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Implementation Plan Twenty-Five Total Maximum Daily Loads for Bacteria in the Greater Trinity River Region

Upper Trinity River

Segment 0805

Assessment Units 0805_03 and 0805_04

Cottonwood Branch and Grapevine Creek

Segments 0822A and 0822B

Assessment Units 0822A_02 and 0822B_01

Lower West Fork Trinity River

Segments 0841, 0841B, 0841C, 0841E, 0841G, 0841H, 0841I, 0841J, 0841L, 0841M, 0841R, 0841T, and 0841U

Assessment Units 0841_01, 0841_02, 0841B_01, 0841C_01, 0841E_01, 0841G_01, 0841H_01, 0841I_01, 0841J_01, 0841L_01, 0841M_01, 0841R_01, 0841T_01, and 0841U_01

Mountain Creek Lake Tributaries

Segments 0841F, 0841K, 0841N, 0831P, 0841Q, and 0841V

Assessment Units 0841F_01, 0841K_01, 0841N_01, 0841P_01, 0841Q_01, and 0841V_01

Sycamore Creek

Segment 0806E

Assessment Unit 0806E_01

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TMDL implementation plans are also available on the TCEQ website at:
www.tceq.texas.gov/waterquality/tmdl/

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This Implementation Plan report was prepared by the North Central Texas Council of Government's Environment and Development Department in collaboration with the Coordination Committee of the Greater Trinity River Bacteria TMDL Implementation Project and the members of Subcommittees on Monitoring Coordination; Stormwater; and Wastewater.

Table of Contents

Tables

Figures

All figures are available at greater resolution online at:
<http://www.nctcog.org/envir/natural-resources/tmdl>.

List of Acronyms and Abbreviations

ALU	aquatic life use
ATU	aerobic treatment unit
AU	assessment unit
BMP	best management practice
CAFO	concentrated animal feeding operation
CFR	Code of Federal Regulations
CFU	colony-forming units
cfs	cubic feet per second
cms	cubic meters per second
CGP	Construction General Permit (TX)
C-MOM	capacity management, operation, and maintenance program
CRP	clean rivers program
DART	Dallas Area Rapid Transit
DFW	Dallas – Fort Worth International Airport
dL	deciliter
DMR	discharge monitoring report
DO	dissolved oxygen
E. coli	*Escherichia coli*
EPA	Environmental Protection Agency (U.S.)
FC	fecal coliform
FDC	flow duration curve
FWSD	fresh water supply district
FOG	fats, oils, and grease
FY	fiscal year
GI	green infrastructure
GIS	geographic information system
gpcd	gallons per capita per day
H-GAC	Houston-Galveston Area Council of Governments
IDDE	illicit discharge detection and elimination
I/I	inflow and infiltration
I-Plan	implementation plan
IS	implementation strategy
iSWM	*integrated* Stormwater Management
LA	load allocation
LID	low impact development
LDC	load duration curve
mL	milliliter
MGD	million gallons per day
MOS	margin of safety
MPN	most