Fecal Production (x 10^9 cfu/day) of Deer Population
OK520510000110_20	N. Canadian River	116,399	969	0.008	484
OK520520000010_00	N. Canadian River	6,290	36	0.006	18
OK520520000010_10	N. Canadian River	38,781	221	0.006	110
OK520520000010_20	N. Canadian River	20,684	118	0.006	59
OK520520000010_30	N. Canadian River	18,132	103	0.006	52
OK520520000010_40	N. Canadian River	32,955	193	0.006	96
OK520520000210_00	N. Canadian River	1,024	6	0.006	3
OK520520000250_00	N. Canadian River	7,246	48	0.007	24
OK520520000070_00	Crutcho Creek	14,319	83	0.006	42
OK520520000150_00	Crooked Oak Creek	6,194	37	0.006	18
OK520520000240_00	Mustang Creek	20,186	134	0.007	67

3.2.2 Non-Permitted Agricultural Activities and Domesticated Animals

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

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

Table 3-8 provides estimated numbers of selected commercially raised farm animals by watershed based on the 2002 U.S. Department of Agriculture (USDA) county agricultural census data (USDA 2002). The estimated animal populations in Table 3-8 were derived by using the percentage of the watershed within each county. Because the watersheds are generally much smaller than the counties, and commercially raised farm animal are not evenly distributed across counties or constant with time, these are rough estimates only. Among the animal group represented, 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.

Two other potential sources of bacteria include the Oklahoma National Stockyards Company and the Lawns by Murphy, L.L.C. manure composting operations located adjacent to Oklahoma River (North Canadian River, OK520520000010_40). The location of the stockyard is shown on Figure 3-5. Neither facility operates under an NPDES permit. Portions of the stockyard operations are connected to the Oklahoma City sanitary sewer collection system. It appears that the animal waste manure is transported from the stockyards to the adjacent Lawns by Murphy, L.L.C facility where it is composted and mixed with soil and other organic material. Storm water runoff from both operations may enter the Oklahoma River.

The number of animals processed through the stockyard can be found at the ODAFF's website http://www.oda.state.ok.us/mktdev-reports.htm. Table 3-8a shows the number of animals processed in Oklahoma National Stockyards in 2008.

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 animal populations and the fecal coliform production rates from ASAE, an estimate of fecal coliform production from each group of commercially raised farm animals was calculated in Table 3-9 for each watershed of the Study Area. Note that only a small fraction of these fecal coliform are expected to represent loading into waterbodies, either washed into streams by runoff or by direct deposition from wading animals. Cattle appear to represent the largest potential source of fecal bacteria among the animal groups represented.

Table 3-8a Number of Animals Processed in Oklahoma National Stockyards

Reporting Week	Heads	Reporting Week	Heads
1/7 - 01/8/2008	12865	6/30 - 7/1/2008	7478
1/14 - 1/15/2008	1287	7/7 - 7/8/2008	8202
1/21 - 1/22/2008	5500	7/14 - 7/15/2008	9414
1/28 - 1/29/2008	7229	7/21 - 7/22/2008	6311
2/4 - 2/5/2008	9458	7/28 - 7/29/2008	7924
2/11 - 2/12/2008	10557	8/4 - 8/5/2008	8230

2/18 - 2/19/2008	9832	8/11 - 8/12/2008	9276
2/25 - 2/26/2008	15415	8/18 - 8/19/2008	7223
3/3 - 3/4/2008	13367	8/25 - 8/26/2008	8583
3/10 - 3/11/2008	10537	9/1 - 9/2/2008	428
3/17 - 3/18/2008	12020	9/8 - 9/9/2008	11721
3/24 - 3/25/2008	6367	9/15 - 9/16/2008	7033
3/31 - 4/1/2008	8187	9/22 - 9/23/2008	10892
4/7 - 4/8/2008	8270	9/29 - 9/30/2008	8395
4/14 - 4/15/2008	7909	10/6 - 10/7/2008	7629
4/21 - 4/22/2008	8970	10/13 - 10/14/2008	5834
4/28 - 4/29/2008	10822	10/20 - 10/21/2008	7796
5/5 - 5/6/2008	10136	10/27 - 10/28/2008	12108
5/12 - 5/13/2008	10790	11/3 - 11/4/2008	11218
5/19 - 5/20/2008	11686	11/10 - 11/11/2008	11608
5/26 - 5/27/2008	1085	11/17 - 11/18/2008	15491
6/2 - 6/3/2008	15113	11/24 - 11/25/2008	7850
6/9 - 6/10/2008	10498	12/1 - 12/2/2008	14235
6/16 - 6/17/2008	8449	12/8 - 12/9/2008	9766
6/23 - 6/24/2008	8556	Average:	**9174**

Table 3-8 Commercially Raised Farm Animals

Waterbody ID	Waterbody Name	Cattle & Calves-all	Dairy Cows	Horses & Ponies	Goats	Sheep & Lambs	Hogs & Pigs	Ducks & Geese	Chickens & Turkeys
OK520510000110_20	N. Canadian River	8887	140	745	2	333	1060	103	767
OK520520000010_00	N. Canadian River	307	4	56	0	20	8	7	38
OK520520000010_10	N. Canadian River	1892	23	348	0	121	51	42	232
OK520520000010_20	N. Canadian River	1009	12	185	0	64	27	23	124
OK520520000010_30	N. Canadian River	885	11	163	0	56	24	20	109
OK520520000010_40*	N. Canadian River	1578	19	281	0	100	52	33	200
OK520520000210_00*	N. Canadian River	50	1	9	0	3	1	1	6
OK520520000250_00*	N. Canadian River	1150	14	38	0	22	98	2	21
OK520520000070_00*	Crutcho Creek	717	9	129	0	46	22	15	90
OK520520000150_00*	Crooked Oak Creek	318	4	56	0	20	11	7	41
OK520520000240_00	Mustang Creek	3456	43	96	0	61	302	4	42

* Due to the small amount of agricultural land in these watersheds, animal numbers are likely overestimated.

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

Waterbody ID	Waterbody Name	Cattle & Calves-all	Dairy Cows	Horses & Ponies	Goats	Sheep & Lambs	Hogs & Pigs	Ducks & Geese	Chickens & Turkeys	Total
OK520510000110_20	N. Canadian River	924,223	14,162	313	27	3,998	11,450	1,612	104	955,890
OK520520000010_00	N. Canadian River	31,910	383	24	0	235	88	107	5	32,753
OK520520000010_10	N. Canadian River	196,782	2,364	146	0	1,448	546	662	32	201,980
OK520520000010_20	N. Canadian River	104,953	1,261	78	0	772	291	353	17	107,725
OK520520000010_30	N. Canadian River	92,007	1,105	68	0	677	255	310	15	94,438
OK520520000010_40	N. Canadian River	164,094	1,908	118	0	1,202	560	520	27	168,429
OK520520000210_00	N. Canadian River	5,194	62	4	0	38	14	17	1	5,332
OK520520000250_00	N. Canadian River	119,570	1,432	16	0	265	1,060	35	3	122,381
OK520520000070_00	Crutcho Creek	74,529	875	54	0	547	240	241	12	76,498
OK520520000150_00	Crooked Oak Creek	33,084	379	23	0	242	122	102	6	33,958
OK520520000240_00	Mustang Creek	359,429	4,304	40	0	738	3,258	70	6	367,844

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 2008a). 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 stream segment 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 8 percent of the OSWD systems 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.

For the purpose of estimating fecal coliform loading in watersheds, an OSWD failure rate of 8 percent was used. Using this 8 percent failure rate, calculations were made to characterize fecal coliform loads in each watershed.

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

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

Table 3-10 Estimates of Sewered and Unsewered Households

Waterbody ID	Waterbody Name	Public Sewer	Septic Tank	Other Means	Housing Units	% Sewered
OK520510000110_20	N. Canadian River	1774	5144	46	6964	25.5%
OK520520000010_00	N. Canadian River	119	258	6	383	31.1%
OK520520000010_10	N. Canadian River	2247	4882	115	7244	31.0%
OK520520000010_20	N. Canadian River	1943	2011	47	4002	48.6%
OK520520000010_30	N. Canadian River	4984	828	25	5837	85.4%
OK520520000010_40	N. Canadian River	63804	869	252	64925	98.3%
OK520520000210_00	N. Canadian River	759	23	5	787	96.4%
OK520520000250_00	N. Canadian River	3480	307	21	3808	91.4%
OK520520000070_00	Crutcho Creek	17157	557	55	17769	96.6%
OK520520000150_00	Crooked Oak Creek	4478	295	26	4799	93.3%
OK520520000240_00	Mustang Creek	5007	831	1	5839	85.8%

The average of number of people per household was calculated to be 2.4 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)
OK520510000110_20	N. Canadian River	116399.0235	5144	412	2617
OK520520000010_00	N. Canadian River	6289.525168	258	21	131
OK520520000010_10	N. Canadian River	38781.09728	4882	391	2484
OK520520000010_20	N. Canadian River	20683.73259	2011	161	1023
OK520520000010_30	N. Canadian River	18132.46723	828	66	421
OK520520000010_40	N. Canadian River	32955.42345	869	70	442
OK520520000210_00	N. Canadian River	1023.687473	23	2	12
OK520520000250_00	N. Canadian River	7245.508929	307	25	156
OK520520000070_00	Crutcho Creek	14319.06011	557	45	284
OK520520000150_00	Crooked Oak Creek	6193.837131	295	24	150
OK520520000240_00	Mustang Creek	20186.44837	831	66	423

3.2.4 Domestic Pets

Fecal matter from dogs and cats is transported to streams by runoff from urban and suburban areas and can be a potential source of bacteria loading. On average nationally, there are 0.58 dogs per household and 0.66 cats per household (American Veterinary Medical Association 2004). Using the U.S. Census data at the block level (U.S. Census Bureau 2000), dog and cat populations can be estimated for each watershed. Table 3-12 summarizes the estimated number of dogs and cats for the watersheds of the Study Area.

Table 3-12 Estimated Numbers of Pets

Waterbody ID	Waterbody Name	Dogs	Cats
OK520510000110_20	N. Canadian River	13,970	15,897
OK520520000010_00	N. Canadian River	851	968
OK520520000010_10	N. Canadian River	12,620	14,361
OK520520000010_20	N. Canadian River	5,910	6,725
OK520520000010_30	N. Canadian River	25,193	28,667
OK520520000010_40	N. Canadian River	85,093	96,831
OK520520000210_00	N. Canadian River	1,013	1,152
OK520520000250_00	N. Canadian River	6,014	6,844
OK520520000070_00	Crutcho Creek	24,034	27,349
OK520520000150_00	Crooked Oak Creek	5,605	6,378
OK520520000240_00	Mustang Creek	13,341	15,181

Table 3-13 provides an estimate of the fecal coliform load from pets. These estimates are based on estimated fecal coliform production rates of 5.4×10^8 per day for cats and 3.3×10^9 per day for dogs (Schueler 2000).

Table 3-13 Estimated Fecal Coliform Daily Production by Pets (x 10^9)

Waterbody ID	Waterbody Name	Dogs	Cats	Total
OK520510000110_20	N. Canadian River	46,101	8,584	54,685
OK520520000010_00	N. Canadian River	2,808	523	3,331
OK520520000010_10	N. Canadian River	41,646	7,755	49,401
OK520520000010_20	N. Canadian River	19,504	3,632	23,136
OK520520000010_30	N. Canadian River	83,136	15,480	98,616
OK520520000010_40	N. Canadian River	280,808	52,288	333,097
OK520520000210_00	N. Canadian River	3,342	622	3,964
OK520520000250_00	N. Canadian River	19,847	3,696	23,543
OK520520000070_00	Crutcho Creek	79,311	14,768	94,079
OK520520000150_00	Crooked Oak Creek	18,495	3,444	21,939
OK520520000240_00	Mustang Creek	44,026	8,198	52,224

3.3 Summary of Bacteria Sources

Table 3-14 summarizes the suspected sources of bacteria loading in each impaired watershed. Since there are no NPDES-permitted sewerage facilities present in the North Canadian River (OK520520000010_00, OK520520000010_40 & OK520520000210_00), Crutcho Creek (OK520520000070_00) and Mustang Creek (OK520520000240_00) watersheds, nonsupport of the PBCR use is caused by either nonpoint sources or MS4s. In watersheds with both point and nonpoint sources of bacteria, the available data suggests that the proportion of bacteria from sewage discharges ranges from minor to moderate. Those waterbodies in which sewage plants are a minor contributor of bacteria include North Canadian River (OK520520000110_20, OK520520000010_10, OK520520000010_20, OK520520000010_30 & OK520520000250_00) and Crooked Oak Creek (OK520520000150_00). Except for sub-watersheds of North Canadian River (OK520520000110_20 & OK520520000010_00), sub-watersheds in this study are highly urbanized with either Phase I or Phase II MS4s. Bacteria from MS4s are believed to be the major source for these highly urbanized sub-watersheds.

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

Waterbody ID	Waterbody Name	MS4s	Point Sources (Sewage Discharge)	Nonpoint Sources	Major Source
OK520510000110_20	N. Canadian River	Yes	Yes	Yes	Nonpoint
OK520520000010_00	N. Canadian River	No	No	Yes	Nonpoint
OK520520000010_10	N. Canadian River	Yes	Yes	Yes	MS4
OK520520000010_20	N. Canadian River	Yes	Yes	Yes	MS4
OK520520000010_30	N. Canadian River	Yes	Yes	Yes	MS4
OK520520000010_40	N. Canadian River	Yes	No	Yes	MS4
OK520520000210_00	N. Canadian River	Yes	No	Yes	MS4
OK520520000250_00	N. Canadian River	Yes	Yes	Yes	MS4
OK520520000070_00	Crutcho Creek	Yes	No	Yes	MS4
OK520520000150_00	Crooked Oak Creek	Yes	Yes	Yes	MS4
OK520520000240_00	Mustang Creek	Yes	No	Yes	MS4

Table 3-15 below provides a summary of the estimated fecal coliform loads in percentage for the four major nonpoint source categories (commercially raised farm animals, pets, deer, and septic tanks) that are contributing to the elevated bacteria concentrations in each watershed. Commercially raised farm animals and pets are estimated to be the primary contributors of fecal coliform loading to land surfaces. However, its contribution of bacteria to streams may be greatly reduced if BMPs are properly implemented. 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 may represent a major source of the fecal bacteria found in streams.

The magnitude of loading to a stream may not reflect the magnitude of loading to land surfaces. While no studies quantify these effects, bacteria may die off or survive at different rates depending on the manure characteristics and a number of other environmental conditions.

Manure handling practices, use of BMPs, and relative location to streams can also affect stream loading. Also, the structural properties of some manure, such as cow patties, may limit their wash off into streams by runoff. Because litter is applied in a pulverized form, it could be a larger source during storm runoff events. The Shoal Creek report showed that poultry litter was about 71% of the high flow load and cow pats contributed only about 28% of it (Missouri Department of Natural Resources, 2003). The Shoal Creek report also showed that poultry litter was insignificant under low flow conditions up to 50% frequency. In contrast, malfunctioning septic tank effluent may be present in pooled water on the surface, or in shallow groundwater, which may enhance its conveyance to streams.

Table 3-15 Summary of Fecal Coliform Load Estimates from Nonpoint Sources to Land Surfaces

Waterbody ID	Waterbody Name	Commercially Raised Farm Animals	Pets	Deer	Estimated Loads from Septic Tanks
OK520510000110_20	N. Canadian River	94.3%	5.4%	0.05%	0.3%
OK520520000010_00	N. Canadian River	90.4%	9.2%	0.05%	0.4%
OK520520000010_10	N. Canadian River	79.5%	19.5%	0.04%	1.0%
OK520520000010_20	N. Canadian River	81.6%	17.5%	0.04%	0.8%
OK520520000010_30	N. Canadian River	48.8%	51.0%	0.03%	0.2%
OK520520000010_40	N. Canadian River	33.5%	66.3%	0.02%	0.1%
OK520520000210_00	N. Canadian River	57.3%	42.6%	0.03%	0.1%
OK520520000250_00	N. Canadian River	83.8%	16.1%	0.02%	0.1%
OK520520000070_00	Crutcho Creek	44.8%	55.0%	0.02%	0.2%
OK520520000150_00	Crooked Oak Creek	60.6%	39.1%	0.03%	0.3%
OK520520000240_00	Mustang Creek	87.5%	12.4%	0.02%	0.1%

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 WQS 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 stream segments;
- 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

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

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

4.2 Development of Flow Duration Curves

Flow duration curves serve as the foundation of LDCs and are graphical representations of the flow characteristics of a stream at a given site. Flow duration curves utilize the historical hydrologic record from stream gages to forecast future recurrence frequencies. Many stream segments 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 stream segments 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 stream segment 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 2009).

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 4-11 are flow duration curves for each impaired waterbody. The flow duration curve for North Canadian River, segment OK520510000110_20 was based on measured flows from 2/7/2001 through 4/28/2009 at USGS gage station 07241800 (North Canadian River at Shawnee, OK). .

The flow duration curves for North Canadian River, segments OK520520000010_00 and OK520520000010_10 were based on measured flows from 1/1/1980 through 4/27/2009 at USGS gage station 07241550 (North Canadian River near Harrah, OK).

The flow duration curve for North Canadian River, segment OK520520000010_20 was based on measured flows from 10/1/1988 through 4/27/2009 at USGS gage station 07241520 (North Canadian River at Britton Road in Oklahoma City, OK).

The flow duration curves for North Canadian River, segments OK520520000010_30 and OK520520000010_40 were based on measured flows from 10/1/1989 through 6/30/1991 at USGS gage station 07241503 (North Canadian River at NE 36th Street in Oklahoma City, OK).

The flow duration curves for North Canadian River, segments OK520520000210_00 and OK520520000250_00 were based on measured flows from 1/1/1980 through 4/27/2009 at USGS gage station 07241000 (North Canadian River below Lake Overholser near Oklahoma City, OK).

No flow gage exists on Crutcho Creek (OK520520000070_00) and Crooked Oak Creek (OK520520000150_00) Therefore, flows for this waterbody were prorated using the watershed area based on measured flows at USGS gage station 07242247 (Deep Fork at Hefner Rd at Oklahoma City, Ok). The flow duration curve was based on measured flows from 1995 through 1998.

No flow gage exists on Mustang Creek (OK520520000240_00). Therefore, flows for this waterbody were prorated using the watershed area based on measured flows at USGS gage station 07229500 (Little River near Norman, OK). The flow duration curve was based on measured flows from 1951 through 1955.

Figure 4-1 Flow Duration Curve for North Canadian River (OK520510000110_20)

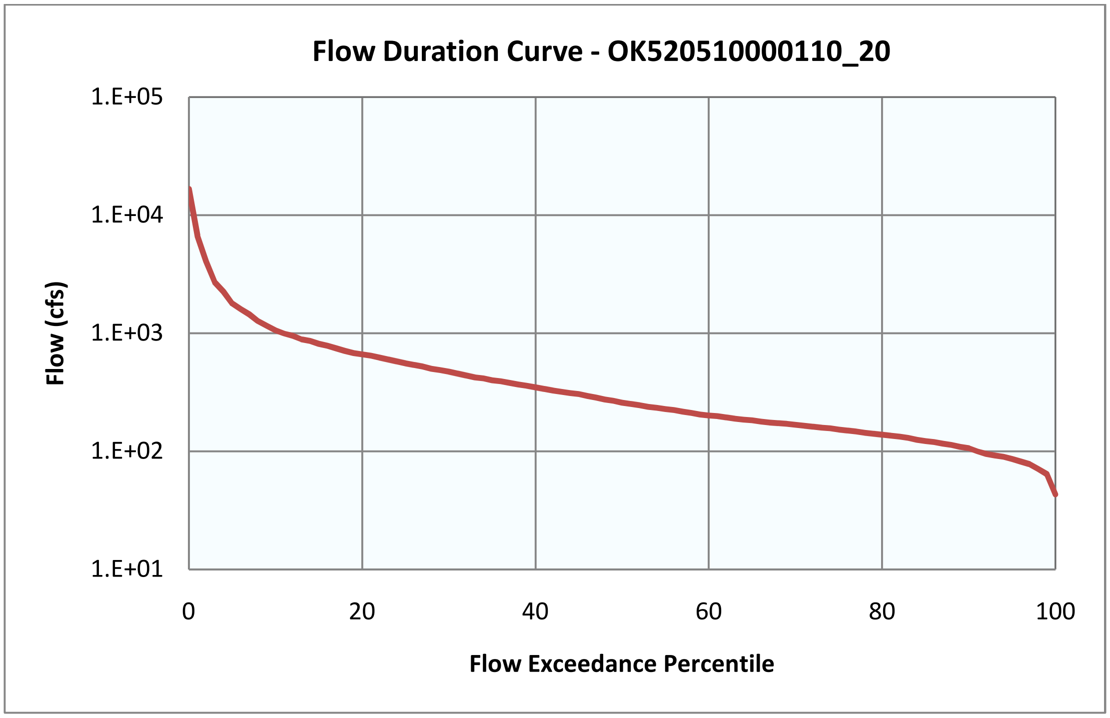


Figure 4-2 Flow Duration Curve for North Canadian River (OK520520000010_00)

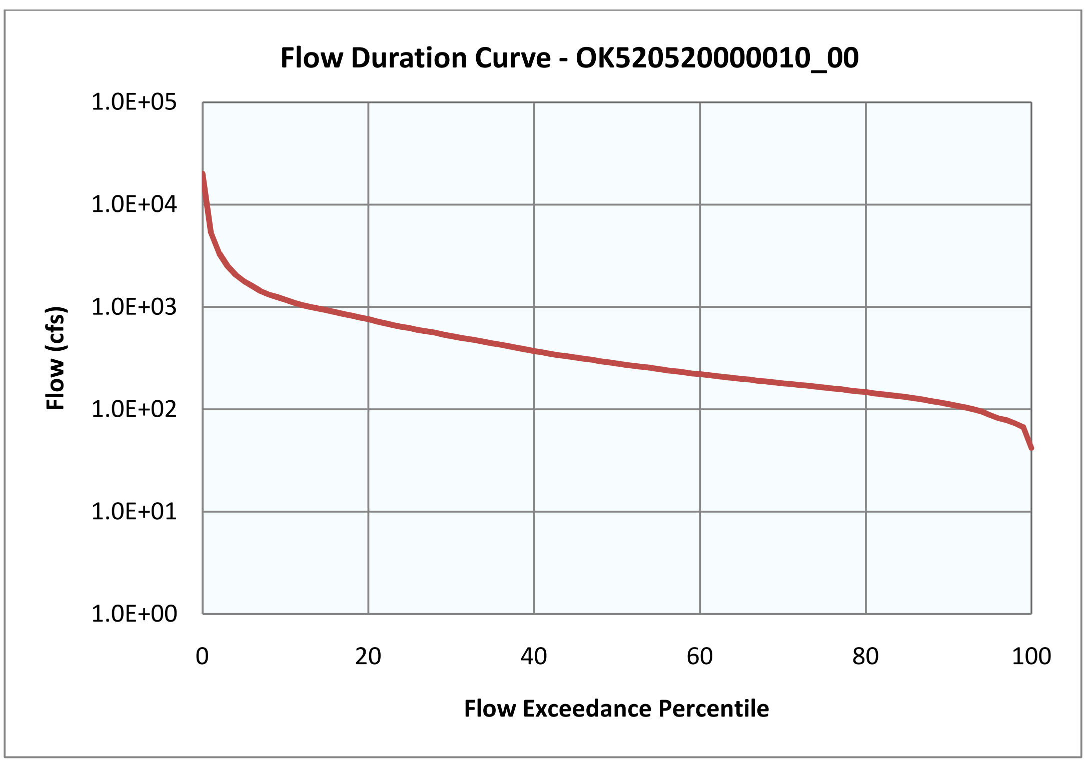


Figure 4-3 Flow Duration Curve for North Canadian River (OK520520000010_10)

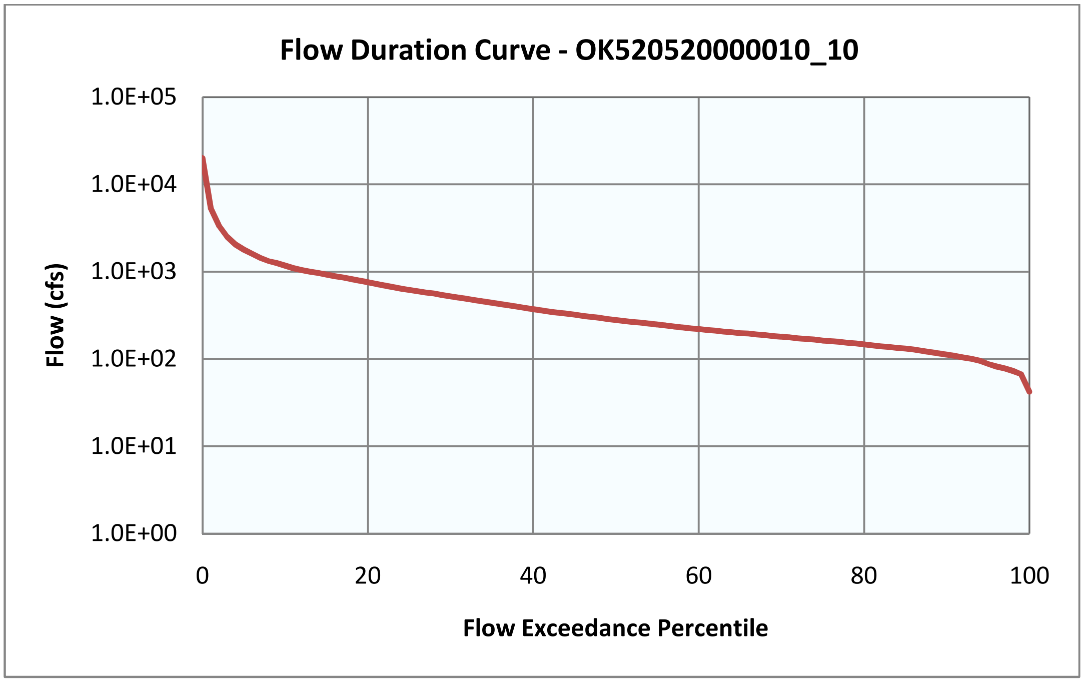


Figure 4-4 Flow Duration Curve for North Canadian River (OK520520000010_20)

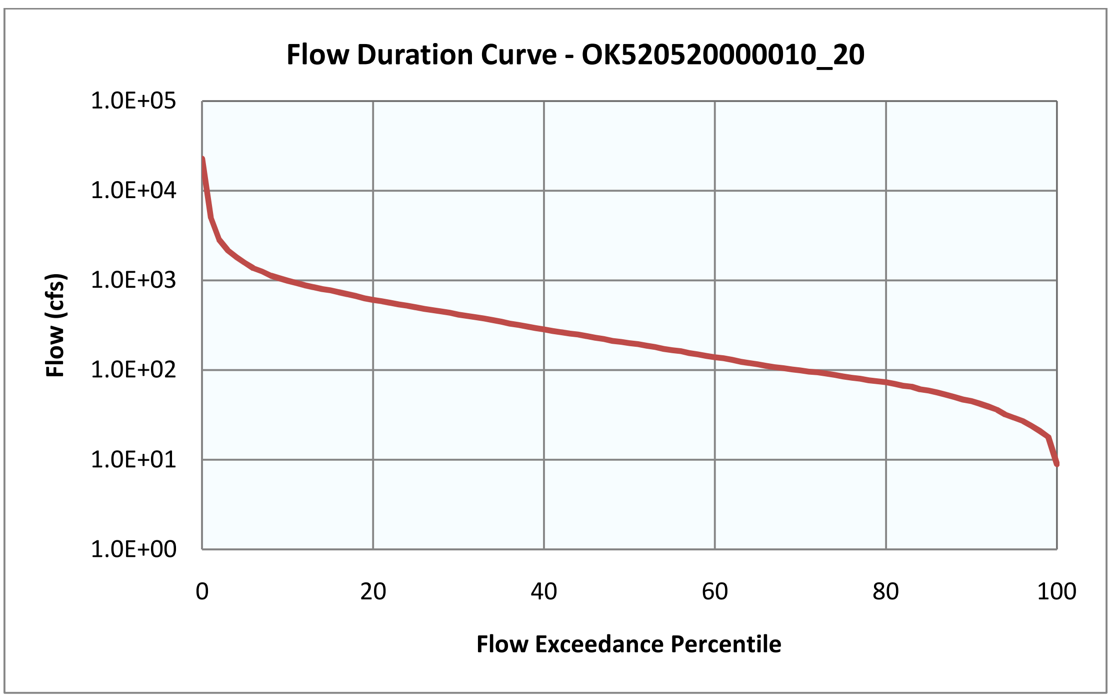


Figure 4-5 Flow Duration Curve for North Canadian River (OK520520000010_30)

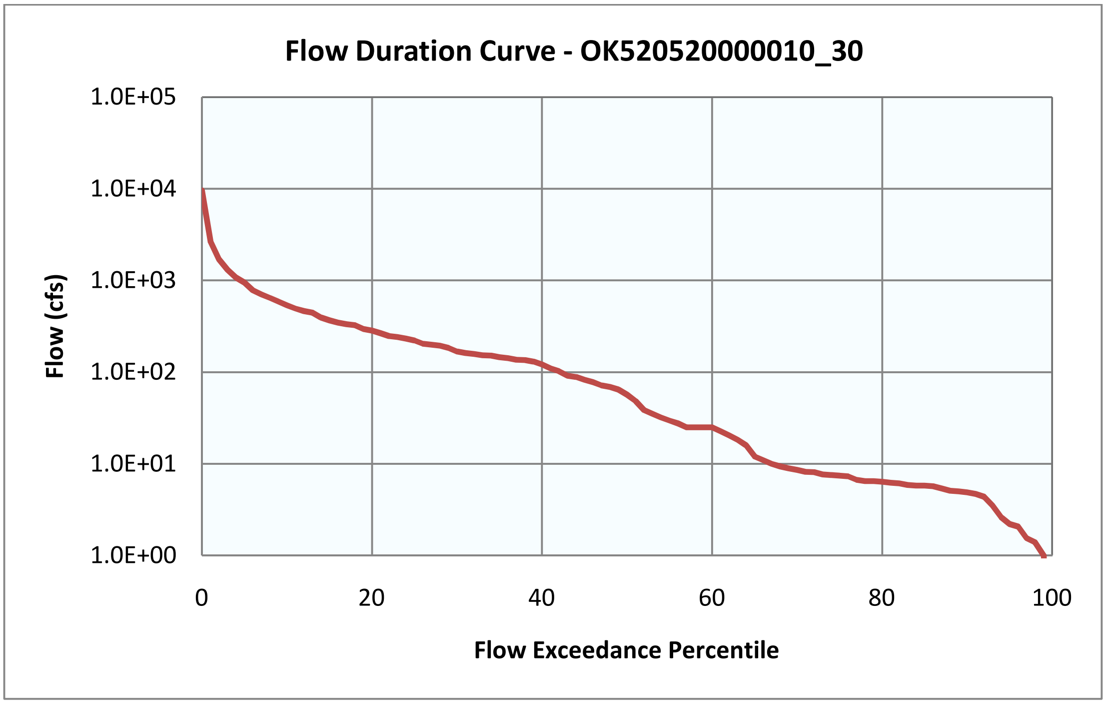


Figure 4-6 Flow Duration Curve for North Canadian River (OK520520000010_40)

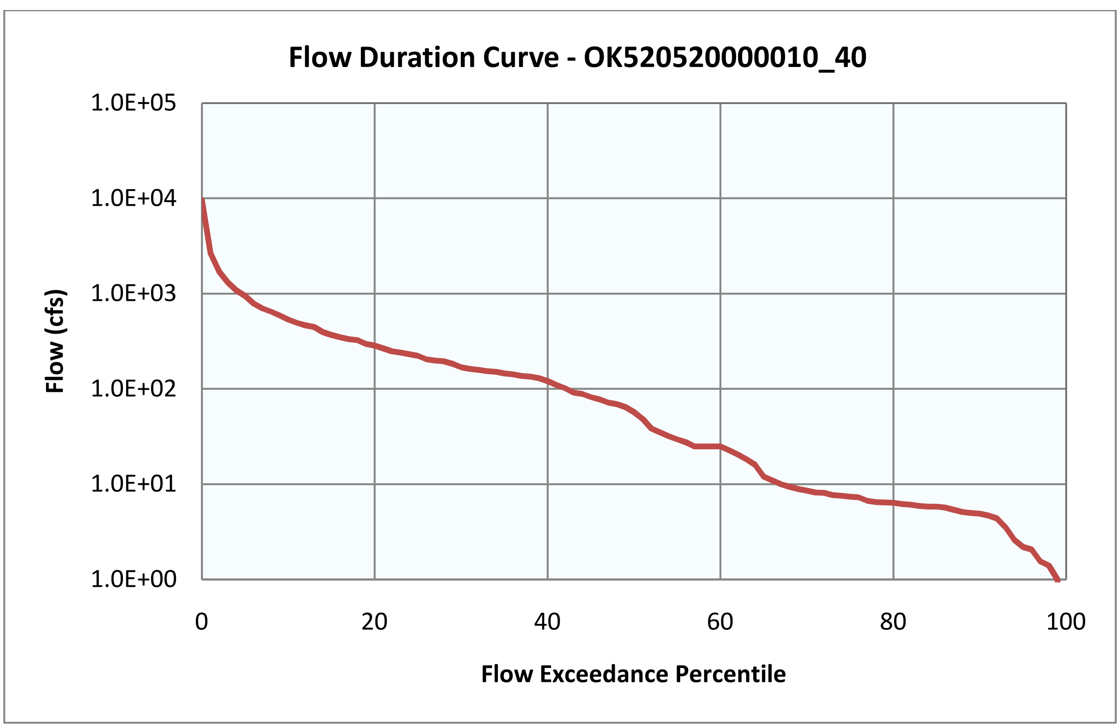


Figure 4-7 Flow Duration Curve for North Canadian River (OK520520000210_00)

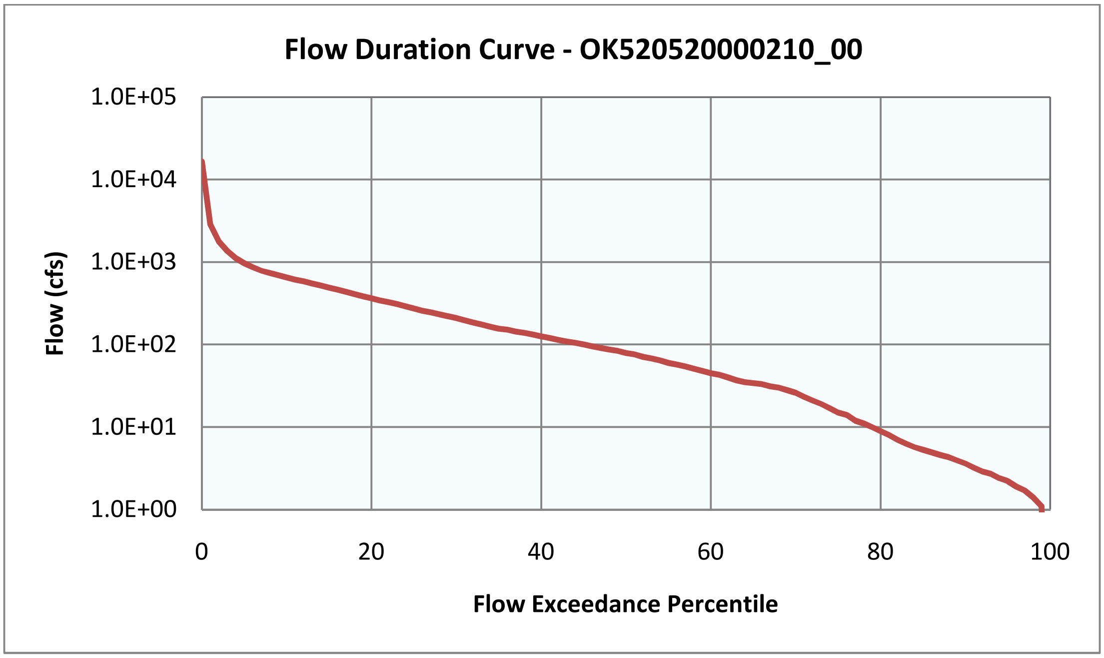


Figure 4-8 Flow Duration Curve for North Canadian River (OK520520000250_00)

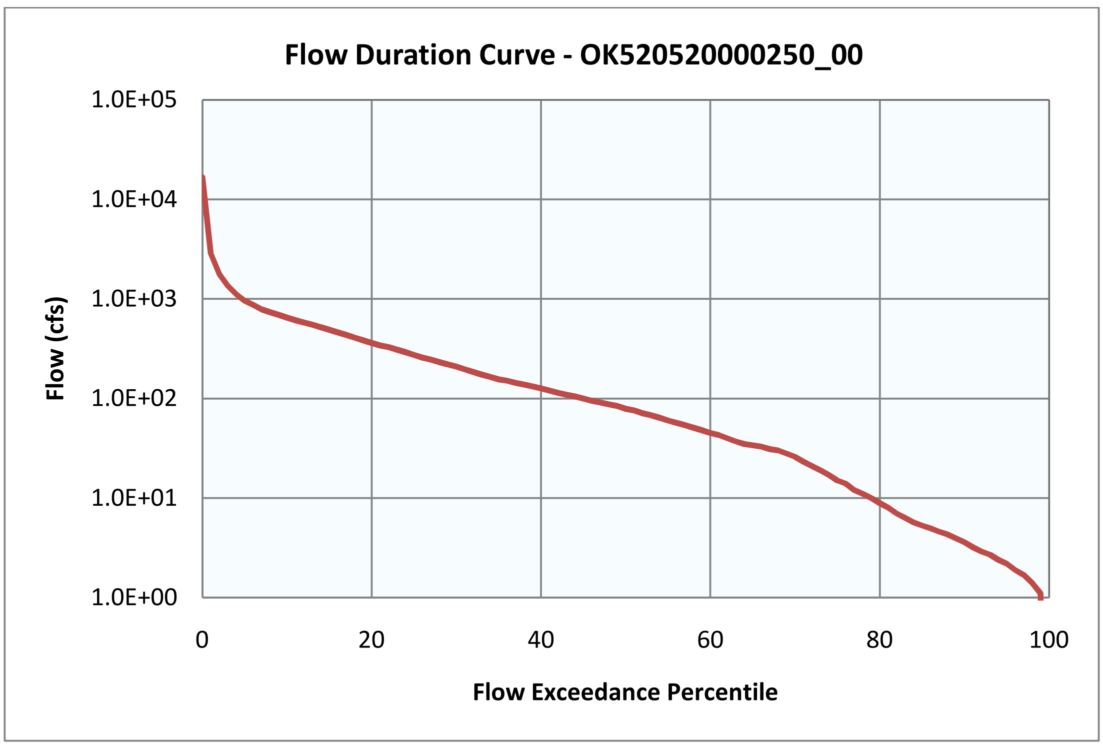


Figure 4-9 Flow Duration Curve for Crutcho Creek (OK520520000070_00)

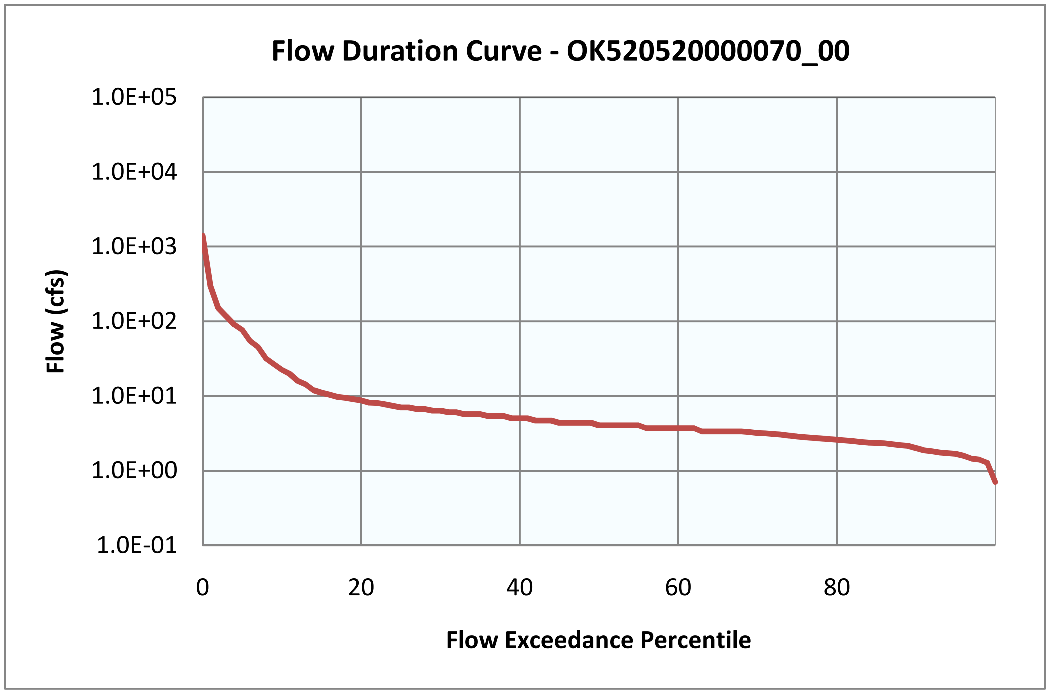


Figure 4-10 Flow Duration Curve for Crooked Oak Creek (OK520520000150_00)

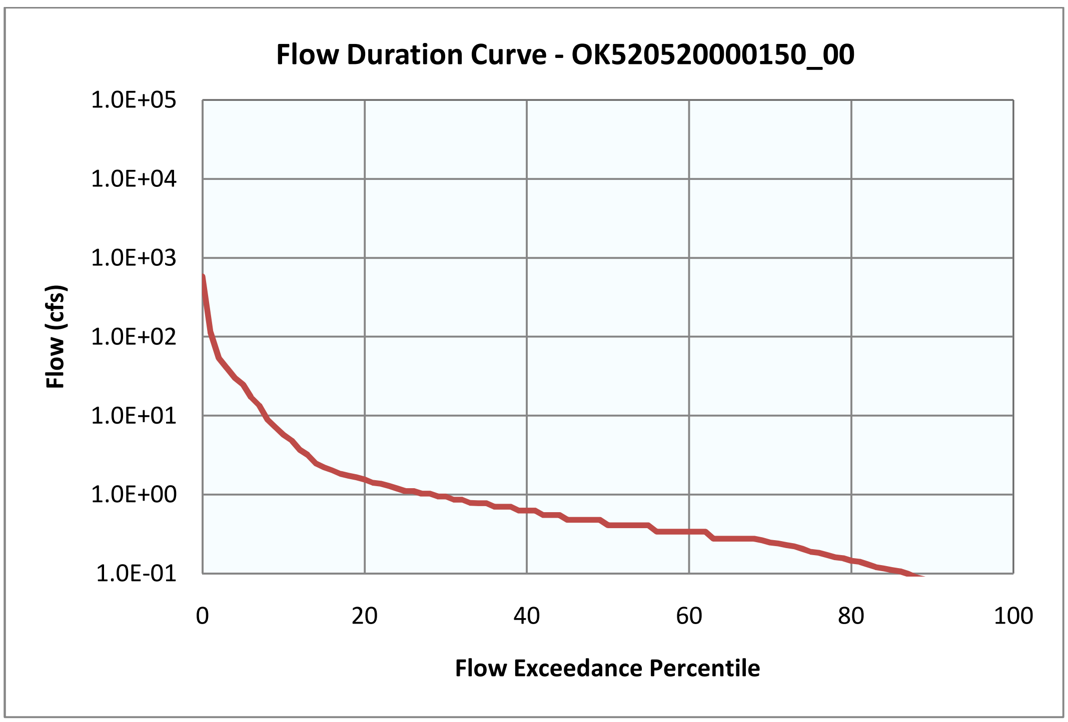
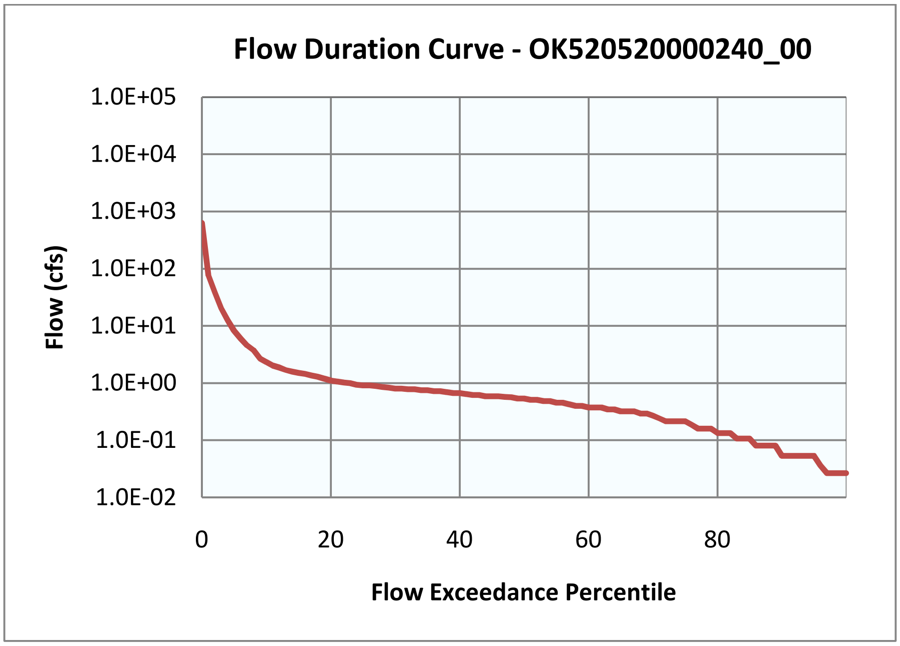


Figure 4-11 Flow Duration Curve for Mustang Creek (OK520520000240_00)



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 WQS for fecal bacteria at the point of discharge. However, for TMDL analysis it is necessary to understand the relative contribution of WWTPs to the overall pollutant loading and its general compliance with required effluent limits. The monthly bacteria load for continuous point source dischargers is estimated by multiplying the monthly average flow rates by the monthly geometric mean using a conversion factor. The current pollutant loading from each permitted point source discharge is calculated using the equation below.

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

Where:

unit conversion factor = 37,854,120

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

4.4 Development of TMDLs Using Load Duration Curves

The final step in the TMDL calculation process involves a group of additional computations derived from the preparation of LDCs. These computations are necessary to derive a PRG (which is one method of presenting how much bacteria loading must be reduced to meet WQS 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) for waterbodies not supporting the PBCR use;
- matching the water quality observations with the flow data from the same date;
- display a curve on a plot that represents the allowable load multiplied by 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: PBCR WQS = 400 cfu /100 ml (Fecal coliform); 406 cfu/100 ml (E. coli); or 108 cfu/100 ml (Enterococci), or

unit conversion factor = 24,465,525

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

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

Step 2: Develop LDCs. A LDC is calculated using the following formula:

*LDC (lb/day) = TMDL * (1 – MOS)*

The MOS may be defined explicitly or implicitly. A typical explicit approach would reserve some specific fraction of the TMDL 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 was selected.

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 point sources are typically associated with urban and industrialized areas, and recent USEPA guidance includes NPDES-permitted stormwater discharges as point source discharges and, therefore, part of the WLA.

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

WLA for WWTP. WLAs may be set to zero for watersheds with no existing or planned continuous permitted point sources. For watersheds with permitted point sources, WLAs may be derived from NPDES permit limits. A WLA may be calculated for each active NPDES wastewater discharger 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 (mgd) * unit conversion factor*

Where:

Where: WQS = 200 cfu /100 ml (Fecal coliform); 126 cfu/100 ml (E. coli); or 33 cfu/100 ml (Enterococci)

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

unit conversion factor = 37,854,120

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

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

LA = TMDL - WLA_WWTP - WLA_MS4 - MOS

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

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

Step 6: Estimate LA Load Reduction. After existing loading estimates are computed for each bacteria indicator, nonpoint load reduction estimates for each stream segment 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 WQ standards are considered to be met if 1) either the geometric mean of all data is less than the geometric mean criteria, or 2) no sample exceeds the instantaneous criteria, the TMDL PRG will be the lesser of that required to meet the geometric mean or instantaneous criteria.

SECTION 5
TMDL CALCULATIONS

5.1 Estimated Loading and Critical Conditions

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

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

To estimate existing loading, bacteria observations from 1998 to 2008 are paired with the flows measured or estimated in that segment on the same date. Pollutant loads are then calculated by multiplying the measured bacteria concentration by the flow rate and a unit conversion factor of $24{,}465{,}525\ ml*s / ft^3*day$. The associated flow exceedance percentile is then matched with the measured flow from the tables provided in Appendix C. The observed bacteria loads are then added to the LDC plot as points. These points represent individual ambient water quality samples of bacteria. Points above the LDC indicate the bacteria instantaneous standard was exceeded at the time of sampling. Conversely, points under the LDC indicate the sample met the WQS.

The LDC approach recognizes that the assimilative capacity of a waterbody depends on the flow, and that maximum allowable loading varies with flow condition. Existing loading, and load reductions required to meet the TMDL water quality target can also be calculated under different flow conditions. The difference between existing loading and the water quality target is used to calculate the loading reductions required. Percent reduction goals are calculated for each watershed and bacterial indicator species as the reductions in load required in order that no more than 25 percent of the fecal coliform instantaneous water quality observations and no E. coli and enterococci observations would exceed the water quality target. This is because for the PBCR use to be supported, criteria for each bacteria indicator must be met in each impaired waterbody. For E. coli and enterococci, PRGs are also calculated based on geometric mean standards. The final PRG is the lesser of PRGs calculated based on either instantaneous standards or geometric mean standards. For fecal coliform, PRGs are not calculated based on geometric mean standard because geometric mean standard is the same as instantaneous standard.

Table 5-1 presents the percent reductions necessary for each bacteria indicator in each of the impaired waterbodies in the Study Area. Attainment of WQS in response to TMDL implementation will be based on results measured at each of the stream segments listed in Table 5-1. The appropriate PRG for each bacteria indicator for each stream segment in Table 5-1 is denoted by the bold text.

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

WQM Station	Waterbody ID	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instant-aneous	Instant-aneous	Geo-mean	Instant-aneous	Geo-mean
NC-08	OK520510000110_20	N. Canadian River	**3.0%**			93.6%	**86.4%**
520510000110-001AT	OK520520000010_00	N. Canadian River	**53.0%**			96.6%	**91.6%**
NC-07	OK520520000010_10	N. Canadian River	**78.9%**			99.3%	**97.0%**
NC-06	OK520520000010_20	N. Canadian River	**48.6%**			99.97%	**98.9%**
NC-05	OK520520000010_30	N. Canadian River	**86.7%**	95.6%	**37.6%**	99.8%	**98.0%**
NC-04	OK520520000010_40	N. Canadian River	**48.6%**			99.9%	**98.1%**
NC-03	OK520520000210_00	N. Canadian River				99.7%	**92.9%**
USGS07241000	OK520520000250_00	N. Canadian River	**67.3%**				
OK520520-00-0070G OK520520-00-0070B	OK520520000070_00	Crutcho Creek	**28.1%**				
OK520520-00-0150G WCNCE450	OK520520000150_00	Crooked Oak Creek	**72.4%**	75.7%	**66.6%**		
WCNCW654 & OK520520-00-0240G	OK520520000240_00	Mustang Creek		88.8%	**42.6%**		

A subset of the LDCs for each impaired waterbody is shown in Figures 5-1 through 5-11. While some waterbodies may be listed for multiple bacterial indicators, only one LDC for each waterbody is presented in Figures 5-1 through 5-11 – the LDC for the bacterial indicator that is highlighted by bold text in Table 5-1. In other words, Figures 5-1 through 5-11 display an 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 percent reduction goal (PRG) is calculated so that the bacteria standards under primary contact recreation season (May - Sept) are met. This percent reduction should be sufficient to ensure that secondary contact recreation criteria are also met in the rest of the year.

The LDC for North Canadian River segment OK520510000110_20 (Figure 5-1) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station NC-08. The LDC indicates that Enterococcus levels sometimes exceed the instantaneous water quality criteria during all flow conditions when samples were collected, possibly indicating water quality impairments due to nonpoint sources or a combination of point and nonpoint sources. The exceedances found during dry weather conditions indicate some level of pollution may be due to point sources, failing onsite systems, or direct deposition of animal manure.

The LDC for North Canadian River segment OK520520000010_00 (Figure 5-2) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station 520510000110-001AT. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria under mid-range and low flow conditions. However, since there is no point source discharge in the watershed, the bacteria loading must come from nonpoint sources, including contributions from the upstream segment.

The LDC for North Canadian River segment OK520520000010_10 (Figure 5-3) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station NC-07. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria under mid-range and low flow conditions, indicative of a combination of point and nonpoint sources.

The LDC for North Canadian River segment OK520520000010_20 (Figure 5-4) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station NC-06. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria during mid-range and low flow conditions, indicative a combination of point sources and nonpoint sources.

The LDC for North Canadian River segment OK520520000010_30 (Figure 5-5) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station NC-05. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria under all flow conditions when samples were collected, indicative a combination of point and nonpoint sources.

The LDC for North Canadian River segment OK520520000010_40 (Figure 5-6) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station NC-04. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria under mid-range and low flow conditions, indicative a combination of point and nonpoint sources. However, since there is no point source discharge in the watershed, the bacteria loading must come from nonpoint sources.

The LDC for North Canadian River segment OK520520000210_00 (Figure 5-7) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station NC-03. The LDC indicates that Enterococcus levels sometimes exceed the instantaneous water quality criteria under all flow conditions when samples were collected, indicative a combination of point and nonpoint sources. However, since there is no point source discharge in the watershed, the bacteria loading must come from nonpoint sources.

The LDC for North Canadian River segment OK520520000250_00 (Figure 5-8) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station USGS07241000. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria during all flow condition, indicative of a combination of point and nonpoint sources.

The LDC for Crutcho Creek segment OK520520000070_00 (Figure 5-9) is based on fecal coliform bacteria measurements and flows during primary contact recreation season at WQM station OK520520-00-0070G and OK520520-00-0070B. The LDC indicates that fecal coliform levels exceeded the instantaneous the instantaneous water quality criteria during mid-range and moist flow conditions, indicative of nonpoint sources.

The LDC for Crooked Oak Creek segment OK520520000150_00 (Figure 5-10) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK520520-00-0150G and WCNCE450. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria during mid-range and low flow conditions (all samples were collected in these flow conditions), indicative of a combination of point and nonpoint sources.

The LDC for Mustang Creek segment OK520520000240_00 (Figure 5-11) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station WCNCW654 & OK520520-00-0240G. The LDC indicates that fecal coliform levels have exceeded the instantaneous water quality criteria during mid-range and low flow conditions, possibly indicating a combination of nonpoint and point sources.

Figure 5-1 Load Duration Curve for Enterococci in North Canadian River (OK520510000110_20)

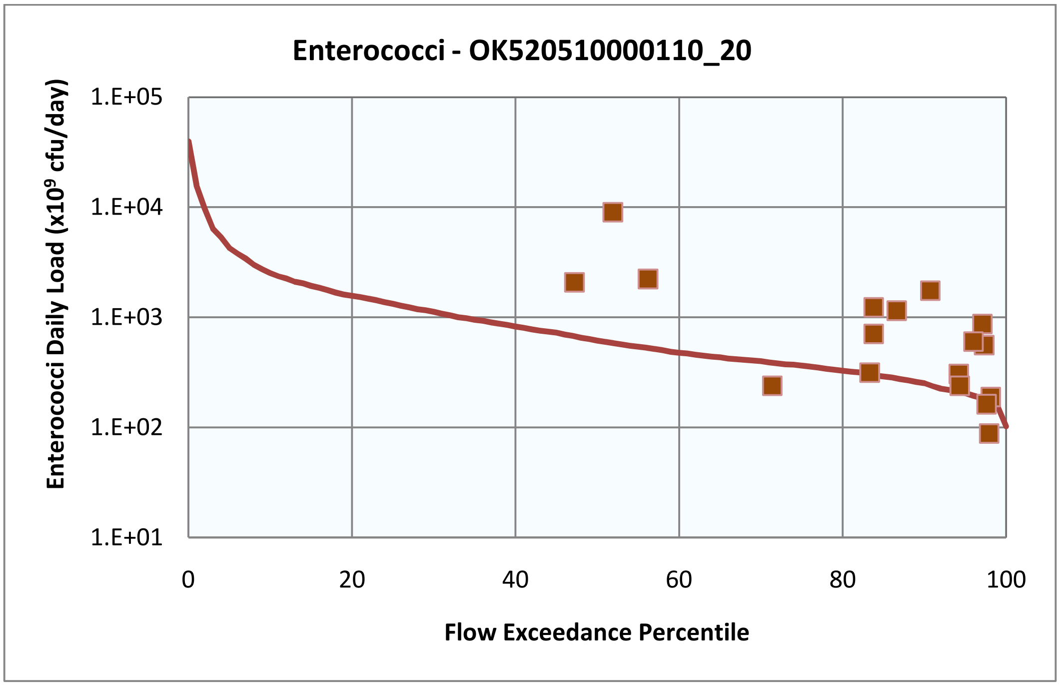


Figure 5-2 Load Duration Curve for Fecal Coliform in North Canadian River (OK520520000010_00)

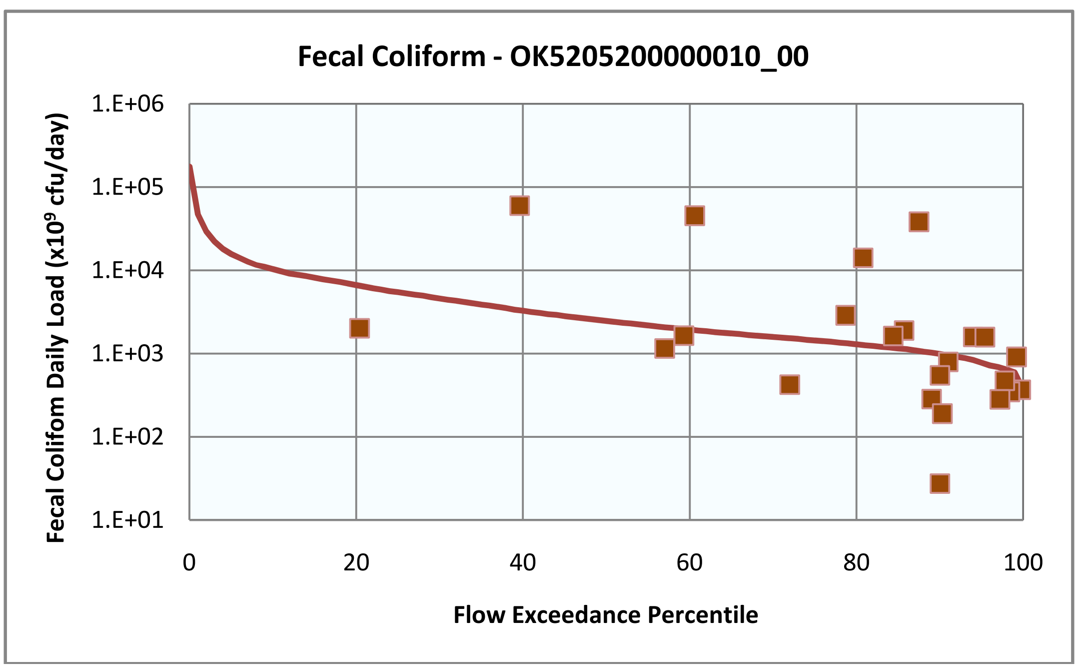


Figure 5-3 Load Duration Curve for Enterococci in North Canadian River (OK520520000010_10)

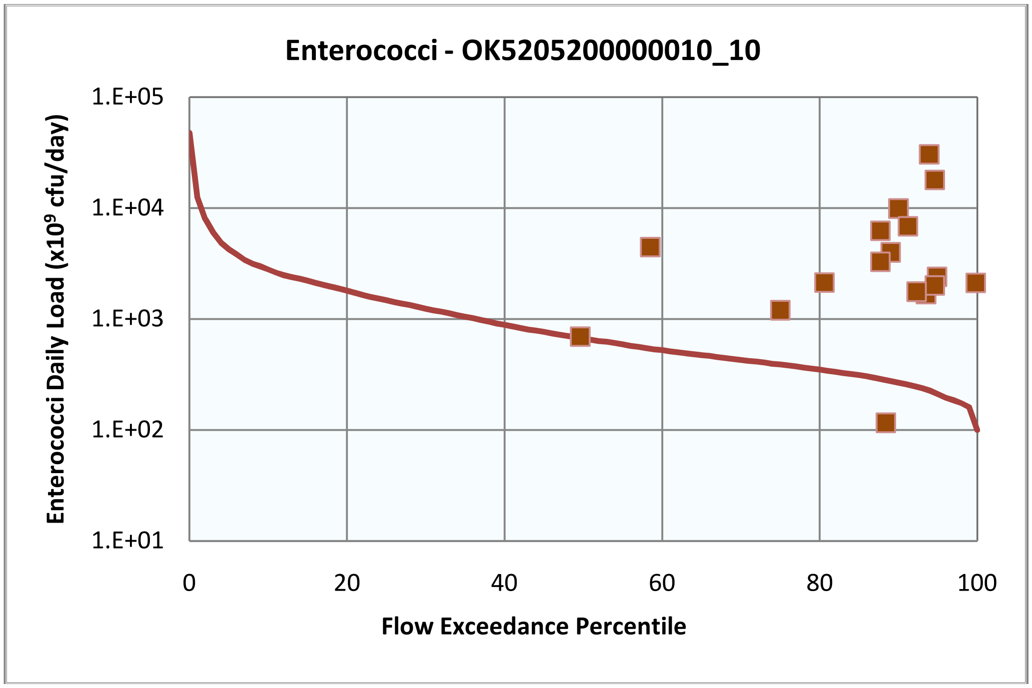


Figure 5-4 Load Duration Curve for Enterococci in North Canadian River (OK520520000010_20)

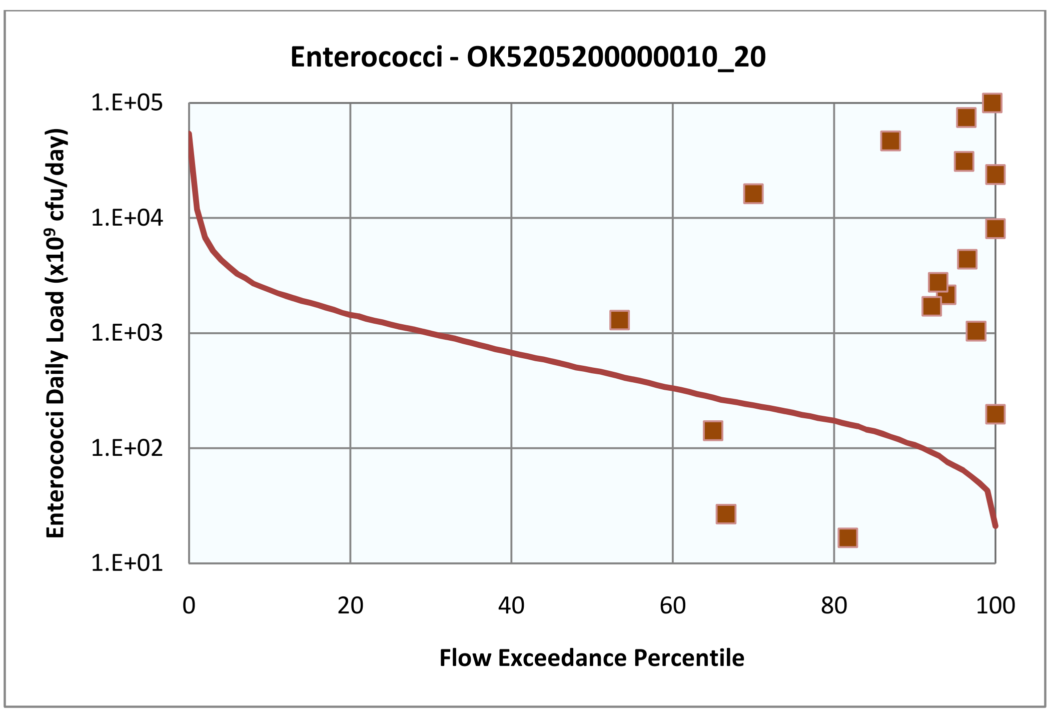


Figure 5-5 Load Duration Curve for Enterococci in North Canadian River (OK520520000010_30)

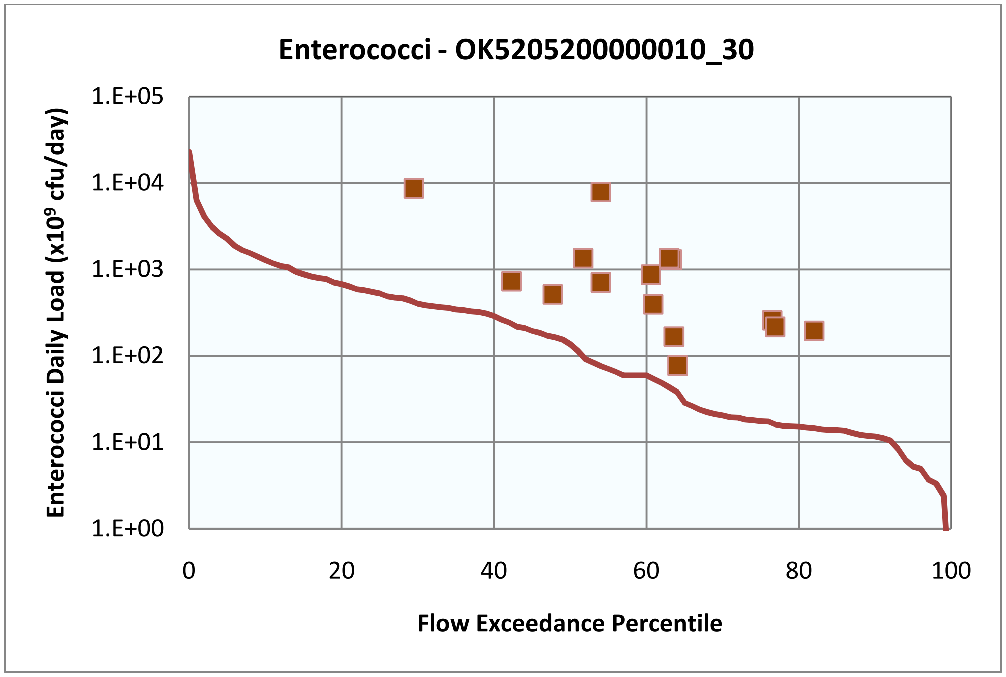


Figure 5-6 Load Duration Curve for Enterococci in North Canadian River (OK520520000010_40)

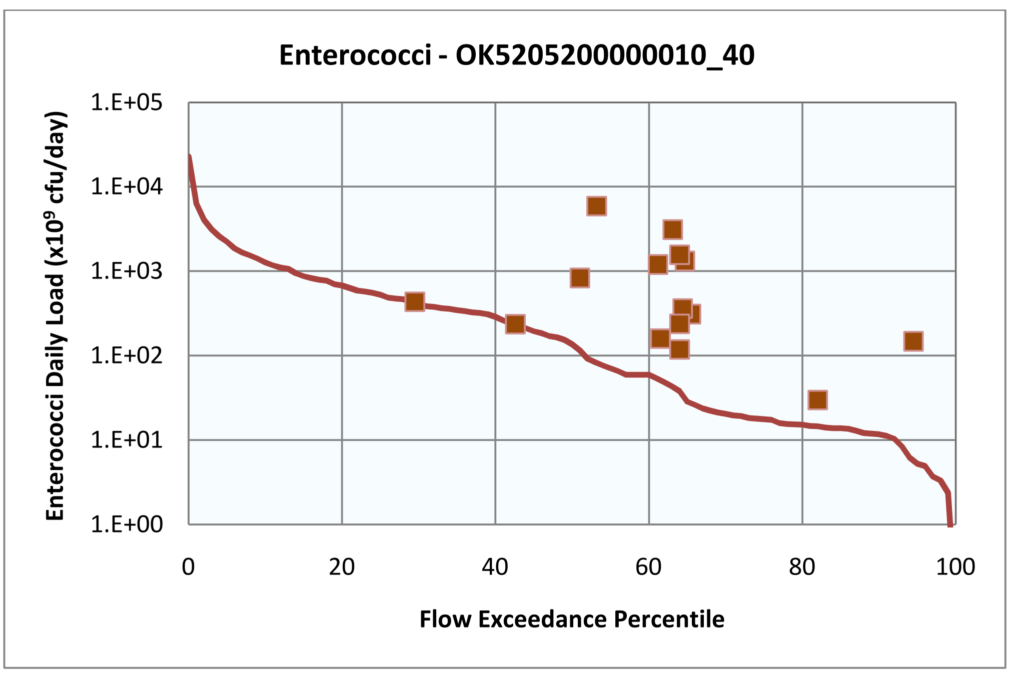


Figure 5-7 Load Duration Curve for Enterococci in North Canadian River (OK520520000210_00)

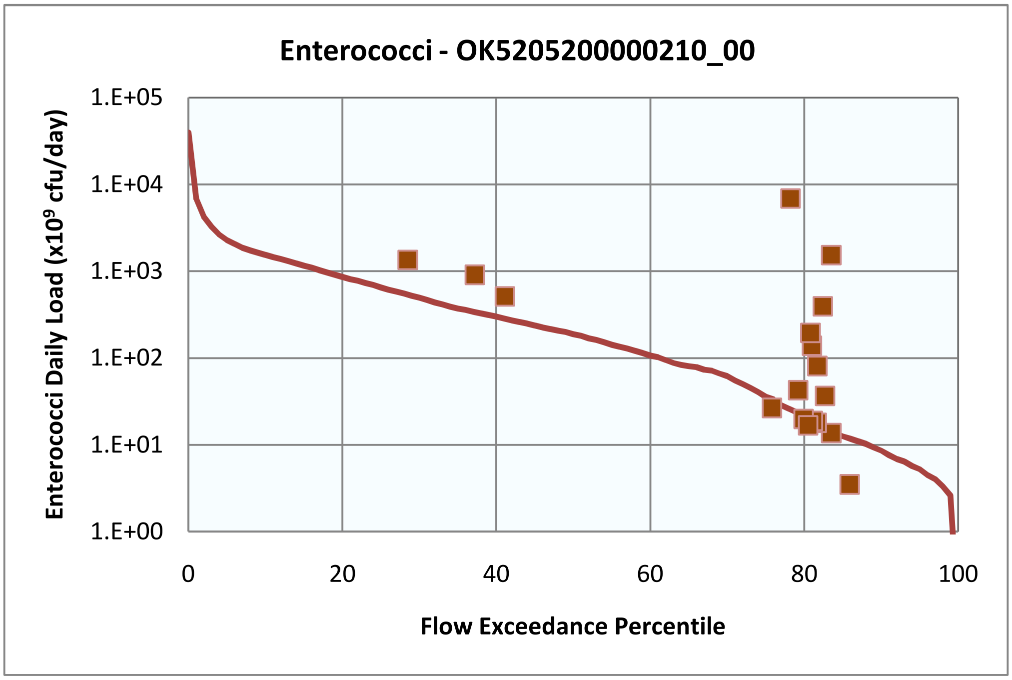


Figure 5-8 Load Duration Curve for Fecal Coliform in North Canadian River (OK520520000250_00)

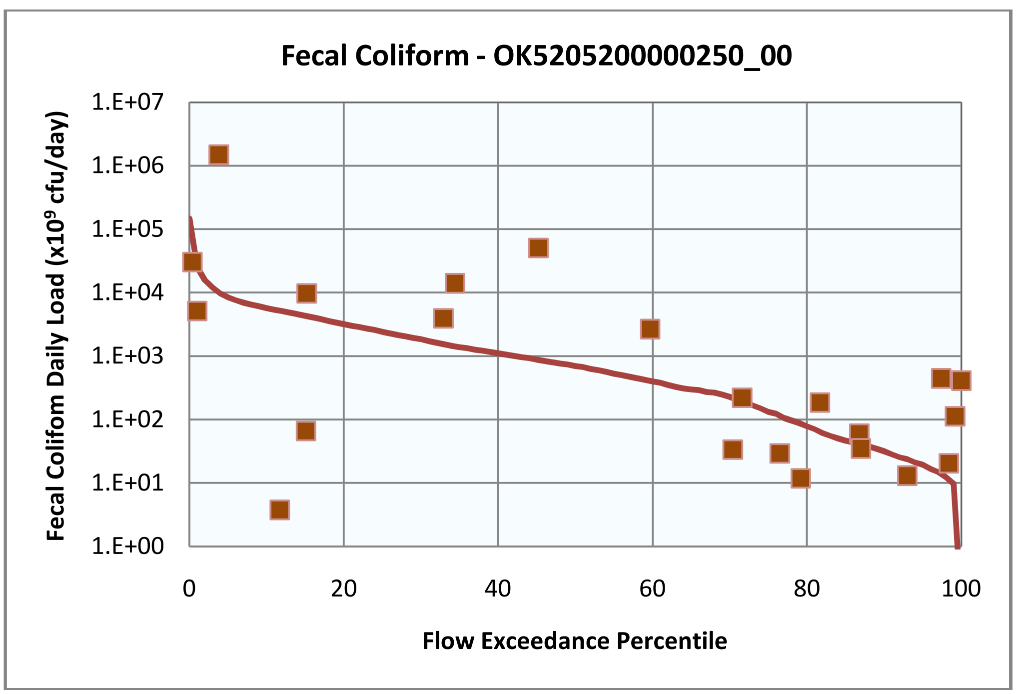


Figure 5-9 Load Duration Curve for Fecal Coliform in Crutcho Creek (OK520520000070_00)

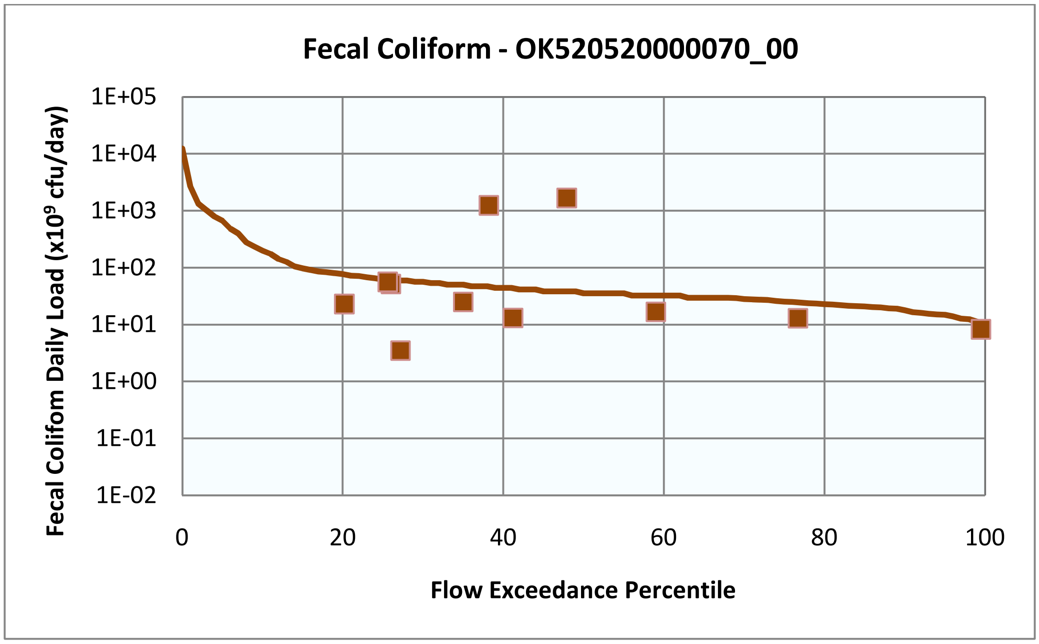


Figure 5-10 Load Duration Curve for Fecal Coliform in Crooked Oak Creek (OK520520000150_00)

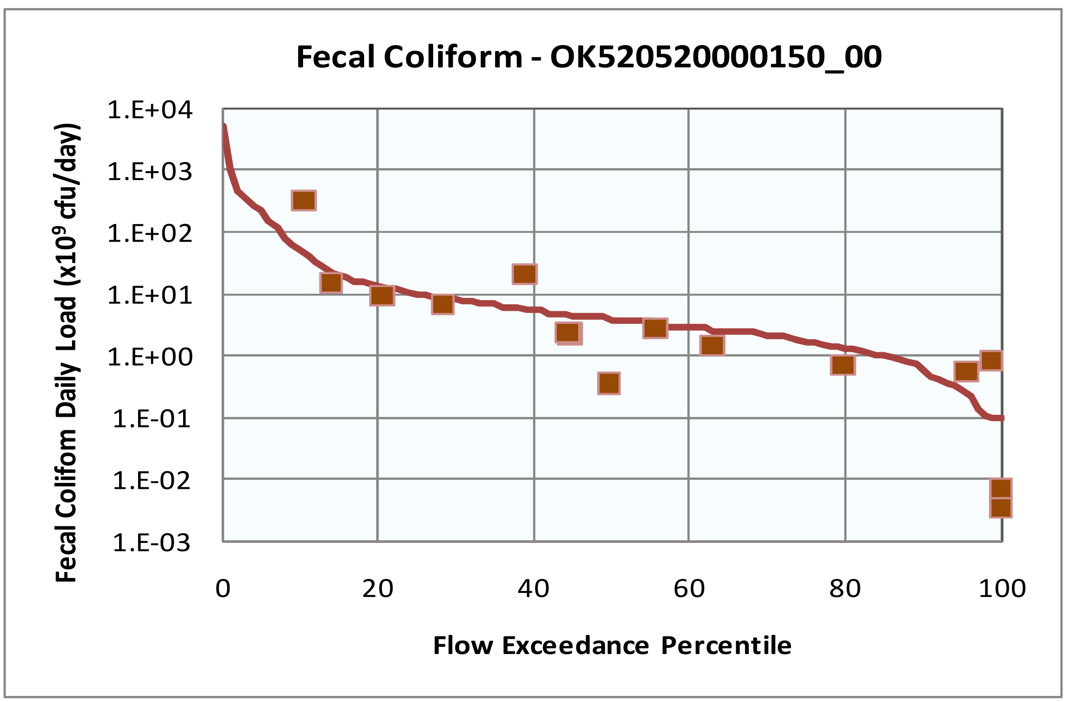
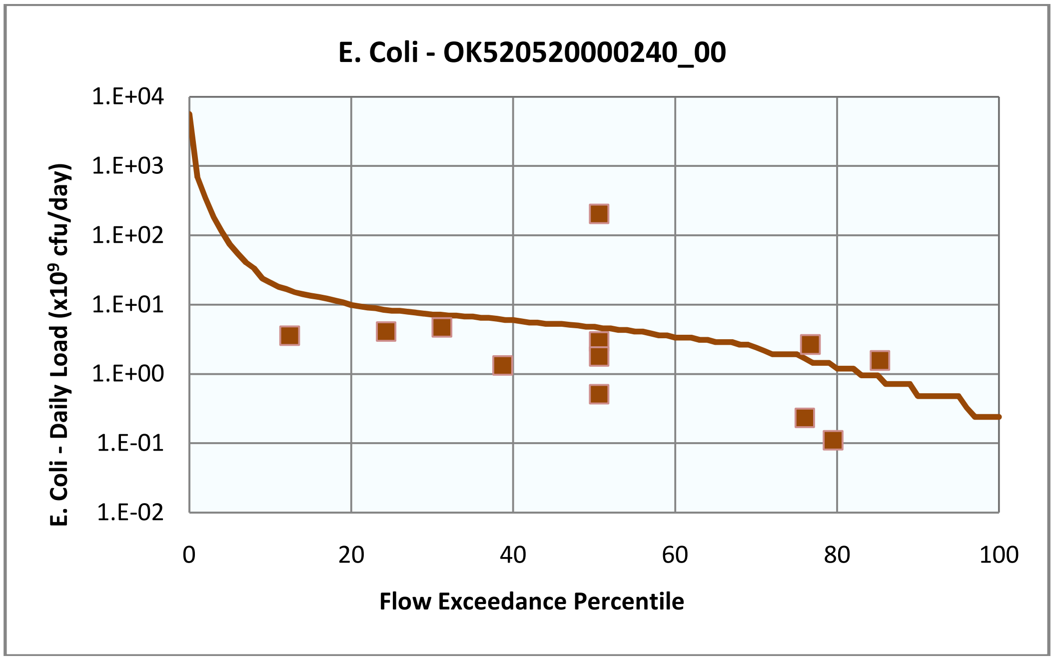


Figure 5-11 Load Duration Curve for E. Coli in Mustang Creek (OK520520000240_00)



5.2 Wasteload Allocation

NPDES-permitted facilities are allocated a daily wasteload calculated as their permitted daily average discharge flow rate multiplied by the geometric mean 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 North 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 stream segment, then the WLA is zero. Compliance with the WLA will be achieved by adhering to the fecal coliform limits and disinfection requirements of NPDES permits. Table 5-2 indicates which point source dischargers within Oklahoma currently have a disinfection requirement in their permit. Certain facilities that utilize lagoons for treatment have not been required to provide disinfection since storage time and exposure to ultraviolet radiation from sunlight should reduce bacteria levels. In the future, all point source dischargers which are assigned a wasteload allocation but do not currently have a bacteria limit in their permit will receive a permit limit consistent with the wasteload allocation as their permits are reissued. These TMDLs represent a continuum of desired loads over all flow conditions, rather than fixed at a single value, because loading capacity varies as a function of the flow present in the stream. Regardless of the magnitude of the WLA calculated in these TMDLs, future new discharges of bacteria or increased bacteria load from existing discharges will be considered consistent with the TMDL provided that NPDES permit requires instream criteria to be met.

Table 5-2 Wasteload Allocations for NPDES-Permitted Facilities

Waterbody ID	Name	NPDES Permit No.	Design Flow (mgd)	Dis-infection	Wasteload Allocation (cfu/day)		
					Fecal Coliform	*E. Coli*	Enterococci
OK520520000110_20 North Canadian River	MCLOUD PWA	OK0029009	0.7	Y	5.30E+09	3.34E+09	8.74E+08
OK520520000110_20 North Canadian River	HARRAH PWA	OK0038482	0.95	Y	7.19E+09	4.53E+09	1.19E+09
OK520520000010_10 North Canadian River	OKLA CITY - DUNJEE PARK	OK0030520	0.195	Y	1.48E+09	9.30E+08	2.44E+08
OK520520000010_10 North Canadian River	JONES PWA	OK0030996	0.252	Y	1.91E+09	1.20E+09	3.15E+08
OK520520000010_10 North Canadian River	CHOCTAW UTILITIES AUTHORITY	OK0037834	1	Y	7.57E+09	4.77E+09	1.25E+09
OK520520000010_20 North Canadian River	OKLA CITY - NORTH CANADIA	OK0036978	80	Y	6.06E+11	3.82E+11	9.99E+10
OK520520000010_20 North Canadian River	SPENCER, CITY OF	OK0022535	0.48	Y	3.63E+09	2.29E+09	6.00E+08
OK520520000010_30 North Canadian River	DEL CITY	OK0026085	2.86	Y	2.17E+10	1.36E+10	3.57E+09
OK520520000010_30 North Canadian River	MIDWEST CITY	OK0026841	12	Y	9.08E+10	5.72E+10	1.50E+10
OK520520000150_00 Crooked Oak Creek	VALLEY BROOK	OK0032239	0.47	Y	3.56E+09	2.24E+09	5.87E+08
OK520520000250_00 North Canadian River	HOLLIDAY OUTT MHP	OK0039136	0.0125	N	9.46E+07	5.96E+07	1.56E+07
OK520520000250_00 North Canadian River	LAKEVIEW TERRACE MHP	OKG580019	0.05	N	3.79E+08	2.38E+08	6.25E+07

Permitted stormwater discharges are considered point sources. The WLA calculations for MS4s must be expressed as different maximum loads allowable under different flow conditions. Therefore the percentage of a watershed that is under a MS4 jurisdictional is used to estimate the amount of the overall LA that should be dedicated as the MS4 contribution. Most of the study areas are located within urbanized municipal boundaries except for North

Canadian River (OK520520000110_20 & OK520520000010_00). The flow dependent calculations for the WLA established for the MS4s are provided in Tables 5-4 through 5-21.

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 stream segments are the result of a variety of nonpoint source loading. The LAs for each stream segment are calculated as the difference between the TMDL, MOS, and WLA for WWTP and MS4s as follows:

LA = TMDL – WLA_WWTP – WLA_MS4 - MOS

5.4 Seasonal Variability

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

5.5 Margin of Safety

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs include an MOS. The MOS is a conservative measure incorporated into the TMDL equation that accounts for lack of knowledge associated with calculating the allowable pollutant loading to ensure WQS 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 lack of knowledge, then the MOS is considered explicit.

An explicit Margin of Safety of 10% was selected in this TMDL report. This MOS was applied by setting the water quality target 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.

5.6 TMDL Calculations

The bacteria TMDLs for the 303(d)-listed stream segments 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 lack of knowledge concerning the relationship between effluent limitations and water quality.

This definition can be expressed by the following equation:

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

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

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

For each stream segment the TMDLs presented in this report are expressed as a percent reduction across the full range of flow conditions. The TMDL, WLA, LA, and MOS will vary with flow condition, and are calculated at every 5^{th} flow interval percentile (Tables 5-4 through 5-14). For illustrative purposes, the TMDL, WLA, LA, and MOS calculated for the median flow at each site are presented in Table 5-3.

The LDC and the equation of:

Average LA = average TMDL – MOS – WLA_WWTP - WLA_MS4

can provide an individual value for the LA in counts per day, which represents the area under the TMDL target line and above the WLA line. For MS4s the load reduction will be the same as the PRG established for the LA (nonpoint sources). The stormwater permit holders are not required by the TMDL to achieve the total load reduction to restore water quality standards. Instead, they are responsible only for their own contributions. Where there are no continuous point sources the WLA is zero. The LDCs and TMDL calculations for additional bacterial indicators are provided in Subsection 5.7.

Table 5-3 TMDL Summary Examples

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria Species	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4† (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
NC-08	OK520510000110_20	N. Canadian River	ENT	6.82E+11	2.06E+09	9.62E+10	5.15E+11	6.82E+10
520510000110-001AT	OK520520000010_00	N. Canadian River	FC	2.74E+12	0	0	2.47E+12	2.74E+11
NC-07	OK520520000010_10	N. Canadian River	ENT	7.40E+11	1.81E+09	4.46E+11	2.18E+11	7.40E+10
NC-06	OK520520000010_20	N. Canadian River	ENT	5.26E+11	1.01E+11	3.41E+11	3.13E+10	5.26E+10
NC-05	OK520520000010_30	N. Canadian River	ENT	1.51E+11	1.86E+10	1.17E+11	0	1.51E+10
NC-04	OK520520000010_40	N. Canadian River	ENT	1.51E+11	0	1.36E+11	0	1.51E+10
NC-03	OK520520000210_00	N. Canadian River	ENT	2.09E+11	0	1.88E+11	0	2.09E+10
USGS07241000	OK520520000250_00	N. Canadian River	FC	7.73E+11	4.73E+08	6.95E+11	0	7.73E+10
OK520520-00-0070G OK520520-00-0070B	OK520520000070_00	Crutcho Creek	FC	3.95E+10	0	3.55E+10	0	3.95E+09
OK520520-00-0150G & WCNCE450	OK520520000150_00	Crooked Oak Creek	FC	4.00E+09	3.56E+09	4.13E+07	0	4.00E+08
WCNCW654 & OK520520-00-0240G	OK520520000240_00	Mustang Creek	EC	5.32E+09	0	4.79E+09	0	5.32E+08

† Derived for illustrative purposes at the median flow value

Table 5-4 Enterococci TMDL Calculations for North Canadian River (OK520510000110_20)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	16600.00	4.39E+13	2.06E+09	6.21E+12	3.33E+13	4.39E+12
5	1784.50	4.72E+12	2.06E+09	6.67E+11	3.57E+12	4.72E+11
10	1059.00	2.80E+12	2.06E+09	3.96E+11	2.12E+12	2.80E+11
15	811.40	2.14E+12	2.06E+09	3.03E+11	1.62E+12	2.14E+11
20	660.80	1.75E+12	2.06E+09	2.47E+11	1.32E+12	1.75E+11
25	557.00	1.47E+12	2.06E+09	2.08E+11	1.11E+12	1.47E+11
30	472.70	1.25E+12	2.06E+09	1.76E+11	9.46E+11	1.25E+11
35	400.15	1.06E+12	2.06E+09	1.49E+11	8.00E+11	1.06E+11
40	348.00	9.20E+11	2.06E+09	1.30E+11	6.96E+11	9.20E+10
45	305.00	8.06E+11	2.06E+09	1.14E+11	6.10E+11	8.06E+10
50	258.00	6.82E+11	2.06E+09	9.62E+10	5.15E+11	6.82E+10
55	228.00	6.02E+11	2.06E+09	8.49E+10	4.55E+11	6.02E+10
60	201.00	5.31E+11	2.06E+09	7.48E+10	4.01E+11	5.31E+10
65	183.00	4.84E+11	2.06E+09	6.81E+10	3.65E+11	4.84E+10
70	168.00	4.44E+11	2.06E+09	6.25E+10	3.35E+11	4.44E+10
75	153.00	4.04E+11	2.06E+09	5.69E+10	3.05E+11	4.04E+10
80	138.00	3.65E+11	2.06E+09	5.13E+10	2.75E+11	3.65E+10
85	122.00	3.22E+11	2.06E+09	4.53E+10	2.43E+11	3.22E+10
90	106.10	2.80E+11	2.06E+09	3.94E+10	2.11E+11	2.80E+10
95	86.00	2.27E+11	2.06E+09	3.18E+10	1.71E+11	2.27E+10
100	43.00	1.14E+11	2.06E+09	1.58E+10	8.44E+10	1.14E+10

Table 5-5 Fecal Coliform TMDL Calculations for North Canadian River (OK520520000010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	20000.00	1.96E+14	0	0	1.76E+14	1.96E+13
5	1785.50	1.75E+13	0	0	1.57E+13	1.75E+12
10	1170.00	1.14E+13	0	0	1.03E+13	1.14E+12
15	928.00	9.08E+12	0	0	8.17E+12	9.08E+11
20	757.20	7.41E+12	0	0	6.67E+12	7.41E+11
25	619.00	6.06E+12	0	0	5.45E+12	6.06E+11
30	519.00	5.08E+12	0	0	4.57E+12	5.08E+11
35	440.00	4.31E+12	0	0	3.88E+12	4.31E+11
40	371.00	3.63E+12	0	0	3.27E+12	3.63E+11
45	321.00	3.14E+12	0	0	2.83E+12	3.14E+11
50	280.00	2.74E+12	0	0	2.47E+12	2.74E+11
55	248.00	2.43E+12	0	0	2.18E+12	2.43E+11
60	220.00	2.15E+12	0	0	1.94E+12	2.15E+11
65	198.00	1.94E+12	0	0	1.74E+12	1.94E+11
70	179.00	1.75E+12	0	0	1.58E+12	1.75E+11
75	163.00	1.60E+12	0	0	1.44E+12	1.60E+11
80	147.00	1.44E+12	0	0	1.29E+12	1.44E+11
85	131.00	1.28E+12	0	0	1.15E+12	1.28E+11
90	112.00	1.10E+12	0	0	9.86E+11	1.10E+11
95	88.00	8.61E+11	0	0	7.75E+11	8.61E+10
100	42.00	4.11E+11	0	0	3.70E+11	4.11E+10

Table 5-6 Enterococci TMDL Calculations for North Canadian River (OK520520000010_10)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	20000.00	5.28E+13	1.81E+09	3.20E+13	1.56E+13	5.28E+12
5	1785.50	4.72E+12	1.81E+09	2.85E+12	1.39E+12	4.72E+11
10	1170.00	3.09E+12	1.81E+09	1.87E+12	9.13E+11	3.09E+11
15	928.00	2.45E+12	1.81E+09	1.48E+12	7.24E+11	2.45E+11
20	757.20	2.00E+12	1.81E+09	1.21E+12	5.90E+11	2.00E+11
25	619.00	1.64E+12	1.81E+09	9.88E+11	4.83E+11	1.64E+11
30	519.00	1.37E+12	1.81E+09	8.28E+11	4.04E+11	1.37E+11
35	440.00	1.16E+12	1.81E+09	7.02E+11	3.43E+11	1.16E+11
40	371.00	9.80E+11	1.81E+09	5.91E+11	2.89E+11	9.80E+10
45	321.00	8.48E+11	1.81E+09	5.12E+11	2.50E+11	8.48E+10
50	280.00	7.40E+11	1.81E+09	4.46E+11	2.18E+11	7.40E+10
55	248.00	6.55E+11	1.81E+09	3.95E+11	1.93E+11	6.55E+10
60	220.00	5.81E+11	1.81E+09	3.50E+11	1.71E+11	5.81E+10
65	198.00	5.23E+11	1.81E+09	3.15E+11	1.54E+11	5.23E+10
70	179.00	4.73E+11	1.81E+09	2.85E+11	1.39E+11	4.73E+10
75	163.00	4.31E+11	1.81E+09	2.59E+11	1.27E+11	4.31E+10
80	147.00	3.88E+11	1.81E+09	2.34E+11	1.14E+11	3.88E+10
85	131.00	3.46E+11	1.81E+09	2.08E+11	1.02E+11	3.46E+10
90	112.00	2.96E+11	1.81E+09	1.78E+11	8.68E+10	2.96E+10
95	88.00	2.33E+11	1.81E+09	1.39E+11	6.81E+10	2.33E+10
100	42.00	1.11E+11	1.81E+09	6.59E+10	3.22E+10	1.11E+10

Table 5-7 Enterococci TMDL Calculations for North Canadian River (OK520520000010_20)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	22700.00	6.00E+13	1.01E+11	4.94E+13	4.53E+12	6.00E+12
5	1570.00	4.15E+12	1.01E+11	3.33E+12	3.05E+11	4.15E+11
10	994.00	2.63E+12	1.01E+11	2.07E+12	1.90E+11	2.63E+11
15	771.90	2.04E+12	1.01E+11	1.59E+12	1.46E+11	2.04E+11
20	606.00	1.60E+12	1.01E+11	1.23E+12	1.13E+11	1.60E+11
25	500.00	1.32E+12	1.01E+11	9.97E+11	9.14E+10	1.32E+11
30	416.00	1.10E+12	1.01E+11	8.14E+11	7.47E+10	1.10E+11
35	346.00	9.14E+11	1.01E+11	6.62E+11	6.07E+10	9.14E+10
40	284.00	7.50E+11	1.01E+11	5.27E+11	4.83E+10	7.50E+10
45	239.00	6.32E+11	1.01E+11	4.29E+11	3.93E+10	6.32E+10
50	199.00	5.26E+11	1.01E+11	3.41E+11	3.13E+10	5.26E+10
55	167.00	4.41E+11	1.01E+11	2.72E+11	2.49E+10	4.41E+10
60	139.00	3.67E+11	1.01E+11	2.11E+11	1.93E+10	3.67E+10
65	116.00	3.07E+11	1.01E+11	1.61E+11	1.47E+10	3.07E+10
70	99.00	2.62E+11	1.01E+11	1.24E+11	1.13E+10	2.62E+10
75	85.00	2.25E+11	1.01E+11	9.31E+10	8.53E+09	2.25E+10
80	73.00	1.93E+11	1.01E+11	6.69E+10	6.14E+09	1.93E+10
85	59.00	1.56E+11	1.01E+11	3.64E+10	3.34E+09	1.56E+10
90	45.00	1.19E+11	1.01E+11	5.93E+09	5.44E+08	1.19E+10
95	29.35	1.01E+11	1.01E+11	0.00E+00	0.00E+00	1.01E+10
100	8.90	1.01E+11	1.01E+11	0.00E+00	0.00E+00	1.01E+10

Table 5-8 Enterococci TMDL Calculations for North Canadian River (OK520520000010_30)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	9590.00	2.53E+13	1.86E+10	2.28E+13	0	2.53E+12
5	944.20	2.49E+12	1.86E+10	2.23E+12	0	2.49E+11
10	535.30	1.41E+12	1.86E+10	1.25E+12	0	1.41E+11
15	367.90	9.72E+11	1.86E+10	8.56E+11	0	9.72E+10
20	284.80	7.53E+11	1.86E+10	6.59E+11	0	7.53E+10
25	221.75	5.86E+11	1.86E+10	5.09E+11	0	5.86E+10
30	168.80	4.46E+11	1.86E+10	3.83E+11	0	4.46E+10
35	145.05	3.83E+11	1.86E+10	3.26E+11	0	3.83E+10
40	121.20	3.20E+11	1.86E+10	2.70E+11	0	3.20E+10
45	82.00	2.17E+11	1.86E+10	1.76E+11	0	2.17E+10
50	57.00	1.51E+11	1.86E+10	1.17E+11	0	1.51E+10
55	29.65	7.83E+10	1.86E+10	5.19E+10	0	7.83E+09
60	25.00	6.61E+10	1.86E+10	4.09E+10	0	6.61E+09
65	12.00	3.17E+10	1.86E+10	9.97E+09	0	3.17E+09
70	8.60	2.27E+10	1.86E+10	1.89E+09	0	2.27E+09
75	7.40	1.96E+10	1.86E+10	9.90E+08	0	0
80	6.40	1.86E+10	1.86E+10	0	0	0
85	5.80	1.86E+10	1.86E+10	0	0	0
90	4.90	1.86E+10	1.86E+10	0	0	0
95	2.20	1.86E+10	1.86E+10	0	0	0
100	0.00	1.86E+10	1.86E+10	0	0	0

Table 5-9 Enterococci TMDL Calculations for North Canadian River (OK520520000010_40)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	9590.00	2.53E+13	0.00E+00	2.28E+13	0.00E+00	2.53E+12
5	944.20	2.49E+12	0.00E+00	2.25E+12	0.00E+00	2.49E+11
10	535.30	1.41E+12	0.00E+00	1.27E+12	0.00E+00	1.41E+11
15	367.90	9.72E+11	0.00E+00	8.75E+11	0.00E+00	9.72E+10
20	284.80	7.53E+11	0.00E+00	6.77E+11	0.00E+00	7.53E+10
25	221.75	5.86E+11	0.00E+00	5.27E+11	0.00E+00	5.86E+10
30	168.80	4.46E+11	0.00E+00	4.01E+11	0.00E+00	4.46E+10
35	145.05	3.83E+11	0.00E+00	3.45E+11	0.00E+00	3.83E+10
40	121.20	3.20E+11	0.00E+00	2.88E+11	0.00E+00	3.20E+10
45	82.00	2.17E+11	0.00E+00	1.95E+11	0.00E+00	2.17E+10
50	57.00	1.51E+11	0.00E+00	1.36E+11	0.00E+00	1.51E+10
55	29.65	7.83E+10	0.00E+00	7.05E+10	0.00E+00	7.83E+09
60	25.00	6.61E+10	0.00E+00	5.95E+10	0.00E+00	6.61E+09
65	12.00	3.17E+10	0.00E+00	2.85E+10	0.00E+00	3.17E+09
70	8.60	2.27E+10	0.00E+00	2.05E+10	0.00E+00	2.27E+09
75	7.40	1.96E+10	0.00E+00	1.76E+10	0.00E+00	1.96E+09
80	6.40	1.69E+10	0.00E+00	1.52E+10	0.00E+00	1.69E+09
85	5.80	1.53E+10	0.00E+00	1.38E+10	0.00E+00	1.53E+09
90	4.90	1.29E+10	0.00E+00	1.17E+10	0.00E+00	1.29E+09
95	2.20	5.81E+09	0.00E+00	5.23E+09	0.00E+00	5.81E+08
100	0.00	2.64E+06	0.00E+00	2.38E+06	0.00E+00	2.64E+05

Table 5-10 Enterococci TMDL Calculations for North Canadian River (OK520520000210_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	16600.00	4.39E+13	0	3.95E+13	0	4.39E+12
5	961.80	2.54E+12	0	2.29E+12	0	2.54E+11
10	647.60	1.71E+12	0	1.54E+12	0	1.71E+11
15	488.80	1.29E+12	0	1.16E+12	0	1.29E+11
20	362.00	9.57E+11	0	8.61E+11	0	9.57E+10
25	273.00	7.21E+11	0	6.49E+11	0	7.21E+10
30	208.80	5.52E+11	0	4.97E+11	0	5.52E+10
35	156.00	4.12E+11	0	3.71E+11	0	4.12E+10
40	126.00	3.33E+11	0	3.00E+11	0	3.33E+10
45	100.00	2.64E+11	0	2.38E+11	0	2.64E+10
50	79.00	2.09E+11	0	1.88E+11	0	2.09E+10
55	60.00	1.59E+11	0	1.43E+11	0	1.59E+10
60	45.00	1.19E+11	0	1.07E+11	0	1.19E+10
65	34.00	8.98E+10	0	8.09E+10	0	8.98E+09
70	26.00	6.87E+10	0	6.18E+10	0	6.87E+09
75	15.00	3.96E+10	0	3.57E+10	0	3.96E+09
80	8.90	2.35E+10	0	2.12E+10	0	2.35E+09
85	5.30	1.40E+10	0	1.26E+10	0	1.40E+09
90	3.60	9.51E+09	0	8.56E+09	0	9.51E+08
95	2.20	5.81E+09	0	5.23E+09	0	5.81E+08
100	0.00	2.64E+06	0	2.38E+06	0	2.64E+05

Table 5-11 Fecal Coliform TMDL Calculations for North Canadian River (OK520520000250_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	16600.00	1.62E+14	4.73E+08	1.46E+14	0	1.62E+13
5	961.80	9.41E+12	4.73E+08	8.47E+12	0	9.41E+11
10	647.60	6.34E+12	4.73E+08	5.70E+12	0	6.34E+11
15	488.80	4.78E+12	4.73E+08	4.30E+12	0	4.78E+11
20	362.00	3.54E+12	4.73E+08	3.19E+12	0	3.54E+11
25	273.00	2.67E+12	4.73E+08	2.40E+12	0	2.67E+11
30	208.80	2.04E+12	4.73E+08	1.84E+12	0	2.04E+11
35	156.00	1.53E+12	4.73E+08	1.37E+12	0	1.53E+11
40	126.00	1.23E+12	4.73E+08	1.11E+12	0	1.23E+11
45	100.00	9.79E+11	4.73E+08	8.80E+11	0	9.79E+10
50	79.00	7.73E+11	4.73E+08	6.95E+11	0	7.73E+10
55	60.00	5.87E+11	4.73E+08	5.28E+11	0	5.87E+10
60	45.00	4.40E+11	4.73E+08	3.96E+11	0	4.40E+10
65	34.00	3.33E+11	4.73E+08	2.99E+11	0	3.33E+10
70	26.00	2.54E+11	4.73E+08	2.29E+11	0	2.54E+10
75	15.00	1.47E+11	4.73E+08	1.32E+11	0	1.47E+10
80	8.90	8.71E+10	4.73E+08	7.79E+10	0	8.71E+09
85	5.30	5.19E+10	4.73E+08	4.62E+10	0	5.19E+09
90	3.60	3.52E+10	4.73E+08	3.12E+10	0	3.52E+09
95	2.20	2.15E+10	4.73E+08	1.89E+10	0	2.15E+09
100	0.00	0	0	0	0	0

Table 5-12 Fecal Coliform TMDL Calculations for Crutcho Creek (OK520520000070_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	1410.94	1.38E+13	0	1.24E+13	0	1.38E+12
5	76.26	7.46E+11	0	6.72E+11	0	7.46E+10
10	22.41	2.19E+11	0	1.97E+11	0	2.19E+10
15	11.09	1.08E+11	0	9.76E+10	0	1.08E+10
20	8.73	8.55E+10	0	7.69E+10	0	8.55E+09
25	7.05	6.90E+10	0	6.21E+10	0	6.90E+09
30	6.38	6.25E+10	0	5.62E+10	0	6.25E+09
35	5.71	5.59E+10	0	5.03E+10	0	5.59E+09
40	5.04	4.93E+10	0	4.44E+10	0	4.93E+09
45	4.37	4.27E+10	0	3.85E+10	0	4.27E+09
50	4.03	3.95E+10	0	3.55E+10	0	3.95E+09
55	4.03	3.95E+10	0	3.55E+10	0	3.95E+09
60	3.70	3.62E+10	0	3.25E+10	0	3.62E+09
65	3.36	3.29E+10	0	2.96E+10	0	3.29E+09
70	3.19	3.12E+10	0	2.81E+10	0	3.12E+09
75	2.86	2.79E+10	0	2.52E+10	0	2.79E+09
80	2.59	2.53E+10	0	2.28E+10	0	2.53E+09
85	2.35	2.30E+10	0	2.07E+10	0	2.30E+09
90	2.02	1.97E+10	0	1.78E+10	0	1.97E+09
95	1.68	1.64E+10	0	1.48E+10	0	1.64E+09
100	0.71	6.90E+09	0	6.21E+09	0	6.90E+08

Table 5-13 Fecal Coliform TMDL Calculations for Crooked Oak Creek (OK520520000150_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	577.14	5.65E+12	3.56E+09	5.08E+12	0	5.65E+11
5	24.92	2.44E+11	3.56E+09	2.16E+11	0	2.44E+10
10	5.75	5.63E+10	3.56E+09	4.71E+10	0	5.63E+09
15	2.22	2.18E+10	3.56E+09	1.60E+10	0	2.18E+09
20	1.56	1.53E+10	3.56E+09	1.02E+10	0	1.53E+09
25	1.12	1.09E+10	3.56E+09	6.28E+09	0	1.09E+09
30	0.95	9.27E+09	3.56E+09	4.78E+09	0	9.27E+08
35	0.78	7.67E+09	3.56E+09	3.34E+09	0	7.67E+08
40	0.63	6.14E+09	3.56E+09	1.96E+09	0	6.14E+08
45	0.48	4.69E+09	3.56E+09	6.60E+08	0	4.69E+08
50	0.41	4.00E+09	3.56E+09	4.13E+07	0	4.00E+08
55	0.41	4.00E+09	3.56E+09	4.13E+07	0	4.00E+08
60	0.34	3.56E+09	3.56E+09	0	0	0
65	0.28	3.56E+09	3.56E+09	0	0	0
70	0.25	3.56E+09	3.56E+09	0	0	0
75	0.19	3.56E+09	3.56E+09	0	0	0
80	0.15	3.56E+09	3.56E+09	0	0	0
85	0.11	3.56E+09	3.56E+09	0	0	0
90	0.07	3.56E+09	3.56E+09	0	0	0
95	0.03	3.56E+09	3.56E+09	0	0	0
100	0.00	3.56E+09	3.56E+09	0	0	0

Table 5-14 E. coli TMDL Calculations for Mustang Creek (OK520520000240_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	629.71	6.25E+12	0	5.63E+12	0	6.25E+11
5	8.31	8.25E+10	0	7.43E+10	0	8.25E+09
10	2.33	2.32E+10	0	2.09E+10	0	2.32E+09
15	1.50	1.49E+10	0	1.34E+10	0	1.49E+09
20	1.10	1.10E+10	0	9.87E+09	0	1.10E+09
25	0.91	9.05E+09	0	8.14E+09	0	9.05E+08
30	0.80	7.99E+09	0	7.19E+09	0	7.99E+08
35	0.75	7.45E+09	0	6.71E+09	0	7.45E+08
40	0.67	6.65E+09	0	5.99E+09	0	6.65E+08
45	0.59	5.86E+09	0	5.27E+09	0	5.86E+08
50	0.54	5.32E+09	0	4.79E+09	0	5.32E+08
55	0.46	4.52E+09	0	4.07E+09	0	4.52E+08
60	0.38	3.73E+09	0	3.35E+09	0	3.73E+08
65	0.32	3.19E+09	0	2.87E+09	0	3.19E+08
70	0.27	2.66E+09	0	2.40E+09	0	2.66E+08
75	0.21	2.13E+09	0	1.92E+09	0	2.13E+08
80	0.13	1.33E+09	0	1.20E+09	0	1.33E+08
85	0.11	1.06E+09	0	9.58E+08	0	1.06E+08
90	0.05	5.32E+08	0	4.79E+08	0	5.32E+07
95	0.05	5.32E+08	0	4.79E+08	0	5.32E+07
100	0.03	2.66E+08	0	2.40E+08	0	2.66E+07

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 5-12 through 5-18 and Tables 5-15 through 5-21, respectively.

Figure 5-12 Load Duration Curve for Enterococci in North Canadian River (OK520520000010_00)

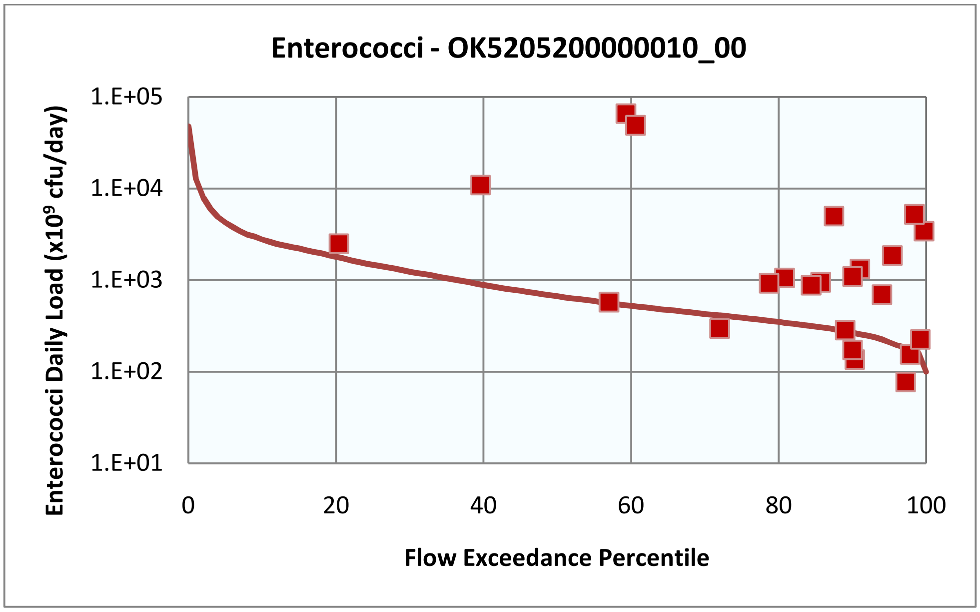


Table 5-15 Enterococci TMDL Calculations for North Canadian River (OK520520000010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	20000.00	5.28E+13	0	0	4.76E+13	5.28E+12
5	1785.50	4.72E+12	0	0	4.25E+12	4.72E+11
10	1170.00	3.09E+12	0	0	2.78E+12	3.09E+11
15	928.00	2.45E+12	0	0	2.21E+12	2.45E+11
20	757.20	2.00E+12	0	0	1.80E+12	2.00E+11
25	619.00	1.64E+12	0	0	1.47E+12	1.64E+11
30	519.00	1.37E+12	0	0	1.23E+12	1.37E+11
35	440.00	1.16E+12	0	0	1.05E+12	1.16E+11
40	371.00	9.80E+11	0	0	8.82E+11	9.80E+10
45	321.00	8.48E+11	0	0	7.63E+11	8.48E+10
50	280.00	7.40E+11	0	0	6.66E+11	7.40E+10
55	248.00	6.55E+11	0	0	5.90E+11	6.55E+10
60	220.00	5.81E+11	0	0	5.23E+11	5.81E+10
65	198.00	5.23E+11	0	0	4.71E+11	5.23E+10
70	179.00	4.73E+11	0	0	4.26E+11	4.73E+10
75	163.00	4.31E+11	0	0	3.88E+11	4.31E+10
80	147.00	3.88E+11	0	0	3.50E+11	3.88E+10
85	131.00	3.46E+11	0	0	3.12E+11	3.46E+10
90	112.00	2.96E+11	0	0	2.66E+11	2.96E+10
95	88.00	2.33E+11	0	0	2.09E+11	2.33E+10
100	42.00	1.11E+11	0	0	9.99E+10	1.11E+10

Figure 5-13 Load Duration Curve for *Fecal Coliform* in North Canadian River (OK520520000010_10)

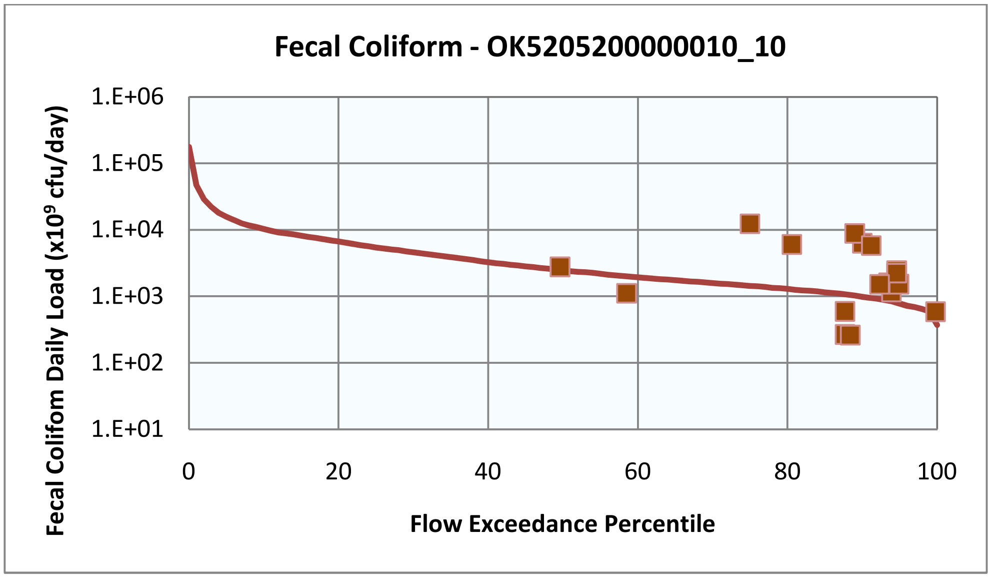


Table 5-16 Fecal Coliform TMDL Calculations for North Canadian River (OK520520000010_10)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	20000.00	1.96E+14	1.10E+10	1.18E+14	5.78E+13	1.96E+13
5	1785.50	1.75E+13	1.10E+10	1.06E+13	5.15E+12	1.75E+12
10	1170.00	1.14E+13	1.10E+10	6.92E+12	3.38E+12	1.14E+12
15	928.00	9.08E+12	1.10E+10	5.49E+12	2.68E+12	9.08E+11
20	757.20	7.41E+12	1.10E+10	4.47E+12	2.18E+12	7.41E+11
25	619.00	6.06E+12	1.10E+10	3.66E+12	1.78E+12	6.06E+11
30	519.00	5.08E+12	1.10E+10	3.06E+12	1.50E+12	5.08E+11
35	440.00	4.31E+12	1.10E+10	2.60E+12	1.27E+12	4.31E+11
40	371.00	3.63E+12	1.10E+10	2.19E+12	1.07E+12	3.63E+11
45	321.00	3.14E+12	1.10E+10	1.89E+12	9.24E+11	3.14E+11
50	280.00	2.74E+12	1.10E+10	1.65E+12	8.05E+11	2.74E+11
55	248.00	2.43E+12	1.10E+10	1.46E+12	7.13E+11	2.43E+11
60	220.00	2.15E+12	1.10E+10	1.29E+12	6.32E+11	2.15E+11
65	198.00	1.94E+12	1.10E+10	1.16E+12	5.68E+11	1.94E+11
70	179.00	1.75E+12	1.10E+10	1.05E+12	5.14E+11	1.75E+11
75	163.00	1.60E+12	1.10E+10	9.57E+11	4.67E+11	1.60E+11
80	147.00	1.44E+12	1.10E+10	8.63E+11	4.21E+11	1.44E+11
85	131.00	1.28E+12	1.10E+10	7.68E+11	3.75E+11	1.28E+11
90	112.00	1.10E+12	1.10E+10	6.56E+11	3.20E+11	1.10E+11
95	88.00	8.61E+11	1.10E+10	5.13E+11	2.51E+11	8.61E+10
100	42.00	4.11E+11	1.10E+10	2.41E+11	1.18E+11	4.11E+10

Figure 5-14 Load Duration Curve for *Fecal Coliform* in North Canadian River (OK520520000010_20)

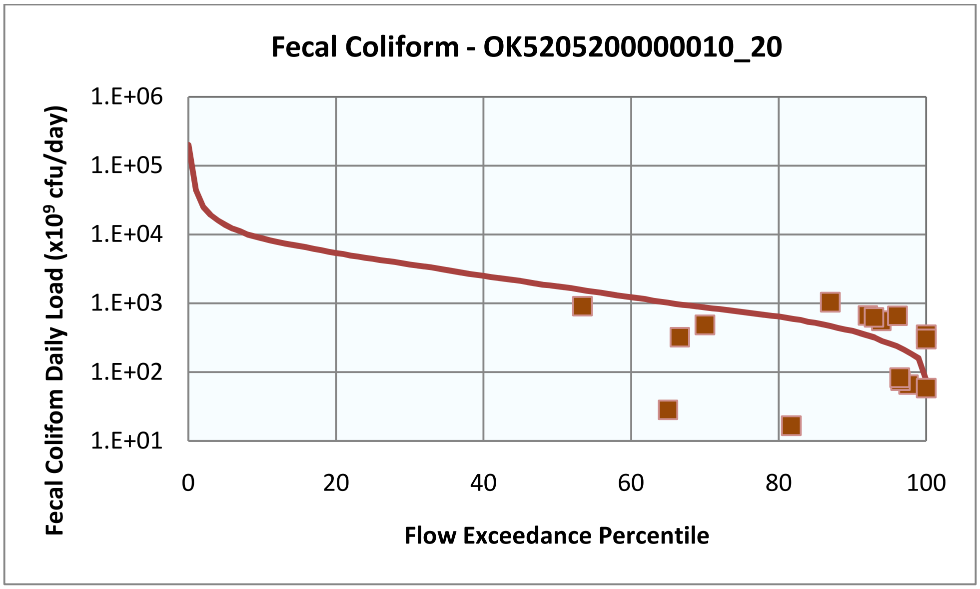


Table 5-17 Fecal Coliform TMDL Calculations for North Canadian River (OK520520000010_20)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	22700.00	2.22E+14	6.09E+11	1.83E+14	1.67E+13	2.22E+13
5	1570.00	1.54E+13	6.09E+11	1.21E+13	1.11E+12	1.54E+12
10	994.00	9.73E+12	6.09E+11	7.46E+12	6.84E+11	9.73E+11
15	771.90	7.55E+12	6.09E+11	5.67E+12	5.20E+11	7.55E+11
20	606.00	5.93E+12	6.09E+11	4.33E+12	3.97E+11	5.93E+11
25	500.00	4.89E+12	6.09E+11	3.48E+12	3.19E+11	4.89E+11
30	416.00	4.07E+12	6.09E+11	2.80E+12	2.57E+11	4.07E+11
35	346.00	3.39E+12	6.09E+11	2.23E+12	2.05E+11	3.39E+11
40	284.00	2.78E+12	6.09E+11	1.73E+12	1.59E+11	2.78E+11
45	239.00	2.34E+12	6.09E+11	1.37E+12	1.26E+11	2.34E+11
50	199.00	1.95E+12	6.09E+11	1.05E+12	9.60E+10	1.95E+11
55	167.00	1.63E+12	6.09E+11	7.89E+11	7.24E+10	1.63E+11
60	139.00	1.36E+12	6.09E+11	5.63E+11	5.17E+10	1.36E+11
65	116.00	1.14E+12	6.09E+11	3.78E+11	3.46E+10	1.14E+11
70	99.00	9.69E+11	6.09E+11	2.41E+11	2.21E+10	9.69E+10
75	85.00	8.32E+11	6.09E+11	1.28E+11	1.17E+10	8.32E+10
80	73.00	7.14E+11	6.09E+11	3.08E+10	2.83E+09	7.14E+10
85	59.00	6.09E+11	6.09E+11	0	0	0
90	45.00	6.09E+11	6.09E+11	0	0	0
95	29.35	6.09E+11	6.09E+11	0	0	0
100	8.90	6.09E+11	6.09E+11	0	0	0

Figure 5-15 Load Duration Curve for *Fecal Coliform* in North Canadian River (OK520520000010_30)

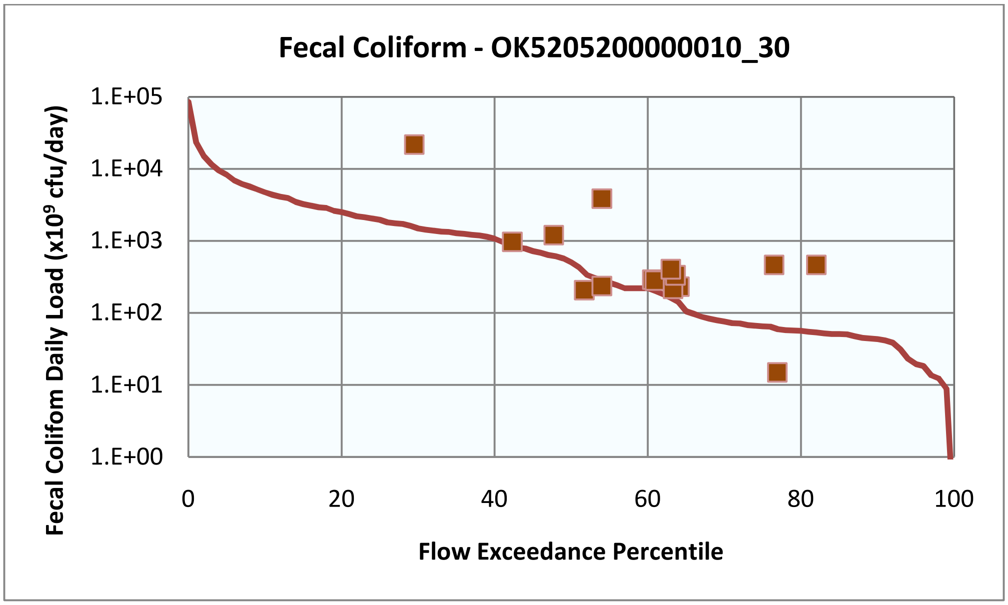


Table 5-18 Fecal Coliform TMDL Calculations for North Canadian River (OK520520000010_30)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	9590.00	9.39E+13	1.13E+11	8.44E+13	0	9.39E+12
5	944.20	9.24E+12	1.13E+11	8.20E+12	0	9.24E+11
10	535.30	5.24E+12	1.13E+11	4.60E+12	0	5.24E+11
15	367.90	3.60E+12	1.13E+11	3.13E+12	0	3.60E+11
20	284.80	2.79E+12	1.13E+11	2.40E+12	0	2.79E+11
25	221.75	2.17E+12	1.13E+11	1.84E+12	0	2.17E+11
30	168.80	1.65E+12	1.13E+11	1.37E+12	0	1.65E+11
35	145.05	1.42E+12	1.13E+11	1.17E+12	0	1.42E+11
40	121.20	1.19E+12	1.13E+11	9.55E+11	0	1.19E+11
45	82.00	8.02E+11	1.13E+11	6.10E+11	0	8.02E+10
50	57.00	5.58E+11	1.13E+11	3.90E+11	0	5.58E+10
55	29.65	2.90E+11	1.13E+11	1.49E+11	0	2.90E+10
60	25.00	2.45E+11	1.13E+11	1.08E+11	0	2.45E+10
65	12.00	1.17E+11	1.13E+11	0	0	0
70	8.60	1.13E+11	1.13E+11	0	0	0
75	7.40	1.13E+11	1.13E+11	0	0	0
80	6.40	1.13E+11	1.13E+11	0	0	0
85	5.80	1.13E+11	1.13E+11	0	0	0
90	4.90	1.13E+11	1.13E+11	0	0	0
95	2.20	1.13E+11	1.13E+11	0	0	0
100	0.00	1.13E+11	1.13E+11	0	0	0

Figure 5-16 Load Duration Curve for E. *Coli* in North Canadian River (OK520520000010_30)

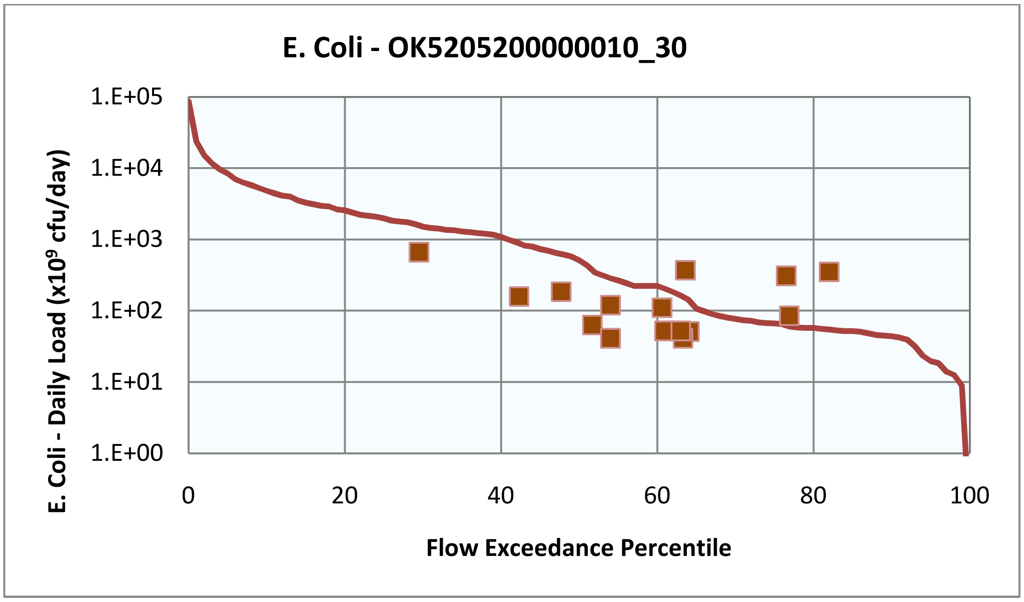


Table 5-19 E. Coli TMDL Calculations for North Canadian River (OK520520000010_30)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	9590.00	9.53E+13	7.09E+10	8.57E+13	0	9.53E+12
5	944.20	9.38E+12	7.09E+10	8.37E+12	0	9.38E+11
10	535.30	5.32E+12	7.09E+10	4.71E+12	0	5.32E+11
15	367.90	3.65E+12	7.09E+10	3.22E+12	0	3.65E+11
20	284.80	2.83E+12	7.09E+10	2.48E+12	0	2.83E+11
25	221.75	2.20E+12	7.09E+10	1.91E+12	0	2.20E+11
30	168.80	1.68E+12	7.09E+10	1.44E+12	0	1.68E+11
35	145.05	1.44E+12	7.09E+10	1.23E+12	0	1.44E+11
40	121.20	1.20E+12	7.09E+10	1.01E+12	0	1.20E+11
45	82.00	8.15E+11	7.09E+10	6.62E+11	0	8.15E+10
50	57.00	5.66E+11	7.09E+10	4.39E+11	0	5.66E+10
55	29.65	2.95E+11	7.09E+10	1.94E+11	0	2.95E+10
60	25.00	2.48E+11	7.09E+10	1.53E+11	0	2.48E+10
65	12.00	1.19E+11	7.09E+10	3.64E+10	0	1.19E+10
70	8.60	8.54E+10	7.09E+10	6.01E+09	0	8.54E+09
75	7.40	7.09E+10	7.09E+10	0	0	0
80	6.40	7.09E+10	7.09E+10	0	0	0
85	5.80	7.09E+10	7.09E+10	0	0	0
90	4.90	7.09E+10	7.09E+10	0	0	0
95	2.20	7.09E+10	7.09E+10	0	0	0
100	0.00	7.09E+10	7.09E+10	0	0	0

Figure 5-17 Load Duration Curve for *Fecal Coliform* in North Canadian River (OK520520000010_40)

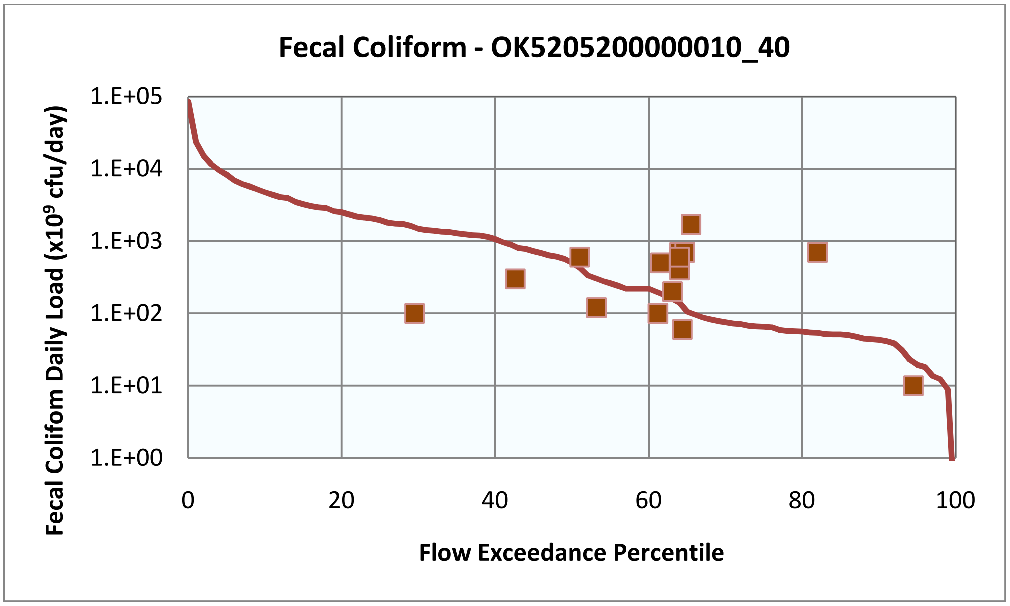


Table 5-20 Fecal Coliform TMDL Calculations for North Canadian River (OK520520000010_40)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	9590.00	9.39E+13	0	8.45E+13	0	9.39E+12
5	944.20	9.24E+12	0	8.32E+12	0	9.24E+11
10	535.30	5.24E+12	0	4.71E+12	0	5.24E+11
15	367.90	3.60E+12	0	3.24E+12	0	3.60E+11
20	284.80	2.79E+12	0	2.51E+12	0	2.79E+11
25	221.75	2.17E+12	0	1.95E+12	0	2.17E+11
30	168.80	1.65E+12	0	1.49E+12	0	1.65E+11
35	145.05	1.42E+12	0	1.28E+12	0	1.42E+11
40	121.20	1.19E+12	0	1.07E+12	0	1.19E+11
45	82.00	8.02E+11	0	7.22E+11	0	8.02E+10
50	57.00	5.58E+11	0	5.02E+11	0	5.58E+10
55	29.65	2.90E+11	0	2.61E+11	0	2.90E+10
60	25.00	2.45E+11	0	2.20E+11	0	2.45E+10
65	12.00	1.17E+11	0	1.06E+11	0	1.17E+10
70	8.60	8.42E+10	0	7.57E+10	0	8.42E+09
75	7.40	7.24E+10	0	6.52E+10	0	7.24E+09
80	6.40	6.26E+10	0	5.64E+10	0	6.26E+09
85	5.80	5.68E+10	0	5.11E+10	0	5.68E+09
90	4.90	4.80E+10	0	4.32E+10	0	4.80E+09
95	2.20	2.15E+10	0	1.94E+10	0	2.15E+09
100	0.00	9.79E+06	0	8.81E+06	0	9.79E+05

Figure 5-18 Load Duration Curve for *Fecal Coliform* in North Canadian River (OK520510000110_20)

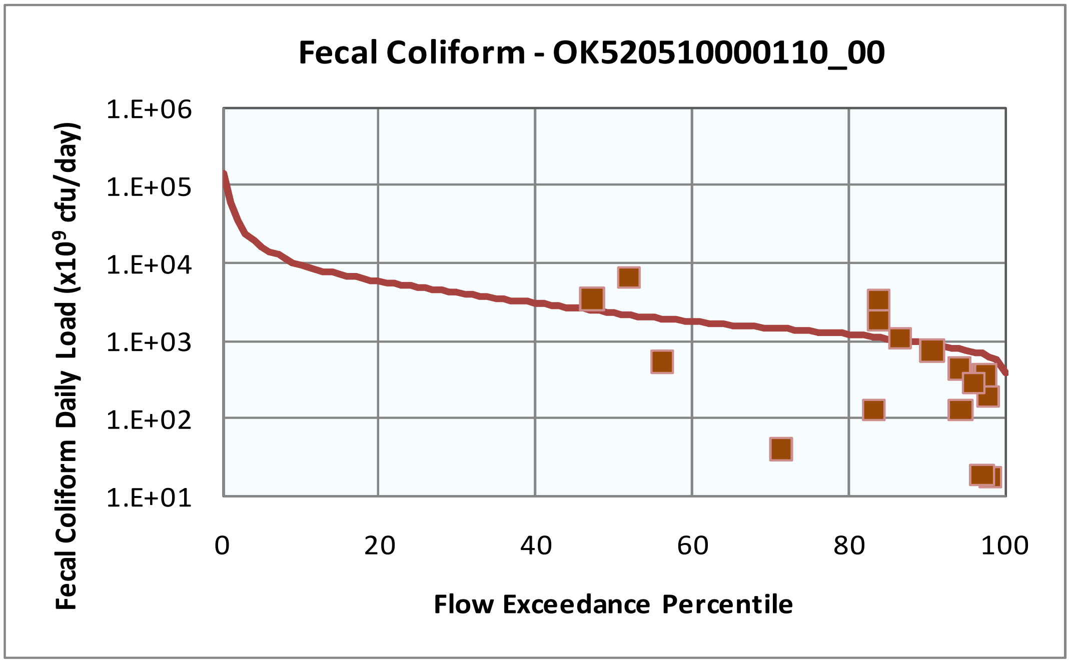


Table 5-21 Fecal Coliform TMDL Calculations for North Canadian River (OK520510000110_20)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	16600.00	1.62E+14	0.00E+00	2.30E+13	1.23E+14	1.62E+13
5	1784.50	1.75E+13	0.00E+00	2.47E+12	1.32E+13	1.75E+12
10	1059.00	1.04E+13	0.00E+00	1.46E+12	7.86E+12	1.04E+12
15	811.40	7.94E+12	0.00E+00	1.12E+12	6.02E+12	7.94E+11
20	660.80	6.47E+12	0.00E+00	9.14E+11	4.91E+12	6.47E+11
25	557.00	5.45E+12	0.00E+00	7.70E+11	4.14E+12	5.45E+11
30	472.70	4.63E+12	0.00E+00	6.54E+11	3.51E+12	4.63E+11
35	400.15	3.92E+12	0.00E+00	5.53E+11	2.97E+12	3.92E+11
40	348.00	3.41E+12	0.00E+00	4.81E+11	2.58E+12	3.41E+11
45	305.00	2.98E+12	0.00E+00	4.22E+11	2.26E+12	2.98E+11
50	258.00	2.52E+12	0.00E+00	3.57E+11	1.92E+12	2.52E+11
55	228.00	2.23E+12	0.00E+00	3.15E+11	1.69E+12	2.23E+11
60	201.00	1.97E+12	0.00E+00	2.78E+11	1.49E+12	1.97E+11
65	183.00	1.79E+12	0.00E+00	2.53E+11	1.36E+12	1.79E+11
70	168.00	1.64E+12	0.00E+00	2.32E+11	1.25E+12	1.64E+11
75	153.00	1.50E+12	0.00E+00	2.12E+11	1.14E+12	1.50E+11
80	138.00	1.35E+12	0.00E+00	1.91E+11	1.02E+12	1.35E+11
85	122.00	1.19E+12	0.00E+00	1.69E+11	9.06E+11	1.19E+11
90	106.10	1.04E+12	0.00E+00	1.47E+11	7.88E+11	1.04E+11
95	86.00	8.42E+11	0.00E+00	1.19E+11	6.39E+11	8.42E+10
100	43.00	4.21E+11	0.00E+00	5.95E+10	3.19E+11	4.21E+10

Figure 5-19 Load Duration Curve for *E. Coli* in Crooked Oak Creek (OK520520000150_00)

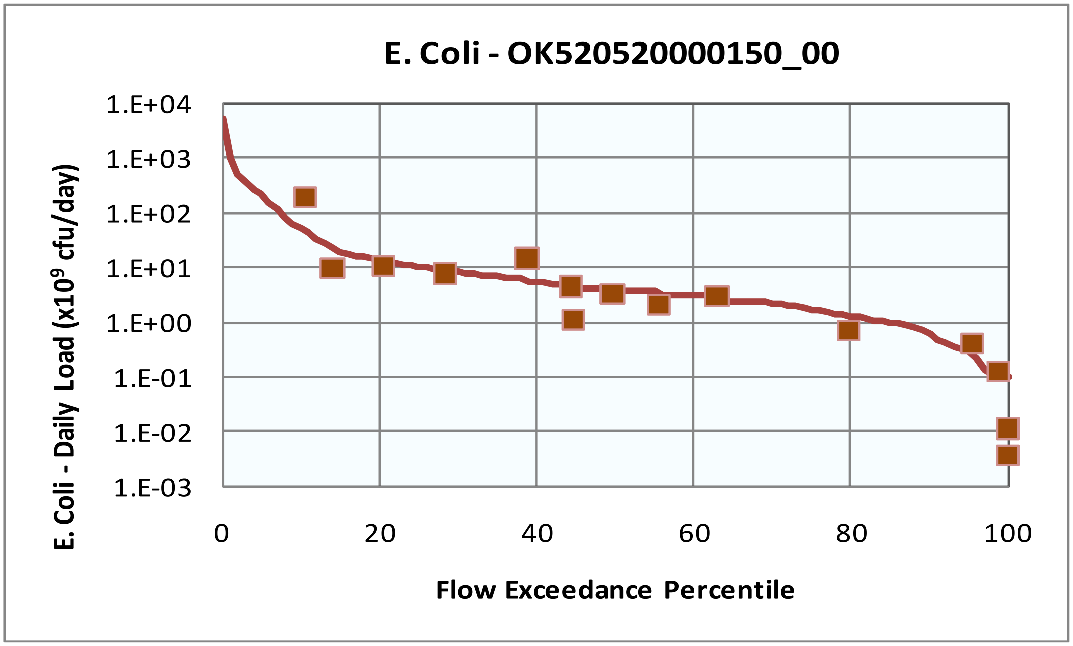


Table 5-22 E. Coli TMDL Calculations for Crooked Oak Creek (OK520520000150_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	577.14	5.73E+12	2.24E+09	5.16E+12	0	5.73E+11
5	24.92	2.48E+11	2.24E+09	2.21E+11	0	2.48E+10
10	5.75	5.71E+10	2.24E+09	4.92E+10	0	5.71E+09
15	2.22	2.21E+10	2.24E+09	1.76E+10	0	2.21E+09
20	1.56	1.55E+10	2.24E+09	1.17E+10	0	1.55E+09
25	1.12	1.11E+10	2.24E+09	7.74E+09	0	1.11E+09
30	0.95	9.41E+09	2.24E+09	6.23E+09	0	9.41E+08
35	0.78	7.78E+09	2.24E+09	4.76E+09	0	7.78E+08
40	0.63	6.23E+09	2.24E+09	3.36E+09	0	6.23E+08
45	0.48	4.76E+09	2.24E+09	2.04E+09	0	4.76E+08
50	0.41	4.06E+09	2.24E+09	1.41E+09	0	4.06E+08
55	0.41	4.06E+09	2.24E+09	1.41E+09	0	4.06E+08
60	0.34	3.39E+09	2.24E+09	8.10E+08	0	3.39E+08
65	0.28	2.76E+09	2.24E+09	2.39E+08	0	2.76E+08
70	0.25	2.45E+09	2.24E+09	0	0	0
75	0.19	2.24E+09	2.24E+09	0	0	0
80	0.15	2.24E+09	2.24E+09	0	0	0
85	0.11	2.24E+09	2.24E+09	0	0	0
90	0.07	2.24E+09	2.24E+09	0	0	0
95	0.03	2.24E+09	2.24E+09	0	0	0
100	0.00	2.24E+09	2.24E+09	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 a reasonable assurance that the pollutant reductions as required by these TMDLs can be achieved and water quality can be restored to maintain designated uses. ODEQ's Continuing Planning Process (CPP), required by the CWA §303(e)(3) and 40 CFR 130.5, summarizes Oklahoma's commitments and programs aimed at restoring and protecting water quality throughout the state (ODEQ 2007). The CPP can be viewed from ODEQ's website at http://www.deq.state.ok.us/WQDnew/pubs/2002_cpp_final.pdf. Table 5-23 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 5-23 Partial List of Oklahoma Water Quality Management Agencies

Agency	Web Link
Oklahoma Conservation Commission	http://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division
Oklahoma Department of Wildlife Conservation	http://www.wildlifedepartment.com
Oklahoma Department of Agriculture, Food, and Forestry	http://www.oda.state.ok.us/aems.htm
Oklahoma Water Resources Board	http://www.owrb.ok.gov/quality/index.php

The Oklahoma Conservation Commission manages the nonpoint source pollution (319) program in Oklahoma. The OCC works with state partners such as ODAFF and federal partners such EPA and NRCS, to address water quality problems similar to those seen in the North Canadian watershed. 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 OAC Title 252, Chapter 606 and the Oklahoma Pollutant Discharge Elimination System (OPDES) Act and in accordance with the agreement between ODEQ and USEPA relating to administration and enforcement of the delegated NPDES Program. Implementation of point source WLAs is done through permits issued under the OPDES program.

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

Discharges from wastewater treatment facilities in the watershed will have to meet the bacterial standards as required in the OPDES permit. Stormwater discharges are also considered as point sources. Requirements for the regulated MS4s are set forth in their stormwater permits. A selection of BMPs may be implemented to reduce bacteria load from stormwater. The stormwater permit holders are not required by the TMDL to achieve the total load reduction to restore water quality standards. Instead, they are responsible only for their own contributions.

The reduction rates called for in this TMDL report are as high as 98.9 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 WQS should be considered. There are three basic approaches to such revisions that may apply.

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

Unless or until the WQS 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

The Association of Central Oklahoma Governments (ACOG) prepared a draft bacteria TMDL report for North Canadian River in 2006. The TMDL report was opened for public review on March 22, 2006 and a public meeting was held in the City of El Reno on April 10, 2006. The public review period ended on April 21, 2006. Due to comments and requests from the public, the draft TMDL report was opened for public review again starting July 25, 2006. A second public meeting was held at the building of the DEQ on September 12, 2006. The second public comment period ended on October 12, 2006. The ACOG draft TMDL report was not finalized.

This report uses the same monitoring data as the ACOG report. Other existing data from USGS, OWRB, OCC, and Oklahoma City are also used. In addition to the stream segments of North Canadian River covered by the ACOG report, this report also addresses the bacteria impairments for four tributaries to North Canadian River (Crutcho Creek, Crooked Oak Creek, Airport Heights Creek and Mustang Creek). The public comments received in 2006 on the ACOG report were considered and incorporated into this report where appropriate.

This report will start a new comment/review opportunity and the previous comments will not be part of this record unless re-submitted.

The process for public participation is as follows:

This report was technically approved by the EPA in July of 2009. A public notice was published on July 28, 2009 and the report was made available for public review and comments. The public comment period started on July 28, 2009 and ended on October 2, 2009. During this period, a request to extend the public comment period was received from Oklahoma Cattlemen's Association and the public comment period was extended to November 2, 2009. A public meeting was held on November 2, 2009 at the DEQ building. Everyone at the meeting was offered the chance to provide recorded formal oral comments. A court report recorded all the formal oral comments. Five oral comments were recorded. In addition, six written comments were received. They are from Oklahoma Cattleman's Association, Oklahoma City Department of Public Works, Oklahoma City Department of Water & Wastewater Utilities, Anchor QEA (on behave of Oklahoma Farm Bureau, OFB Legal Foundation, Oklahoma Cattlemen's Association, American Farmers and Ranchers, Oklahoma Pork Council, and the Poultry Federation), Oklahoma Farm Bureau, and Mr. Matthew Woodson.

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

SECTION 7
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APPENDIX A
AMBIENT WATER QUALITY BACTERIA DATA – 1998 TO 2009

Appendix A

Ambient Water Quality Bacteria Data – 1998 to 2009

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
USGS07241000	North Canadian River	OK520520000250_00	01/20/04	140	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	02/11/04	110	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	03/09/04	660	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	04/06/04	520	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	11/09/04	280	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	12/14/04	250	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	02/16/05	170	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	03/01/05	1100	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	04/20/05	130	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	12/12/05	530	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	01/25/06	470	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	02/28/06	920	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	03/22/06	470	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	11/29/06	110	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	12/12/06	100	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	01/09/07	60	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	02/28/07	21	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	03/29/07	1800	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	04/23/07	580	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	11/08/07	96	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	12/13/07	3700	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	01/30/08	46	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	03/10/08	28	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	12/29/08	47	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	02/23/09	70	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	04/13/09	1300	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	05/11/04	920	FC	400
USGS07241000	North Canadian River	OK520520000250_00	06/15/04	520	FC	400
USGS07241000	North Canadian River	OK520520000250_00	07/06/04	820	FC	400
USGS07241000	North Canadian River	OK520520000250_00	08/17/04	410	FC	400
USGS07241000	North Canadian River	OK520520000250_00	09/08/04	92	FC	400
USGS07241000	North Canadian River	OK520520000250_00	10/06/04	580	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	05/09/05	66	FC	400
USGS07241000	North Canadian River	OK520520000250_00	06/01/05	140	FC	400
USGS07241000	North Canadian River	OK520520000250_00	07/19/05	670	FC	400
USGS07241000	North Canadian River	OK520520000250_00	08/17/05	180	FC	400
USGS07241000	North Canadian River	OK520520000250_00	09/14/05	1400	FC	400
USGS07241000	North Canadian River	OK520520000250_00	05/25/06	520	FC	400
USGS07241000	North Canadian River	OK520520000250_00	06/27/06	1100	FC	400

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
USGS07241000	North Canadian River	OK520520000250_00	07/10/06	1000	FC	400
USGS07241000	North Canadian River	OK520520000250_00	08/29/06	550	FC	400
USGS07241000	North Canadian River	OK520520000250_00	09/27/06	1000	FC	400
USGS07241000	North Canadian River	OK520520000250_00	10/30/06	110	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	05/23/07	430	FC	400
USGS07241000	North Canadian River	OK520520000250_00	06/12/07	2100	FC	400
USGS07241000	North Canadian River	OK520520000250_00	07/03/07	600	FC	400
USGS07241000	North Canadian River	OK520520000250_00	08/22/07	5000	FC	400
USGS07241000	North Canadian River	OK520520000250_00	09/06/07	1100	FC	400
USGS07241000	North Canadian River	OK520520000250_00	10/25/07	2600	FC	2000
USGS07241000	North Canadian River	OK520520000250_00	06/18/08	1200	FC	400
USGS07241000	North Canadian River	OK520520000250_00	07/08/08	200	FC	400
USGS07241000	North Canadian River	OK520520000250_00	09/30/08	110	FC	400
ACOG's Data						
NC-03	North Canadian River	OK520520000210_00	9/29/2003	30	FC	400
NC-03	North Canadian River	OK520520000210_00	9/22/2003	130	FC	400
NC-03	North Canadian River	OK520520000210_00	9/15/2003	400	FC	400
NC-03	North Canadian River	OK520520000210_00	9/8/2003	20	FC	400
NC-03	North Canadian River	OK520520000210_00	9/2/2003	300	FC	400
NC-03	North Canadian River	OK520520000210_00	8/25/2003	460	FC	400
NC-03	North Canadian River	OK520520000210_00	8/18/2003	90	FC	400
NC-03	North Canadian River	OK520520000210_00	8/11/2003	7,300	FC	400
NC-03	North Canadian River	OK520520000210_00	8/4/2003	200	FC	400
NC-03	North Canadian River	OK520520000210_00	7/28/2003	290	FC	400
NC-03	North Canadian River	OK520520000210_00	7/21/2003	100	FC	400
NC-03	North Canadian River	OK520520000210_00	7/14/2003	700	FC	400
NC-03	North Canadian River	OK520520000210_00	7/7/2003	120	FC	400
NC-03	North Canadian River	OK520520000210_00	6/30/2003	100	FC	400
NC-03	North Canadian River	OK520520000210_00	6/23/2003	120	FC	400
NC-03	North Canadian River	OK520520000210_00	6/16/2003	200	FC	400
NC-03	North Canadian River	OK520520000210_00	6/9/2003	300	FC	400
NC-03	North Canadian River	OK520520000210_00	5/20/2003	31,000	FC	400
NC-03	North Canadian River	OK520520000210_00	6/3/2003	400	FC	400
NC-03	North Canadian River	OK520520000210_00	5/28/2003	800	FC	400
NC-03	North Canadian River	OK520520000210_00	9/29/2003	100	EC	406
NC-03	North Canadian River	OK520520000210_00	9/22/2003	11,200	EC	406
NC-03	North Canadian River	OK520520000210_00	9/15/2003	800	EC	406
NC-03	North Canadian River	OK520520000210_00	9/8/2003	30	EC	406
NC-03	North Canadian River	OK520520000210_00	9/2/2003	500	EC	406
NC-03	North Canadian River	OK520520000210_00	8/25/2003	110	EC	406
NC-03	North Canadian River	OK520520000210_00	8/18/2003	250	EC	406
NC-03	North Canadian River	OK520520000210_00	8/11/2003	1,100	EC	406
NC-03	North Canadian River	OK520520000210_00	8/4/2003	2,600	EC	406
NC-03	North Canadian River	OK520520000210_00	7/28/2003	110	EC	406

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-03	North Canadian River	OK520520000210_00	7/21/2003	100	EC	406
NC-03	North Canadian River	OK520520000210_00	7/14/2003	200	EC	406
NC-03	North Canadian River	OK520520000210_00	7/7/2003	90	EC	406
NC-03	North Canadian River	OK520520000210_00	6/30/2003	90	EC	406
NC-03	North Canadian River	OK520520000210_00	6/23/2003	200	EC	406
NC-03	North Canadian River	OK520520000210_00	6/16/2003	300	EC	406
NC-03	North Canadian River	OK520520000210_00	6/9/2003	300	EC	406
NC-03	North Canadian River	OK520520000210_00	5/20/2003	29,000	EC	406
NC-03	North Canadian River	OK520520000210_00	6/3/2003	288	EC	406
NC-03	North Canadian River	OK520520000210_00	5/28/2003	63	EC	406
NC-03	North Canadian River	OK520520000210_00	9/29/2003	30	ENT	108
NC-03	North Canadian River	OK520520000210_00	9/22/2003	130	ENT	108
NC-03	North Canadian River	OK520520000210_00	9/15/2003	400	ENT	108
NC-03	North Canadian River	OK520520000210_00	9/8/2003	20	ENT	108
NC-03	North Canadian River	OK520520000210_00	9/2/2003	300	ENT	108
NC-03	North Canadian River	OK520520000210_00	8/25/2003	460	ENT	108
NC-03	North Canadian River	OK520520000210_00	8/18/2003	90	ENT	108
NC-03	North Canadian River	OK520520000210_00	8/11/2003	7,300	ENT	108
NC-03	North Canadian River	OK520520000210_00	8/4/2003	200	ENT	108
NC-03	North Canadian River	OK520520000210_00	7/28/2003	290	ENT	108
NC-03	North Canadian River	OK520520000210_00	7/21/2003	100	ENT	108
NC-03	North Canadian River	OK520520000210_00	7/14/2003	700	ENT	108
NC-03	North Canadian River	OK520520000210_00	7/7/2003	120	ENT	108
NC-03	North Canadian River	OK520520000210_00	6/30/2003	100	ENT	108
NC-03	North Canadian River	OK520520000210_00	6/23/2003	120	ENT	108
NC-03	North Canadian River	OK520520000210_00	6/16/2003	200	ENT	108
NC-03	North Canadian River	OK520520000210_00	6/9/2003	300	ENT	108
NC-03	North Canadian River	OK520520000210_00	5/20/2003	31,000	ENT	108
NC-03	North Canadian River	OK520520000210_00	6/3/2003	15000	ENT	108
NC-03	North Canadian River	OK520520000210_00	5/28/2003	200	ENT	108
NC-04	North Canadian River	OK520520000010_40	9/30/2003	1,700	FC	400
NC-04	North Canadian River	OK520520000010_40	9/23/2003	700	FC	400
NC-04	North Canadian River	OK520520000010_40	9/16/2003	400	FC	400
NC-04	North Canadian River	OK520520000010_40	9/9/2003	60	FC	400
NC-04	North Canadian River	OK520520000010_40	9/3/2003	700	FC	400
NC-04	North Canadian River	OK520520000010_40	8/26/2003	100	FC	400
NC-04	North Canadian River	OK520520000010_40	8/19/2003	**9.999**	FC	400
NC-04	North Canadian River	OK520520000010_40	8/12/2003	600	FC	400
NC-04	North Canadian River	OK520520000010_40	8/5/2003	500	FC	400
NC-04	North Canadian River	OK520520000010_40	7/29/2003	700	FC	400
NC-04	North Canadian River	OK520520000010_40	7/22/2003	200	FC	400
NC-04	North Canadian River	OK520520000010_40	7/8/2003	600	FC	400
NC-04	North Canadian River	OK520520000010_40	7/1/2003	120	FC	400
NC-04	North Canadian River	OK520520000010_40	6/24/2003	300	FC	400

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-04	North Canadian River	OK520520000010_40	6/10/2003	100	FC	400
NC-04	North Canadian River	OK520520000010_40	5/20/2003	37000	FC	400
NC-04	North Canadian River	OK520520000010_40	6/2/2006	3000	FC	400
NC-04	North Canadian River	OK520520000010_40	5/27/2006	5000	FC	400
NC-04	North Canadian River	OK520520000010_40	9/30/2003	146	EC	406
NC-04	North Canadian River	OK520520000010_40	9/23/2003	206	EC	406
NC-04	North Canadian River	OK520520000010_40	9/16/2003	109	EC	406
NC-04	North Canadian River	OK520520000010_40	9/9/2003	10	EC	406
NC-04	North Canadian River	OK520520000010_40	9/3/2003	74	EC	406
NC-04	North Canadian River	OK520520000010_40	8/26/2003	74	EC	406
NC-04	North Canadian River	OK520520000010_40	8/19/2003	85	EC	406
NC-04	North Canadian River	OK520520000010_40	8/12/2003	31	EC	406
NC-04	North Canadian River	OK520520000010_40	8/5/2003	10	EC	406
NC-04	North Canadian River	OK520520000010_40	7/29/2003	10	EC	406
NC-04	North Canadian River	OK520520000010_40	7/22/2003	109	EC	406
NC-04	North Canadian River	OK520520000010_40	7/8/2003	**9.999**	EC	406
NC-04	North Canadian River	OK520520000010_40	7/1/2003	31	EC	406
NC-04	North Canadian River	OK520520000010_40	6/24/2003	256	EC	406
NC-04	North Canadian River	OK520520000010_40	6/10/2003	52	EC	406
NC-04	North Canadian River	OK520520000010_40	5/20/2003	2481	EC	406
NC-04	North Canadian River	OK520520000010_40	6/2/2006	1968	EC	406
NC-04	North Canadian River	OK520520000010_40	5/27/2006	2187	EC	406
NC-04	North Canadian River	OK520520000010_40	9/30/2003	1,100	ENT	108
NC-04	North Canadian River	OK520520000010_40	9/23/2003	200	ENT	108
NC-04	North Canadian River	OK520520000010_40	9/16/2003	300	ENT	108
NC-04	North Canadian River	OK520520000010_40	9/9/2003	1,000	ENT	108
NC-04	North Canadian River	OK520520000010_40	9/3/2003	600	ENT	108
NC-04	North Canadian River	OK520520000010_40	8/26/2003	2,200	ENT	108
NC-04	North Canadian River	OK520520000010_40	8/19/2003	2,500	ENT	108
NC-04	North Canadian River	OK520520000010_40	8/12/2003	700	ENT	108
NC-04	North Canadian River	OK520520000010_40	8/5/2003	300	ENT	108
NC-04	North Canadian River	OK520520000010_40	7/29/2003	4,000	ENT	108
NC-04	North Canadian River	OK520520000010_40	7/22/2003	7,000	ENT	108
NC-04	North Canadian River	OK520520000010_40	7/8/2003	4,000	ENT	108
NC-04	North Canadian River	OK520520000010_40	7/1/2003	7,000	ENT	108
NC-04	North Canadian River	OK520520000010_40	6/24/2003	100	ENT	108
NC-04	North Canadian River	OK520520000010_40	6/10/2003	100	ENT	108
NC-04	North Canadian River	OK520520000010_40	5/20/2003	51,000	ENT	108
NC-04	North Canadian River	OK520520000010_40	6/2/2006	46,000	ENT	108
NC-04	North Canadian River	OK520520000010_40	5/27/2006	5,000	ENT	108
NC-05	North Canadian River	OK520520000010_30	9/30/2003	400	FC	400
NC-05	North Canadian River	OK520520000010_30	9/23/2003	3,100	FC	400
NC-05	North Canadian River	OK520520000010_30	9/16/2003	2,700	FC	400
NC-05	North Canadian River	OK520520000010_30	9/9/2003	600	FC	400

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-05	North Canadian River	OK520520000010_30	9/2/2003	4,900	FC	400
NC-05	North Canadian River	OK520520000010_30	8/26/2003	500	FC	400
NC-05	North Canadian River	OK520520000010_30	8/19/2003	90	FC	400
NC-05	North Canadian River	OK520520000010_30	8/12/2003	200	FC	400
NC-05	North Canadian River	OK520520000010_30	8/5/2003	500	FC	400
NC-05	North Canadian River	OK520520000010_30	7/29/2003	500	FC	400
NC-05	North Canadian River	OK520520000010_30	7/22/2003	800	FC	400
NC-05	North Canadian River	OK520520000010_30	7/8/2003	900	FC	400
NC-05	North Canadian River	OK520520000010_30	7/1/2003	300	FC	400
NC-05	North Canadian River	OK520520000010_30	6/24/2003	700	FC	400
NC-05	North Canadian River	OK520520000010_30	6/10/2003	5,000	FC	400
NC-05	North Canadian River	OK520520000010_30	5/20/2003	41,000	FC	400
NC-05	North Canadian River	OK520520000010_30	6/2/2006	3,000	FC	400
NC-05	North Canadian River	OK520520000010_30	5/27/2006	1,100	FC	400
NC-05	North Canadian River	OK520520000010_30	9/30/2003	158	EC	406
NC-05	North Canadian River	OK520520000010_30	9/23/2003	350	EC	406
NC-05	North Canadian River	OK520520000010_30	9/16/2003	309	EC	406
NC-05	North Canadian River	OK520520000010_30	9/9/2003	51	EC	406
NC-05	North Canadian River	OK520520000010_30	9/2/2003	120	EC	406
NC-05	North Canadian River	OK520520000010_30	8/26/2003	110	EC	406
NC-05	North Canadian River	OK520520000010_30	8/19/2003	85	EC	406
NC-05	North Canadian River	OK520520000010_30	8/12/2003	63	EC	406
NC-05	North Canadian River	OK520520000010_30	8/5/2003	52	EC	406
NC-05	North Canadian River	OK520520000010_30	7/29/2003	41	EC	406
NC-05	North Canadian River	OK520520000010_30	7/22/2003	369	EC	406
NC-05	North Canadian River	OK520520000010_30	7/8/2003	52	EC	406
NC-05	North Canadian River	OK520520000010_30	7/1/2003	41	EC	406
NC-05	North Canadian River	OK520520000010_30	6/24/2003	185	EC	406
NC-05	North Canadian River	OK520520000010_30	6/10/2003	663	EC	406
NC-05	North Canadian River	OK520520000010_30	5/20/2003	8164	EC	406
NC-05	North Canadian River	OK520520000010_30	6/2/2006	959	EC	406
NC-05	North Canadian River	OK520520000010_30	5/27/2006	465	EC	406
NC-05	North Canadian River	OK520520000010_30	9/30/2003	300	ENT	108
NC-05	North Canadian River	OK520520000010_30	9/23/2003	1,300	ENT	108
NC-05	North Canadian River	OK520520000010_30	9/16/2003	1,500	ENT	108
NC-05	North Canadian River	OK520520000010_30	9/9/2003	200	ENT	108
NC-05	North Canadian River	OK520520000010_30	9/2/2003	900	ENT	108
NC-05	North Canadian River	OK520520000010_30	8/26/2003	1,500	ENT	108
NC-05	North Canadian River	OK520520000010_30	8/19/2003	1,300	ENT	108
NC-05	North Canadian River	OK520520000010_30	8/12/2003	1,300	ENT	108
NC-05	North Canadian River	OK520520000010_30	8/5/2003	700	ENT	108
NC-05	North Canadian River	OK520520000010_30	7/29/2003	3,000	ENT	108
NC-05	North Canadian River	OK520520000010_30	7/22/2003	400	ENT	108
NC-05	North Canadian River	OK520520000010_30	7/8/2003	3,000	ENT	108

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-05	North Canadian River	OK520520000010_30	7/1/2003	10,000	ENT	108
NC-05	North Canadian River	OK520520000010_30	6/24/2003	300	ENT	108
NC-05	North Canadian River	OK520520000010_30	6/10/2003	2,000	ENT	108
NC-05	North Canadian River	OK520520000010_30	5/20/2003	42,000	ENT	108
NC-05	North Canadian River	OK520520000010_30	6/2/2006	9,000	ENT	108
NC-05	North Canadian River	OK520520000010_30	5/27/2006	900	ENT	108
NC-06	North Canadian River	OK520520000010_20	9/30/2003	200	FC	400
NC-06	North Canadian River	OK520520000010_20	9/24/2003	700	FC	400
NC-06	North Canadian River	OK520520000010_20	9/17/2003	700	FC	400
NC-06	North Canadian River	OK520520000010_20	9/10/2003	120	FC	400
NC-06	North Canadian River	OK520520000010_20	9/3/2003	2300	FC	400
NC-06	North Canadian River	OK520520000010_20	8/27/2003	500	FC	400
NC-06	North Canadian River	OK520520000010_20	8/20/2003	20	FC	400
NC-06	North Canadian River	OK520520000010_20	8/13/2003	700	FC	400
NC-06	North Canadian River	OK520520000010_20	8/6/2003	1000	FC	400
NC-06	North Canadian River	OK520520000010_20	7/30/2003	2000	FC	400
NC-06	North Canadian River	OK520520000010_20	7/23/2003	120	FC	400
NC-06	North Canadian River	OK520520000010_20	7/16/2003	800	FC	400
NC-06	North Canadian River	OK520520000010_20	7/9/2003	130	FC	400
NC-06	North Canadian River	OK520520000010_20	7/1/2003	10	FC	400
NC-06	North Canadian River	OK520520000010_20	6/24/2003	120	FC	400
NC-06	North Canadian River	OK520520000010_20	6/17/2003	**9.999**	FC	400
NC-06	North Canadian River	OK520520000010_20	6/2/2006	3000	FC	400
NC-06	North Canadian River	OK520520000010_20	5/27/2006	2000	FC	400
NC-06	North Canadian River	OK520520000010_20	5/19/2006	6000	FC	400
NC-06	North Canadian River	OK520520000010_20	6/10/2003	210	FC	400
NC-06	North Canadian River	OK520520000010_20	9/30/2003	74	EC	406
NC-06	North Canadian River	OK520520000010_20	9/24/2003	41	EC	406
NC-06	North Canadian River	OK520520000010_20	9/17/2003	41	EC	406
NC-06	North Canadian River	OK520520000010_20	9/10/2003	20	EC	406
NC-06	North Canadian River	OK520520000010_20	9/3/2003	41	EC	406
NC-06	North Canadian River	OK520520000010_20	8/27/2003	41	EC	406
NC-06	North Canadian River	OK520520000010_20	8/20/2003	10	EC	406
NC-06	North Canadian River	OK520520000010_20	8/13/2003	41	EC	406
NC-06	North Canadian River	OK520520000010_20	8/6/2003	**9.999**	EC	406
NC-06	North Canadian River	OK520520000010_20	7/30/2003	1112	EC	406
NC-06	North Canadian River	OK520520000010_20	7/23/2003	132	EC	406
NC-06	North Canadian River	OK520520000010_20	7/16/2003	292	EC	406
NC-06	North Canadian River	OK520520000010_20	7/9/2003	**9.999**	EC	406
NC-06	North Canadian River	OK520520000010_20	7/1/2003	20	EC	406
NC-06	North Canadian River	OK520520000010_20	6/24/2003	63	EC	406
NC-06	North Canadian River	OK520520000010_20	6/17/2003	108	EC	406
NC-06	North Canadian River	OK520520000010_20	6/10/2003	122	EC	406
NC-06	North Canadian River	OK520520000010_20	6/2/2006	226	EC	406

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-06	North Canadian River	OK520520000010_20	5/27/2006	10	EC	406
NC-06	North Canadian River	OK520520000010_20	5/19/2006	1935	EC	406
NC-06	North Canadian River	OK520520000010_20	9/30/2003	3600	ENT	108
NC-06	North Canadian River	OK520520000010_20	9/24/2003	1400	ENT	108
NC-06	North Canadian River	OK520520000010_20	9/17/2003	2600	ENT	108
NC-06	North Canadian River	OK520520000010_20	9/10/2003	700	ENT	108
NC-06	North Canadian River	OK520520000010_20	9/3/2003	600	ENT	108
NC-06	North Canadian River	OK520520000010_20	8/27/2003	1800	ENT	108
NC-06	North Canadian River	OK520520000010_20	8/20/2003	2100	ENT	108
NC-06	North Canadian River	OK520520000010_20	8/13/2003	1100	ENT	108
NC-06	North Canadian River	OK520520000010_20	8/6/2003	13000	ENT	108
NC-06	North Canadian River	OK520520000010_20	7/30/2003	1100	ENT	108
NC-06	North Canadian River	OK520520000010_20	7/23/2003	900	ENT	108
NC-06	North Canadian River	OK520520000010_20	7/16/2003	8000	ENT	108
NC-06	North Canadian River	OK520520000010_20	7/9/2003	700	ENT	108
NC-06	North Canadian River	OK520520000010_20	7/1/2003	40	ENT	108
NC-06	North Canadian River	OK520520000010_20	6/24/2003	800	ENT	108
NC-06	North Canadian River	OK520520000010_20	6/17/2003	300	ENT	108
NC-06	North Canadian River	OK520520000010_20	6/10/2003	100	ENT	108
NC-06	North Canadian River	OK520520000010_20	6/2/2006	400	ENT	108
NC-06	North Canadian River	OK520520000010_20	5/27/2006	60	ENT	108
NC-06	North Canadian River	OK520520000010_20	5/19/2006	15000	ENT	108
NC-07	North Canadian River	OK520520000010_10	9/30/2003	2,300	FC	400
NC-07	North Canadian River	OK520520000010_10	9/24/2003	3,100	FC	400
NC-07	North Canadian River	OK520520000010_10	9/17/2003	2,200	FC	400
NC-07	North Canadian River	OK520520000010_10	9/10/2003	670	FC	400
NC-07	North Canadian River	OK520520000010_10	9/3/2003	1,700	FC	400
NC-07	North Canadian River	OK520520000010_10	8/27/2003	500	FC	400
NC-07	North Canadian River	OK520520000010_10	8/20/2003	90	FC	400
NC-07	North Canadian River	OK520520000010_10	8/13/2003	200	FC	400
NC-07	North Canadian River	OK520520000010_10	8/6/2003	500	FC	400
NC-07	North Canadian River	OK520520000010_10	7/30/2003	700	FC	400
NC-07	North Canadian River	OK520520000010_10	7/23/2003	1,100	FC	400
NC-07	North Canadian River	OK520520000010_10	7/16/2003	1,000	FC	400
NC-07	North Canadian River	OK520520000010_10	7/9/2003	600	FC	400
NC-07	North Canadian River	OK520520000010_10	7/2/2003	90	FC	400
NC-07	North Canadian River	OK520520000010_10	6/25/2003	200	FC	400
NC-07	North Canadian River	OK520520000010_10	6/18/2003	3,100	FC	400
NC-07	North Canadian River	OK520520000010_10	6/10/2003	400	FC	400
NC-07	North Canadian River	OK520520000010_10	6/2/2006	8000	FC	400
NC-07	North Canadian River	OK520520000010_10	5/27/2006	290	FC	400
NC-07	North Canadian River	OK520520000010_10	5/19/2006	14000	FC	400
NC-07	North Canadian River	OK520520000010_10	9/30/2003	10	EC	406
NC-07	North Canadian River	OK520520000010_10	9/24/2003	285	EC	406

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-07	North Canadian River	OK520520000010_10	9/17/2003	262	EC	406
NC-07	North Canadian River	OK520520000010_10	9/10/2003	30	EC	406
NC-07	North Canadian River	OK520520000010_10	9/3/2003	231	EC	406
NC-07	North Canadian River	OK520520000010_10	8/27/2003	233	EC	406
NC-07	North Canadian River	OK520520000010_10	8/20/2003	84	EC	406
NC-07	North Canadian River	OK520520000010_10	8/13/2003	227	EC	406
NC-07	North Canadian River	OK520520000010_10	8/6/2003	41	EC	406
NC-07	North Canadian River	OK520520000010_10	7/30/2003	175	EC	406
NC-07	North Canadian River	OK520520000010_10	7/23/2003	443	EC	406
NC-07	North Canadian River	OK520520000010_10	7/16/2003	31	EC	406
NC-07	North Canadian River	OK520520000010_10	7/9/2003	10	EC	406
NC-07	North Canadian River	OK520520000010_10	7/2/2003	31	EC	406
NC-07	North Canadian River	OK520520000010_10	6/25/2003	74	EC	406
NC-07	North Canadian River	OK520520000010_10	6/18/2003	238	EC	406
NC-07	North Canadian River	OK520520000010_10	6/10/2003	275	EC	406
NC-07	North Canadian River	OK520520000010_10	6/2/2006	281	EC	406
NC-07	North Canadian River	OK520520000010_10	5/27/2006	97	EC	406
NC-07	North Canadian River	OK520520000010_10	5/19/2006	3076	EC	406
NC-07	North Canadian River	OK520520000010_10	9/30/2003	6700	ENT	108
NC-07	North Canadian River	OK520520000010_10	9/24/2003	2700	ENT	108
NC-07	North Canadian River	OK520520000010_10	9/17/2003	1800	ENT	108
NC-07	North Canadian River	OK520520000010_10	9/10/2003	1900	ENT	108
NC-07	North Canadian River	OK520520000010_10	9/3/2003	1300	ENT	108
NC-07	North Canadian River	OK520520000010_10	8/27/2003	68800	ENT	108
NC-07	North Canadian River	OK520520000010_10	8/20/2003	312000	ENT	108
NC-07	North Canadian River	OK520520000010_10	8/13/2003	3100	ENT	108
NC-07	North Canadian River	OK520520000010_10	8/6/2003	47000	ENT	108
NC-07	North Canadian River	OK520520000010_10	7/30/2003	157000	ENT	108
NC-07	North Canadian River	OK520520000010_10	7/23/2003	7000	ENT	108
NC-07	North Canadian River	OK520520000010_10	7/16/2003	36000	ENT	108
NC-07	North Canadian River	OK520520000010_10	7/9/2003	117000	ENT	108
NC-07	North Canadian River	OK520520000010_10	7/2/2003	10	ENT	108
NC-07	North Canadian River	OK520520000010_10	6/25/2003	**9.999**	ENT	108
NC-07	North Canadian River	OK520520000010_10	6/18/2003	50	ENT	108
NC-07	North Canadian River	OK520520000010_10	6/10/2003	300	ENT	108
NC-07	North Canadian River	OK520520000010_10	6/2/2006	300	ENT	108
NC-07	North Canadian River	OK520520000010_10	5/27/2006	110	ENT	108
NC-07	North Canadian River	OK520520000010_10	5/19/2006	16000	ENT	108
NC-08	North Canadian River	OK520520000110_20	9/30/2003	300	FC	400
NC-08	North Canadian River	OK520520000110_20	9/24/2003	600	FC	400
NC-08	North Canadian River	OK520520000110_20	9/17/2003	1100	FC	400
NC-08	North Canadian River	OK520520000110_20	9/10/2003	110	FC	400
NC-08	North Canadian River	OK520520000110_20	9/3/2003	1100	FC	400
NC-08	North Canadian River	OK520520000110_20	8/27/2003	200	FC	400

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-08	North Canadian River	OK520520000110_20	8/20/2003	**9.999**	FC	400
NC-08	North Canadian River	OK520520000110_20	8/13/2003	370	FC	400
NC-08	North Canadian River	OK520520000110_20	8/6/2003	200	FC	400
NC-08	North Canadian River	OK520520000110_20	7/30/2003	10	FC	400
NC-08	North Canadian River	OK520520000110_20	7/23/2003	200	FC	400
NC-08	North Canadian River	OK520520000110_20	7/16/2003	140	FC	400
NC-08	North Canadian River	OK520520000110_20	7/9/2003	60	FC	400
NC-08	North Canadian River	OK520520000110_20	7/2/2003	40	FC	400
NC-08	North Canadian River	OK520520000110_20	6/25/2003	100	FC	400
NC-08	North Canadian River	OK520520000110_20	6/18/2003	**9.999**	FC	400
NC-08	North Canadian River	OK520520000110_20	6/10/2003	500	FC	400
NC-08	North Canadian River	OK520520000110_20	6/2/2006	500	FC	400
NC-08	North Canadian River	OK520520000110_20	5/27/2006	400	FC	400
NC-08	North Canadian River	OK520520000110_20	5/19/2006	1000	FC	400
NC-08	North Canadian River	OK520520000110_20	9/30/2003	134	EC	406
NC-08	North Canadian River	OK520520000110_20	9/24/2003	107	EC	406
NC-08	North Canadian River	OK520520000110_20	9/17/2003	145	EC	406
NC-08	North Canadian River	OK520520000110_20	9/10/2003	20	EC	406
NC-08	North Canadian River	OK520520000110_20	9/3/2003	120	EC	406
NC-08	North Canadian River	OK520520000110_20	8/27/2003	63	EC	406
NC-08	North Canadian River	OK520520000110_20	8/20/2003	52	EC	406
NC-08	North Canadian River	OK520520000110_20	8/13/2003	41	EC	406
NC-08	North Canadian River	OK520520000110_20	8/6/2003	10	EC	406
NC-08	North Canadian River	OK520520000110_20	7/30/2003	98	EC	406
NC-08	North Canadian River	OK520520000110_20	7/23/2003	31	EC	406
NC-08	North Canadian River	OK520520000110_20	7/16/2003	**9.999**	EC	406
NC-08	North Canadian River	OK520520000110_20	7/9/2003	10	EC	406
NC-08	North Canadian River	OK520520000110_20	7/2/2003	**9.999**	EC	406
NC-08	North Canadian River	OK520520000110_20	6/25/2003	10	EC	406
NC-08	North Canadian River	OK520520000110_20	6/18/2003	**9.999**	EC	406
NC-08	North Canadian River	OK520520000110_20	6/10/2003	161	EC	406
NC-08	North Canadian River	OK520520000110_20	6/2/2006	318	EC	406
NC-08	North Canadian River	OK520520000110_20	5/27/2006	85	EC	406
NC-08	North Canadian River	OK520520000110_20	5/19/2006	288	EC	406
NC-08	North Canadian River	OK520520000110_20	9/30/2003	700	ENT	106
NC-08	North Canadian River	OK520520000110_20	9/24/2003	400	ENT	106
NC-08	North Canadian River	OK520520000110_20	9/17/2003	230	ENT	106
NC-08	North Canadian River	OK520520000110_20	9/10/2003	50	ENT	106
NC-08	North Canadian River	OK520520000110_20	9/3/2003	1500	ENT	106
NC-08	North Canadian River	OK520520000110_20	8/27/2003	300	ENT	106
NC-08	North Canadian River	OK520520000110_20	8/20/2003	110	ENT	106
NC-08	North Canadian River	OK520520000110_20	8/13/2003	400	ENT	106
NC-08	North Canadian River	OK520520000110_20	8/6/2003	140	ENT	106
NC-08	North Canadian River	OK520520000110_20	7/30/2003	460	ENT	106

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
NC-08	North Canadian River	OK520520000110_20	7/23/2003	90	ENT	106
NC-08	North Canadian River	OK520520000110_20	7/16/2003	300	ENT	106
NC-08	North Canadian River	OK520520000110_20	7/9/2003	110	ENT	106
NC-08	North Canadian River	OK520520000110_20	7/2/2003	100	ENT	106
NC-08	North Canadian River	OK520520000110_20	6/25/2003	410	ENT	106
NC-08	North Canadian River	OK520520000110_20	6/18/2003	60	ENT	106
NC-08	North Canadian River	OK520520000110_20	6/10/2003	300	ENT	106
NC-08	North Canadian River	OK520520000110_20	6/2/2006	200	ENT	106
NC-08	North Canadian River	OK520520000110_20	5/27/2006	90	ENT	106
NC-08	North Canadian River	OK520520000110_20	5/19/2006	400	ENT	106
OWRB Data						
520510000110-001AT	North Canadian River	OK520520000010_00	6/6/2001	110	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	8/8/2001	100	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	9/18/2002	600	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	5/15/2002	300	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	7/16/2002	300	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	8/26/2002	4000	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	8/26/2003	300	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	7/9/2001	200	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	9/30/2003	10	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	5/13/2003	500	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	6/17/2003	100	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	9/9/2003	70	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	7/22/2003	200	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	7/19/2006	680	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	6/12/2006	260	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	7/10/2006	750	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	8/8/2006	590	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	9/6/2006	8500	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	9/27/2006	200	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	7/24/2006	150	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	8/23/2006	12800	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	5/1/2006	6500	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	6/26/2006	780	FC	400
520510000110-001AT	North Canadian River	OK520520000010_00	2/12/2002	340	FC	2000
520510000110-001AT	North Canadian River	OK520520000010_00	6/6/2001	355	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	8/8/2001	10	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	9/18/2002	74	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	5/15/2002	327	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	7/16/2002	305	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	8/26/2002	51	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	8/26/2003	10	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	7/9/2001	10	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	9/30/2003	275	EC	406

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
520510000110-001AT	North Canadian River	OK520520000010_00	5/13/2003	143	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	6/17/2003	41	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	9/9/2003	20	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	7/22/2003	31	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	7/19/2006	30	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	6/12/2006	52	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	7/10/2006	384	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	8/8/2006	86	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	9/6/2006	9208	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	9/27/2006	262	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	7/24/2006	20	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	8/23/2006	10462	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	5/1/2006	2178	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	6/26/2006	81	EC	406
520510000110-001AT	North Canadian River	OK520520000010_00	6/6/2001	5000	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	8/8/2001	100	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	9/18/2002	300	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	5/15/2002	12000	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	7/16/2002	500	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	8/26/2002	300	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	8/26/2003	2800	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	7/9/2001	100	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	9/30/2003	400	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	5/13/2003	270	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	6/17/2003	70	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	9/9/2003	50	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	7/22/2003	3000	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	7/19/2006	298	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	6/12/2006	85	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	7/10/2006	882	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	8/8/2006	146	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	9/6/2006	9208	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	9/27/2006	63	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	7/24/2006	41	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	8/23/2006	1674	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	5/1/2006	1182	ENT	108
520510000110-001AT	North Canadian River	OK520520000010_00	6/26/2006	250	ENT	108
OCC's Data						
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	05/16/00	100	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	06/19/00	15000	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	07/24/00	9000	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	08/28/00	20	FC	400

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	11/07/00	46000	FC	2000
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	12/12/00	30	FC	2000
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	01/23/01	160	FC	2000
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	02/26/01	220	FC	2000
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	04/03/01	800	FC	2000
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	05/08/01	300	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	06/12/01	170	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	07/17/01	>120	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	08/21/01	>300	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	09/26/01	100	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	10/31/01	110	FC	2000
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	05/21/98	300	FC	400
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	06/17/98	170	FC	400
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	08/19/98	170	FC	400
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	09/15/98	500	FC	400
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	08/28/00	10	EC	406
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	11/07/00	1210	EC	2030
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	12/12/00	<10	EC	2030
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	01/23/01	143	EC	2030
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	02/26/01	145	EC	2030
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	04/03/01	74	EC	2030
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	05/08/01	269	EC	406
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	06/12/01	85	EC	406
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	07/17/01	>160	EC	406
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	08/21/01	595	EC	406
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	09/26/01	50	EC	406
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	10/31/01	70	EC	2030
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	05/23/02	130	EC	406
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	06/20/02	300	EC	406
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	11/07/00	9000	ENT	540
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	12/12/00	210	ENT	540
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	01/23/01	20	ENT	540
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	02/26/01	3000	ENT	540
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	04/03/01	180	ENT	540
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	05/08/01	2000	ENT	108
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	06/12/01	90	ENT	108
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	07/17/01	34	ENT	108
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	08/21/01	50	ENT	108
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	09/26/01	20	ENT	108

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	10/31/01	120	ENT	540
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	05/16/00	300	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	06/20/00	12500	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	07/24/00	11000	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	08/28/00	200	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	05/08/01	800	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	06/12/01	4300	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	07/17/01	148	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	08/21/01	>300	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	09/26/01	300	FC	400
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	10/31/01	230	FC	2000
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	11/07/00	7000	FC	2000
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	12/12/00	20	FC	2000
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	01/23/01	20	FC	2000
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	02/26/01	240	FC	2000
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	04/03/01	900	FC	2000
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	08/28/00	410	EC	406
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	05/08/01	581	EC	406
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	06/12/01	631	EC	406
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	07/17/01	152	EC	406
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	08/21/01	465	EC	406
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	09/26/01	230	EC	406
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	10/31/01	110	EC	2030
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	11/07/00	2063	EC	2030
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	12/12/00	10	EC	2030
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	01/23/01	10	EC	2030
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	02/26/01	216	EC	2030
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	04/03/01	1100	EC	2030
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	08/28/00	1200	ENT	108
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	05/08/01	1000	ENT	108
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	06/12/01	6000	ENT	108
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	07/17/01	158	ENT	108
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	08/21/01	330	ENT	108
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	09/26/01	70	ENT	108
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	10/31/01	150	ENT	540
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	11/07/00	50000	ENT	540
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	12/12/00	10	ENT	540
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	01/23/01	9.999	ENT	540
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	02/26/01	900	ENT	540

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
OK520520-00-0150G	Crooked Oak Creek	OK520520000150_00	04/03/01	500	ENT	540
OK520520-00-0240G	Mustang Creek	OK520520000240_00	05/21/98	230	FC	400
OK520520-00-0240G	Mustang Creek	OK520520000240_00	06/17/98	300	FC	400
OK520520-00-0240G	Mustang Creek	OK520520000240_00	08/19/98	500	FC	400
OK520520-00-0240G	Mustang Creek	OK520520000240_00	09/15/98	800	FC	400
OK520520-00-0240G	Mustang Creek	OK520520000240_00	05/20/99	230	FC	400
OK520520-00-0240G	Mustang Creek	OK520520000240_00	05/23/02	40	EC	406
OK520520-00-0240G	Mustang Creek	OK520520000240_00	07/18/02	230	EC	406
OK520520-00-0240G	Mustang Creek	OK520520000240_00	08/22/02	140	EC	406
OK520520-00-0240G	Mustang Creek	OK520520000240_00	09/19/02	>=16000	EC	406
Oklahoma City Data						
WCNCW654	Mustang Creek	OK520520000240_00	07/29/03	190	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	05/10/04	190	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	06/14/04	30	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	07/19/04	220	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	08/23/04	20	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	09/27/04	30	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	05/23/05	710	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	07/18/05	150	FC	400
WCNCW654	Mustang Creek	OK520520000240_00	12/08/03	20	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	01/20/04	10	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	02/23/04	10	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	11/01/04	210	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	12/06/04	10	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	01/10/05	280	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	02/14/05	30	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	03/21/05	20	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	04/25/05	180	FC	2000
WCNCW654	Mustang Creek	OK520520000240_00	07/29/03	640	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	05/10/04	640	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	06/14/04	30	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	07/19/04	80	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	08/23/04	80	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	09/27/04	50	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	05/23/05	240	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	07/18/05	180	EC	406
WCNCW654	Mustang Creek	OK520520000240_00	12/08/03	40	EC	2030
WCNCW654	Mustang Creek	OK520520000240_00	01/20/04	3600	EC	2030
WCNCW654	Mustang Creek	OK520520000240_00	02/23/04	3200	EC	2030

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
WCNCW654	Mustang Creek	OK520520000240_00	11/01/04	720	EC	2030
WCNCW654	Mustang Creek	OK520520000240_00	12/06/04	10	EC	2030
WCNCW654	Mustang Creek	OK520520000240_00	01/10/05	140	EC	2030
WCNCW654	Mustang Creek	OK520520000240_00	02/14/05	80	EC	2030
WCNCW654	Mustang Creek	OK520520000240_00	03/21/05	50	EC	2030
WCNCW654	Mustang Creek	OK520520000240_00	04/25/05	230	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	12/16/03	260	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	01/27/04	190	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	03/02/04	3000	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	05/18/04	80	FC	400
WCNCW617	Airport heights Creek	OK520520000350_00	06/22/04	6400	FC	400
WCNCW617	Airport heights Creek	OK520520000350_00	07/27/04	220	FC	400
WCNCW617	Airport heights Creek	OK520520000350_00	08/31/04	130	FC	400
WCNCW617	Airport heights Creek	OK520520000350_00	09/30/04	20	FC	400
WCNCW617	Airport heights Creek	OK520520000350_00	11/09/04	280	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	12/14/04	430	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	01/19/05	190	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	02/22/05	30	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	03/29/05	150	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	04/28/05	110	FC	2000
WCNCW617	Airport heights Creek	OK520520000350_00	06/01/05	4700	FC	400
WCNCW617	Airport heights Creek	OK520520000350_00	07/26/05	380	FC	400
WCNCW617	Airport heights Creek	OK520520000350_00	12/16/03	520	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	1127/04	420	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	03/02/04	8900	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	05/18/04	180	EC	406
WCNCW617	Airport heights Creek	OK520520000350_00	06/22/04	5900	EC	406
WCNCW617	Airport heights Creek	OK520520000350_00	07/27/04	10	EC	406
WCNCW617	Airport heights Creek	OK520520000350_00	08/31/04	250	EC	406
WCNCW617	Airport heights Creek	OK520520000350_00	09/30/04	60	EC	406
WCNCW617	Airport heights Creek	OK520520000350_00	11/09/04	170	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	12/14/04	430	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	01/19/05	320	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	02/22/05	90	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	03/29/05	240	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	04/28/05	520	EC	2030
WCNCW617	Airport heights Creek	OK520520000350_00	06/01/05	10200	EC	406
WCNCW617	Airport heights Creek	OK520520000350_00	07/26/05	320	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	08/02/05	180	FC	400

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc. (#/100ml)	Bacteria Indicator	Single Sample Criteria* (#/100)
WCNCE450	Crooked Oak Creek	OK520520000150_00	09/07/05	34	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	10/11/05	260	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	11/15/05	170	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	12/20/05	430	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	01/24/06	70	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	04/04/06	<10	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	05/09/06	250	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	06/13/06	190	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	07/18/06	180	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	08/22/06	1300	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	10/03/06	130	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	11/08/06	230	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	12/04/06	300	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	01/09/07	30	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	02/13/07	390	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	03/20/07	60	FC	2000
WCNCE450	Crooked Oak Creek	OK520520000150_00	05/02/07	2400	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	06/05/07	280	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	06/11/07	250	FC	400
WCNCE450	Crooked Oak Creek	OK520520000150_00	08/02/05	90	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	09/07/05	310	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	10/11/05	270	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	11/15/05	180	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	12/20/05	350	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	01/24/06	70	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	04/04/06	20	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	05/09/06	290	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	06/13/06	190	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	07/18/06	350	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	08/22/06	920	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	10/03/06	30	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	11/08/06	180	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	12/04/06	120	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	01/09/07	<10	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	02/13/07	200	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	03/20/07	20	EC	2030
WCNCE450	Crooked Oak Creek	OK520520000150_00	05/02/07	1500	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	06/05/07	320	EC	406
WCNCE450	Crooked Oak Creek	OK520520000150_00	06/11/07	160	EC	406

FC=fecal coliform; EC=E.coli; ENT=enterococci;

*Single sample criterion for secondary contact recreation season is shown for all samples collected between October 1st and April 30th.

Data in red were not detected at the detection limits and were replaced with detection limits. For ACOG's data, "<10" was replaced with 9.999.

APPENDIX B
SANITARY SEWER OVERFLOWS DATA

ODEQSummaryofAvailableReportsofSanitarySewerOverflows

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
DEL CITY	S20536	01/06/05	4019 S.E. 14TH PL.	200		
DEL CITY	S20536	01/06/05	4109 S.E. 14TH PL.	200		
DEL CITY	S20536	01/24/05	3205 DEL VIEW RD.	1,000	GREASE & RAGS	
DEL CITY	S20536	02/10/05	4129 OVERLAND DR.	500	GREASE & RAGS	MANHOLE
DEL CITY	S20536	04/12/05	4640 S.E. 15	2,000	BLOCKAGE	PIPE
DEL CITY	S20536	04/15/05	1800 VICKIE DR.	2,000	BLOCKAGE	MANHOLE
DEL CITY	S20536	05/16/05	3100 DEL VIEW DR.	2,000	BLOCKAGE	MANHOLE
DEL CITY	S20536	06/10/05	5 BURK DR.	700	BLOCKAGE	MANHOLE
DEL CITY	S20536	08/09/05	4128 S.E. 43	20	BLOCKAGE	PIPE
DEL CITY	S20536	12/13/05	3921 S.E. 26	2,000	RAGS	MANHOLE
DEL CITY	S20536	12/22/05	2424 MCCRACKEN DR.	2,000	BLOCKAGE	MANHOLE
DEL CITY	S20536	12/30/05	1008 HAMPTON	142	RAGS & ROOTS	PIPE
DEL CITY	S20536	01/04/06	3930 S.E. 27	2,000	BLOCKAGE	MANHOLE
DEL CITY	S20536	05/01/06	3400 BLK. RIDGLEA CT.	1,200	RAGS	MANHOLE
DEL CITY	S20536	05/03/06	825 VICKIE DR.	300	GREASE & RAGS	MANHOLE
DEL CITY	S20536	05/11/06	3420 SIMMONS	160	BLOCKAGE	MANHOLE
DEL CITY	S20536	05/19/06	4200 LIONHART	1,000		
DEL CITY	S20536	05/30/06	3613 S.E. 22	8,000	GREASE & RAGS	MANHOLE
DEL CITY	S20536	07/10/06				
DEL CITY	S20536	07/28/06	3401 RIDGLEA	700	GREASE	MANHOLE
DEL CITY	S20536	08/30/06	100 BURK WAY	10,000	ROOTS & GREASE	MANHOLE
DEL CITY	S20536	09/22/06	3205 DEL VIEW DR.	300	BLOCKAGE	MANHOLE
DEL CITY	S20536	10/24/06	3413 FROSTWOOD TERR.	500	RAGS	PIPE
DEL CITY	S20536	12/12/06	3301 CHETWOOD DR.	200	GREASE & ROOTS	MANHOLE
DEL CITY	S20536	12/26/06	3100 DEL VIEW DR.	300		
DEL CITY	S20536	01/02/07	2424 MCCRACKEN	500	GREASE	MANHOLE
DEL CITY	S20536	01/16/07	3100 DEL VIEW DR.	1,000	BLOCKAGE	
DEL CITY	S20536	01/19/07	4729 S.E. 17TH	2,000	GREASE	MANHOLE
DEL CITY	S20536	01/26/07	3100 DEL VIEW	600	ROOTS & GREASE	MANHOLE
DEL CITY	S20536	01/29/07	3205 DEL VIEW	3,000	GREASE	MANHOLE
DEL CITY	S20536	03/02/07	3421 FROSTWOOD	300	BLOCKAGE	PIPE
DEL CITY	S20536	03/02/07	2400 EPPERLY	1,000	RAGS	MANHOLE
DEL CITY	S20536	03/02/07	3613 S.E. 22	1,000	DEBRIS	PIPE
DEL CITY	S20536	03/12/07	4750 WOODVIEW	500	DEBRIS	MANHOLE
DEL CITY	S20536	04/12/07	4708 S.E. 27TH	1,000	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
DEL CITY	S20536	04/23/07	3217 DENTWOOD	100	GREASE	PIPE
DEL CITY	S20536	05/11/07			RAIN	
DEL CITY	S20536	05/11/07				
DEL CITY	S20536	06/21/07	3100 DEL VIEW	500	GREASE	MANHOLE
DEL CITY	S20536	06/29/07	CITY WIDE	15,000	RAIN	
DEL CITY	S20536	07/10/07	AREAS THROUGH OUT THE CITY	15,000	WATER IN SYSTEM	MANHOLE
DEL CITY	S20536	08/27/07	3001 DEL MAR	100	PUMP FAILURE	LIFT STATION
DEL CITY	S20536	09/26/07	4705 TRINA	100	BLOCKAGE	PIPE
DEL CITY	S20536	10/03/07	4937 JEFFERY DR.	500	BLOCKAGE	MANHOLE
DEL CITY	S20536	11/06/07	3501 TERRY WAY	500	BLOCKAGE	
DEL CITY	S20536	11/27/07	4833 LISA LN.	1,000	BLOCKAGE	PIPE
DEL CITY	S20536	12/10/07	WWTP - 4500 N.E. 4TH	>4 MILLN	POWER OUTAGE	HEAD WORKS
DEL CITY	S20536	01/28/08	EAGLE POINT APTS. - 761 SCOTT ST.		CLOGGED LINE	
DEL CITY	S20536	01/29/08	2424 MCCRACKEN	1,000	GREASE	MANHOLE
DEL CITY	S20536	03/31/08	4100 FAIRVIEW	1,000	GREASE	PIPE
DEL CITY	S20536	04/11/08	4309 WOFFORD	10,000	RAIN	MANHOLE
DEL CITY	S20536	06/30/08	4825 VERA	2,000	GREASE & RAGS	MANHOLE
MIDWEST CITY	S20541	01/03/05	724 THREE OAKS DR.	1,017	LINE STOPPAGE	MANHOLE
MIDWEST CITY	S20541	01/07/05	2830 OAK AVE	3,438	OBSTRUCTION	MANHOLE
MIDWEST CITY	S20541	01/07/05	N.E. 23RD & DOUGLAS	100,000	MAIN BREAK	PIPE
MIDWEST CITY	S20541	01/25/05	9601 N.E. 16TH	2,731	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	02/09/05	3501 HOLMAN CT.	250	BLOCKAGE	PIPE
MIDWEST CITY	S20541	02/28/05	3809 PARKWOODS LN.	4,680	ROOTS	PIPE
MIDWEST CITY	S20541	03/04/05	1708 WALTZ WAY	425	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	03/14/05	3508 PARKWOODS LN.	2,034	GREASE	MANHOLE
MIDWEST CITY	S20541	03/26/05	201 E. CAMPBELL DR.	500	GREASE, ROOTS & TRASH	MANHOLE
MIDWEST CITY	S20541	03/29/05	2516 N. TOWRY	2,034	GREASE	MANHOLE
MIDWEST CITY	S20541	04/07/05	9716 WILLOW WIND DR.	2,034	ROOTS	MANHOLE
MIDWEST CITY	S20541	05/09/05	11125 N.E. 5TH	200,000	VALVE FAILURE	PIPE
MIDWEST CITY	S20541	05/11/05	1723 ALBERT DR.	595	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	05/12/05	116 W. RIDGEWOOD DR.	510	ROOTS	MANHOLE
MIDWEST CITY	S20541	05/19/05	317 W. JARMAN DR.	100	VANDALISM	MANHOLE
MIDWEST CITY	S20541	06/09/05	11101 N.E. 5TH	515	TOY IN AIR RELEASE VALVE	MANHOLE
MIDWEST CITY	S20541	06/10/05	8730 S.E. 15TH	4,578	GREASE & ROOTS	MANHOLE
MIDWEST CITY	S20541	06/13/05	1017 LOTUS AVE	200	GREASE	MANHOLE
MIDWEST CITY	S20541	06/25/05	8608 N.E. 16TH	200	GREASE	MANHOLE
MIDWEST CITY	S20541	06/27/05	952 BROWN DR.	900	PAPER TOWELS	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
MIDWEST CITY	S20541	07/01/05	8608 N.E. 16TH	1,000	GREASE	MANHOLE
MIDWEST CITY	S20541	07/11/05	108 W. LILAC LN.	510	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	08/10/05	3201 GLENVALLEY DR.	255	BLOCKAGE	PIPE
MIDWEST CITY	S20541	08/22/05	9421 N.E. 16	6,268	ROOTS, RAGS & GREASE	MANHOLE
MIDWEST CITY	S20541	08/25/05	6345 E. RENO	400	GREASE & PAPER	PIPE
MIDWEST CITY	S20541	09/06/05	601 ROYAL AVE	50	GREASE	MANHOLE
MIDWEST CITY	S20541	11/18/05	1409 MCGREGOR	20	GREASE & ROOTS	PIPE
MIDWEST CITY	S20541	11/21/05	8801 N.E. 12	370	ROOTS	PIPE
MIDWEST CITY	S20541	11/23/05	202 W. MARSHALL DR.	30	ROOTS	PIPE
MIDWEST CITY	S20541	11/28/05	1617 CHRISTINE DR.	1,960	ROOTS	PIPE
MIDWEST CITY	S20541	12/02/05	517 W. RICKENBACKER	2,120	GREASE	PIPE
MIDWEST CITY	S20541	12/02/05	207 GUY DR.	15	GREASE	PIPE
MIDWEST CITY	S20541	12/13/05	1705 NATIONAL BLVD.	765	TOWELS	MANHOLE
MIDWEST CITY	S20541	12/14/05	517 WILSON DR.	15	BLOCKAGE	PIPE
MIDWEST CITY	S20541	12/19/05	1009 TALL OAKS DR.	200	GREASE	MANHOLE
MIDWEST CITY	S20541	12/23/05	2412 N. TOWRY DR.	250	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	12/27/05	9241 N.E. 16TH	25	PAPER	PIPE
MIDWEST CITY	S20541	12/31/05	1936 TREAT DR.	2,340	GREASE & ROOTS	PIPE
MIDWEST CITY	S20541	01/01/06	620 BRADLEY CIR	1,719	ROOTS & BROKEN PIPE	PIPE
MIDWEST CITY	S20541	01/03/06	1254 GIVENS DR.	2,352	GREASE, ROOTS & SLUDGE	PIPE
MIDWEST CITY	S20541	01/04/06	1254 GIVENS	2,352	GREASE, ROOTS & SLUDGE	PIPE
MIDWEST CITY	S20541	01/05/06	8905 N.E. 10	340	GREASE	PIPE
MIDWEST CITY	S20541	01/09/06	616 BRADLEY CIR.	4,068	GREASE & ROOTS	PIPE
MIDWEST CITY	S20541	01/11/06	1300 PARKWOODS CT.	170	ROOTS, GREASE & PAPER	MANHOLE
MIDWEST CITY	S20541	01/14/06	422 W. FAIRCHILD	1,356	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	01/17/06	2308 TOWRY DR.	3,438	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	01/18/06	211 W. RIDGEWOOD DR.	3,051	GREASE & SLUDGE	MANHOLE
MIDWEST CITY	S20541	01/31/06	9200 S.E. 29TH	510	ROOTS	PIPE
MIDWEST CITY	S20541	01/31/06	1443 MAPLE DR.	395	PAPER & GREASE	PIPE
MIDWEST CITY	S20541	02/06/06	8819 N.E. 12	100	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	02/10/06	312 BOLTON DR.	50	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	02/17/06	8809 N.E. 12	500	ROOTS	MANHOLE
MIDWEST CITY	S20541	02/21/06	6224 S.E. 9TH	20	BLOCKAGE	PIPE
MIDWEST CITY	S20541	03/03/06	217 S. HIGHLAND AVE.	100	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	03/06/06	8709 N.E. 10	50	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	03/09/06	905 GENERAL SENTER	50	ROOTS	MANHOLE
MIDWEST CITY	S20541	03/10/06	1033 S. HOLLY LN.	20	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
MIDWEST CITY	S20541	03/24/06	2412 TOWRY	22,374	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	04/03/06	119 LILAC CT.	100	ROOTS	MANHOLE
MIDWEST CITY	S20541	04/11/06	414 N. ANDERSON RD.	36,000	ROOTS & BABY WIPES	MANHOLE
MIDWEST CITY	S20541	04/14/06	8716 S.E. 15	50,000	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	04/17/06	8771 S.E. 15TH	15,000	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	05/24/06	3407 WOODVALE DR.	680	BLOCKAGE	PIPE
MIDWEST CITY	S20541	05/31/06	10804 WINDMILL FARMS	15,000	BIC LIGHTER IN AIR RELEASE VALVE	PIPE
MIDWEST CITY	S20541	06/19/06	6345 E. RENO	100	GREASE & PAPER	MANHOLE
MIDWEST CITY	S20541	07/05/06	1201 S. WESTMINISTER	100	POWER SURGE	LIFT STATION
MIDWEST CITY	S20541	07/07/06	1612 WEBSTER	25	GREASE	MANHOLE
MIDWEST CITY	S20541	08/14/06	11125 N.E. 5TH	300	DEBRIS IN AIR VALVES	PIPE
MIDWEST CITY	S20541	08/16/06	104 CAMBRIDGE	500	BLOCKAGE	PIPE
MIDWEST CITY	S20541	08/17/06	217 W. SILVERMEADOW DR.	680	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	09/01/06	408 COUNTRY CLUB CIR.	4,000	GREASE	PIPE
MIDWEST CITY	S20541	09/12/06	4032 DOGWOOD DR.	170	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	09/19/06	3213 GLENOAKS DR.	10	ROOTS & GREASE	PIPE
MIDWEST CITY	S20541	09/21/06	820 MEADOWGREEN DR.	510	GREASE & SLUDGE	PIPE
MIDWEST CITY	S20541	10/20/06	304 & 308 GUY DR.	200	GREASE	PIPE
MIDWEST CITY	S20541	11/04/06	1700 S. DOUGLAS	588	BLOCKAGE	PIPE
MIDWEST CITY	S20541	11/14/06	609 GENERAL SENTER DR.	100	RAGS	MANHOLE
MIDWEST CITY	S20541	11/15/06	625 MORAINE	78	UNKNOWN	MANHOLE
MIDWEST CITY	S20541	12/07/06	7126 S.E. 15TH	85	GREASE	PIPE
MIDWEST CITY	S20541	12/21/06	540 E. ROSE DR.	5	ROOTS & SLUDGE	MANHOLE
MIDWEST CITY	S20541	12/22/06	2702 & 2804 DEL REY	200	GREASE & ROOTS	MANHOLE
MIDWEST CITY	S20541	12/28/06	500 KERR DR.	350	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	12/29/06	500 KERR DR.			
MIDWEST CITY	S20541	01/11/07	200 W. MORNINGSIDE DR.	5	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	01/21/07	303 E. ERCOUPE DR.	7,000	ROOTS & REPAIR	PIPE
MIDWEST CITY	S20541	01/24/07	805 HOLLOWAY DR.	50	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	01/26/07	119 LILAC CT.	300	GREASE & SLUDGE	MANHOLE
MIDWEST CITY	S20541	02/05/07	204 W. MARSHALL DR.	20	RAGS & DEBRIS	PIPE
MIDWEST CITY	S20541	02/05/07	4024 CRABTREE	200	GREASE	PIPE
MIDWEST CITY	S20541	02/06/07	9920 MARK TRAIL	800	GREASE	MANHOLE
MIDWEST CITY	S20541	02/08/07	8616 CEDAR RIDGE	55	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	02/09/07	3304 IDYLWILD DR.	2,352	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	02/09/07	414 N. ANDERSON RD.	1,000	ROOTS & PAPER	MANHOLE
MIDWEST CITY	S20541	02/12/07	3408 GLENOAKS DR.	1,356	DEBRIS	PIPE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
MIDWEST CITY	S20541	02/12/07	8800 N.E. 16TH	425	DEBRIS	MANHOLE
MIDWEST CITY	S20541	02/13/07	8608 N.E. 16TH	50	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	02/18/07	402 E. RICKENBACKER DR.	100	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	02/19/07	3740 ROLLING LANE CIR.	1,017	GREASE & PAPER	MANHOLE
MIDWEST CITY	S20541	02/20/07	6200 S.E. 10TH	15	BLOCKAGE	PIPE
MIDWEST CITY	S20541	02/21/07	402 MID AMERICA	50	BLOCKAGE	PIPE
MIDWEST CITY	S20541	02/25/07	6200 S.E. 10TH	42.5	BLOCKAGE	PIPE
MIDWEST CITY	S20541	02/25/07	1635 FELIX PL.	63	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	02/27/07	112 W. RIDGEWOOD DR.	40	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	02/27/07	6224 S.E. 9TH	30	ROOTS & GRASS	PIPE
MIDWEST CITY	S20541	03/02/07	4001 N. OAK GROVE DR.	2,730	ROOTS & DEBRIS	PIPE
MIDWEST CITY	S20541	03/12/07	3505 MOCKINGBIRD LN.	35	ROOTS	PIPE
MIDWEST CITY	S20541	03/12/07	120 BEARD DR.	75	ROOTS	PIPE
MIDWEST CITY	S20541	03/13/07	1801 TREAT DR.	50	GREASE	MANHOLE
MIDWEST CITY	S20541	03/14/07	537 WILSON DR.	500	PAPER	MANHOLE
MIDWEST CITY	S20541	03/14/07	9241 N.E. 16	200	PAPER	MANHOLE
MIDWEST CITY	S20541	03/25/07	1417 MAGNOLIA LN.	85	BLOCKAGE	PIPE
MIDWEST CITY	S20541	03/27/07	1604 THOMPSON DR.	267	GREASE	PIPE
MIDWEST CITY	S20541	03/30/07	506 W. LOCKHEED	50	BLOCKAGE	PIPE
MIDWEST CITY	S20541	04/02/07	1604 THOMPSON DR.	20	GREASE	PIPE
MIDWEST CITY	S20541	04/02/07	312 W. LILAC LN.	2,500	ROOTS & SLUDGE	MANHOLE
MIDWEST CITY	S20541	04/03/07	312 W. LILAC LN.	2,500	ROOTS & SLUDGE	
MIDWEST CITY	S20541	04/07/07	416 E. JARMAN DR.	100	ROOTS	MANHOLE
MIDWEST CITY	S20541	04/17/07	226 E. JACOBS DR.	585	BLOCKAGE	PIPE
MIDWEST CITY	S20541	04/17/07	805 ARTHUR DR.	70	ROOTS	PIPE
MIDWEST CITY	S20541	04/20/07	909 ESTHER AVE.	340	STOPPED MAIN	PIPE
MIDWEST CITY	S20541	04/26/07	2044 WESTBURY DR.	30	ROOTS & BABY WIPES	PIPE
MIDWEST CITY	S20541	05/03/07	209 E. ERCOUPE DR.	100	ROOTS	PIPE
MIDWEST CITY	S20541	05/07/07	1624 SYMPHONY LN.	55	BLOCKAGE	PIPE
MIDWEST CITY	S20541	05/08/07	6204 S.E. 5TH	325	ROOTS	PIPE
MIDWEST CITY	S20541	05/11/07	3620 GARDEN VIEW DR.	3	BLOCKAGE	PIPE
MIDWEST CITY	S20541	05/11/07	407 MOISELLE ST.	50	GREASE & SLUDGE	PIPE
MIDWEST CITY	S20541	05/17/07	625 MORRAINE AVE.	30	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	05/26/07	10909 ASHTON TERR.	474	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	06/20/07	705 TIMBERIDGE DR.	476	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	06/20/07	9309 S.E. 29TH	1,105	ROOTS & DEBRIS	MANHOLE
MIDWEST CITY	S20541	06/26/07	6712 S.E. 15TH	15	BLOCKAGE	PIPE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
MIDWEST CITY	S20541	06/29/07	121 W. LILAC CT.	3,000	LINE COLLAPSED	MANHOLE
MIDWEST CITY	S20541	06/29/07	927 CEDAR HILLS	10,000		
MIDWEST CITY	S20541	06/29/07	920 N. MIDWEST BLVD.	10,000	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	06/29/07	201 SHAPARD DR.	7,000	MALFUNCTION	LIFT STATION
MIDWEST CITY	S20541	07/10/07	8410 S.E. 18TH		GREASE & ROOTS	MANHOLE
MIDWEST CITY	S20541	07/12/07	1208 W. PEEBLY DR.	2,500	BLOCKAGE	PIPE
MIDWEST CITY	S20541	07/14/07	301 MOISELLE ST.	100	ROOTS	PIPE
MIDWEST CITY	S20541	08/02/07	207 E. CAMPBELL	30	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	08/04/07	201 OAK ST.	510	GREASE	MANHOLE
MIDWEST CITY	S20541	08/06/07	11246 S.E. 15TH	1,000	PUMP FAILURE	LIFT STATION
MIDWEST CITY	S20541	08/08/07	407 MOISELLE ST.	100	PLASTIC BAGS	PIPE
MIDWEST CITY	S20541	08/08/07	2400 WATTS DR.	200	MUD & STICKS	MANHOLE
MIDWEST CITY	S20541	08/25/07	500 E. KERR	960	GREASE	MANHOLE
MIDWEST CITY	S20541	08/30/07	1029 BIG OAK DR.	170	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	08/31/07	909 GENERAL SENTER DR.	170	GREASE & ROOTS	PIPE
MIDWEST CITY	S20541	08/31/07	305 W. JARMAN DR.	799	ROOTS	PIPE
MIDWEST CITY	S20541	10/16/07	7407 S.E. 15TH	10	VANDALISM	
MIDWEST CITY	S20541	10/18/07	806 STANSELL DR.	100	GREASE	
MIDWEST CITY	S20541	10/21/07	9241 N.E. 16TH	100	ROOTS & PAPER	MANHOLE
MIDWEST CITY	S20541	10/25/07	1009 TALL OAKS DR.	20	GREASE	MANHOLE
MIDWEST CITY	S20541	10/29/07	1430 CHRISTINE DR.	2,349	BROKEN MAIN	MANHOLE
MIDWEST CITY	S20541	10/31/07	9624 HARMONY DR.	127	ROOTS	MANHOLE
MIDWEST CITY	S20541	10/31/07	4000 LOCUST DR.	63	TRASH	PIPE
MIDWEST CITY	S20541	11/06/07	801 S. MIDWEST BLVD.	2,000	ROOTS	PIPE
MIDWEST CITY	S20541	11/17/07	817 STANSELL	20	ROOTS	MANHOLE
MIDWEST CITY	S20541	11/20/07	3412 PLEASANT DR.	15	ROOTS	PIPE
MIDWEST CITY	S20541	11/20/07	3408 PLEASANT DR.	20	ROOTS	PIPE
MIDWEST CITY	S20541	11/21/07	536 CARDINAL PL.	40	ROOTS	MANHOLE
MIDWEST CITY	S20541	11/28/07	616 S. POST RD.	100	GREASE	MANHOLE
MIDWEST CITY	S20541	11/29/07	408 E. JARMAN DR.	50	ROOTS	MANHOLE
MIDWEST CITY	S20541	12/01/07	12316 GOLDBERG RD.	500	DEBRIS	PIPE
MIDWEST CITY	S20541	12/02/07	1220 BROOK LANE	100	DEBRIS	MANHOLE
MIDWEST CITY	S20541	12/04/07	96W S.E. 6TH	1,020	RAGS	MANHOLE
MIDWEST CITY	S20541	12/05/07	624 MORAINE AVE	20	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	12/06/07	952 BROWN DR.	100	ROOTS & PAPER TOWELS	MANHOLE
MIDWEST CITY	S20541	12/12/07	8833 OAK RIDGE DR.	2	ROOTS & GREASE	PIPE
MIDWEST CITY	S20541	12/12/07	431 W. FAIRCHILD	510	GREASE	PIPE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
MIDWEST CITY	S20541	12/14/07	700 HEDGE DR.	127	ROOTS	PIPE
MIDWEST CITY	S20541	12/18/07	2901 WOODSIDE DR.	1,014	GREASE & ROOTS	MANHOLE
MIDWEST CITY	S20541	12/20/07	218 E. MYRTLE DR.	30	BLOCKAGE	PIPE
MIDWEST CITY	S20541	12/26/07	1408 EVERGREEN	255	PAPER TOWELS & ROOTS	
MIDWEST CITY	S20541	12/30/07	3220 N. PEEBLY	6,105	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	12/31/07	2308 TOWRY	255	PAPER	PIPE
MIDWEST CITY	S20541	01/04/08	2901 ROBIN RD.	510	ROOTS & GREASE	PIPE
MIDWEST CITY	S20541	01/07/08	3217 SHADYBROOK DR.	1,176	ROOTS	PIPE
MIDWEST CITY	S20541	01/07/08	223 SHADYBROOK PL.	100		
MIDWEST CITY	S20541	01/07/08	2308 N. TOWRY	510	ROOTS & BABY WIPES	PIPE
MIDWEST CITY	S20541	01/09/08	1617 LLOYD DR.	765	GREASE	MANHOLE
MIDWEST CITY	S20541	01/10/08	1425 MARYDALE	100	WIPES & GREASE	MANHOLE
MIDWEST CITY	S20541	01/13/08	1132 HAWTHORNE DR.	15,000	ROOTS, BABY WIPES & ROOTS	
MIDWEST CITY	S20541	01/17/08	1309 CHRISTINE DR.	238	ROOTS & RAGS	
MIDWEST CITY	S20541	02/11/08	8803 N.E. 12TH	50	DEBRIS	PIPE
MIDWEST CITY	S20541	02/11/08	428 MONRONEY DR.	127.5	DEBRIS	MANHOLE
MIDWEST CITY	S20541	02/11/08	8900 E. RENO	200	DEBRIS	MANHOLE
MIDWEST CITY	S20541	02/12/08	116 E. RIDGEWOOD	1,340	DEBRIS	MANHOLE
MIDWEST CITY	S20541	02/18/08	2600 N. AIR DEPOT	20	ELECTRICAL CONNECTION FAILURE	LIFT STATION
MIDWEST CITY	S20541	02/20/08	7231 S.E. 29TH	50	DEBRIS	MANHOLE
MIDWEST CITY	S20541	02/25/08	641 FROLICH DR.	100	DEBRIS	PIPE
MIDWEST CITY	S20541	02/29/08	2401 N. AIR DEPOT	50	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	03/03/08	311 WILSON DR.	125	DEBRIS	MANHOLE
MIDWEST CITY	S20541	03/20/08	800 ARTHUR DR.	30	BLOCKAGE	MANHOLE
MIDWEST CITY	S20541	03/24/08	712 N. MIDWEST BLVD.	10	GREASE & ROOTS	PIPE
MIDWEST CITY	S20541	03/24/08	641 FROLICH DR.	80	BLOCKAGE	PIPE
MIDWEST CITY	S20541	03/26/08	3812 ROSEWOOD DR.	90	BLOCKAGE	PIPE
MIDWEST CITY	S20541	03/27/08	3737 ROLLING LANE CIR	200	ROOTS	PIPE
MIDWEST CITY	S20541	04/01/08	2213 FLANNERY DR.	10	ROOTS & GREASE	PIPE
MIDWEST CITY	S20541	04/03/08	3825 ROSEWOOD DR.	30	ROOTS	MANHOLE
MIDWEST CITY	S20541	04/07/08	808 TIMBER RIDGE	150	ROOTS	PIPE
MIDWEST CITY	S20541	04/25/08	1016 JUNIPER AVE.	100	GREASE & SLUDGE	MANHOLE
MIDWEST CITY	S20541	04/28/08	1000 ARTHUR DR.	200	DEBRIS	MANHOLE
MIDWEST CITY	S20541	05/08/08	909 ESTHER AVE	510	CONTRACTOR ERROR	PIPE
MIDWEST CITY	S20541	05/13/08	2908 WOODCREEK RD	11	ROOTS & GREASE	MANHOLE
MIDWEST CITY	S20541	05/13/08	3425 HOLMAN CT.	200	GREASE	PIPE
MIDWEST CITY	S20541	05/23/08	604 E. RICKENBACKER	5	GREASE, ROOTS & RAGS	PIPE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
MIDWEST CITY	S20541	06/07/08	2516 N. TOWRY DR.	100	RAGS & GREASE	MANHOLE
MIDWEST CITY	S20541	06/13/08	2337 N. TOWRY DR.	200	ROOTS & GREASE	PIPE
MIDWEST CITY	S20541	06/14/08	126 E. NORTHRUP DR.	1,275	RAGS & ROOTS	PIPE
MIDWEST CITY	S20541	06/16/08	6500 S.E. 15TH	200	ROOTS & GREASE	PIPE
MIDWEST CITY	S20541	06/27/08	104 THREE OAKS DR.	100	GREASE & RAGS	MANHOLE
MIDWEST CITY	S20541	06/27/08	6212 S.E. 7TH	100	ROOTS & RAGS	PIPE
MIDWEST CITY	S20541	07/11/08	6300 E. RENO	30	GREASE & PAPER	MANHOLE
SPENCER	S20542	01/03/05	8900 N.E. 52	50	GREASE & ROOTS	
SPENCER	S20542	01/10/05	3401 DOUGLAS		GREASE	MANHOLE
SPENCER	S20542	01/13/05	5510 SPENCER RD.	175	ROOTS	
SPENCER	S20542	01/13/05	5510 SPENCER RD.	175	ROOTS	
SPENCER	S20542	01/15/05	3307 N. DOUGLAS	5,000	ROOTS & GREASE	
SPENCER	S20542	01/18/05	9304 N.E. 50	50	GREASE	
SPENCER	S20542	01/21/05	3408 N.E. 33RD CIR	20	GREASE	
SPENCER	S20542	01/25/05	5416 PALMER ST.	100	GREASE & ROOTS	
SPENCER	S20542	01/27/05	5510 SPENCER RD.	50	GREASE	MANHOLE
SPENCER	S20542	02/08/05	4914 PALMER	25	PRIVATE PROBLEM THAT HAS OCCURED MANY TIMES	
SPENCER	S20542	02/10/05	4251 N. DOUGLAS	300	ROOTS	
SPENCER	S20542	02/11/05	9300 N.E. 45	300		
SPENCER	S20542	03/30/05	2924 JUSTIN (REAR)	150	GREASE	MANHOLE
SPENCER	S20542	04/14/05	BEHIND 8219 N.E. 23	10,000	POWER OUTAGE	LIFT STATION
SPENCER	S20542	04/18/05	N.E. 36TH & DOUGLAS	200	GREASE & RAGS	MANHOLE
SPENCER	S20542	05/02/05	3401 DOUGLAS BLVD.	300	GREASE & ROOTS	
SPENCER	S20542	06/03/05	8320 N.E. 34TH PL.	50	ROOTS & GREASE	
SPENCER	S20542	06/24/05	8319 N.E. 34TH PL.	100	GREASE	
SPENCER	S20542	07/05/05	3700 ROGERS DR.	500	GREASE	
SPENCER	S20542	08/05/05	ROGERS MIDDLE SCHOOL	125	GREASE	MANHOLE
SPENCER	S20542	08/09/05	3409 & 3405 33RD CT	50	GREASE	
SPENCER	S20542	08/30/05	8505 N.E. 36	50	ILLEGALLY DUMPED OIL	PIPE
SPENCER	S20542	08/30/05	5005 SPENCER RD.	500	PUMP MOTORS WERE TRIPPED	LIFT STATION
SPENCER	S20542	09/02/05	8320 N.E. 39TH	150	GREASE	MANHOLE
SPENCER	S20542	11/15/05	8632 N.E. 33RD	200	GREASE	MANHOLE
SPENCER	S20542	11/16/05	9220 N.E. 45	1,500	GREASE	MANHOLE
SPENCER	S20542	11/17/05	5003 SPENCER RD.		PUMPS FAILURE	LIFT STATION

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
SPENCER	S20542	11/17/05	5510 SPENCER RD.	50	GREASE & RAGS	
SPENCER	S20542	11/30/05	9220 N.E. 45	2,000	GREASE & ROOTS	MANHOLE
SPENCER	S20542	12/09/05	8320 N.E. 39	500	GREASE	MANHOLE
SPENCER	S20542	12/09/05	3700 ROGERS DR.	100	GREASE	MANHOLE
SPENCER	S20542	12/16/05	8400 N.E. 39TH	100	GREASE	
SPENCER	S20542	12/17/05	2901 DOUGLAS	100		
SPENCER	S20542	12/18/05	2901 DOUGLAS BLVD	100	GREASE	
SPENCER	S20542	12/19/05	8322 N.E. 36TH	50	GREASE	MANHOLE
SPENCER	S20542	12/19/05	8350 N.E. 36	100	GREASE	
SPENCER	S20542	12/20/05	8320 N.E. 36	150	GREASE	MANHOLE
SPENCER	S20542	12/21/05	4550 ANN FELTON (INHABITAT)	1,000	GREASE	MANHOLE
SPENCER	S20542	12/21/05	8320 N.E. 36			
SPENCER	S20542	12/22/05	3401 DOUGLAS BLVD.	1,500		
SPENCER	S20542	12/22/05	3401 DOUGLAS BLVD.		GREASE	
SPENCER	S20542	12/24/05	3701 ROGERS DR.	700	GREASE	
SPENCER	S20542	12/28/05	3104 DOUGLAS BLVD. IN FIELD	550	GREASE	
SPENCER	S20542	12/31/05	8950 N.E. 52	100	GREASE	
SPENCER	S20542	12/31/05	8941 N.E. 51			
SPENCER	S20542	01/10/06	3710 DOUGLAS BLVD.	50	GREASE	
SPENCER	S20542	01/23/06	3205 N. DOUGLAS	1,000		
SPENCER	S20542	01/30/06	9208 N.E. 45	500	GREASE	
SPENCER	S20542	02/12/06	3401 DARYL LANE	3,000	GREASE	
SPENCER	S20542	02/13/06	3516 DARYL LN.	10	GREASE	
SPENCER	S20542	02/16/06	4401 SPENCER RD.	300	GREASE	
SPENCER	S20542	02/17/06	3401 DOUGLAS BLVD.	2,000	GREASE	
SPENCER	S20542	02/26/06	8632 N.E. 33	300	GREASE	
SPENCER	S20542	03/01/06	4701 SPENCER RD.	250	BLOCKAGE	
SPENCER	S20542	03/02/06	8900 N.E. 52ND	25	BLOCKAGE	PIPE
SPENCER	S20542	03/16/06	3700 ROGERS DR.	250	GREASE	MANHOLE
SPENCER	S20542	03/23/06	4608 SPENCER RD.	250	GREASE	MANHOLE
SPENCER	S20542	03/28/06	9200 N.E. 45	500	ROOTS & GREASE	MANHOLE
SPENCER	S20542	03/28/06	4101 DOUGLAS			MANHOLE
SPENCER	S20542	03/30/06	3409 DARYL LN	100	GREASE	MANHOLE
SPENCER	S20542	03/30/06	3501 & 3516 DARYL LN		GREASE & ROOTS	MANHOLE
SPENCER	S20542	04/03/06	3516 DARYL LN	50	ROOTS & GREASE	
SPENCER	S20542	04/19/06	3516 DARYL LN.	20	GREASE & ROOTS	
SPENCER	S20542	04/26/06	5300 SPENCER RD.		GREASE	

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
SPENCER	S20542	06/02/06	5001 SPENCER RD. - RAILROAD TRACKS	>1,000	GREASE	
SPENCER	S20542	06/09/06	8640 N.E. 33	250	GREASE	
SPENCER	S20542	06/09/06	5001 SPENCER RD.	1,000	GREASE	
SPENCER	S20542	06/13/06	5501 SPENCER RD. BEHIND RR TRACKS			
SPENCER	S20542	06/20/06	5001 SPENCER RD.	200		
SPENCER	S20542	06/21/06	5001 SPENCER RD.	3,000	GREASE	
SPENCER	S20542	06/26/06	3301 DOUGLAS	400	GREASE	
SPENCER	S20542	08/18/06	50TH & SPENCER RD.	1,500	GREASE	
SPENCER	S20542	08/30/06	5007 INDIANA	100		
SPENCER	S20542	09/06/06	8632 N.E. 33	50	BLOCKAGE	
SPENCER	S20542	09/13/06	9308 N.E. 46			
SPENCER	S20542	09/25/06	3801 ROGERS DR.	200	GREASE	
SPENCER	S20542	10/16/06	9300 N.E. 45TH		ROOTS & GREASE	
SPENCER	S20542	11/21/06	PRECIOUS PET CEMETERY ON DOUGLAS	150	ROOTS & GREASE	
SPENCER	S20542	01/01/07	ROGERS MIDDLE SCHOOL		GREASE	
SPENCER	S20542	01/06/07	3401 N. DOUGLAS		GREASE	
SPENCER	S20542	01/18/07	3401 DOUGLAS		GREASE	
SPENCER	S20542	01/18/07	8619 MAIN	5	GREASE	
SPENCER	S20542	01/21/07	3601 DOUGLAS	>1,000	GREASE	
SPENCER	S20542	01/22/07	8319 N.E. 39TH	>3,000	GREASE	
SPENCER	S20542	01/22/07	3508 DOUGLAS BLVD.	<200	GREASE	
SPENCER	S20542	02/05/07	3405 SPENCER RD.	5	GREASE	
SPENCER	S20542	02/07/07	3401 DOUGLAS IN FIELD	<500	GREASE	
SPENCER	S20542	02/08/07	8644 PARADISE DR.	<1,000	GREASE	
SPENCER	S20542	02/08/07	3429 33RD CT.	<20	GREASE	
SPENCER	S20542	02/13/07	3801 ROGERS DR.	<100	GREASE	
SPENCER	S20542	02/19/07	3408 N. DOUGLAS	<50	GREASE	
SPENCER	S20542	02/20/07	8619 MAIN	10	GREASE	
SPENCER	S20542	02/21/07	9308 N.E. 46TH	500	GREASE	
SPENCER	S20542	02/27/07	8717 N.E. 47	<100	GREASE	
SPENCER	S20542	02/27/07	8505 N.E. 36TH	<20	RAGS	
SPENCER	S20542	02/27/07	9306 N.E. 50TH	<50		
SPENCER	S20542	03/19/07	3408 DOUGLAS BLVD.	<500	GREASE	
SPENCER	S20542	03/19/07	N.E. 36TH & SPENCER RD.	<50	RAGS	
SPENCER	S20542	03/21/07	3413 N.E. 33RD CIR	<10	BLOCKAGE	
SPENCER	S20542	03/26/07	9308 N.E. 46TH	<200	GREASE	
SPENCER	S20542	03/27/07	9308 N.E. 50TH	35		

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
SPENCER	S20542	03/27/07	2800 PAXTON	<50	TRASH	
SPENCER	S20542	03/29/07	8900 N.E. 52ND	20	UNKNOWN	
SPENCER	S20542	03/31/07	3501 DARYL LN.	>5,000	UNKNOWN	
SPENCER	S20542	03/31/07		2,000		
SPENCER	S20542	04/01/07	3516 DARYL	<1,000	BLOCKAGE	
SPENCER	S20542	04/04/07	BEHIND POLICE DEPT.	<500	GREASE & SHOP RAGS	MANHOLE
SPENCER	S20542	04/06/07	8505 N.E. 36TH	<25	RAGS	
SPENCER	S20542	04/09/07	9308 N.E. 46TH	<200	GREASE & SLUDGE	
SPENCER	S20542	04/10/07	8713 SILVER CREEK	<25		
SPENCER	S20542	04/10/07	8320 N.E. 34TH PL.	<25	UNKNOWN	
SPENCER	S20542	04/11/07	8900 N.E. 51ST	>1,000	GREASE & ROOTS	
SPENCER	S20542	04/13/07	4512 PINON	<5	GREASE	
SPENCER	S20542	04/14/07				
SPENCER	S20542	04/17/07	9308 N.E. 46TH	<100	GREASE	
SPENCER	S20542	04/19/07	8505 N.E. 36TH	<20	BLOCKAGE	
SPENCER	S20542	04/21/07	4601 ANN FELTON			MANHOLE
SPENCER	S20542	04/23/07	4501 DOUGLAS IN REAR BY SILVERLAKE	>5,000	ROOTS	
SPENCER	S20542	05/02/07	8612 N.E. 33RD	<300	COLLAPSED MAIN	
SPENCER	S20542	05/08/07	5200 N. DOUGLAS	<5	BLOCKAGE	
SPENCER	S20542	05/11/07			RAIN	MANHOLE
SPENCER	S20542	05/12/07	3501 N. DOUGLAS	<25		
SPENCER	S20542	05/14/07	50TH ST. L.S.	25,000	ELECTRICAL PROBLEM	LIFT STATION
SPENCER	S20542	05/17/07	3508 N. DOUGLAS	1,000	GREASE	
SPENCER	S20542	05/21/07	8326 N.E. 34TH	50	ROOTS	
SPENCER	S20542	05/23/07	9308 N.E. 46TH	<500	ROOTS & GREASE	
SPENCER	S20542	06/10/07	ROGERS MIDDLE SCHOOL	1,000	GREASE	
SPENCER	S20542	06/17/07	N.E. 50TH ST. L.S.	25,000	PUMP FAILURE	
SPENCER	S20542	06/18/07	50TH ST. L.S.	500,000	PUMP FAILURE	LIFT STATION
SPENCER	S20542	06/19/07	5001 SPENCER RD. - RR TRACKS	>50,000	UNKNOWN	
SPENCER	S20542	06/22/07	50TH ST L.S.			
SPENCER	S20542	06/25/07	50TH ST L.S.			
SPENCER	S20542	06/26/07	50TH ST. L.S.		RAIN	
SPENCER	S20542	06/28/07	50TH ST. L.S.			
SPENCER	S20542	06/28/07	50TH ST L.S.	100,000	RAIN	
SPENCER	S20542	07/02/07	3801 ROGERS		POP BOTTLES IN MH	
SPENCER	S20542	08/03/07		200	GREASE	

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
SPENCER	S20542	08/04/07	8900 N.E. 51ST	<25	GREASE	
SPENCER	S20542	08/07/07	5020 INDIANA		GREASE	
SPENCER	S20542	08/07/07	5019 SPENCER RD.			
SPENCER	S20542	08/13/07	3429 N.E. 33RD	<25	GREASE & RAGS	
SPENCER	S20542	08/14/07	8640 N.E. 33RD	50		
SPENCER	S20542	08/19/07	9205 N.E. 45TH	<5	GREASE	
SPENCER	S20542	08/19/07	9209 N.E. 45TH	<5	GREASE	
SPENCER	S20542	08/19/07	9405 N.E. 45TH	<5	GREASE	
SPENCER	S20542	08/19/07	9220 N.E. 45TH		BLOCKAGE	
SPENCER	S20542	08/21/07	2800 DOUGLAS	<1,000	UNKNOWN	
SPENCER	S20542	08/21/07	BENT TRAIL & DOUGLAS	1,000		
SPENCER	S20542	09/04/07	8900 N.E. 51	<25	GREASE	
SPENCER	S20542	09/12/07	3801 ROGERS DR.	1,000	GREASE	
SPENCER	S20542	09/12/07	3401 N. DOUGLAS	500	BLOCKAGE	
SPENCER	S20542	09/20/07	8200 N.E. 36TH	<100	LINE STOPPAGE	
SPENCER	S20542	09/23/07	8517 SILVER CREEK		GRASS	MANHOLE
SPENCER	S20542	09/30/07	8815 & 8519 SILVER CREEK			
SPENCER	S20542	12/03/07	2924 JUSTIN PL.	50	GREASE	MANHOLE
SPENCER	S20542	12/21/07	8420 N.E. 39TH	2,000		MANHOLE
SPENCER	S20542	12/26/07	5401 SPENCER RD.	200		
SPENCER	S20542	12/26/07	8622 N.E. 33RD	50		
SPENCER	S20542	01/08/08	BENTREE & DOUGLAS	50		
SPENCER	S20542	02/11/08	4608 ANN FELTON	500	VANDALISM	MANHOLE
SPENCER	S20542	02/22/08	9304 N.E. 46TH	100	ROOTS	MANHOLE
SPENCER	S20542	03/03/08	DOUGLAS BLVD. & BENTREE COUNTRY WAY	100	DEBRIS	
SPENCER	S20542	03/17/08	S.W. CORNER OF INTEGRIS MENTAL HEALTH CENTER PROPERTY	1,000	DEBRIS	
SPENCER	S20542	03/25/08	4401 SPENCER RD.	2,000	ROOTS & RAGS	
SPENCER	S20542	06/02/08	3801 ROGERS DRIVE	50	SEWER LINE WAS STOPPED UP @ 3701 ROGERS DR DUE TO DEBRIS	
SPENCER	S20542	06/03/08	5200 SPENCER RD.	50	UNKNOWN	
OKC - DUNJEE	S20544	08/26/05	N.E. 39TH & RICHARDSON	50	BLOCKAGE	MANHOLE
HARRAH	S20546	01/10/05	20368 N.E. 10	50	GREASE	
HARRAH	S20546	01/10/05	23RD & STRAIGHT ST.	100	GREASE	
HARRAH	S20546	01/10/05	2147 STRAIGHT ST	100	GREASE	
HARRAH	S20546	01/18/05		500		
HARRAH	S20546	01/19/05	1650 1ST	500	ROOTS	

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
HARRAH	S20546	01/21/05		700	GREASE	
HARRAH	S20546	01/24/05	APPLE VALLEY APTS.	700	GREASE & TOWELS	
HARRAH	S20546	05/05/05	10TH & CHURCH	800	GREASE	
HARRAH	S20546	05/31/05	APPLE VALLEY APTS	200	GREASE	
HARRAH	S20546	06/09/05	GOLD & SILVER ON HARRAH RD.	1,000	GREASE & RAGS	
HARRAH	S20546	06/17/05	PLANT	20,000	POWER FAILURE	
HARRAH	S20546	07/07/05	PLANT	1,500	POWER FAILURE	
HARRAH	S20546	10/18/05	2082 LAHOMA CIR	200	ROOTS & GREASE	MANHOLE
HARRAH	S20546	10/27/05	20368 N.E. 10TH	200	GREASE	
HARRAH	S20546	11/01/05	2173 STATE ST.	300	GREAS & ROOTS	
HARRAH	S20546	11/14/05	20368 N.E. 10TH	300	GREASE	MANHOLE
HARRAH	S20546	11/18/05	2450 WHITESMEADOW ROAD	5,000	ELECTRICAL FAILURE	LIFT STATION
HARRAH	S20546	02/08/06	APPLE VALLEY APTS.	1,000	CHUNKS OF ASPHALT	
HARRAH	S20546	03/28/06	1275 MCCLURG DR.	1,000	GREASE	
HARRAH	S20546	12/05/06	WWTP	10,000	ELECTRIC FAILURE	
HARRAH	S20546	12/05/06	PLANT	10,000	ELECTRICAL FAILURE	
HARRAH	S20546	12/05/06	PLANT	4,000	ELECTRIC FAILURE	
HARRAH	S20546	12/27/06	20290 ROCK HOLLOW	2,000	GREASE & BABY WIPES	
HARRAH	S20546	01/23/07	2550 WHITES MEADOW DR.	3,500	SERVICE LINE BROKE	LIFT STATION
HARRAH	S20546	02/29/08	1834 CHURCH AVE.		COLLAPSED SEWER MAIN	
HARRAH	S20546	03/13/08	PLANT	1,000	MALFUNCTION	HEAD WORKS
HARRAH	S20546	03/27/08	20368 N.E. 23RD	2,500	GREASE & ROOTS	MANHOLE
HARRAH	S20546	04/18/08	1851 CHURCH	5,000	COLLAPSED LINE	PIPE
HARRAH	S20546	05/05/08	PLANT	1,500	FAILED VALVE	HEAD WORKS
MCLOUD	S20547	07/07/05			SUBMERGED FLOE RAISING IN CONTACT BASIN	
MCLOUD	S20547	12/21/05	PLANT	348,000	MALFUNCTION	CLARIFIER
MCLOUD	S20547	12/22/05	PLANT	617,000	MALFUNCTION	CLARIFIER
MCLOUD	S20547	12/23/05	PLANT	862,000	MALFUNCTION	CLARIFIER
MCLOUD	S20547	12/24/05				
OKC - N. CAN	S20580	01/03/05	6004 S. LINN	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/03/05	3533 S.W. 36TH	400	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/10/05	S.E. 80TH & SOONER RD.	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/11/05	N. MAY & BRITTON	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/20/05	1200 N.W. 51	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/20/05	2500 N. STERLING	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/20/05	2400 GENERAL PERSHING	99	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	01/24/05	6040 N.W. EXPRESSWAY	180	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/26/05	E. MEMORIAL & BENSON	264	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/26/05	6303 N. PENN	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/28/05	825 GOLD MEADOW	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/03/05	2320 N.W. 45TH PL.	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/05/05	S.E. 51ST & S. HATTIE	120	GREASE & SLUDGE	MANHOLE
OKC - N. CAN	S20580	02/06/05	1321 N.W. 13	500	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	02/06/05	10325 S. MCKINLEY	100	PAPER & STICKS	MANHOLE
OKC - N. CAN	S20580	02/08/05	549 S.W. 62ND TERR	20	GREASE, SLUDGE & PAPER	MANHOLE
OKC - N. CAN	S20580	02/11/05	4430 N.W. 59	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/11/05	940 BRADLEY AVE.	100	GREASE	MANHOLE
OKC - N. CAN	S20580	02/14/05	10023 N.W. 36TH PL	5,000	EQUIPMENT FAILURE	LIFT STATION
OKC - N. CAN	S20580	02/14/05	5029 UNION CIR.	75	GREASE	MANHOLE
OKC - N. CAN	S20580	02/17/05	5909 S. LEE	490	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/17/05	4808 DIMPLE DR.	72	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/05	628 S.E. 38	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/21/05	7211 LAKEWOOD CIR.	660	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/21/05	317 S. MORGAN RD.	858	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/22/05	5801 BROADWAY EXT.	120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/22/05	10217 N. MCKINLEY	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/25/05	3156 N. PORTLAND	255	GREASE & PAPER	MANHOLE
OKC - N. CAN	S20580	03/01/05	2409 N. MOULTON DR.	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/07/05	N.W. 24TH & DREXEL BLVD.	800	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/12/05	4000 N. MARTIN LUTHER KING	205	SLUDGE	MANHOLE
OKC - N. CAN	S20580	03/13/05	12201 S.W. 14	800	DEBRIS	MANHOLE
OKC - N. CAN	S20580	03/13/05	2049 MATTERN DR.	605	ROOTS & PAPER	MANHOLE
OKC - N. CAN	S20580	03/16/05	N.W. 36TH & OVERHOLSER	50,000	BROKEN PIPE	LIFT STATION
OKC - N. CAN	S20580	03/22/05	PLANT	50	DISCHARGE LINE BROKE	PIPE
OKC - N. CAN	S20580	03/22/05	N.E. 29TH & PROSPECT	75	GREASE	MANHOLE
TULSA	S20580	03/23/05	PLANT	50	DISCHARGE LINE BROKE	PIPE
OKC - N. CAN	S20580	03/25/05	7700 N. HUDSON	3,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/26/05	N.W. 90TH & MILITARY AVE.	200	GREASE & RAGS	MANHOLE
OKC - N. CAN	S20580	04/01/05	7100 TERMINAL DR.	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/01/05	709 S.E. 79TH	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/03/05	3120 N. TUDOR RD.	128	ROOTS	MANHOLE
OKC - N. CAN	S20580	04/06/05	4005 N.W. 62	200	GREASE, SLUDGE & PAPER	MANHOLE
OKC - N. CAN	S20580	04/06/05	5520 N. BARNES	300	GREASE & PAPER	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	04/07/05	3200 N. TUDOR RD.	200	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	04/11/05	6012 S. VILLA	225	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/11/05	10109 ABERDEEN LN.	74	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/13/05	4608 SHALLOW BROOK DR.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/13/05	1640 N. BRYANT	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/13/05	7317 N. BROADWAY	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/16/05	6016 S. MILLER	20	GREASE & PAPER	MANHOLE
OKC - N. CAN	S20580	04/17/05	11000 N. COLTRANE RD.	150	GREASE & ROCKS	MANHOLE
OKC - N. CAN	S20580	04/18/05	4334 N.W. EXPRESSWAY	1,580	GREASE & STICKS	MANHOLE
OKC - N. CAN	S20580	04/20/05	4816 CREEKWOOD DR.	123	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	04/25/05	604 FLAMINGO AVE	450	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/27/05	436 N.W. 83	1,100	RAGS	MANHOLE
OKC - N. CAN	S20580	05/02/05	4913 ERIC DR.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/09/05	N.W. 10TH & ANITA	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/09/05	3216 PARKER DR.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/10/05	1813 FLAMINGO AVE	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/10/05	513 S.W. 42	50	BLOCKAGE	
OKC - N. CAN	S20580	05/10/05	513 S.W. 42	50	GREASE & STICKS	MANHOLE
OKC - N. CAN	S20580	05/23/05	S.W. 64TH & DUKE	200	MAIN COLLAPSED	
OKC - N. CAN	S20580	06/01/05	S.W. 23RD & MERIDIAN	342	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/20/05	PLANT	500	OVERFLOW	LAGOON/BASIN
OKC - N. CAN	S20580	06/20/05	6028 N. MEREDIAN PL.	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/20/05	3113 S.W. 28TH	64	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/22/05	3200 TUDOR RD.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/22/05	S.W. GRAND BLVD. & S. PENN	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/04/05	403 GREENGATE DR.	30	GREASE, ROOTS & PAPER	MANHOLE
OKC - N. CAN	S20580	07/06/05	742 S.W. 32	1,260	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	07/07/05	124 BELLGATE DR.	35	GREASE	MANHOLE
OKC - N. CAN	S20580	07/08/05	6501 JOHNNIE TERR.	108	BLOCKAGE	MANHOLE
OKC - N. CAN.	S20580	07/27/05	7112 S.W. 29	500	BLOCKAGE	MANHOLE
OKC - N. CAN.	S20580	07/28/05	4137 N.W. 51	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/29/05	5113 N.W. 20	35	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/10/05	1620 N.E. 9TH	60	DEBRIS	MANHOLE
OKC - N. CAN	S20580	08/19/05	1600 N.E. 5TH	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/22/05	3304 S. META	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/30/05	N.E. 39TH & RICHARDSON	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	09/01/05	108TH & HIAWASSEE	5	BIOSOLIDS FELL OUT OF TRUCK	

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	09/09/05	3409 S. PORTLAND AVE.	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	09/16/05	4613 N.W. 19	600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	09/26/05	1008 S.E. 51	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	09/26/05	2501 E. MEMORIAL	360	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/02/05	1309 EDINBURG DR.	83	DEBRIS	MANHOLE
OKC - N. CAN	S20580	10/05/05	1 PENTREE DR.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/10/05	320 S. BRYANT PL.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/13/05	21 S.E. 55	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/17/05	2958 VILLAGE CIR.	4,000	L.S. DOWN	LIFT STATION
OKC - N. CAN	S20580	10/18/05	5716 BRANIFF DR.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/24/05	3442 N.W. 42	250	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/25/05	3228 S.W. 62	70	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/28/05	1128 GLADE AVE.	180	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/31/05	1128 GLADE AVE.	180	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/31/05	6413 N.W. 24TH	1	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/10/05	4705 CREEKWOOD DR.	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/14/05	928 NOEL DR.	900	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/16/05	N.E. 23RD & M.L. KING	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/17/05	7113 S. SHARTEL	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/28/05	4705 S. WOODWARD	365	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/12/05	4720 ROYAL OAK DR.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/12/05	1115 N.E. 55TH	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/14/05	7201 S. PENN	3,960	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/15/05	1020 FLAMINGO AVE.	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/15/05	1312 N.E. 45TH	36	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/18/05	2104 N.W. 25	200	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	12/22/05	S.E. 48TH & MADER BLVD.	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/26/05	S.E. 47TH & MADERA DR.	80	GREASE & SLUDGE	MANHOLE
OKC - N. CAN	S20580	12/27/05	2900 S.W. 54	25	GREASE & SLUDGE	MANHOLE
OKC - N. CAN	S20580	12/27/05	716 N.W. 28	20	SLUDGE	MANHOLE
OKC - N. CAN	S20580	12/27/05	1061 PRUITT DR.	500	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	12/28/05	501 S.E. 72	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/28/05	N.W. 30TH & BROOKLINE	53	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/28/05	6308 S. LINDSEY	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/29/05	7806 LYREWOOD LN.	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/30/05	10217 N. MCKINLEY	1,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/03/06	6316 S. HARVEY	20	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	01/03/06	2044 N.E. 27	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/03/06	329 N.W. 91	20	GREASE, ROOTS & SLUDGE	MANHOLE
OKC - N. CAN	S20580	01/04/06	1731 N.E. 18TH	45	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/04/06	329 N.W. 91	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/10/06	7208 S. DREXEL AVE	150	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/10/06		1,800	DEBRIS	MANHOLE
OKC - N. CAN	S20580	01/11/06	3309 N. PROSPECT	172	BLOCKAGE	
OKC - N. CAN	S20580	01/11/06	S.W. 67TH & WALKER	1,800	BLOCKAGE	
OKC - N. CAN	S20580	01/11/06		172	DEBRIS	MANHOLE
OKC - N. CAN	S20580	01/13/06	S.E. GRAND BLVD. & HIGHLAND DR.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/18/06	1723 N.E. 19	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/18/06	2306 N. FLORIDA	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/18/06	2912 PIONEER AVE.	2,400	ROOTS	MANHOLE
OKC - N. CAN	S20580	01/20/06	8520 S. LAND	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/23/06	5320 HUDDLESTON DR.	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/31/06	6001 BRANIFF DR.	310	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/02/06	S.E. 51ST & GEORGIA PL.	60	SLUDGE & PAPER	MANHOLE
OKC - N. CAN	S20580	02/06/06	9508 S. MCKINLEY	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/10/06	3000 BROOKHOLLOW RD.	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/13/06	7012 COUNTRY CLUB PL.	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/21/06	4732 HEMLOCK CIR.	18	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/21/06	2613 N. RHODE ISLAND	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/22/06	6303 WATERFORD BLVD.	400	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/24/06	2228 N.E. 19TH	73	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/02/06	3008 N. ANN ARBOR AVE.	575	DEBRIS	MANHOLE
OKC - N. CAN	S20580	03/02/06	N.E. 15TH & FONSHILL	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/03/06	200 N.E. 48	191	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/06/06	5216 S.E. 56	93	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/06/06	1524 N. GRAND AVE.	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/06/06	4916 S.E. 86	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/09/06	5705 S. SHIELDS	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/06	2917 S.E. 56TH	370	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/06				
OKC - N. CAN	S20580	03/15/06	1400 N.E. 63RD	600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/15/06	9 N. GREENGATE DR.	2,670	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/17/06	N.E. 28TH & LINCOLN BLVD.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/20/06	N.E. 20TH & LINCOLN BLVD.	50	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	03/20/06	4320 LUNOW DR.	1,485	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/27/06	2101 E. I-44 SERVICE RD.	144	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/30/06	N.E. 8TH & STONEWALL	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/04/06	1531 S.W. 56	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/04/06	2640 S.W. 44	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/10/06	3100 N.W. 41	3,550	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/11/06	210 QUADRUM DR.	270	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/12/06	4326 S.W. 21	510	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/12/06	4820 N. SANTE FE	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/14/06	7408 SEARS TERR.	176	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/17/06	8318 S. SHARTELL	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/18/06	3020 N. ANN ARBOR	120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/18/06	3020 N. ANN ARBOR	120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/19/06	1530 N. GRAND BLVD.	150	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/21/06	4800 N. SANTE FE	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/24/06	2000 S. MERIDIAN	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/24/06	2521 S.W. 62	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/24/06	3116 WALDEN AVE.	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/24/06	2017 N. NEBRASKA	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/26/06	2052 N.E. 30	500	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	05/01/06	5605 N. ROSS	900	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/01/06	1300 S. GRAND BLVD.	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/01/06	801 S.E. 70TH	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/03/06	3117 S.W. 48	90	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/08/06	4500 N. STEANSON	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/08/06	804 S.W. 2	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/11/06	1824 GRAHAM CIR..	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/15/06	3020 N. ANN ARBOR	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/15/06	133 S.E. GRAND BLVD.	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/17/06	2013 N.E. 27TH	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/22/06	I-40 & MERIDIAN AVE.	500	CONTRACTOR ERROR REBUILDING L.S.	LIFT STATION
OKC - N. CAN	S20580	06/02/06	6508 ASHBY TERR.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/06/06	WILSHIRE CREEK & WILSHIRE BLVD.	2,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/09/06	N.W. 102ND & BROADWAY EXTENSION	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/13/06	S.E. 51ST & GEORGIA PL.	84	PAPER	MANHOLE
OKC - N. CAN	S20580	06/26/06	4109 S. WALKER	1,420	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/30/06	2912 S.W. 62	294	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	07/03/06	16 S.W. 24	820	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/17/06	724 N.W. 110TH	186	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/18/06	6401 S. MCLEMORE DR.	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/19/06	6220 N. CLASSEN	51	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/08/06	5016 N.W. 10	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/14/06	5801 S. HARVEY	79	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/17/06	1116 N. LOTTIE AVE.	120	RAGS, PAPER & SLUDGE	MANHOLE
OKC - N. CAN	S20580	08/22/06	N.E. 26TH & LINDSEY	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/23/06	112 N.W. 16TH	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/30/06	1825 N.E. 48TH	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	09/21/06	5408 HIGHLY DR.	600	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	09/21/06	3530 GARDEN PL.	50	COLLAPSED LINE	MANHOLE
OKC - N. CAN	S20580	09/22/06	9600 N.W. 4TH	30,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/09/06	N.E. 143RD & COLTRANE RD.	4,260	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/09/06	4431 N.W. 16TH	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/10/06	5800 S.E. 70	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/12/06	1832 N.E. 54TH	430	BLOCKAGE	
OKC - N. CAN	S20580	10/20/06	2125 S.W. 47TH	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/24/06	1229 N.E. 41ST TERR.	118	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/30/06	1722 N. MERIDIAN	5	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/30/06	4604 SHALLOW BROOK DR.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/31/06	5111 BURR OAKS	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/01/06	N.E. 16TH TERR. & MLK.	70	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/03/06	3124 S.W. 42	120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/06/06	4121 N.W. 31ST TERR.	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/06/06	4100 SPRINGLAKE DR.	91	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/07/06	2945 N.W. EXPRESSWAY	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/08/06	494 BRIARWOOD DR.	1,340	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/09/06	5205 SHALIMAR DR.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/13/06	3828 N.W. 51	200	BLOCKAGE	
OKC - N. CAN	S20580	11/20/06	7575 W. FORDSON DR.	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/20/06	4112 N.W. 56TH PL.	1,095	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/27/06	6640 N.W. 10	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/27/06	10904 N. LINCOLN BLVD.	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/27/06	1943 N.W. 9TH	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/07/06	3615 N. ML KING BLVD.	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/15/06	3900 N.W. 51ST	50	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	12/15/06	400 N.E. 61	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/18/06	5109 GAINES ST.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/18/06	12500 S. WESTERN	3,500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/19/06	S.W. GRAND & BROCK DR.	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/19/06	704 S.W. 67TH	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/19/06	1216 S.W. 56TH	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/20/06	5900 N. CLASSEN CT.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/26/06	12500 S. WESTERN	45,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/27/06	4916 SHALLOW BROOK	1,500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/28/06	2719 N.E. 23	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/29/06	13404 AUBURN LN.	1,220	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/29/06	2224 N.W. 56	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/02/07	3136 S.W. 23RD	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/03/07	3105 N.W. 35	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/03/07	11700 N. HUDSON AVE.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/04/07	100 N.E. 67TH	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/07/07	1705 S.E. 51ST	100	GREASE, ROOTS & PAPER	MANHOLE
OKC - N. CAN	S20580	01/07/07	5017 GEORGIA TERR.	100	GREASE, ROOTS & PAPER	MANHOLE
OKC - N. CAN	S20580	01/08/07	914 N. BRAUER	100	GREASE	MANHOLE
OKC - N. CAN	S20580	01/09/07	LINCOLN BLVD. & WOODLAND DR.	180	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/11/07	6312 ASHBY TER.	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/12/07	309 S.W. 62ND	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/16/07	12000 HOLLY ROCK DR.	425	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/17/07	3348 S.W. 17TH	860	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/18/07	4925 BRIARWOOD DR.	380	GREASE	MANHOLE
OKC - N. CAN	S20580	01/23/07	WWTP	250	LEAKING LINE	PIPE
OKC - N. CAN	S20580	01/24/07	1148 N. MACARTHUR BLVD.	45	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/24/07	1900 E. EUCLID	1,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/24/07	2629 S.W. 60TH	3,160	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/26/07	PLANT	150	OVERFLOW	
OKC - N. CAN	S20580	01/29/07	2901 S.W. 65TH PL.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/30/07	411 SCOTT ST.	120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/02/07	5208 N.W. 26TH	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/07/07	2616 S.W. 54TH	240	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/07/07	N.W. 56TH & GRAND BLVD.	4,905	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/08/07	7109 S. SHARTEL	1,040	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/08/07	5609 N. EVEREST	320	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	02/19/07	4808 S.E. 50TH	1,180	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/22/07	224 S.W. 39TH	2,640	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/23/07	8520 S. LAND	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/26/07	3400 S.E. 47TH	126	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/27/07	1100 S.W. 62	175	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/27/07	10310 BONNYCASTLE DR.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/07	5601 S. VILLA	2,100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/07	9600 S. MCKINLEY	1,690	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/05/07	12000 HOLLYROCK DR.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/07/07	3808 S.E. 45TH	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/09/07	5119 BURR OAK RD.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/12/07	440 N.W. 23	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/12/07	4121 N.W. 31ST TERR.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/12/07	PLANT	100	CONSTRUCTION	CLARIFIER
OKC - N. CAN	S20580	03/12/07	PLANT	5,000	RAINFALL	HEAD WORKS
OKC - N. CAN	S20580	03/13/07	N.W. 8TH & KENTUCKY	63	GREASE	MANHOLE
OKC - N. CAN	S20580	03/13/07	4900 S. WALKER	250	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/16/07	40 S.W. 57TH	264	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/16/07	5600 W. WILSHIRE BLVD.	1,760	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/18/07	1408 N.E. 52	500	ROOTS	MANHOLE
OKC - N. CAN	S20580	03/18/07	425 N. WILLOWOOD DR.	50	GREASE	MANHOLE
OKC - N. CAN	S20580	03/19/07	1408 N.E. 52	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/19/07	425 N. WILLOWOOD DR.	50	BLOCAKGE	MANHOLE
OKC - N. CAN	S20580	03/21/07	701 E. WILSHIRE	200	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	03/21/07	2640 S.W. 61ST	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/23/07	4139 N.W. 18TH	60	GREASE	MANHOLE
OKC - N. CAN	S20580	03/24/07	1626 N.W. 38TH	10	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	03/26/07	1626 N.W. 38TH	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/27/07	5216 S.E. 56TH	168	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/29/07	449 N.W. 99TH	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/29/07	915 N.W. 57TH	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/01/07	PLANT	30 MILLN	RAIN	MANHOLE
OKC - DEER CREEK	S20580	04/02/07	N.W. 122ND & MERIDIAN	1,600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/02/07	2544 S.W. 52ND	225	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/02/07	531 STACI DR.	71	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/04/07	4516 N.W. 29TH	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/06/07	N.W. 50TH & QUAPAW	660	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	04/06/07	1112 WESTBURY LN.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/06/07	1909 N.W. 35TH	145	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/09/07	5515 W. WILSHIRE BLVD.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/16/07	4801 N. LINCOLN	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/18/07	3900 E. I-240 SERVICE RD.	246	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/24/07	3108 N.W. EXPRESSWAY	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/27/07	2700 N.W. 56TH	35	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/27/07	5200 E. HEFNER	9,720	BROKEN MAIN	MANHOLE
OKC - N. CAN	S20580	05/02/07	829 GOLD MEDAL DR.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/07/07	N.W. 62ND & HARVARD	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/08/07	4517 S. BROOKLINE	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/08/07	PLANT	5 MILLN	RAIN	HEAD WORKS
OKC - N. CAN	S20580	05/09/07	PLANT	30 MILLN	RAIN	HEAD WORKS
OKC - N. CAN	S20580	05/10/07	1020 N.W. 86TH	2,225	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/11/07	PLANT	3 MILL	RAIN	HEAD WORKS
OKC - N. CAN	S20580	05/14/07	248 HUNTER DR.	2,360	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/15/07	4949 S.W. 20	240	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/16/07	500 CENTRAL PARK DR.	250	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/17/07	3615 ML KING AVE	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/17/07	8501 S.W. 75TH	200	GREASE & PAPER	MANHOLE
OKC - N. CAN	S20580	05/18/07	MEMORIAL RD. & INDIAN MERIDIAN	20	SPILL	
OKC - N. CAN	S20580	05/22/07	PLANT	150	PLUGGED LINE	
OKC - N. CAN	S20580	05/24/07	2728 N.W. 55TH TERR.	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/30/07	4716 ROYAL OAK DR.	185	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/01/07	4502 SUNNYVIEW DR.	150	L.S. MALFUNCTION	
OKC - N. CAN	S20580	06/01/07	3615 N. MLK KING AVE.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/04/07	4125 N. EVEREST AVE.	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/11/07	1809 N.E. 56TH	54	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/18/07	7028 S. VILLA AVE.	810	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/18/07	7028 S. VILLA AVE.	810	ROOTS	MANHOLE
OKC - N. CAN	S20580	06/19/07	612 S.W. 40TH PL.	70	BLOCKAGE	
OKC - N. CAN	S20580	06/21/07	PLANT	3,000	OVERFLOW	MANHOLE
OKC - N. CAN	S20580	06/25/07	7208 S. DREXEL	200	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	06/27/07	2101 N.W. 27	40	BLOCAGE	MANHOLE
OKC - N. CAN	S20580	06/29/07	PLANT	78,560	RAIN	MANHOLE
OKC - N. CAN	S20580	06/29/07	NORTH OF HEADWORKS	>1 MILLN	RAIN	MANHOLE
OKC - N. CAN	S20580	07/02/07	1432 N.W. 32ND	10,500	COLLAPSED	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	07/02/07	1441 N.W. 31ST	5,250	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	07/06/07	1329 N.E. 48TH	400	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/10/07	WWTP	800	RAINFALL	MANHOLE
OKC - N. CAN	S20580	07/12/07	WWTP		RAIN	MANHOLE
OKC - N. CAN	S20580	07/17/07	63RD & HIAWASSEE	20	SPILL	
OKC - N. CAN	S20580	07/18/07	1723 N.E. 15TH	2,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/19/07	1515 N. BRYANT	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/24/07	11705 N. BRYANT	10	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	07/24/07	8810 S.W. 8TH	500,000	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	07/30/07	12700 N. EASTERN	5,000	COLLAPSED LINE	MANHOLE
OKC - N. CAN	S20580	08/02/07	N.E. 83RD & MUSGRAVE	5,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/03/07	4200 NEWCASTLE RD.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/20/07	PLANT	15 MILLN	RAIN	MANHOLE
OKC - N. CAN	S20580	08/20/07	6028 N. MERIDIAN	16	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/27/07	1300 CHESTNUT DR.	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/27/07	5809 BRANIFF DR.	3,120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	08/28/07	1900 S. MACARTHUR BLVD.	62	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	08/29/07	S.E. 59TH & BRYANT	600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	09/11/07	500 CENTRAL PARK DR.	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	09/24/07	2830 S.W. 59TH	1,880	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/01/07	N.W. 10TH & ANITA	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/04/07	309 S.W. 62	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/04/07	200 MAGNOLIA BLOSSOM CT.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/15/07	9808 S. SHARTEL	3	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/15/07	4804 N.W. 29TH	600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/15/07	34 N.E. 66TH	5	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/15/07	1631 S.W. 56TH	3	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/15/07	2228 N.W. 56TH	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/15/07	2913 N. HARVARD	450	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/18/07	7540 S.W. 59TH	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/24/07	6301 N. WARREN AVE.	5	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/24/07	3409 N. UTAH AVE	5	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/25/07	1544 1/2 N.E. 29TH	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/29/07	11101 N. PENN	1,115	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/30/07	1942 N.W. 13TH	900	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/30/07	3400 N.W. 36TH	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	10/30/07	1837 N.W. 7TH	200	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	11/01/07	3144 LYON BLVD.	4	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/01/07	3148 LYON BLVD.	4	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/01/07	5401 N. STONEWALL DR.	450	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/02/07	607 S.E. 27TH	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/02/07	4404 N.W. 51ST	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/07/07	4000 MORNING STAR RD.	60	BROKEN MAIN	MANHOLE
OKC - N. CAN	S20580	11/07/07	2829 WARWICK DR.	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/08/07	2812 N.W. 59TH	100	GREASE	MANHOLE
OKC - N. CAN	S20580	11/08/07	S.W. 27TH & QUAPAH AVE.	100	ROOTS & DEBRIS	MANHOLE
OKC - N. CAN	S20580	11/09/07	711 N. WARREN AVE.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/13/07	3100 N.W. 24	3	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/13/07	4129 N.W. 28TH	4	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/14/07	238 S.E. 57TH	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/14/07	5505 S. LINN AVE.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/17/07	4808 DIMPLE DR.	150	GREASE & DEBRIS	MANHOLE
OKC - N. CAN	S20580	11/20/07	2329 PINON PL.	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/20/07	1836 N.E. 53RD	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/26/07	4000 S.E. 51	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/26/07	12817 N.E. 37	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/27/07	16601 N.E. 178TH	5,000	MALFUNCTION	PIPE
OKC - N. CAN	S20580	11/27/07	2800 N. LINCOLN BLVD.	180	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	11/28/07	5901 S. MAY	378	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/03/07	3216 S.E. 54TH	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/03/07	2139 GLEN ELLYN	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/03/07	1122 N.W. 5TH	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/03/07	4820 N.W. 65TH	546	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/03/07	1001 N.W. 89TH	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/03/07	5117 BRIARWOOD DR.	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/04/07	4720 N. MILLER	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/05/07	940 N. BRADLEY AVE.	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/06/07	5005 GEORGIA TERR.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/06/07	1534 N.W. 41ST	4	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/10/07	5015 N. WARREN AVE.	12	BLOCKAGE	MANHOLE
OKC	S20580	12/11/07	PLANT	50	PUMP FAILURE	
OKC - N. CAN	S20580	12/11/07	PLANT	3,050	POWER FAILURE	MANHOLE
OKC - N. CAN	S20580	12/12/07	N.W. 86TH & FRANCIS	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/13/07	PLANT	9,375	RAIN & ICE MELTING	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	12/14/07	737 S. MERIDIAN	8	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/17/07	1815 N. MCKINLEY	1,510	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/18/07	630 N. MERIDIAN	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/18/07	5423 S. LINN AVE.	465	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/18/07	4804 COBLE ST.	670	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/18/07	1308 S.W. 21ST	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/19/07	7201 MELROSE LN.	1,010	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/26/07	7240 N.W. 10TH	1,660	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/26/07	808 E. HILL	760	MUD	MANHOLE
OKC - N. CAN	S20580	12/26/07	4800 FOSTER RD.	1,845	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/26/07	3160 N. PORTLAND	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	12/30/07	3300 N.W. 62ND	2,175	GREASE, PAPER & DEBRIS	MANHOLE
OKC - N. CAN	S20580	12/31/07	3300 N.W. 62ND	2,175	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/02/08	6161 N. MAY	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/02/08	9628 GOLD FIELD PL.	1,010	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/02/08	1727 N.E. 18TH	120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/02/08	3136 S.W. 23RD	500	GREASE & ROOTS	MANHOLE
OKC - N. CAN	S20580	01/07/08	13516 FOX CREEK DR.	10,050	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/07/08	3901 HIDDLESTON CIR.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/07/08	5201 SHALIMAR DR.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/07/08	3500 N.W. 56TH	910	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/14/08	5008 GEORGIA PL.	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/14/08	3305 S.E. 54TH	2,720	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/14/08	3313 S.E. 54TH	680	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/14/08	3317 S.E. 54TH	680	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/14/08	2645 S.W. 60TH	1,380	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/14/08	409 S.W. 43RD	710	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/14/08	8317 N.W. 8TH	740	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/15/08	820 S.W. 30TH	5	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/16/08	5900 S.E. 48TH	59	MISSING PIPE	MANHOLE
OKC - N. CAN	S20580	01/17/08	2649 S.W. 61ST	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/22/08	3032 S.W. 52ND	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/22/08	S.W. GRAND BLVD. & BROCK DR.	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/22/08	2900 S.W. 54TH	670	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/22/08	1424 N.E. 37TH	890	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/28/08	N.W. 11TH & WARREN AVE.	400	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/28/08	3208 S.W. 38TH	2	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	01/28/08	1900 N.E. 30TH	410	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/28/08	728 KATHERINE PL.	11,750	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/30/08	W. SIDE OF PLANT	1,000	FIRE HYDRANT ADAPTOR BROKE	
OKC - N. CAN	S20580	01/30/08	N.W. 79TH & WESTERN	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/30/08	6301 N. ANN ARBOR AVE.	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/30/08	W. SIDE OF PLANT	50	FIRE HOSE CONNECTION MALFUNCTION	
OKC - N. CAN	S20580	01/31/08	1508 S.E. 48TH PL.	1	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	01/31/08	1119 S.E. 66TH	600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/04/08	320 S. BRYANT PL.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/04/08	228 S.W. 39TH	2,800	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/11/08	2209 S.W. 33RD	150	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/11/08	1115 S.E. 66TH	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/11/08	2055 N.E. 29TH	700	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/11/08	N.E. 8TH & STONEWALL	80	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/11/08	8901 N. WESTERN	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/11/08	824 S.E. 68TH	132	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/13/08	N.W. 101ST & HARVEST HILLS RD.	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/14/08	5017 S.E. 58TH	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/08	6304 CANYON RD.	840	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/08	6605 ASHBY TERR	950	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/08	825 S.E. 51	2,790	MAIN BREAK	MANHOLE
OKC - N. CAN	S20580	02/18/08	3033 S.W. 57TH	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/08	2229 CARLISLE RD.	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/08	1212 N.E. 44TH	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/08	2017 N.E. 10TH	4,560	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/18/08	3100 N.W. 41ST	660	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/19/08	3450 S.E. 44TH	20,000	MALFUNCTION WHILE NEW STATION BEING BUILT	PIPE
OKC - N. CAN	S20580	02/19/08	500 CENTRAL PARK DR.	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/20/08	728 CULBERTSON DR.	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/20/08	4949 S.W. 20TH	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/25/08	1820 N.E. 53RD	5	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/25/08	700 S.E. 59TH	3	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/26/08	1232 DAVINBROOK DR.	900	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/08	1017 S.W. BINKLEY	550	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/08	1021 S.W. BINKLEY	550	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/08	1024 S.W. 31ST	550	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	02/28/08	1020 S.W. 31ST	550	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/08	3212 S.W. 42ND	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/08	3224 S.W. 42ND	250	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/08	541 S.W. 61ST TERR	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/28/08	38 N.E. 64TH	5	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	02/29/08	4300 LUNOW DR.	70	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/03/08	6001 BRANIFF DR.	410	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/03/08	2112 N.E. 23RD	470	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/03/08	908 S.E. 69TH	1,130	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/04/08				
OKC - N. CAN	S20580	03/04/08	3212 TUDOR RD.	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/04/08	2849 S.W. 62ND	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/04/08	4401 N.W. 39TH	150	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/05/08	5316 S. DREXEL AVE	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/05/08	2605 S.W. 61ST	30	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/05/08	1029 S.W. 65TH	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/07/08	4949 S.W. 20TH	1,500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	4326 S.W. 21ST	37	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	2101 N.E. 37TH	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	1300 S.W. 96TH	1,340	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	4913 ERIC DR.	2,060	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	3112 S.W.71ST	880	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	3224 S.W. 42ND	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	3205 S. LINN AVE	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/10/08	713 S.E. 62ND	1,440	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/11/08	N.W. 50TH & WESTERN	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/11/08	2104 N.E. 22ND	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/11/08	11501 N. COLTRANE	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/11/08	4317 S.W. 36TH	45	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/12/08	4617 REPUBLIC DR.	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/14/08	PLANT	50	PUMP MALFUNCTION	MANHOLE
OKC - N. CAN	S20580	03/18/08	2921 S.W. 63RD	395	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/18/08	2801 N.W. EXPRESSWAY	600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/18/08	1100 S.W. 21ST	600	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/20/08	N.E. 16TH TERR & KELHAM	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/20/08	S.E. 32ND & BYERS	400	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/20/08	BYERS @ S.E. 29TH & 30TH	20	BLOCKAGE	MANHOLE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	03/20/08	4705 KAREN DR.	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/24/08	1360 W. I-240 SERVICE RD.	1,060	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/24/08	5500 S.W. 38TH	50	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/24/08	6009 S. SHARTEL	1,470	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/24/08	5500 N. STONEWALL	1,320	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/24/08	MEMORIAL & HIAWASSEE RD.	10	SPILLED CHEMICALS	
OKC - N. CAN	S20580	03/26/08	2115 N. KELHAM AVE	45	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/28/08	N.E. 16TH & MISSOURI	150	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/28/08	7100 TERMINAL DR.	730	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/31/08	4920 LUNOW DR.	1,080	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/31/08	3333 N. SHARTEL	2,278	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/31/08	3204 N.W. 27TH	840	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/31/08	8605 S.W. 76TH	1229	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	03/31/08	504 N. BROADWAY	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/01/08	800 HUNTERS HILL RD.	7	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/02/08	HOGBACK & MEMORIAL	40	AIR RELIEF VALVE FAILED	PIPE
OKC - N. CAN	S20580	04/07/08	2922 S.E. 45TH	780	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/07/08	INDIAN MERIDIAN RD. & N.E. 150TH	200	VALVE MALFUNCTION	PIPE
OKC - N. CAN	S20580	04/10/08	3212 N.W. 62ND	204	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/10/08	WWTP	319,650	RAIN	MANHOLE
OKC - N. CAN	S20580	04/11/08	3900 N. NICKLAS AVE	1,000	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/11/08	N.W. 68TH & COUNTRY CLUB RD	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/11/08	3101 N.E. 63RD	500	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/11/08	718 S.E. 35TH	70	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/11/08	712 S.E. 35TH	120	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/14/08	701 S.E. 89TH	1,290	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/15/08	2405 S. WALKER	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/16/08	5202 S. PENN	271	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/21/08	4712 N.W. 65TH	1,040	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/22/08	517 N. BATH	150	COLLAPSED MAIN	MANHOLE
OKC - N. CAN	S20580	04/22/08	3305 SHERMAN AVE	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/28/08	4132 N.W. 60TH	1,140	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/28/08	4513 CREEKWOOD	810	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	04/29/08	N.E. 178TH @ HOGBACK RD. - INDIAN HILLS MERIDIAN	200	LEAK	
OKC - N. CAN	S20580	04/29/08	16601 NE 178 STREETS	200	PLASTIC BALL WERE DISLODGED FROM MEDIA AT THE REDBUD PLANT	PIPE

Facility	Date	FacilityID	Location	Amount (gal)	Cause	Source
OKC - N. CAN	S20580	05/02/08	S.W. 50TH & LAND	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/08/08	3800 N.W. 51ST	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/08/08	516 S.W. 26TH	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/09/08	4831 N.W. 39TH	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/09/08	11601 FOOTMANS CT.	40	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/09/08	N.E. 30TH & LINCOLN	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/09/08	5000 S.E. 85TH	300	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/12/08	1628 N.W. 29TH	20	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/15/08	2056 N.E. 30TH	15	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/16/08	1837 N.W. 7TH	60	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/20/08	2743 S.W. 61ST	133	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/20/08	5320 N. MILLER	75	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/20/08	3900 N. RICKEY DR.	25	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/21/08	3100 ETON AVE.	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/22/08	128 S.E. 22ND	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/27/08	2604 S.W. 61ST	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/27/08	536 S.W. 61ST. TERR	53	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	05/27/08	TRIPLE X RD. & BRITTON RD.	4	OVERFLOW	
OKC - N. CAN	S20580	06/02/08	909 S.E. 35TH	10	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/02/08	1308 S.E. 54TH	175	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/05/08	3433 N.W. 53RD	830	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/06/08	13520 BLEVINS BLVD.	600	MALFUNCTION	MANHOLE
OKC - N. CAN	S20580	06/09/08	PLANT	216,000	RAIN	MANHOLE
OKC - N. CAN	S20580	06/11/08	116 N.W. 25TH	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/16/08	3724 N.W. 59TH TERR	565	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/23/08	2913 N.E. 18TH	1,320	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	06/24/08	ANDERSON RD. & MEMORIAL RD. TO I-35	20	SPILL FROM TRUCK	
OKC - N. CAN	S20580	06/30/08	5317 EDEN DR.	1,610	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/08/08	3220 S. DUMAS LN.	8	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/11/08	2543 S.W. 58TH	100	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/15/08	2605 S.W. 61ST	200	BLOCKAGE	MANHOLE
OKC - N. CAN	S20580	07/15/08	7109 S. SHARTEL	100	BLOCKAGE	MANHOLE
CHOCTAW	S20592	06/25/07	3200 PLANT RD.		RAIN	LAGOON/BASIN
CHOCTAW	S20592	12/11/07	PLANT		POWER OUTAGE	
YUKON	S23533	11/18/05	1012 SUMMERTON	50	BLOCKAGE	PIPE

APPENDIX C
ESTIMATED FLOW EXCEEDANCE PERCENTILES

Appendix C

Estimated Flow Exceedance Percentiles

Stream Name	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	Crutcho Creek	Crooked Oak Creek	Mustang Creek	Airport Heights Creek
Stream ID	OK520510000110_20	OK520520000010_00	OK520520000010_10	OK520520000010_20	OK520520000010_30	OK520520000010_40	OK520520000210_00	OK520520000250_00	OK520520000070_00	OK520520000150_00	OK520520000240_00	OK52052000350_00
USGS Gage Reference	07241000	07241550	07241550	07241520	07241503	07241503	07241800	07241800	07242247	07242247	07229500	07242247
Watershed Area (sq.mile)	181.9	9.8	60.6	32.3	37.0	48.6	1.6	11.3	22.4	9.7	31.5	2.7
NRCS Curve Number	65.7	63.9	66.0	71.7	72.8	86.8	81.0	79.0	82.8	80.9	72.1	83.9
Ave Annual Rainfall (inch)	38.8	37.6	36.8	36.6	36.7	36.3	35.3	35.2	36.9	36.6	35.5	36.1
Percentile	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**
0	16600.0	20000.0	20000.0	22700.0	9590.0	9590.0	16600.0	16600.0	1410.9	577.14	629.71	148.5
1	6658.1	5336.4	5336.4	4999.3	2649.8	2649.8	2859.2	2859.2	303.7	114.09	77.31	26.6
2	4073.6	3340.0	3340.0	2838.6	1709.0	1709.0	1769.2	1769.2	151.5	53.64	38.85	11.6
3	2690.0	2510.0	2510.0	2170.0	1309.8	1309.8	1360.0	1360.0	116.8	40.27	20.28	8.4
4	2250.0	2050.0	2050.0	1820.0	1079.6	1079.6	1108.4	1108.4	90.6	30.29	12.67	6.0
5	1784.5	1785.5	1785.5	1570.0	944.2	944.2	961.8	961.8	76.3	24.92	8.31	4.8
6	1595.4	1600.0	1600.0	1370.0	784.0	784.0	868.0	868.0	54.9	17.08	6.02	3.1
7	1440.0	1433.7	1433.7	1260.0	702.0	702.0	786.0	786.0	45.1	13.57	4.56	2.3
8	1267.2	1320.0	1320.0	1130.0	645.8	645.8	734.7	734.7	31.7	8.86	3.75	1.3
9	1150.0	1250.0	1250.0	1060.0	590.7	590.7	690.6	690.6	26.6	7.14	2.68	1.0
10	1059.0	1170.0	1170.0	994.0	535.3	535.3	647.6	647.6	22.4	5.75	2.33	0.7
11	995.0	1100.0	1100.0	932.0	493.1	493.1	610.6	610.6	19.7	4.87	2.02	0.6
12	947.0	1040.0	1040.0	886.2	462.9	462.9	581.5	581.5	16.0	3.70	1.88	0.4
13	889.3	1000.0	1000.0	842.0	446.5	446.5	549.0	549.0	14.3	3.18	1.70	0.3
14	858.0	965.0	965.0	802.0	395.3	395.3	518.4	518.4	12.0	2.48	1.58	0.2
15	811.4	928.0	928.0	771.9	367.9	367.9	488.8	488.8	11.1	2.22	1.50	0.2
16	782.4	888.0	888.0	735.9	348.0	348.0	461.4	461.4	10.4	2.03	1.45	0.1
17	743.1	855.5	855.5	700.0	332.2	332.2	434.0	434.0	9.7	1.84	1.37	0.1
18	707.0	822.0	822.0	669.0	325.6	325.6	407.0	407.0	9.4	1.75	1.29	0.1
19	679.7	789.3	789.3	632.7	295.4	295.4	383.0	383.0	9.1	1.65	1.20	0.1

Stream Name	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	Crutcho Creek	Crooked Oak Creek	Mustang Creek	Airport Heights Creek
Stream ID	OK520510000110_20	OK520520000010_00	OK520520000010_10	OK520520000010_20	OK520520000010_30	OK520520000010_40	OK520520000210_00	OK520520000250_00	OK520520000070_00	OK520520000150_00	OK520520000240_00	OK52052000350_00
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NRCS Curve Number	65.7	63.9	66.0	71.7	72.8	86.8	81.0	79.0	82.8	80.9	72.1	83.9
Ave Annual Rainfall (inch)	38.8	37.6	36.8	36.6	36.7	36.3	35.3	35.2	36.9	36.6	35.5	36.1
Percentile	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**
20	660.8	757.2	757.2	606.0	284.8	284.8	362.0	362.0	8.7	1.56	1.10	0.1
21	643.6	724.0	724.0	587.5	266.3	266.3	341.0	341.0	8.2	1.41	1.06	0.1
22	623.0	692.0	692.0	561.0	248.0	248.0	327.0	327.0	8.1	1.38	1.02	0.1
23	599.1	664.0	664.0	540.0	241.1	241.1	309.0	309.0	7.7	1.29	0.99	0.0
24	577.0	640.0	640.0	520.0	231.9	231.9	292.0	292.0	7.4	1.20	0.94	0.0
25	557.0	619.0	619.0	500.0	221.8	221.8	273.0	273.0	7.1	1.12	0.91	0.0
26	536.7	597.0	597.0	481.0	204.6	204.6	257.0	257.0	7.1	1.12	0.91	0.0
27	520.4	578.0	578.0	465.0	198.4	198.4	245.0	245.0	6.7	1.03	0.88	0.0
28	499.5	561.0	561.0	450.0	195.0	195.0	232.0	232.0	6.7	1.03	0.86	0.0
29	487.0	539.0	539.0	434.0	183.4	183.4	220.0	220.0	6.4	0.95	0.83	0.0
30	472.7	519.0	519.0	416.0	168.8	168.8	208.8	208.8	6.4	0.95	0.80	0.0
31	453.8	502.0	502.0	402.0	162.0	162.0	195.8	195.8	6.0	0.86	0.80	0.0
32	439.0	488.0	488.0	388.0	158.0	158.0	184.0	184.0	6.0	0.86	0.78	0.0
33	422.0	472.0	472.0	375.7	153.0	153.0	174.0	174.0	5.7	0.78	0.78	0.0
34	413.0	455.0	455.0	359.6	151.2	151.2	164.6	164.6	5.7	0.78	0.75	0.0
35	400.2	440.0	440.0	346.0	145.1	145.1	156.0	156.0	5.7	0.78	0.75	0.0
36	392.0	427.0	427.0	330.0	141.9	141.9	151.0	151.0	5.4	0.70	0.72	0.0
37	379.0	412.0	412.0	318.0	137.0	137.0	143.5	143.5	5.4	0.70	0.72	0.0
38	368.4	399.0	399.0	305.0	135.0	135.0	138.0	138.0	5.4	0.70	0.70	0.0
39	358.0	383.0	383.0	294.0	129.7	129.7	132.0	132.0	5.0	0.63	0.67	0.0
40	348.0	371.0	371.0	284.0	121.2	121.2	126.0	126.0	5.0	0.63	0.67	0.0
41	338.0	359.0	359.0	273.0	110.0	110.0	120.0	120.0	5.0	0.63	0.64	0.0
42	327.0	348.0	348.0	264.0	102.0	102.0	114.0	114.0	4.7	0.55	0.62	0.0

Stream Name	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	Crutcho Creek	Crooked Oak Creek	Mustang Creek	Airport Heights Creek
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USGS Gage Reference	07241000	07241550	07241550	07241520	07241503	07241503	07241800	07241800	07242247	07242247	07229500	07242247
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NRCS Curve Number	65.7	63.9	66.0	71.7	72.8	86.8	81.0	79.0	82.8	80.9	72.1	83.9
Ave Annual Rainfall (inch)	38.8	37.6	36.8	36.6	36.7	36.3	35.3	35.2	36.9	36.6	35.5	36.1
Percentile	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)	Q(cfs)
43	319.0	338.0	338.0	255.0	91.4	91.4	109.0	109.0	4.7	0.55	0.62	0.0
44	311.0	330.0	330.0	248.0	88.5	88.5	105.0	105.0	4.7	0.55	0.59	0.0
45	305.0	321.0	321.0	239.0	82.0	82.0	100.0	100.0	4.4	0.48	0.59	0.0
46	294.0	312.0	312.0	230.0	77.5	77.5	95.0	95.0	4.4	0.48	0.59	0.0
47	285.2	304.0	304.0	221.0	72.0	72.0	91.0	91.0	4.4	0.48	0.57	0.0
48	274.0	295.0	295.0	212.0	69.0	69.0	87.0	87.0	4.4	0.48	0.56	0.0
49	267.0	287.0	287.0	206.0	64.7	64.7	84.0	84.0	4.4	0.48	0.54	0.0
50	258.0	280.0	280.0	199.0	57.0	57.0	79.0	79.0	4.0	0.41	0.54	0.0
51	252.0	272.0	272.0	194.0	48.3	48.3	76.0	76.0	4.0	0.41	0.51	0.0
52	245.0	266.0	266.0	187.0	38.5	38.5	71.0	71.0	4.0	0.41	0.51	0.0
53	238.0	261.0	261.0	180.0	35.0	35.0	68.0	68.0	4.0	0.41	0.48	0.0
54	233.0	255.0	255.0	172.0	32.0	32.0	64.0	64.0	4.0	0.41	0.48	0.0
55	228.0	248.0	248.0	167.0	29.7	29.7	60.0	60.0	4.0	0.41	0.46	0.0
56	223.0	241.0	241.0	162.0	27.5	27.5	57.0	57.0	3.7	0.34	0.46	0.0
57	217.1	235.0	235.0	155.0	25.0	25.0	54.0	54.0	3.7	0.34	0.43	0.0
58	211.0	230.0	230.0	149.0	25.0	25.0	51.0	51.0	3.7	0.34	0.40	0.0
59	205.0	224.0	224.0	143.0	25.0	25.0	48.0	48.0	3.7	0.34	0.40	0.0
60	201.0	220.0	220.0	139.0	25.0	25.0	45.0	45.0	3.7	0.34	0.38	0.0
61	198.0	215.0	215.0	135.0	22.6	22.6	43.0	43.0	3.7	0.34	0.38	0.0
62	193.0	211.0	211.0	130.0	20.5	20.5	40.0	40.0	3.7	0.34	0.38	0.0
63	189.0	206.0	206.0	124.0	18.3	18.3	37.0	37.0	3.4	0.28	0.35	0.0
64	185.0	202.0	202.0	120.0	16.0	16.0	35.0	35.0	3.4	0.28	0.35	0.0
65	183.0	198.0	198.0	116.0	12.0	12.0	34.0	34.0	3.4	0.28	0.32	0.0

Stream Name	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	North Canadian River	Crutcho Creek	Crooked Oak Creek	Mustang Creek	Airport Heights Creek
Stream ID	OK520510000110_20	OK520520000010_00	OK520520000010_10	OK520520000010_20	OK520520000010_30	OK520520000010_40	OK520520000210_00	OK520520000250_00	OK520520000070_00	OK520520000150_00	OK520520000240_00	OK52052000350_00
USGS Gage Reference	07241000	07241550	07241550	07241520	07241503	07241503	07241800	07241800	07242247	07242247	07229500	07242247
Watershed Area (sq.mile)	181.9	9.8	60.6	32.3	37.0	48.6	1.6	11.3	22.4	9.7	31.5	2.7
NRCS Curve Number	65.7	63.9	66.0	71.7	72.8	86.8	81.0	79.0	82.8	80.9	72.1	83.9
Ave Annual Rainfall (inch)	38.8	37.6	36.8	36.6	36.7	36.3	35.3	35.2	36.9	36.6	35.5	36.1
Percentile	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**	**Q(cfs)**
66	178.0	195.0	195.0	111.0	11.0	11.0	33.0	33.0	3.4	0.28	0.32	0.0
67	175.0	190.0	190.0	108.0	10.0	10.0	31.0	31.0	3.4	0.28	0.32	0.0
68	173.0	187.0	187.0	105.0	9.4	9.4	30.0	30.0	3.4	0.28	0.29	0.0
69	171.0	183.0	183.0	102.0	8.9	8.9	28.0	28.0	3.3	0.26	0.29	0.0
70	168.0	179.0	179.0	99.0	8.6	8.6	26.0	26.0	3.2	0.25	0.27	0.0
71	164.0	176.0	176.0	96.0	8.2	8.2	23.2	23.2	3.2	0.24	0.24	0.0
72	161.0	173.0	173.0	94.0	8.1	8.1	21.0	21.0	3.1	0.23	0.21	0.0
73	158.0	170.0	170.0	91.0	7.7	7.7	19.0	19.0	3.1	0.22	0.21	0.0
74	156.0	166.0	166.0	88.0	7.5	7.5	17.0	17.0	3.0	0.21	0.21	0.0
75	153.0	163.0	163.0	85.0	7.4	7.4	15.0	15.0	2.9	0.19	0.21	0.0
76	149.8	160.0	160.0	82.0	7.3	7.3	14.0	14.0	2.8	0.18	0.19	0.0
77	147.0	157.0	157.0	80.0	6.7	6.7	12.0	12.0	2.8	0.17	0.16	0.0
78	143.0	153.0	153.0	77.0	6.5	6.5	11.0	11.0	2.7	0.16	0.16	0.0
79	141.0	150.0	150.0	75.0	6.5	6.5	10.0	10.0	2.7	0.16	0.16	0.0
80	138.0	147.0	147.0	73.0	6.4	6.4	8.9	8.9	2.6	0.15	0.13	0.0
81	135.3	143.0	143.0	70.0	6.2	6.2	8.0	8.0	2.6	0.14	0.13	0.0
82	133.0	140.0	140.0	67.0	6.1	6.1	7.0	7.0	2.5	0.13	0.13	0.0
83	130.0	137.0	137.0	65.0	5.9	5.9	6.3	6.3	2.4	0.12	0.11	0.0
84	125.0	134.0	134.0	61.0	5.8	5.8	5.7	5.7	2.4	0.12	0.11	0.0
85	122.0	131.0	131.0	59.0	5.8	5.8	5.3	5.3	2.4	0.11	0.11	0.0
86	119.7	128.0	128.0	56.0	5.7	5.7	5.0	5.0	2.3	0.11	0.08	0.0
87	116.0	124.0	124.0	53.0	5.4	5.4	4.6	4.6	2.3	0.10	0.08	0.0
88	113.0	120.0	120.0	50.0	5.1	5.1	4.3	4.3	2.2	0.09	0.08	0.0

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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)**
89	109.0	116.0	116.0	47.0	5.0	5.0	3.9	3.9	2.2	0.08	0.08	0.0
90	106.1	112.0	112.0	45.0	4.9	4.9	3.6	3.6	2.0	0.07	0.05	0.0
91	100.0	108.0	108.0	42.0	4.7	4.7	3.2	3.2	1.9	0.05	0.05	0.0
92	95.0	104.0	104.0	39.0	4.4	4.4	2.9	2.9	1.8	0.05	0.05	0.0
93	92.0	100.0	100.0	36.0	3.5	3.5	2.7	2.7	1.7	0.04	0.05	0.0
94	90.0	95.0	95.0	32.0	2.6	2.6	2.4	2.4	1.7	0.04	0.05	0.0
95	86.0	88.0	88.0	29.4	2.2	2.2	2.2	2.2	1.7	0.03	0.05	0.0
96	82.0	82.0	82.0	27.0	2.1	2.1	1.9	1.9	1.6	0.02	0.04	0.0
97	78.0	78.0	78.0	24.0	1.6	1.6	1.7	1.7	1.5	0.02	0.03	0.0
98	71.0	73.0	73.0	21.0	1.4	1.4	1.4	1.4	1.4	0.01	0.03	0.0
99	64.0	67.0	67.0	18.0	1.0	1.0	1.1	1.1	1.3	0.01	0.03	0.0
100	43.0	42.0	42.0	8.9	0.0	0.0	0.0	0.0	0.7	0.00	0.03	0.0

†incrementalwatershedareabelowothergages

Appendix C

General Methodology for Estimating Stream Flow

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 Stream segments, along with all USGS flow stations located in the 8-digit HUCs with impaired streams. Then all the USGS gage stations upstream and downstream of the subwatersheds with 303(d) listed Stream segments will be identified.

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/Sansd/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 Stream segment and no gages are present upstream or downstream, flows will be estimated for the stream segment 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 ANTI-DEGRADATION POLICY

Appendix D
State of Oklahoma Antidegradation Policy

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

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

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

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

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

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

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

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

785:46-13-1. Applicability and scope

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

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

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

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

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

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

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

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

785:46-13-2. Definitions

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

"Specified pollutants" means

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

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

(C) Phosphorus;

(D) Total Suspended Solids (TSS); and

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

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

(a) General.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Appendix E

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

A. BACKGROUND

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

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

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

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

This approach was further elaborated in a guidance memo issued in 2002. [See Memorandum from Robert Wayland, Director of OWOW and James Hanlon, Director of OWM to Regional Water Division Directors: "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit requirements Based on Those WLAs " (Date published: 11/22/2002)] "The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. …… If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the storm water component of the TMDL, EPA recommends that the TMDL reflect this." This BMP-based approach to stormwater sources in TMDLs is also recognized and described in the most recent EPA guidance. [See "TMDLs To Stormwater Permits Handbook" (DRAFT), EPA, November 2008] This TMDL adopts the EPA recommended approach and relies on appropriate BMPs for implementation. No numeric effluent limitations are required or anticipated for municipal stormwater discharge permits.

B. SPECIFIC SWMP/SWPPP REQUIREMENTS

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

Agricultural activities and other nonpoint sources of bacteria are unregulated. Voluntary measures and incentives should be used and encouraged wherever possible and such sources should strive to attain the reduction goals established in this TMDL. The Oklahoma Conservation Commission has developed a watershed plan for this segment of the North Canadian River that should facilitate these actions.

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

ENTITIES	PHASE 1 / PHASE 2 MS4	DATE ISSUED
Oklahoma City[1]	Phase 1 MS4	01/19/2007
Choctaw	Phase 2 MS4	01/18/2006
Del City	Phase 2 MS4	12/29/2005
Midwest City	Phase 2 MS4	11/07/2005
Moore	Phase 2 MS4	12/1/2005
Mustang	Phase 2 MS4	02/15/2006
Nicoma Park	Phase 2 MS4	01/05/2006
ODOT	Phase 2 MS4	Pending
Spencer	Phase 2 MS4	10/13/2005
Tinker Air Force Base	Phase 2 MS4	11/08/2005
Yukon	Phase 2 MS4	11/14/2005

[1] Co-permittee with ODOT and OTA

The provisions of this appendix apply only to OPDES/NPDES regulated stormwater discharges. Regulated CAFOs within the watershed operate under NPDES permits issued and overseen by EPA. In order to comply with this TMDL, those CAFO permits in the watershed and their associated management plans must be reviewed. Further actions to reduce bacteria loads and achieve progress toward meeting the specified reduction goals must be implemented. This provision will be forwarded to EPA, as the responsible permitting agency, for follow up. The Oklahoma National Stockyards Company operates a large livestock sales facility near the river. The facility does not currently hold a CAFO permit. EPA will be requested to determine whether the stockyards meets the definition of a CAFO and needs permit coverage. EPA and ODAFF will also be requested to determine any permitting requirements for the adjacent Lawns By Murphy manure composting operation. While all potentially contaminated water from the stockyard is supposed to be connected to the Oklahoma City sanitary sewer, this has not been verified. There may be cross-connections with storm sewers or areas of the operation that do not drain to the sanitary sewer inlets. ODAFF will be requested to verify the discharge status of the stockyards.

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

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

As noted above, when a BMP approach is selected a coordinated monitoring program is necessary to establish the effectiveness of the selected BMPs and demonstrate progress toward attaining water quality standards. The monitoring results should be used to refine bacteria controls in the future. With eleven permitted entities in the watershed, it is likely that a cooperative monitoring program would be more cost effective than eleven individual programs. The Association of Central Oklahoma Governments (ACOG) has expressed interest in facilitating a coordinated monitoring program to address this requirement. Individual permittees are not required to participate in a coordinated program and are free to develop their own program if desired.

After EPA approval of the final TMDL, existing MS4 permittees will be notified of the TMDL provisions and schedule. Industrial stormwater permittees are not expected to be a significant source of bacteria but if any are identified, similar actions will be required.

Compliance with the following provisions will constitute compliance with the requirements of this TMDL.

1. Develop A Bacteria Reduction Plan

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

a. Consideration of ordinances or other regulatory mechanisms to require bacteria pollution control, as well enforcement procedures for noncompliance;
b. Evaluation of the existing SWMP in relation to TMDL reduction goals;
c. An evaluation to identify potential significant sources of bacteria entering your MS4. Develop (or modify an existing program as necessary) and implement a program to reduce the discharge of bacteria in municipal storm water contributed by any other significant source identified in the source identification evaluation
d. Educational programs directed at reducing bacterial pollution. Implement a public education program to reduce the discharge of bacteria in municipal storm water contributed (if applicable) by pets, recreational and exhibition livestock, and zoos;
e. Investigation and implementation of BMPs that prevent additional storm water bacteria pollution associated with new development and re-development;
f. Develop (or modify an existing program as necessary) and implement a program to reduce the discharge of bacteria in municipal storm water contributed by areas within your MS4 served by on-site wastewater treatment systems
g. Implementation of BMPs applicable to bacteria. Table E-2 below presents summary information on some BMPs that may be considered. Permittees are not limited to BMPs on this list and should select BMPs appropriate to the local community that are expected to result in progress toward meeting the reduction goals established in the TMDL.
h. Modifications to the dry weather field screening and illicit discharge detection and elimination provisions of the SWMP to consider storm water sampling and other measures intended to specifically identify bacterial pollution sources and high priority areas for bacteria reductions.
i. Periodic evaluation of the effectiveness of the bacteria reduction plan to ensure progress toward attainment of water quality standards.
j. An implementation schedule leading to modification of the SWMP and full implementation of the plan within 3 years of notification.

2. Develop Or Participate In A Bacteria Monitoring Program

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

a. Within 18 months of notification, the permittee shall prepare and submit to the DEQ either a TMDL monitoring plan or a commitment to participate in a coordinated regional monitoring program. Unless disapproved by the Director within 60 days of submission, the plan shall be approved and then implemented by the permittee. The plan or program shall include:

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

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

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

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

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

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

3. Annual Reporting

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

Table E–2. Some BMPs Applicable to Bacteria

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
Animal waste management: A planned system designed to manage liquid and solid waste from livestock and poultry. It improves water quality by storing and spreading waste at the proper time, rate and location.	X		75 %[1]	
Artificial wetland/rock reed microbial filter: A long shallow hydroponic plant/rock filter system that treats polluted waste and wastewater. It combines horizontal and vertical flow of water through the filter, which is filled with aquatic and semi-aquatic plants and microorganisms and provides a high surface area of support media, such as rocks or crushed stone.	X	X		
Compost facility: Treating organic agricultural wastes in order to reduce the pollution potential to surface and ground water. The composting facility must be constructed, operated and maintained without polluting air and/or water resources.	X	X		Permit may be needed
Conservation landscaping: The placement of vegetation in and around stormwater management BMPs. Its purpose is to help stabilize disturbed areas, enhance the pollutant removal capabilities of storm water BMP, and improve the overall aesthetics of a storm water BMP.		X		
Diversions: Establishing a channel with a supporting ridge on the lower side constructed along the general land slope which improves water quality by directing nutrient and sediment laden water to sites where it can be used or disposed of safely.	X	X		
Drain Inlet Inserts: A proprietary BMP that is generally easily installed in a drain inlet or catch basin to treat storm water runoff. Three basic types of inlet insert are available, the tray type, bag type and basket type. The tray type allows flow to pass through filter media residing in a tray located around the perimeter of the inlet.	X	X	5%[2]	
Dry detention pond/basin: Detention ponds/basins that have been designed to temporarily detain stormwater runoff. These ponds fill with stormwater and release it over a period of a few days. They can also be used to provide flood control by including additional flood detention storage.	X	X	40%[2], 51%[3] 88% [4]	
Earthen embankments: A raised impounding structure made from compacted soil. It is appropriate for use with infiltration, detention, extended-detention or retention facilities.	X	X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
Drip irrigation: An irrigation method that supplies a slow, even application of low-pressure water through polyethylene tubing running from supply line directly to a plant's base. Water soaks into the soil gradually, reducing runoff and evaporation (i.e., salinity). Transmission of nutrients and pathogens spread by splashing water and wet foliage created by overhead sprinkler irrigation is greatly reduced. Weed growth is minimized, thereby reducing herbicide applications. Vegetable farming and virtually every type of landscape situation can benefit from the use of drip irrigation.	X	X		
Fencing: A constructed barrier to livestock, wildlife or people. Standard or conventional (barbed or smooth wire), suspension, woven wire, or electric fences consist of acceptable fencing designs to control the animal(s) or people of concern and meet the intended life of the practice.	X		75 %[1]	
Filtration (e.g., sand filters): Intermittent sand filters capture, pre-treat to remove sediments, store while awaiting treatment, and treat to remove pollutants (by percolation through sand media) the most polluted stormwater from a site. Intermittent sand filter BMPs may be constructed in underground vaults, in paved trenches within or at the perimeter of impervious surfaces, or in either earthen or concrete open basins.	X	X	30 %[1], 55%[2], 37% [4]	
Infiltration Basin: A vegetated open impoundment where incoming stormwater runoff is stored until it gradually infiltrates into the soil strata. While flooding and channel erosion control may be achieved within an infiltration basin, they are primarily used for water quality enhancement.		X	50 %[1]	
Infiltration Trench: A shallow, excavated trench backfilled with a coarse stone aggregate to create an underground reservoir. Stormwater runoff diverted into the trench gradually infiltrates into the surrounding soils from the bottom and sides of the trench. The trench can be either an open surface trench or an underground facility.		X	50 %[1]	
Irrigation water management: The process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner. An irrigation system adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, etc.) must be available and capable of applying water to meet the intended purpose(s).	X	X		
Lagoon pump out: A waste treatment impoundment made by constructing an embankment and/or excavating a pit	X	X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
or dugout in order to biologically treat waste (such as manure and wastewater) and thereby reduce pollution potential by serving as a treatment component of a waste management system.				
Land-use conversion: BMPs that involve a change in land use in order to retire land contributing detrimentally to the environment. Some examples of BMPs with associated land use changes are: Conservation Reserve Program (CRP) - cropland to pasture; Forest conservation - pervious urban to forest; Forest/grass buffers - cropland to forest/pasture; Tree planting - cropland/pasture to forest; and Conservation tillage – conventional tillage to conservation tillage.	X	X		
Limit livestock access: Excluding livestock from areas where grazing or trampling will cause erosion of stream banks and lowering of water quality by livestock activity in or adjacent to the water. Limitation is generally accomplished by permanent or temporary fencing. In addition, installation of an alternative water source away from the stream has been shown to reduce livestock access.	X			
Litter control: Litter includes larger items and particulates deposited on street surfaces, such as paper, vegetation residues, animal feces, bottles and broken glass, plastics and fallen leaves. Litter-control programs can reduce the amount of deposition of pollutants by as much as 50%, and may be an effective measure of controlling pollution by storm runoff.		X		
Livestock water crossing facility: Providing a controlled crossing for livestock and/or farm machinery in order to prevent streambed erosion and reduce sediment.	X		100 %[1]	
Manufactured BMP systems: Structural measures which are specifically designed and sized by the manufacturer to intercept stormwater runoff and prevent the transfer of pollutants downstream. They are used solely for water quality enhancement in urban and ultra-urban areas where surface BMPs are not feasible.	X	X		
Onsite treatment system installation: Conventional onsite wastewater treatment and disposal system (onsite system) consists of three major components: a septic tank, a distribution box, and a subsurface soil absorption field (consisting of individual trenches). This system relies on gravity to carry household waste to the septic tank, move effluent from the septic tank to the distribution box, and distribute effluent from the distribution box throughout the subsurface soil absorption field. All of these components are essential for a conventional onsite system to function in an		X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
acceptable manner.				
Porous pavement: An alternative to conventional pavement, it is made from asphalt (in which fine filler fractions are missing) or modular or poured-in concrete pavements. Its use allows rainfall to percolate through it to the sub-base, providing storage and enhancing soil infiltration that can be used to reduce runoff and combined sewer overflows. The water stored in the sub-base then gradually infiltrates the subsoil.		X	50 %[1]	
Proper site selection for animal feeding facility: Establishing or relocating confined feeding facilities away from environmentally vulnerable areas such as sinkholes, streams, and rivers in order to reduce or eliminate the amount of pollutant runoff reaching these areas.	X			
Rain garden /bio-retention basin: Rain gardens are landscaped gardens of trees, shrubs, and plants located in commercial or residential areas in order to treat stormwater runoff through temporary collection of the water before infiltration. They are slightly depressed areas into which storm water runoff is channeled by pipes, curb openings, or gravity.		X	40 %[1]	
Range and pasture management: Systems of practices to protect the vegetative cover on improved pasture and native rangelands. It includes practices such as seeding or reseeding, brush management (mechanical, chemical, physical, or biological), proper stocking rates and proper grazing use, and deferred rotational systems.	X		50 %[1]	
Wet retention ponds/basins: A storm water facility that includes a permanent pool of water and, therefore, is normally wet even during non-rainfall periods. Inflows from storm water runoff may be temporarily stored above this permanent pool.	X	X	32 %[1] 70%[4]	
Riparian buffer zones: A protection method used along streams to reduce erosion, sedimentation, and the pollution of water from agricultural non-point sources.	X	X	43 – 57 %[1]	Forested buffer w/o incentive payment
Septic system pump-out: A typical septic system consists of a tank that receives waste from a residence or business, and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.		X	5 %[1]	

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
Sewer line maintenance (e.g., sewer flushing): Sewer flushing during dry weather is designed to periodically remove solids that have deposited on the bottom of the sewer and the biological slime that grows on the walls of combined sewers during periods of low-flow. Flushing is especially necessary in sewer systems that have low grades which has resulted in velocities during low-flow periods that fall below those needed for self-cleaning.		X		
Stream bank protection and stabilization (e.g., riprap, gabions): Stabilizing shoreline areas that are being eroded by landscaping, constructing bulkheads, riprap revetments, gabion systems, or establishing vegetation.	X	X	40 - 75 %[1]	40 % w/o fencing; 75 % w/ fencing
Street sweeping: The practice of passing over an impervious surface, usually a street or a parking lot, with a vacuum or a rotating brush for the purpose of collecting and disposing of accumulated debris, litter, sand and sediments. In areas with defined wet and dry seasons, sweeping prior to the wet season is likely to be beneficial; following snowmelt and heavy leaf fall are also opportune times.		X		
Terrace: An earth embankment, or a combination ridge and channel, constructed across the field slope. Terraces can be used when there is a need to conserve water, excessive runoff is a problem, and the soils and topography are such that terraces can be constructed and farmed with reasonable effort.	X	X		
Vegetated filter strip: A densely vegetated strip of land engineered to accept runoff from upstream development as overland sheet flow. It may adopt any naturally vegetated form, from grassy meadow to small forest. The purpose of a vegetated filter strip is to enhance the quality of stormwater runoff through filtration, sediment deposition, infiltration and absorption.	X	X	<30% [3]	
Waste system/storage (e.g., lagoons, litter shed): Waste treatment lagoons biologically treat liquid waste to reduce the nutrient and BOD content. Lagoons must be emptied and their contents disposed of properly.	X	X	80 – 100 %[1]	
Water treatment (e.g., disinfection, flocculation, carbon filter system) : Physical, chemical and/or biological processes used to treat concentrated discharges. Physical-chemical processes that have been demonstrated to effectively treat discharge include sedimentation, vortex separation, screening (e.g., fine-mesh screening), and sand-peat filters. Chemical additives used to enhance separation of particles from liquid include chemical coagulants such as	X	X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		REPORTED EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
lime, alum, ferric chloride, and various polyelectrolytes. Biological processes that have been demonstrated to effectively treat discharges include contact stabilization, biodiscs, oxidation ponds, aerated lagoons, and facultative lagoons.				
Wetland development/enhancement: The construction of a wetland for the treatment of animal waste runoff or storm water runoff. Wetlands improve water quality by removing nutrients from animal waste or sediments and nutrients from storm water runoff.	X	X	30 %[1] 78%[4]	Including creation and restora-tion

Sources

1. BMP Efficiencies Chesapeake Bay Watershed Model (PhaseIV) August 1999; Draft FC and Nitrate TMDL IP for Dry River (2001); EPA (1998); EPA(1999b); Novotny (1994); Storm Water BestManagement Practice Categories and Pollutant Removal Efficiencies (2003); USDA (2003); DCR (1999); DEQ/DCR (2001).
2. Barrett,M.E.,ComplyingwiththeEdwardsAquiferRules:TechnicalGuidanceonBestManagementPractices,TexasNaturalResourceConservationCommissionReportRG-348,June,(1999).
3. The Expected Pollutant Removal (Percent) Data Adapted from US EPA, 1993C.
4. National Pollutant Removal Performance Database, Version 3, September, 2007

APPENDIX F
RESPONSE TO COMMENTS

A. Comments from Oklahoma Cattlemen's Association (received on September 7, 2009)

Comment #A1: On behalf of the Oklahoma Cattlemen's Association, Oklahoma Farm Bureau, Oklahoma Poultry Federation, Oklahoma Pork Council, and the American Farmers and Ranchers, I write to respectfully request an extension to the comment periods for the following TMDLs: Lower Cimarron River and Skeleton Creek Draft TMDL, Eucha Lake/Spavinaw Creek Draft TMDL, North Canadian Draft TMDL, and Salt Creek and Sand Creek Draft TMDL

As you are aware, we have been reviewing these TMDLs. As part of our review, we made an official open records request for records related to one of the four TMDLs (DEQ Public Notice of Draft Bacteria TMDL for the North Canadian River in the Oklahoma City Metropolitan Area and the Oklahoma River).

Your office very graciously fulfilled our request. We were invited to ODEQ headquarters to review the requested data. Upon arrival we were presented with 30 boxes of information. We thank you for providing this information.

However, because of the volume of information provided, we are unable to adequately process this information in time to meet the deadlines for public comment. While we have focused our attention on the aforementioned TMDL we have grave concerns about the methodology used in all four of the TMDLs and therefore the findings and conclusions contained in each.

We respectfully request the deadline for public comment be extended to December 31, 2009 for all pending TMDLs. Reports of this size and scope should be properly vetted and we appreciate your consideration of this request.

Response #A1: *The public comment period for North Canadian River Bacteria TMDLs was extended from October 1, 2009 to November 2, 2009. However, the request to extend public comment period for all other pending TMDL reports were denied because the reason cited did not apply to any other TMDLs.*

B. Comments from Oklahoma City Department of Public Works (Received September 24, 2009)

Comment #B1: Executive Summary, Page ES-6, 4th paragraph. "The Municipal Separate Storm Sewer System (MS4) permit for small communities in Oklahoma became effective on February 8, 2005. Eleven entities have MS4 permits in the North Canadian River study area. Oklahoma City has a Phase I MS4 permit. Del City, Mustang, Yukon, Choctaw, Nicoma Park, Spencer, Midwest City, Moore, Oklahoma Department of Transportation (ODOT), and Tinker Air Force Base all have Phase II MS4 permit.

1) As noted in Appendix E, page E-3, Table E-1 (footnote). The Oklahoma Turnpike Authority (OTA) and the Oklahoma Department of Transportation (ODOT) co-permit with Oklahoma City's Phase I MS4 Permit.
2) Table 3-4, "MS4 Entities in the Study Area", page 3-9 also indicates MS4 permitted entities. A table notation similar to that in Appendix E, page E-3 is appropriate.

Response #B1: *A footnote was added to Table 3-4.*

Comment #B2: Executive Summary, Page ES-8, 1st full paragraph. "The TMDL PRG will be the lesser of that required to meet the geometric mean or instantaneous criteria for E. coli and Enterococci because WQS are considered to be met if; 1) either the geometric mean of all data is less than the geometric mean criteria, or 2) no samples exceed the instantaneous criteria."

1) OKC suggest a revision to clarify the data utilized to determine water quality standards violations. Item number one specifies "all data is less than the geometric mean". OKC suggest the revision to state that all applicable recreational season data is less than the long-term geometric mean.
2) Pg. ES-8, Table ES-3

WQM Station	Waterbody ID	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instant-aneous	Instant-aneous	Geo-mean	Instant-aneous	Geo-mean
NC-08	OK520510000110_20	N. Canadian River				**93.6%**	**86.4%**
OK520520-00-0150G	OK520520000150_00	Crooked Oak Creek	**64.1%**				

Both the instantaneous and geometric mean percent reduction goals (yellow highlight in table above) are bold indicating the selection of using both PRG's. According to the guidance "The PRG will be the lesser of that required to meet the geometric mean or instantaneous criteria for E. coli and Enterococci". Subsequently only the geometric mean (86.4%) should be highlighted.

3) WBID OK520520000l50_00, Crooked Oak Creek. OKC has completed a water quality study within this WBID segment (OKC Site WCNCE450). The data for the bacteria parameters E. coli and fecal coliform are displayed in the table below (see Comment 7, bullet 11 (table)). Sufficient data collected by OKC are available within the recreational season to incorporate into this study. This additional data, when calculated in combination with data provided in Appendix A, could change the current PRG (highlighted in red in table above). By our calculations, the geometric mean (calculated from the data provided in Appendix A) will drop from 897.5 5 to 572.3 when OKC data is added.

Response #B2:

1) The suggested changes were made.

2) Only 86.4% should be bold. Changes were made.

3) The OKC data from Site WCNCE450 was added to the assessment and TMDL calculation. With the addition of OKC data, there are enough samples for E coli assessment. E coli were added to the impairment list according to assessment protocols and a TMDL was developed for E coli impairment in Crooked Oak Creek. OKC's Fecal Coliform data were also added to the assessment and TMDL calculation in this report.

Comment #B3: Executive Summary, Page ES-9, 1st & 2nd full paragraph.

1) These paragraphs explain the margin of safety with regard to conservative approaches to account for uncertainty ensuring that both the 30-day geometric mean and instantaneous bacteria standards can be achieved and maintained. However, a better effort should be made to explain, quantify and list the implicit portion of the TMDL.

Response #B3: *An explicit Margin of Safety of 10% was used in this TMDL. The reference regarding the implicit MOS discussion was removed from the report.*

Comment #B4: Section 1, Page 1-2, Table 1-1, "Airport Heights Creek OK520520000350_00 WCNCW425 SW 15, E of Portland"

1) Based on the stream segment provided and the watershed map on Figure 3-1 (pg. 3-4), OKC believes that the Watershed Characterization Site WCNCW617 should represent this watershed. However, based on the assessment for WCNCW617, OKC agrees that the listing for segment OK520520000350_00 should be removed due to a lack of data to make an assessment for PBCR.

Site Number	Projector Number	Collection Date	Site Time	Fecal Coliform (MF-CFU/100 ml)	E. Coli (MF-CFU/100 ml)
617	WCNCW617	12/16/2003	10:30AM	260	520
617	WCNCW617	1/27/2004	10:00AM	190	420
617	WCNCW617	3/2/2004	10:00AM	3000	8900
617	WCNCW617	5/18/2004	10:10AM	80	.180

617	WCNCW617	6/22/2004	10:40 AM	6400	5900
617	WCNCW617	7/27/2004	10:15 AM	220	10
617	WCNCW617	8/31/2004	11:50AM	130	250
617	WCNCW617	9/30/2004	12:35 PM	20	60
617	WCNCW617	11/9/2004	10:30AM	280	170
617	WCNCW617	12/14/2004	10:50AM	430	430
617	WCNCW617	1/19/2005	12:20PM	190	320
617	WCNCW617	2/22/2005	11:00AM	30	90
617	WCNCW617	3/29/2005	10:40 AM	150	240
617	WCNCW617	4/28/2005	10:25AM	110	520
617	WCNCW617	6/1/2005	10:50 AM	4700	10200
617	WCNCW617	7/26/2005	8:30AM	380	320
	Denotes Recreation Season Data				

Response #B4: *Airport Heights Creek was re-assessed using data from monitoring station WCNCW617. The conclusion of the assessment stays the same. Related hanges were made.*

Comment #B5: Section 1, page 1-10, Figure 1-2 Land Use Map by Watershed.

1) This map needs to be re-drawn, several of the notation boxes on the map are incorrect. Specifically, the notation boxes for Airport Heights Creek (350_00), Mustang Creek (240_00) and North Canadian River segments 25000 & 21000.
2) The OKC referenced monitoring locations are not identified on the map. Specifically, site WCNCW654 and WCNCW6 17 (and added WCNCE450 See Comment Number 2, bullet 3).

Response #B5:

1) *The error in stream labeling was corrected.*
2) *Two of OKC's monitoring sites were on the map. The 3rd one was added to the map.*

Comment #B6: Section 2, Page 2-1, Paragraph 1. "The beneficial uses designated for North Canadian River (OK5205100001l020, OK52052000001000, OK52052000000l0 10, OK52052000001020, OK52052000001030, OK52052000001040, OK5205200002l000, & OK520520000250 00), Crutcho Creek, Crooked Oak Creek, and Mustang Creek include PBCR, public/private water supply, warm water aquatic community, industrial and municipal process and cooling water, agricultural water supply, fish consumption, and aesthetics. TMDLs in this report address the PBCR use for all of the waterbodies."

1) The City of Oklahoma City understands the generalizations placed on the watershed of Crutcho Creek, however Crutcho Creek is separated into four WBID segments and only

one of the four WBID segments is listed as not meeting PBCR (OK520520000070_00). Two of the four segments do not have Primary Body Contact Recreation (PBCR) designation but are listed as Secondary Body Contact Recreation (SBCR).

2) It should also be noted that "industrial and municipal process and cooling water" beneficial use has been revoked and should be removed (OAC 785:45-5-15, revised May 27, 2008).

Response #B6:

1) *The two segments classified as Secondary Body Contact Recreation are located in the upper part of Crutcho Creek. The drainage areas of these two segments may be contributing to the bacteria impairments of downstream segments. No change was made.*
2) *Industrial and municipal Process and Cooling Water beneficial use was removed as suggested.*

Comment #B7: Section 2, pages 2-7 & 2-8, Table 2-2 Summary of Indicator Bacteria Samples from Primary Body Contact Recreation Season, 1998-2008.

1) There are two colors (blue and grey) to highlight the bacterial indicators that require a TMDL. Is there a relevance to using different colors to indicate bacterial indicators that require a TMDL?
2) OKC noted many discrepancies between Appendix A and Table 2-2, page 2-7 concerning the number of observations and exceedances for sites NCO8, NCO7, NCO6, NCO5, NC04 and NCO3, OKC went to the original laboratory reports and found that all of the NCO# sites have incomplete or incorrect data listed in Appendix A.
3) Table 2-2, page 2-7 states there were 20 fecal coliform samples, 20 E. coli samples and 20 enterococci samples collected on waterbody segment OK52051000l 10_20. Table ES-3, page ES-8 and Table 5-1, page 5-2 state that the only water quality monitoring station on that segment was NC-08. Appendix A, pages A-8 through A-9 list only 17 fecal coliform samples, 17 E. coli samples and 17 enterococci samples for water quality monitoring station NC-08.
4) Table 2-2, page 2-7 states there were 23 fecal coliform samples, 23 E. coli samples and 23 enterococci samples collected on waterbody segment OK5205200000l0_00. Table P5-3, page ES-8 and Table 5-1, page 5-2 state that the only monitoring station on the segment was 520510000110-001AT (Oklahoma Water Resources Board).
   - Appendix A, pages A-9 through A-10 list 23 fecal coliform data points, however, according to OWRB's 2007 Draft BUMP Report data for this segment, there were 26 fecal coliform concentrations assessed within this segment.
   - Appendix A sample count for enterococci is 23. According to OWRB's 2007 BUMP Report data for this segment, there were 27 enterococci concentrations assessed.
5) Table 2-2, page 2-7 states OK52052000001010, N. Canadian River, sample count for fecal coliform is 20, E. coli is 20 and enterococci is 20.
   a. Appendix A sample count for fecal coliform is 17, E. coli is 17 and enterococci is 17.

6) Table 2-2, page 2-7 states OK52052000001020, N. Canadian River, sample count for fecal coliform is 20, E. coli is 20 and enterococci is 20.
   b. Appendix A sample count for fecal coliform is 17, E. coli is 17 and enterococci is 17.
7) Table 2-2, page 2-7 states OK520520000010_30, N. Canadian River, sample count for fecal coliform is 18, E. coli is 18 and enterococci is 18.
   - Appendix A sample count for fecal coliform is 16, E. coli is 16 and enterococci is 16.
   - Using the E. coli measurements for water quality monitoring site NC-05 given in Appendix A, page A-5, OKC calculated a geometric mean of 26.5 cfu/100mL, which would make water body segment OK520520000010_30 fully supporting of the beneficial use PBCR with respect to E. coli. Only one exceedance of the instantaneous criteria can be found in Appendix A, a 2,481 cfu/100mL measurement on 5/20/2003. Only 16 E. coli measurements were given in Appendix A. Table 2-2, page 2-7 states there were 18 E. coli samples. Presumably, the two missing E. coli measurements caused the geometric mean to increase to the 154.32 cfu/100mL value stated in Table 2-2. Assuming that all the E. coli data listed for NC-OS in Appendix A were used in the calculation in addition to the two missing E. coli measurements, OKC back-calculated to determine the relative magnitude of the two missing E. coli measurements. The two missing E. coli measurements would have to average roughly 215,000 cfu/100mL to increase the geometric mean to 154.32 cfu/100mL. Also, the two missing E. coli measurements added 3 more exceedances of the instantaneous criteria to the one exceedance listed in Appendix A for a total of 4 exceedances as stated in Table 2-2, page 2-7.
8) Table 2-2, page 2-7 states OK520520000010_40, N. Canadian River, sample count for fecal coliform is 18, E. coli is 18 and enterococci is 18.
   - Appendix A sample count for fecal coliform is 16, E. coli is 16 and enterococci is 16.
9) Table 2-2, page 2-7 states OK52O520000210_00, N. Canadian River, sample count for fecal coliform is 19, E. coli is 20 and enterococci is 20.
   - Appendix A sample count for fecal coliform is 17, E. coli is 18 and enterococci is 17.
10) Table 2-2, page 2-7 states OK520520000250_00, N. Canadian River, sample count for fecal coliform is 26.
    - Appendix A sample count for fecal coliform is 23. USGS database only has 22 data points for the same period of record.
    - Pgs. A-1 & A-2, USGS data. There are many data points displayed in Appendix A that the USGS states are estimated (see table below).
      - How are estimated data points qualified in the USGS Data?
      - What method was used to determine the value of these estimated data values?

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc.	Bacteria Indicator
USGS07241000	North Canadian River	OK520520000250_00	02/11/04	110	PC Estimated
USGS07241000	North Canadian River	OK520520000250_00	08/17/05	180	PC Estimated
USGS07241000	North Canadian River	OK520520000250_00	02/28/07	21	PC Estimated
USGS07241000	North Canadian River	OK520520000250_00	04/23/07	580	FC Estimated
USGS07241000	North Canadian River	OK520520000250_00	10/25/07	2600	PC Estimated
USGS07241000	North Canadian River	OK520520000250_00	12/13/07	3700	PC Estimated
USGS07241000	North Canadian River	OK520520000250_00	12/29/08	47	PC Estimated

- o The data shown for 9/30/08 in Appendix A is not displayed in the USGS data tables (see attached USGS data for the period of record listed in Appendix A).

11) Table 2-2, page 2-7 states OK520520000070_00, Crutcho Creek, sample count for fecal coliform is 11, E. coli is 7 and enterococci is 5.
    - o Appendix A sample count for fecal coliform is 13, E. coli is 8 and enterococci is 5.
    - o Fecal coliform data appears to be less than 25% exceedance when calculated with all data provided in Appendix A and therefore the listing should be removed (sec table below).

WQM Station	Water Body Name	Stream Segment ID	Date	Bacteria Conc.	Bacteria Indicator
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	05/16/00	100	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	06/19/00	15000	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	07/24/00	9000	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	08/28/00	20	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	05/08/01	300	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	06/12/01	170	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	07/17/01	>120	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	08/21/01	>300	FC
OK520520-00-0070B	Crutcho Creek	OK520520000070_00	09/26/01	100	FC
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	05/2 1/98	300	FC
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	06/17/98	170	FC
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	08/19/98	170	FC
OK520520-00-0070G	Crutcho Creek	OK520520000070_00	09/15/98	500	FC

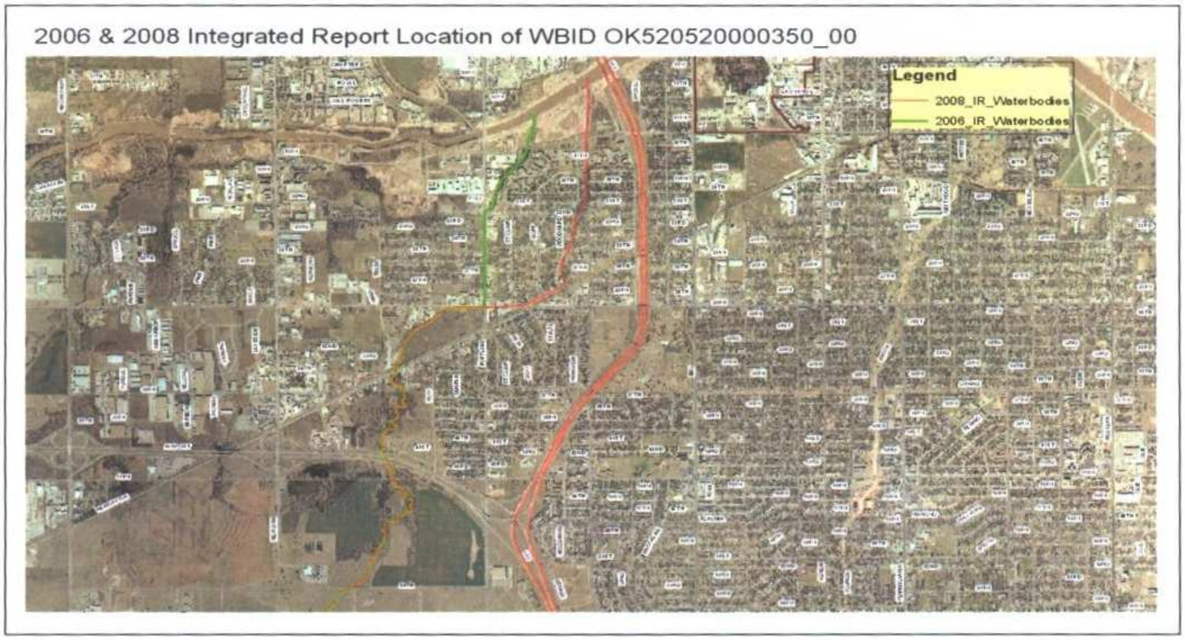
Response #B7:

1) *No. there is no relenvance to the 2 colors. The highlight in Table 2-2 was changed to only one color.*
2) *ACOG's data (sites NC-03 through NC-08) used in this TMDL report were the same data used by ACOG in their TMDL report on North Canadian River in 2006. The ACOG TMDL was not finalized. We noticed there were two or three samples collected at each monitoring site that were not used in ACOG's TMDL report. We contacted ACOG about the missing data. They indicated that the data were excluded from TMDL calculations because flows were not measured when samples were taken. These data were used in the assessment but were not listed in Appendix A. These missing data were added to the table in Appendix A.*
3) *Please refer to item 2) above.*
4) *OWRB's data not listed in Appendix A were labeled as "Environmental replicate". We only included data labeled as "Environmental samples". After further investigation, the "environmental replicate" data were included in the TMDL report.*
5) *Please refer to item 2) above.*
6) *Please refer to item 2) above.*
7) *Please refer to item 2) above.*
    - *The data in listed in Appendix was an error which is the same as the data for site NC-04. The correct data was used in the assessment and TMDL calculations. The error was corrected in Appendix A.*
8) *Please refer to item 2) above.*
9) *Please refer to item 2) above.*
10) *Table 2-2 was revised to show 23 samples.*
    - *The data we downloaded from USGS website has 23 samples.*
    - *We do not know what method USGS used to determine the estimated sample values. However, the only estimated value (8/17/05) used in the TMDL calculations was reviewed and accepted by the USGS as valid data.*
    - *We reviewed our download from USGS website, the fecal coliform data for 9/30/08 was correct.*
11) *The fecal coliform samples ">120" on 07/17/09 and ">300" on /8/21/01 were not used in the assessment or TMDL calculations. With a sample of ">120" or ">300", we still don't know if the standard was violated. One E coli sample was excluded for the same reason.*
    - *The sample count is correct.*
    - *The assessment is correct.*

Comment #B8: Section 2, Page 2-4, and Paragraph 5. "A TMDL will be developed for each bacteria indicator. Airport Heights Creek (OK520510000350 00) is not impaired for bacteria. Therefore, a TMDL will not be developed for the creek. Instead, the TMDL for North Canadian River (OK52052000001040) watershed will include the Airport Heights Creek sub-watershed."

1) OKC data for the Watershed Characterization study station WCNCW6 17 applies to this segment. The WBID needs to be changed on OKC watershed reports submitted to ODEQ

(Site WCNCW425 no WBID, Site WCNCW617 - OK520510000350_00). It appears that the confusion was related to the Geographic Information System (GIS) files for the 2006 Integrated Report and the 2008 Integrated Report (see map below). The 2008 Integrated Report GIS file has the OK5205 10000350_00 segment correctly placed which corresponds to OKC's study site WCNCW617. Insufficient data is available during the recreational season to make an assessment of PBCR (see Comment 16 for data table).



2) Table 2-2, page 2-8 states OK520520000150_00, Crooked Oak Creek, sample count for fecal coliform is 9, E. coli is 6 and enterococci is 6.
    - Appendix A sample count for fecal coliform is 9, E. coil is 6 and enterococci is 6.
    - Fecal coliform data provided in Appendix A combined with OKC data confirms listing, however the % exceedance drops from 44.4% to 33.3% and the geometric mean drops from 898 (897.55) to 572 (572.3). OKC data had an exceedance frequency of 2 out of 9 with geometric mean of 365. 0CC data had an exceedance frequency of 4 of 9 with a geometric mean of 898 (897.55). The OKC data does indicate water quality improvement with regard to fecal coliform in Crooked Oak Creek.
    - E. coil data provided in Appendix A when combined with OKC data has an exceedance of 40% (6 of 15) and a geometric mean of 340. OKC data had exceedance of 2 of 9 samples with a geometric mean of 323, which is lower than OCC data (367).

Site Number	Projector Number	Collection Date	Site Time	Fecal Coliform (MF-CFU/100 ml)	E. Coli (MF-CFU/100 ml)
450	WCNCE450	8/2/2005	10:55 AM	180	90
450	WCNCE450	9/7/2005	12:10PM	34.0	310
450	WCNCE450	10/11/2005	1:00 PM	260	270
450	WCNCE450	11/15/2005	12:55PM	170	180
450	WCNCE450	12/20/2005	2:15PM	430	350
450	WCNCE450	1/24/2006	1:40PM	70	70
450	WCNCE450	4/4/2006	12:05 PM	10	20
450	WCNCE450	5/9/2006	1:30PM	250	290
450	WCNCE450	6/13/2006	1:20 PM	190	190
450	WCNCE450	7/18/2006	12:46 PM	180	350
450	WCNCE450	8/22/2006	12:40 PM	1300	920
450	WCNCE450	10/3/2006	11:26 PM	130	30
450	WCNCE450	11/8/2006	1:14 PM	230	180
450	WCNCE450	12/4/2006	11:50 PM	300	120
450	WCNCE450	1/9/2007	12:30 PM	30	10
450	WCNCE450	2/13/2007	1:13 PM	390	200
450	WCNCE450	3/20/2007	11:30 PM	60	20
450	WCNCE450	5/2/2007	2:01 PM	2400	1500
450	WCNCE450	6/5/2007	2:10 PM.	280	320
450	WCNCE450	6/11/2007	12:50PM	250	160

Denotes recreation season data

Blue text data represents < detection limit. Data used is the detection limits.

Response #B8: *Airport Heights Creek (OK520510000350 00) is not impaired for bacteria based on the OKC data from Site WCNCW617.*

1) *The report was revised to use the correct data from Site WCNCW617 for Airport Heights Creek.*
2) *OKC's data from site WCNCE450 were added to the assessment and TMDL calculations.*
   - *Appendix A was revised to include the OKC data. The new sample counts become 18 for fecal coliform, 15 for E coli and 6 for enterococci.*
   - *With added OKC data, Table 2-2 was revised. The load reduction goal was recalculated for both fecal coliform and E Coli.*

Comment #B9: Section 3, Page 3-2, Paragraph I & Table 3-1. "For some continuous point source discharge facilities the permitted design flow was not available and therefore is not provided in Table 3-1."

1) It appears that the design flows are currently in Table 3-1. Are these the actual design flows or estimates?

***Response #B9**: The design flows in Table 3-1 are design flows taken from the Oklahoma Water Quality Management Plan. The quoted text does not apply in this TMDL report and was deleted from the report.*

Comment #B10: Section 3, Page 3-16 and Paragraph 4. "The number of animals processed through the stockyard is undocumented and was not counted in Table 3-8."

1) This information is available through the ODAFF Market Development Division which details market reports from 2003 through the current date (see website address below). http ://wn.ok1aosfstate.ok.us/~okag/mktdev-reports.htm

***Response #B10:** The number of animals processed through the Oklahoma National Stockyards was downloaded from ODAFF's website: http://www.oda.state.ok.us/mktdev-reports.htm. The TMDL report was updated to reflect the change.*

Comment #B11: Section 4, Page 4-3, Paragraph 2 "Figures 4-1 through 4-11 are flow duration curves for each impaired waterbody. The flow duration curve for North Canadian River, segment OK52051000011020 was based on measured flows at USGS gage station 07241800 (North Canadian River at Shawnee, OK).

The flow duration curves for North Canadian River, segments OK5205200000l0 00 and OK52052000001010 were based on measured flows at USGS gage station 07241550 (North Canadian River near Harrah, OK).

The flow duration curve for North Canadian River, segment OK520520000010_20 was based on measured flows at USGS gage station 07241520 (North Canadian River at Britton Road in Oklahoma City, OK).

The flow duration curves for North. Canadian River, segments OK520520000010 30 and OK520520000010_40 were based on measured flows at USGS gage station 07241503 (North Canadian River at NE 36th Street in Oklahoma City, OK).

The flow duration curves for North Canadian River, segments OK520520000210 00 and OK52052000025000 were based on measured flows at USGS gage station 07241000 (North Canadian River below Lake Overholser near Oklahoma City, OK).

No flow gage exists on Crutcho Creek (OK520520000070_00) and Crooked Oak Creek (OK520520000150_00) Therefore, flows for this waterbody were prorated using the watershed area based on measured flows at USGS gage station 07242247 (Deep Fork at Hefner Rd at Oklahoma City, Ok). The flow duration curve was based on measured flows from 1995 through 1998.

No flow gage exists on Mustang Creek (OK520520000240 00). Therefore, flows for this waterbody were prorated using the watershed area based on measured flows at USGS gage station 07229500 (Little River near Norman, OK). The flow duration curve was based on measured flows from 1951 through 1955."

1) The flow duration curve information given for the highlighted segments explains the period of record for the data used in building the curves, however this information is missing for the other segments listed in section 4.2. It would be helpful to include the period of record for data used to build the other curves as well.

Response #B11: *The time periods of record used to develop flow duration curves were added to the report.*

Comment #B12: Section 4, page 4-4, Figure 4-1 Flow Duration Curve for North Canadian River (OK5205 1000011020)

1) The title within the flow duration curve graph does not match the heading for the graph (title- OK52051000001 l0_00, heading OK52051000011020).

Response #B12: *The error was corrected.*

Comment #B13: Section 5, page 4 paragraph. "Percent reduction goals are calculated for each watershed and bacterial indicator species as the reductions in load required in order that **no more than 10 percent of the existing instantaneous water quality observations would exceed the water quality target.**" (Emphasis added)

Section E.4, pages ES-7 aid ES-8. "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 instantaneous E coli or Enterococci observations **would exceed the water quality target**" (Emphasis added)

1) OKC feels the explanations of the PRG calculations are inconsistent in regard to the percentage of existing instantaneous bacteria observations that are allowed to exceed the WQS for fecal coliform. State Water Quality Standards (785:46-15-6 Assessment of Primary Body Contact Recreation Support) does provide for the following in relation to fecal. coliform as noted on page ES-4 of this TMDL document.

    (c) Fecal Coliform

    (1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be frilly 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.

    Therefore, OKC agrees that no more than 25 percent of the existing instantaneous fecal coliform observations should exceed the water quality target as stated in Section E.4.

2) OKC also feels an instantaneous criteria and geometric mean PRG sample calculation would be informative,

Response #B13: *The inconsistency in descriptions regarding how to calculate Percent Reduction Goal (PRG) was resolved. It is worth noting that TMDL calculations are correct. The report was modified to be consistent.*

Comment #B14: Section 5, page 5-10, Figure 5-1l Load Duration Curve for Enterococci in Mustang Creek (OK52052000024000).

1) The title within the load duration graph does not match the heading for the graph. The load duration graph displays E. coli and the heading for the graph displays enterococci.

Response #B14: *The title of the figure was changed.*

Comment #B15: Section 5, page 5-l0, 1st paragraph. "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 North Canadian River Study Area. The WLA for each facility is derived from the following equation:"

*WLA = WQS*Flow *unit conversion factor (If/day)*

Where:

WQS = 33, 200, and 126 cfu/l00 ml for enterococci, fecal coliform, and E. coli

respectively.

Flow (10^6 gallon/day) =permitted flow

Unit conversion factor = 37,854,120-1 0"6 gallon/day

1) The narrative prior to the calculation describes "...facilities are allocated a daily wasteload calculated as their permitted daily average discharge flow rate multiplied by the **instream single sample water quality criterion.."**, however, the calculation utilizes the geometric mean criteria versus the mentioned single sample criterion 108 cfu/100 ml, 400 cfu/100 ml and 406 cfu/100 ml. (Emphasis added)

Response #B15: *The text was changed from "instream single sample water quality criterion" to "geometric mean criterion". The values in the TMDL calculations are correct and are consistent with permit conditions.*

Comment #B16: Section 5, page 5-10, 2nd paragraph. "Table 5-2 indicates which point source dischargers within Oklahoma currently have a disinfection requirement in their permit. Certain facilities that utilize lagoons for treatment have not been required to provide disinfection since storage time and exposure to ultraviolet radiation from sunlight should reduce bacteria levels. In the future, all point source dischargers which are assigned a wasteload allocation but do not currently have a bacteria limit in their permit will receive a permit limit consistent with the wasteload allocation as their permits are issued."

1) In regards to those mentioned wastewater treatment works in Section 5 which do not have disinfection requirements in their permit, the calculation should not assume that storage time and ultraviolet exposure provides sufficient treatment to reduce bacteria to appropriate levels. Samples acquired at the effluent point where the Lakeview Terrace discharge enters the Unnamed Tributary to the North Canadian River (SE/4, NW/4, SW/4, Section 30, Township 12 North, Range 4 West) indicate elevated fecal bacteria numbers significantly above the single sample water quality criterion.

1st Sampling Event, July 16th, 2009 (during dry weather)

E. coli — 4,320 cfu/l00 ml (most probable number)

enterococci 700 cfu/l00 ml (most probable number)

2nd Sampling Event, July 30th, 2009 (during wet weather)

E coli — 3,110 cfu/l00 ml (most probable number)

enterococci <100 cfu/l00 ml (most probable number)

Date	Indicator Bacteria	Observation (cfu/100mL)	Loading [1] (cfu/100mL)	WLA [2] (cfu/100mL)
7/16/2009	E. coli	4,320	8.18E+09	2.38E+08
7/16/2009	enterococci	700	1 .32E+09	6.25E+07
7/30/2009	E. coli	3,110	5.89E+09	2.38E±08
7/30/2009	enterococci	<100 [3]	1.89E+07	6.25E+07

1. Calculated as follows:

   loading (efu/day) = observation cfu/l00 mL).design flow (mgd).unit conversion factor (ml/10^6gal)

   Where: design flow 0.05 mgd (from Table 3-1, Draft Bacteria Total Maximum Daily Load (TMDL) for North Canadian River Area (OK520520) ODFQ (2009)); unit conversion factor 37854120 mL/$l0^6$ gal

2. From Table 5-2, Draft Bacteria Total Maximum Daily Load (TMDL) for North Canadian River Area (OK5 20520) ODEQ (2009)
3. Used 9.99 cfu/l00 ml, in calculation for observation reported as <100 cfu/100mL

Admittedly, the data pool is small. A larger number of samples would be more representative and allow for a better calculation of the geometric mean. There is no permit requirement for Lakeview Terrace Mobile Home Park to monitor their effluent for indicator bacteria. Since the wasteload is calculated using the discharge and the numerical (single sample criteria), it is likely that loadings calculated for this privately owned wastewater treatment works may be significantly more than calculated within this TMDL study.

Response #B16: *As a result of this TMDL report, both Lakeview Terrace Mobile Home Park and Holliday Outt Mobile Home Park will receive a permit limit for bacteria. The current loadings for these facilities likely do exceed the WLA.*

Comment #B17: Appendix A Title Page The title page specifies Ambient Water Quality Bacteria Data 1999 to 2003. Page Al Table specifies Ambient Water Quality Bacteria Data— 1998 to 2005.

1) From review of the data tables, the range was from 1998 through 2009.

Response #B17: *The change was made.*

Comment #B18: Appendix A, page A-2, USGS Data.

1) Why is the fecal coliform concentration (1,200 CFU/l00 mL) reported on 6/18/2009, North Canadian River (OK520520000250_00) highlighted?

Response #B18: *The actual data was "<1200". A footnote was added at the end of the table.*

Comment #B19: Appendix A, page 4-2, ACOG's Data, North Canadian River (OK520520000210_00), NCO3.

1) There is a missing data point on 7/21/2003 for fecal coliform.

Response #B19: *The data point was added in the TMDL calculations and Appendix A.*

Comment #B20: Appendix A, page A-3, ACOG's Data, North Canadian River (OK520520000210_00), NCO3.

1) There is a missing data point on 7/21/2003 for enterococci.

Response #B20: *The data point was included in TMDL calculations but was missing in Appendix A. The data point was added to Appendix A.*

Comment #B21: Appendix A, pages A-1 thru A- 13. General Comment regarding tables:

1) It would be helpful to add a footnote at the end of the table series to indicate the purpose of the highlighted components.
2) Some numerical values are reported with greater/less than symbols while others are reported as decimals to indicate reported limits. OKC request a clarification regarding the use of these numbers in calculations within the TMDL.

Response #B21:

1) *A footnote was added at the end of table.*
2) *For ACOG's data, "<10" was replaced with "9.999".*

Comment #B22: Appendix A, pages A-9 & A-l0, OWRB data

1) There also appears to be data missing from the following dates: 07/01/03, 08/06/03 & 06/02/04.

Response #B22: *When the data is compiled, only data with label of "general Environmental Sample" were included in the TMDL calculations. These replicates were not included.*

Comment #B23: General Comment.

1) To be successful, a TMDL for bacteria must have effective management actions. This is difficult for two reasons. First, the information needed for this task, the knowledge of the source of contamination, generally is not available due to the many unregulated nonpoint sources that may impact water quality within a watershed and from upstream contributions. Secondly, indicator bacteria measurements do not isolate the type of source, whether human, pets, livestock or wildlife (natural background levels). Without a better understanding of these two areas it is not financially feasible to begin a program to reduce bacteria in a waterbody. The possibility of setting our aim at the wrong source could become very expensive and time consuming, with the potential of no reductions after several years of implementing best management practices. The responsibility to remove bacteria from urbanized waterways that is placed on permitted MS4's should be based on reliable and accurate data so that successful targets and goals can be met that do not place undo responsibilities on the MS4 to remove pollutants which they have no control over. The MS4 reduction percentage should only include the removal of pollutants from which the MS4 has the regulatory control to enforce. It is hoped that any goal that is set-should be attainable and that can be successful.

Response #B23: *The following language was added to Section 5.8 of the TMDL report: "The stormwater permit holders are not required by the TMDL to achieve the total load reduction to restore water quality standards. Instead, they are responsible only for their own contributions".*

Comment #B24: Fecal Coliform Bacterial Standards Revision

1) On September 11, 2009, the Oklahoma Water Resources Board held a 2009 Triennial Revision of the Oklahoma Water Quality Standards (first informal meeting). Agenda item 6 "Removal of fecal coliform as an indicator group for primary body contact recreation" recommended the removal of the fecal coliform indicator bacteria from the Oklahoma Water Quality Standards, Chapter 45 and Chapter 46 (785:45-5-16 (1) and 785:46-15-6 (b)(l), (c)(l-3)). If these changes are accepted by the Oklahoma Water Resources Board and promulgated into the State Water Quality Standards as state law with EPA approval, how would this impact the current instantaneous fecal coliform reduction requirements specified in Table E-S3, page ES-S for Waterbody ID segments on the North Canadian River (OK52052000001000, OK520520000010, OK52052000001020, OK52052000001030, OK52052000001040, OK52052000025000), Crutcho Creek (OK52052000007000) and Crooked Oak Creek (OK5205200001500)? If this change is accepted, would this impact private and publicly owned wastewater permits in regards to indicator bacteria monitoring of wastewater effluent?

Response #B24: *Fecal coliform standard revision was under consideration by Oklahoma Water Resources Board. However, the revision was later dropped. It is not known when or if it will be considered in the future.*

Comment #B25: General Bacterial Criteria Comment

1) Bacterial Standards are currently a heated issue, in Oklahoma as well as in neighboring states, consideration towards a usage and risk based approach may be beneficial for waterbodies that have very low primary body contact recreation usage. For example, there is a lower risk of ingestion or submersion (primary body contact) in a closed conduit (underground) system or an open concrete channel configuration with an average depth of 2" than an open waterbody that maintains sufficient site configuration for potential submersion. 1) is the State considering a tiered approach towards urban waterways with limited site configuration for primary body contact?
2) The current water quality standards are based on the EPA published Ambient Water Quality Criteria for Bacteria 1986, which contains the water quality criteria for fecal bacteria to protect bathers from gastrointestinal illness in recreational waters. An External Peer Review of EPA Analysis of Epidemiological Data from EPA Bacteriological Studies (prepared by Versar, Inc. February 2004) requested a peer review to answer three (3) key questions, one of which is as follows: "Is it scientifically defensible to extrapolate the relationship (in terms of linear regression or other quantitative means) between bacterial indicator density and illness rate for fresh water beyond the 1% risk level?" All three technical reviewers acknowledged that the design and implementation of standards below the 1 % risk level is not scientifically defensible. Our current standards are set at 8/1000 or 0.8% gastrointestinal rates. 1) Does the State intend to review these current criteria to determine if standards below the 1% risk level are appropriate and scientifically defensible?
3) The EPA Document Ambient Water Quality Criteria for Bacteria 1986 specifies, "In general, samples should be collected during dry weather periods to establish so-called "steady state" conditions" (page 8). The report also specifies on page 9 "These densities are for steady state dry weather conditions." The report specified the current standards are based on dry weather conditions and are not developed to accommodate wet weather conditions. 1) Is the State considering the exemption of fecal bacterial criteria during lower potential exposure risk — i.e. during elevated hydrological conditions?
4) The EPA Document Ambient Water Quality Criteria for Bacteria 1986 specified "The presence of these indicators, in rural areas, shows the presence of warm blooded animals fecal pollution. Therefore, EPA recommends the application of these criteria unless sanitary and epidemiological studies show the sources of the indicator bacteria to be non-human and the indicator densities arc not indicative of a health risk to those swimming in such waters." (page 10). The criterion appears to allow for further studies refining possible natural background levels that may not contribute to pathogen impairment. The State currently has no language within the numerical criteria or the use support assessment protocol for dealing with natural background levels, which may be uncontrollable and unregulated sources of fecal contamination. 1) Is the State considering adding language to the current numerical and use support assessment protocol to address potential natural background levels from natural sources?

Response #B25: *All of the questions in this comment are related to Water Quality Standards and were forwarded to Oklahoma Water Resources Board for consideration. The report does include a recommendation that the current standards for bacteria should be reviewed. See Section 5.8.*

C. Comments from Oklahoma City Department of Water & Wastewater Utilities (received on October 27, 2009)

Comment #C1: For clarification, please include a statement concerning how target screening levels were developed in Oklahoma Administrative Code (OAC) 785:46 described on pages ES-3 to ES-5 and provide brief context: Were these screening level targets recommended by EPA? Are they used in other similar Oklahoma waters?

Response #C1: *The Oklahoma Administrative Code 785:46 is developed by Oklahoma Water Resources Board. The screening levels in this document are used by all state agencies (OWRB, OCC and DEQ) to determine the impairment status of any streams/lakes in Oklahoma.*

Comment #C2: Additional background information would be helpful regarding the classification of the stream as primary body contact recreation.

Response #C2: *The classification of a stream is provided in the Oklahoma Water Quality Standards (OAC 785:45). Please contact Oklahoma Water Resources Board for more information regarding the standards.*

C**omment #C3:** ODEQ identified sanitary sewer overflow (SSO) events on page ES-6 as potential sources of bacterial load. 550 events are typically high flow short duration events impacting the instantaneous standards. Was a correlation completed to estimate impacts during storm/wet weather days?

Response #C3: *Generally speaking, during and/or days after storm events, the stream flow is higher and the bacteria level in the stream is higher too. However, the bacteria may come from many different sources. No correlation studies to estimate SSO's impact are included in this report.*

Comment #C4: In the equation for the TMDL for MS4 (Average LA = average TMDL - MOS - WLA_WWTF - WLA MS4) page ES-8 there appears to be a double counting of the margin of safety since the average TMDL has a MOS included its development.

Response #C4: *The equation is essentially the same as TMDL = Σ WLA + Σ LA + MOS with the point source term and MOS term moved to the left side of the equation. The margin of safety was counted only once.*

Comment #C5: Please add a description or reference for the fecal coliform, E. coli and enterococci test methods to verify that these methods will be the same as used by treatment facilities during operation.

Response #C5: *This TMDL report uses all existing data collected by various agencies. All data were believed to meet QAPP or QA/QC requirements and were taken at their reported value in this report. All tests were conducted using approved test methods that are also* *required for discharge monitoring reports filed by treatment facilities. Please refer to the original data report or QAPP etc for testing methods.*

Comment #C6: Based on a review of river segment data for OK520520000010-l0 (Dungee) and OK5205200000 10-20 NCWWTP) in Appendix A, the title of Table 2-2 appears to be incorrect. The title of Table 2-2 "Summary of Indicator Bacteria samples from Primary Body Contact Recreation Season 1998" 2008" does not show that the data used to develop the TMDL was collected in 2003. Could Table 2-2 be modified to show when the data was collected for each river segment?

Response #C6: *The title for Table 2-2 shows date ranges for all streams and is correct. If a reader is interested in a specific stream, the complete data can be found in Appendix A. We believe this is a good arrangement. No change was made.*

Comment #C7: Data for river segments OK520520000010-10 (Dungee) and OK520520000010-20 (NCWWTP) were only sampled 17 times in 2003 according to data in Appendix A. However, Table 2-2 indicates 20 times, Could ODEQ please verify number of sampling events?

Response #C7: *Please refer to response #B7.*

Comment #C8: The use of 2003 data (Table 2-2 and Appendix A) for the establishment of TMDLs in 2009 for River segments OK5205200000l0-10 (Dungec) and OK5205200000 10-20 (NCWWTP) may not be representative of actual current conditions in the receiving stream. Is additional data available representative of more current conditions in the receiving stream?

Response #C8: *We are not aware of any additional data available for the segment other than the data used in the report.*

Comment #C9: The report appears to be inconsistent as sanitary sewer overflows (SSO) are reported from 2005 to 2008 (Table 3-3) and river segment data from 2003 (Appendix A). Is the river sampling data for the same time period as the SSO data?

Response #C9: *We believe we should use the available data which best represent the current conditions. Both SSO data and stream bacteria data meet this criterion.*

Comment #C10: Flow data from 2007 USGS reports was used to develop the LDC (page 4-3). Could the LDC be developed using the most recent data (2008 and 2009)?

Response #C10: *Most recent flow data were used to develop the LDCs. The most recent data used was April 28, 2009. The reference was changed.*

Comment #C11: The equation for the development of the TMDL shown on page 4-10 limits the flow from each point source (WWTP) to the current design flow. Will this limit the expansion of wastewater treatment plants in this service area?

Response #C11: *This will not limit the expansion of the wastewater treatment plant because as long as the treatment plant meets the concentration limit its discharge will not cause bacteria impairment in the receiving streams. Language to this effect is included in Section 5.2.*

D. Comments from Anchor QEA on behalf of Oklahoma Farm Bureau, OFB Legal Foundation, Oklahoma Cattlemen's Association, American Farmers and Ranchers, Oklahoma Pork Council, and the Poultry Federation (Received November 2, 2009)

Comment #D1: The source assessment for point sources provided in the TMDL most likely underestimates the point sources of bacteria in the watershed, placing an unfair burden on the other sources of bacteria in the watershed to achieve the required loading reduction to meet the TMDL.

The TMDL acknowledges the following potential point sources of bacterial fecal load the North Canadian River Area: National Pollutant Discharge Elimination System (NPDES) permitted sewer outflows from waste water treatment plants (WWTPs), sanitary sewer overflows (SSOs), NPDES Municipal Separate Storm Sewer Systems (MS4s), and NPDES permitted no-discharge sewer facilities.

After subtracting the permitted WWTP load and margin of safety (MOS) from the TMDL, the remaining allowable load has been divided between MS4s and nonpoint loading (LA) depending upon the percent of MS4 area for each watershed (Table 3-5 and 3-14). The percent reduction goal (PRG), as determined by the difference between current bacteria levels and the TMDL, is then applied to both the MS4 and LA loads in proportion to the MS4 area of each watershed. The WWTP load is not assessed any PRG, allowing the permitted discharge to continue with their current practices. Potential loads from two other point sources, SSO, and no-discharge sewers are assumed to be zero. Both of these assumptions place an unfair and unreasonable burden of load reduction on the other sources in the watershed, which may not be causing the impairment in the first place.

1. The load allocation to WWTP sewer outflows is not supported by data.

The permitted load for each WWTP facility is used as an estimate of loading and no reduction in WWTP loads is required to meet the TMDL because they are NPDES permitted. Although, this is a standard approach, the authors do not provide confirmation that the WWTPs are in compliance with their load permits. Compliance data would ensure that additional unfair load allocation is not shifted to nonpoint sources.

2. The TMDL does not account for the bacteria load attributable to SSOs

Sanitary sewer overflows (SSOs) are the accidental release of sewage from the collection system of a WWTP. In general, older collection systems are prone to frequent accidental releases due to blockage and degradation of distribution pipes as well as power outages, plant malfunctions, and heavy rain in the case of very impaired systems. As indicated in Appendix B of the TMDL, these types of overflows occurred in the North Canadian River Area. The authors of this TMDL acknowledge the potential importance of SSOs in the watershed in their report:

> ***"SSOs are a common result of the aging wastewater infrastructure around the state." and "SSOs could be a significant source of bacteria loading to streams in the study area."***

A total of 1,059 SSOs were reported in the TMDL area in a 3.5 year period, with several events comprising millions of gallons of waste. Both the reported rate and magnitude of SSOs in the North Canadian River Area are high compared to more modern systems such the Clear Creek, TX watershed, which is highly urbanized and includes part of Houston (TCEQ 2008). In addition, the reported SSOs originated from only half of the permitted WWTP facilities, with no data provided from the other facilities, so actual incidence of SSOs is likely under-reported. Clearly SSOs are a potential major contributor to fecal bacteria load in the North Canadian River Area — especially during high flow periods. A reasonable approach to this problem would be to estimate a SSO load, which may then be the target of load reduction efforts through WWTP infrastructure improvement. Not accounting for this contribution and its potential role in the impairments of the river system is a significant oversight of the TMDL.

3. The TMDL does not account for the bacteria load from NPDES permitted no-discharge sewer facilities.

No-discharge sewer facilities ideally would not contribute any fecal bacteria load, however these systems are also susceptible to failure. The draft TMDL acknowledges this:

> ***…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.***

In fact, such facilities commonly contribute to instream fecal bacteria load due to poorly maintained infrastructure and as mentioned in the TMDL, these discharges happen during rainfall which is when, it seems, most bacteria exceedances occur. Given the rate of SSOs and the acknowledgement of "***aging waste water infrastructure***" in the North Canadian River Area, it is reasonable to assume that no-discharge sewer facilities are also a non-trivial source of fecal bacteria load. However, no attempt is made to estimate a load from this source, and consequently it is excluded from load allocations. As with the SSOs, not accounting for this contribution and its potential role in the impairments of the river system is a significant oversight of the TMDL. This practice, as well as the exclusion of the SSO bacteria contribution, unfairly places the burden of reducing the contribution from other sources in the watershed that may have little impact on abating the impairment and ignores the need for infrastructure repair.

Response #D1:

1) All point dischargers except Holliday Outt MHP and Lakeview Terrace MHP have bacteria limits in their NPDES permit. The permit limits in concentration are equal to the bacteria water quality standards. As long as the discharges meet their bacteria concentration limits, these discharges will not cause impairment in receiving streams. All point discharges are required to monitor their discharges and report to DEQ on a monthly basis. Non-compliances of permit limits are corrected through enforcement actions. Therefore, no reductions are required from point dischargers with bacteria limits. However, Holliday Outt MHP and Lakeview Terrace MHP, who don't have bacteria limits in their permits, will *receive bacteria limits when they renew their permits. These limits are enforceable whereas non-point source allocations are voluntary.*

2) *No waste load allocations are assigned to SSOs in this TMDL report because all SSOs are considered unpermitted discharges and should be corrected and minimized through enforcement actions. For example, Consent Orders have been issued to Midwest City (case # 06-388) and Oklahoma City (case # 04-171, 07-276) to stop and correct the unpermitted discharges. Also, a number of Notices of Violation (NOV) were issued in effort to correct SSOs. Section 3.1.2 includes a summary of DEQ enforcement procedures for SSOs.*

Additional information regarding Consent Orders addressing SSOs that have been issued in the study area was added to Section 3.1.2.

3) *No-discharge facilities, by definition, do not discharge. Therefore, it is reasonable to assume that no-discharge facilities do not contribute bacteria to any rivers or streams. No bacteria load can be assigned to no-discharge facilities. The report also recognizes that no-discharge facilities may become a source of bacteria in certain circumstances. Any discharges from no-discharge facilities are considered unpermitted discharges and are addressed through enforcement actions. Nonpoint source reductions are not enforceable.*

Comment #D2: Incomplete and incorrect assessment of the nonpoint source loads may lead to inaccurate conclusions regarding the relative importance of inputs from different nonpoint sources.

According to the draft North Canadian River Area TMDL, potential nonpoint sources of fecal bacteria in the North Canadian River Area include urban runoff, wild animals, domestic livestock, domestic pets, failing onsite water disposal systems (OSWDs), and land-applied human sewage sludge. EPA TMDL guidelines (USEPA 2002) require a TMDL to provide quantitative load estimates of all identified potential nonpoint sources. This TMDL violates these guidelines by 1) providing incomplete estimates of fecal production by cattle and wildlife, 2) deliberately excluding land-applied human sewage sludge as a load source, and 3) not estimating relative loading of nonpoint sources to the water bodies. Problematically, conclusions regarding the relative contributions of nonpoint sources are then presented. These conclusions are most likely incorrect given the flaws in the nonpoint load estimates.

1. Estimates of fecal production for cattle and wildlife are flawed

The authors state that cattle population densities are probably overestimated "***due to the small amount of agricultural land in these watersheds (Table 3-8)***". The authors later conclude in this TMDL that cattle comprise a dominant nonpoint bacteria source. This conclusion is not consistent with the earlier admission of overestimating the cattle population. Consequently a more comprehensive land-use-based approach to better estimate cattle input is needed before drawing such a conclusion.

Additional bias in the potential nonpoint source estimation occurs because deer are the only animals considered in estimates of wildlife fecal bacteria loads. This may result in substantial underestimation of bacterial loads from wildlife. The TMDL indicates that birds, in particular, may be providing significant bacteria loads to the North Canadian River:

> ***"…there is a large, active heron/egret/cormorant rookery along the North Canadian River at NW 10th & Council Road. There is also a large active roost of pigeons and starlings underneath the river bridge at 1-40, with their waste dropping directly into the river on a continuous basis (Figure 3-5).... Since their dropping is directly into the river or on the river banks, it may be a significant bacteria source to the river."***

A TMDL for the Lower San Antonio River (TCEQ2008) had similar conditions related to wildlife bird populations congregating near the river. That TMDL acknowledged and accounted for the potential input of F. coli from avian wildlife as well as other mammalian wildlife, indicating that loads from avian wildlife and wild mammals other than deer can significantly impact background fecal bacteria loading and should not be excluded from source estimates.

2. The TMDL does not account for the bacteria load attributable to land-applied human sewage sludge.

Land application of human sewage sludge is potentially a significant nonpoint source of fecal bacteria in a watershed (USEPA 2001). The submitted TMDL indicates that human sewage sludge is heavily applied in some parts of the North Canadian River Area watershed (Figure 3-4), but no bacterial loading estimate is provided for this potential source. Human sludge as a nonpoint source is deliberately excluded from the loading estimate because "***The treatment, management and disposal of se wage sludge is regulated by DEQ to minimize environmental effects***". This exclusion is done even after the TMDL acknowledges that this sludge is placed on highly erodible soils and "abused" land. It is not clear why regulation of a source would negate its inclusion in loading estimates. In fact, if the source is regulated, then loading estimates may be readily available. As discussed above regarding the SSOs and no-discharge WWTPs, assuming no contribution from this source unfairly places additional load reduction burden on other sources within the watershed and may not be addressing the sources that could be truly causing the impairment.

3. The TMDL estimates bacteria loads from animal feces and OSWDs to land surfaces, but not as loads to the waterbodies. Therefore conclusions regarding their relative loading to the waterbodies are unsupported.

The draft TMDL estimates the daily bacteria production in animal feces on land surfaces by estimating the sub-watershed populations of various animal groups (deer, pets, cattle and other livestock) and multiplying population numbers by estimates of feces bacteria shed per day for each animal group (bacteria values taken from ASAE 1999). Likewise, a loading equation recommended by the EPA (USEPA 2001) is used to estimate in-situ contributions from failing OSWDs to fecal bacteria loads.

Although the authors acknowledge that "***The magnitude of loading to a stream may not reflect the magnitude of loading to land surface***", they nevertheless use these land surface estimates for OSWDs, deer, pets and livestock when they state that cattle are the largest contributor of nonpoint source bacteria. By the authors' own statement, this conclusion is flawed. Many physical processes can affect the attrition and dilution of fecal bacteria between their deposition sites and nearby waterbodies. Therefore relative contributions of nonpoint sources to fecal bacteria loads should only be considered in the context of loading to a waterbody, not loading to a land surface.

Response #D2: ***T****he estimates of fecal production from different sources are informational and are by no means the conclusions of this TMDL. These estimates were believed to be the best estimates given the current available data and resources.*

1) *The report recognized that the estimates of fecal production for cattle and wildlife might be overestimated. But they were the best estimates given the available data, technology and resources. The report also stated that the estimated fecal productionis from animals to the land surface of the watersheds and it is not possible to estimate how much of these fecal materials would eventually reach streams. These estimates were provided for information on relative potential contribution and did not have any impact on the load reduction goal and TMDL calculations.*

   The report identified the avian species as a potential source and also pointed out there were not sufficient data to estimate their contribution.

2) *The report identified land-applied sludge as a potential source of fecal bacteria but data are not available for an estimate. The treatment and disposal of sewage sludge is subject to regulation to control bacteria levels. Other non-point sources are not regulated.*

3) *To account for the various physical processes for fecal materials from production to reach waterbodies as suggested in the comments requires extensive monitoring and detailed watershed modeling and would be cost prohibitive. The benefit is very limited from the TMDL standpoint because these load estimates did not affect the TMDL calculations. Using fecal production to the land surface as an indicator of fecal load to waterbodies is a reasonable approach. The report acknowledges that the loading to waterbodies will be less than the total production and discusses the factors that may affect waterbody loading (see Section 3.3). There are no conclusions regarding the amount of loading to waterbodies.*

No changes were made as the result of this comment.

Comment #D3: Implementation of the TMDL should not be considered infeasible without first providing comprehensive point and nonpoint source estimates and considering reducing loads from point sources.

The authors state that no reduction in point source loads is needed because they are already regulated. This implies that required load reductions, which are in excess of 95% in most of the sub-watersheds, must all be a result of nonpoint source management — and that this nonpoint source management only applies to certain nonpoint sources and not others. The EPA's TMDL guidance (USEPA 1991, USEPA 2002) states that, in order to receive approval, a TMDL should provide reasonable assurances that nonpoint source reduction can achieve the target load reductions. However, here "***The ODEQ recognizes that achieving such high reductions may not be realistic***" without modifying the water quality criteria or removing the primary body contact recreation (PBCR) designation. The ODEQ is essentially saying that if TMDL cannot be achieved by reducing specific nonpoint source loads then the water quality goals may need to be changed. However, because the ODEQ has not sufficiently accounted for all the sources that may be causing the impairment, the proposed implementation plan is not only unrealistic, it is flawed at a basic level. Load reduction should focus on the sources that are known to be causing the impairment and implementation infeasibility should not be considered without first improving and completing the existing source load estimates and considering management to reduce point source loads. In particular the TMDL should provide load estimates for SSOs, no-discharge sewers and land-applied human sewage sludge and refine the estimates of both livestock and wildlife inputs. Then management of all point sources, including permitted point sources, and nonpoint sources should then be considered.

In conclusion, ODEQs current draft North Canadian River Area TMDL contains substantial source assessment flaws and biases which may distort the conclusions drawn therein regarding load contribution, and which may place unfair burden of source reduction on sources that may not be causing the impairment in the waterbody. We strongly recommend that the TMDL be revised taking the comments in this letter under consideration.

Response #D3: *The reason that no reduction is required for point sources (sewer plants) is that they already meet bacteria standards at their point of discharge. MS4s are considered as point sources and receive the same reduction goal as non-point sources. MS4 discharges are regulated whereas non-point sources are not. No point source wasteload allocations in this TMDL are set at a higher level due to anticipated non-point source reductions, so the reasonable assurance requirements do not apply.*

The TMDLs were established based on the current Oklahoma water quality standards. The DEQ recognizes that some reduction goals are not realistic. The bacteria standards may need to be revisited because the standard were established based on studies conducted decades ago and the EPA is conducting new studies and may come up with new recommendations.

This TMDL does not include any "implementation plan" and none is required by EPA rules. Regulated point sources must comply with the TMDL but non-point source reductions are voluntary.

The fecal productions in the watersheds were the best estimates given the available data, financial and human resources.

No changes were made as the result of this comment.

E. Comments from Oklahoma Farm Bureau (Received November 2, 2009)

Comment #E1: OFB comment: The draft TMDL says (erroneously) nonpoint source is the area that needs to be addressed, and that source is primarily cattle. If you look at a map of the TMDL watershed area, it is counter intuitive to name cattle as the leading source of nonpoint source pollution. The ODEQ acknowledges they have probably overestimated the number of cattle in the watersheds (see the note on Table 3-8, Page 3-18) and we concur. The estimate ignores the fact the subwatersheds that are the subject of this TMDL are largely in urban areas, where it is unlikely cattle are present in substantial numbers, if at all.

> *Page ES-6 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 and domestic pets are estimated to be the largest contributors of fecal coliform loading to land surfaces.*
>
> *Page 3-17 Cattle appear to represent the largest potential source of fecal bacteria among the animal groups represented.*
>
> *Page 3-23 Table 3-15 below provides a summary of the estimated fecal coliform loads in percentage for the four major nonpoint source categories (commercially raised farm animals, pets, deer, and septic tanks) that are contributing to the elevated bacteria concentrations in each watershed. Commercially raised farm animals and pets are estimated to be the primary contributors of fecal coliform loading to land surfaces.*
>
> *Page 3-16 Table 3-8 provides estimated numbers of selected commercially raised farm animals by watershed based upon the 2002 US. Department of Agriculture county agricultural census data (UDSA 2002). The estimated animal populations in Table 3-8 were derived using the percentage of the watershed within each county. Because the watersheds are generally much smaller than the counties, and commercially raised farm animals are not evenly distributed across counties or constant with time, these are rough estimates only. Among the animal groups represented, 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.*

Response #E1: *As indicated in Table 3-15 of the TMDL report, cattle are not the dominant nonpoint source in every sub-watershed. In three sub-watersheds, pets are the dominant sources. The number of cattle was estimated based on the USDA countywide data. We acknowledge that the number may be overestimated somewhat but they were not erroneous. For the sub-watershed of OK520520000010_40, there are thousands of cattle processed through Oklahoma National Stockyard Company each week (Table 3-8a). These cattle were not specifically counted in the cattle estimate from USDA data. In 9 of the 11 subwatersheds, MS4 discharges are identified as the major source of bacteria loading, not nonpoint sources or cattle. See Section 3.3 and Table 3-14.*

Comment #E2: OFB comment: There is more than one reference to Concentrated Animal Feeding Operations (CAFOs) and land application of poultry litter or manure. We are not aware of poultry litter being commercially applied in the central part of the state. The ODEQ admits there are no CAFOs within the watershed, yet continues to include references to them, stating they are a source of pollution. These references to CAFOs and land application of poultry litter and manure should be deleted from the draft TMDL.

Page ES-6 There are no CAFOs located in the Study Area.

Response #E2: *Except for the statement that no CAFOs are located in the study area, language related to CAFOs as a potential source in Section 3.1.4 was deleted.*

Comment #E3: OFB comment: There is no cite indicating where USEPA said CAFOs are designated as significant sources of pollution. This statement should be deleted, however, if ODEQ decides to keep it, it should be properly cited and we think the proper quote is: "CAFOs are designated by USEPA as potential sources of pollution...."

Page 3-13 3.1.4 Concentrated Animal Feeding Operations

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.

There is no CAFO located in the study area.

Response #E3: *See Response #E2.*

Comment #E4: OFB comment: We must assume the land application fields refer to CAFOs. The ODEQ has said there are no CAFOs within the watersheds of this TMDL, so why are "land application fields" included? "Land application fields" should be deleted from this list of possible nonpoint sources for purposes of this TMDL.

Page 3-14 These sources include wildlife, various agricultural activities and domesticated animals, land application fields, urban runoff failing onsite wastewater disposal (OSWD) systems, and domestic pets.

Response #E4: *The reference to land application fields was removed.*

Comment #E5: OFB comment: Again, in the first paragraph, we think the number of farm animals is overestimated. In the third paragraph, there are references to manure handling. ODEQ has admitted there are no CAFOs in the watershed, so why the reference to manure handling? Further, there is a reference to a Shoal Creek report from Missouri. Why is this report pertinent to this TMDL? We are not aware of poultry litter being land applied in this watershed. The entire third paragraph should be deleted from the report.

Page 3-23,24 Table 3-15 below provides a summary of the estimated fecal coliform loads in percentage for the four major nonpoint source categories (commercially raised farm animals, pets, deer, and septic tanks) that are contributing to the elevated bacteria concentrations in each watershed. Commercially raised farm animals and pets are estimated to be the primary contributors of fecal coliform loading to land surfaces. However, its contribution of bacteria to streams may be greatly reduced if BMPs are *properly implemented. 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 may represent a major source of the fecal bacteria in streams.*

The magnitude of loading to a stream may not reflect the magnitude of loading to land surfaces. While no studies quantify these effects, bacteria may die off or survive at different rates depending on the manure characteristics and a number of other environmental conditions.

Manure handling practices, use of BMPs, and relative location to streams can also affect stream loading. Also, the structural properties of some manure, such as cow patties, may limit their wash off into streams by runoff Because litter is applied in a pulverized form, it could be a larger source during storm runoff events. The Shoal Creek report showed that poultry litter was about 71% of the high flow load and cow pats contributed only about 28% of it (Missouri Department of Natural Resources, 2003). The Shoal Creek report also showed that poultry litter was insignificant under low flow conditions up to 50% frequency. In contrast, malfunctioning septic tank effluent may be present in pooled water on the surface, or in shallow groundwater, which may enhance its conveyance to streams.

Response #E5: *While there are no CAFOs in the study area, there are cattle, horses, dogs, cats and other animals in the study area. The Shoal Creek TMDL was referenced to show that the structural properties of manures may limit their wash off into streams by runoff. No change was made.*

Comment #E6: OFB comment: The number of animals processed through the stockyard is not undocumented. We question whether ODEQ requested the information from the stockyard. Further, to the best of our knowledge, all of the stockyard operation is connected to the Oklahoma City sanitary sewer collection system.

Page 3-16 The number of animals processed through the stockyard is undocumented and was not counted in Table 3-8.

Response #E6: *The number of animals processed through the stockyard was obtained through the ODAFF's market report and the number of animals processed through the stockyard each week in 2008 was added in Table 3-8a.*

While the Oklahoma City stockyard operation is supposed to be connected to the Oklahoma City sanitary sewer, this has not been verified. There may be cross-connections with storm sewer or areas of the operation that do not drain to the sanitary sewer inlets. Language was added to Appendix E stating that ODAFF will be requested to verify the discharge status of the stockyards.

Comment #E7:. OFB comment: This statement is not incorrect, but it is somewhat misleading. It would be more correct to say: The Oklahoma Department of Agriculture, Food and Forestry has the regulatory authority over agricultural point and nonpoint source pollution, while the Oklahoma Conservation Commission is the agency to assist landowners with nonpoint source management through the use of best management practices.

> *Page 5-33 Nonpoint source pollution is managed by the Oklahoma Conservation Commission.*
>
> *See 27A 0.S. § 1-3-101.*
>
> *D. Oklahoma Department Agriculture, Food, and Forestry.*
>
> *1. The Oklahoma Department of Agriculture, Food, and Forestry shall have the following jurisdictional areas of environmental responsibility except as provided in paragraph 2 of this subsection:*
>
> *a. point source discharges and nonpoint source runoff from agricultural crop production, agricultural services, livestock production, silviculture, feed yards, livestock markets and animal waste,*
>
> *and*
>
> *F. Oklahoma Conservation Commission. The Oklahoma Conservation Commission shall have the following jurisdictional areas of environmental responsibility:*
>
> *1. Soil conservation, erosion control and nonpoint source management except as otherwise provided by law;*

Response #E7: *The sentence was rephrased as "the Oklahoma Conservation Commission manages the nonpoint source pollution (319) program in Oklahoma."*

Comment #E8: OFB comment: We suggest these sentences be deleted as ODEQ has already admitted there are no CAFOs in the TMDL area.

> *Page 5-33 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.*

Response #E8: *This section is a general summary of water quality programs administrated by other environmental agencies. No changes were made.*

F. Comments from Matthew Woodson (received on November 2, 2009)

Comment #F1: Boating on the North Canadian River offers a unique opportunity for simultaneous recreation and education for the public with regards to water quality. Over recent years an increase in boating activity has taken place along sections adjacent to Lake Overholser and near Byers St. Bridge. With hundreds of people utilizing this resource for exercise and recreation there is a unique opportunity to engage the public who have a vested interest in the North Canadian's water quality.

I propose identifying groups that are willing and able to participate in a public awareness program to assist in efforts to monitor and improve the water quality of this river. Building a coalition of representatives from industry, tourism, civic groups, education, science, and recreation will provide a means of gathering a disseminating information about the North Canadian, and how to improve its water quality.

If my recommendations seem helpful to the goals of DEQ, I am willing to participate in building the above mentioned coalition.

***Response #F1**: Thank you for your interest. Public education will be in important factor in successfully improving water quality in the study area.*

G. Formal Comments from Public Meeting (November, 2, 2009)

MR. DEWALD: Thank you. Good evening. And for the record, my name is Scott DeWald, I'm with the Oklahoma Cattleman's Association.

I do have a set of comments in addition to the comments that have been provided by the law firm of McAfee and Taft, and will provide those to you upon the conclusion.

I'm not going to repeat everything that is in our formal comments but there are a few things that I would like to add to those formal comments and that I think are critically important. And I won't take a lot of time.

There was a comment made that the livestock numbers are probably over estimated. And we certainly do agree with that, that they are grossly over-estimated. We don't believe that one can use the percentage of the watershed with each county to determine cattle population numbers. It's especially true, when such a watershed like this is a large part of the metropolitan area.

But further and much more significant than this is utilization of the 2002 US Department of Ag, County Ag Census Data. In order to fully understand the numbers provided by the census (inaudible) questions used to gather the information.

In this case, the question regarded the number of cattle in the operation on December 31, 2002.

Bottom line, is we're discussing the data that was used to ascertain the inventory of cattle. And it came from the 2002 census on agriculture.

And the question that was asked on the census of which I have a copy, is how many cattle were at that operation on December 31, 2002.

Now if cattle populations were static, this might be an appropriate question and set of answers. However, cattle populations are not static. The majority of operations in this area are cow-kept enterprises. Many calves, roughly half of the population, will move out of the watershed when they are marketed.

In other words, one could ask the same question during different times of the year and be presented with entirely different inventory numbers. And I think that's critically important.

By itself, the question merely defines how many cattle were on an operation as of a certain date. However, and most significantly, it does not answer the question of how long those cattle were on or will be on that particular operation.

Now there's another important element of the census and that is if each producer is requested to complete one census; the census attempts to eliminate duplicative reporting. However, as many producers operate in more than one county, it's highly likely that many of the cattle reported in the Oklahoma County numbers never resided in the watershed. In fact, never resided in the county, could have resided in Ellis County, for instance.

So I think that's something that's going to have to be really reviewed to see those numbers. Those numbers to me when they first came out in terms of cattle inventories, were fairly shocking. And I do think that they are over-estimated. But I think it's more than merely the methodology to determine how many acres of watershed within the county, and then do the math, I think it has to do with the actual numbers that were reported and the data that was utilized.

So I would really encourage DEQ to take a very strong look at working maybe a bit closer with USDA NASS or some of the agricultural organizations to get a better handle on some of the ebbs and flows of the livestock industry in the state of Oklahoma.

Once again, cattle are not static. Cattle are marketed and moved. We are in a predominately cow-kept portion of the state. There's some stocker operations, but very few.

Cattle are going to be where the feed is, where the feed is available, they're going to be marketed and moved out further west. There's all kinds of places these are going to go. So to just say that we have a population number and then do the math on it to determine how much is in the watershed, in my opinion is incorrect and something that we need to take a hard look at.

Lastly, and then I'm going to sit down and be quiet. But it appears to me that we're assuming that a hundred percent of the waste allocation is being attributed to livestock production regardless of whether it ever reaches the watershed. And that to me is quite troubling and something I think that needs to be looked at.

The other is, I know we've heard tonight that the Department of Environmental Quality does not regulate non-point sources. And I understand that. But I also understand that this document will be a living breathing document that will be referred to 20 years from now. And if we don't stand up and try to at least make the record straight on populations and other things and on saying that cattle are the major contributor of pollution to the river, we're doing an injustice to the industry and to the state for that matter as well.

Lastly, I will tell you I'm alarmed that we're going to go through 400 more TMDLs in the state of Oklahoma over the course of the next few years.

My request would be that we be very very careful and very judicious about how we select numbers to ascertain who is going to be accredited with particular waste allocations and waste load allocations.

So those are my comments and I appreciate it very much.

Response #G1*: We understand the number of cattle is not static. At any given time, the number of cattle may be different from the USDA's census data. The estimated animal number in Table 3-8 is based on the USDA's data . The USDA's data are the best readily available data for animal counts. The methodology and data used to estimate animal numbers in the TMDL report are valid. In addition, this information provided in Table 3-8 was not used in the Percent Reduction Goal or TMDL calculations. Therefore, it does not have any impact on TMDL allocations.*

Table 5-4 through 5-22 show that the TMDL allocations consist of point sources, MS4s, various non-point sources and a margin of safety. The statement of "a hundred percent of the waste allocation is being attributed to livestock production regardless of whether it ever reaches the watershed" is false.

No change was made.

MS. PEEK: Hi. I'm Marla Peek with the Oklahoma Farm Bureau. As you mentioned, Oklahoma Farm Bureau has submitted a set of comments. And we have submitted comments with other agricultural organizations as well. We utilized a consultant, Anchor QEA, because we felt like we needed someone who had some real technical expertise and a Ph.D. to look at this TMDL other than just what we thought.

I wanted to comment on the Conservation Commission's presentation. I always appreciate knowing what they do. And to me, as a person working for a farm organization, it's nothing new. My concern is that by giving their presentation tonight, that they somehow lend credibility to this TMDL. And I hope that's not what was meant to do. Conservation is always a wonderful thing. But I hope that -- it didn't appear that this was an endorsement of the DEQ's TMDL.

When you look at a picture of the watershed that this TMDL covers, so much of it is in an urban area. And then you have a conclusion that the point sources are held harmless. They don't contribute. They are regulated, therefore, they are not a contributor to the bacterial level in the water. And so the only place to make this reduction is the non-point source. And the biggest non-point source is cattle.

Well if you look at a map of the watershed you might be hard pressed to figure out where those cattle are in the middle of those cities. Now I'm sure there are some, but I think they might be hard to find.

Certainly, in the western part, when you're in a city area, I think the cattle are few and far between. Perhaps there's more on the eastern side as you get more into the open country. But for those reasons we had a consultant look at this TMDL. We can't just sit back and say, oh, don't worry about it. Because there's been litigation on bacteria in those waterways. And we, in Ag, cannot sit back and say don't worry about it. It matters. And DEQ, we would like to see them go back and look at this. This TMDL needs to be right for the reasons that Scott mentioned. Because in the next litigation, it will be referenced.

"Well the DEQ said livestock was the leading source of non-point source pollution in this watershed."

We don't think that's the case.

One more comment. We would like for you all to come and ask us for our assistance when you are trying to pull together data. I think there's more information that a team (inaudible) can use than the data bases that you can get to on your computer.

And I think as Scott mentioned, the problems using the census data, I think there's other ways of looking at these things especially when you're looking at a watershed which is right where most of us live.

Those are my comments at this time. Thank you.

***Response #G2**: please refer to response #D1, D2 & G1. No change was made.*

MR. MASON: My name is Steve Mason. I have the pleasure of serving on the Board of the Department of Environmental Quality.

Tonight, though, I'm here representing myself as a citizen of the metroplex and a consumer and a user of the river. I'm a recreational user of the river.

In 1993, as everyone knows, we passed MAPS. Since that time we've invested greater than a hundred million dollars along the Oklahoma River improving the use of that river. And I'm encouraged and I'm pleased that bit by bit we continue to improve the quality of that river with interaction of various state agencies and municipalities and the private citizens. And I would encourage everyone's continued participation while -- to improve the quality of the river. Thank you.

***Response #G3**: Thank you for your interest in water quality.*

MR. LINDSEY: Sure. My name is Roy Lee Lindsey. I represent the Oklahoma Pork Council.

A couple of quick comments I think again, both Marla and Scott referred to in the formal comments that were submitted on behalf of the agricultural organizations and we're one of those organizations and obviously, we fully endorse those comments as they were submitted.

But there are a couple of things that we would like to share that I think need to be shared and maybe even re-enforced a little bit.

First of all, I want to say thank you to the folks at DEQ who have extended the comment period on this TMDL. We asked for the data that went into this and you all were kind enough to put together that data and share it with us. But the 30 boxes of material that you gave us was a little bit overwhelming, so the extra 30 days certainly helped us as we looked through that data. And we appreciate that extension.

One of the things that stands out to me because so much of my industry is involved in the use of -- capital facilities was this TMDL referenced CAFOs (phonetic spelling) a great deal and yet then went on to say there's no CAFOs in this watershed. And if there's no CAFOs in this watershed, I don't know why it's relevant to this TMDL.

So I would request that those references be removed. If they're not a factor in this watershed, then they shouldn't be included as a reference just for somebody else to point a figure at in this TMDL.

We also -- I guess the last thing that I want to say is that there were several TMDLs that all came out at about the same time. And I know those comment periods have closed. But as we looked at this TMDL in particular, if the methodology used on this TMDL is the same methodology used on the other three or four that closed in the last 30 to 45 days, we would consider if that's the same methodology then all of those have the same fundamental flaws. And those flaws are outlined in our formal written comments. And we hope that you'll look at those. And please do not interpret, the fact that we, as ag organizations, failed to comment on those first three or four TMDLs that closed 30 days ago. That doesn't mean that we're endorsing what those TMDLs said. What it means is that when we looked at 30 boxes of data for this TMDL, we said there's no way given our limited resources, we could review 120 boxes of data for the other four as well. So we picked one to concentrate on and shared comments on, but we believe those comments would be equally appropriate on several of those other TMDLs that have just closed. And I know that that comment period is closed, but our request is that as you review what our written comments are here, you apply those as well to those TMDLs that closed about 30 days ago. Thank you.

***Response #G4**: Please refer to Response #E2 regarding no CAFOs in the watershed.*

We believe the methodology used in this TMDL is valid. We have used the same methodology in many bacteria TMDL developments in the past few years. Over a hundred TMDLs developed with this methodology have gone through the public review process and been approved by the EPA.

MR. HART: I'm Larry Hart and I'm the general counsel for the Oklahoma Department of Agricultural Food Enforcement. I had just one quick comment. With regard to Appendix E, storm water permitting requirements and presented the best management practices approach, Appendix E4, the last sentence of the first full paragraph, reads:

EPA, and ODAFF will also be requested to determine any permitting requirements for the adjacent bonds by Murphy, a newer composting operation.

And I just wanted to for the purposes of the record point out that the -- there was an emergency cease and desist order that was issued by the Department on July 1, 2009 and with that there was a stop sale order. Those required actions required Murphy -- they stopped Murphy from operating as an un-permitted agricultural compost facility and ordered them to cease and desist any conditions that might result in the discharge of the waters of the state.

Subsequent to that, Murphy put up a temporary berm and has since certified that there's no threat of discharge to the river or to the surface of the ground waters in the state. There's been an interim agreed order that was entered September 16, 2009 with regard to that, and in that same date there was a release of emergency cease and desist order of Murphy's application to the -- they are still putting up some of their required structures with regard to their permit application, but they're in the process of doing that. They have been complying with the Department's requirements.

***Response #G5**: Thanks for the comments.*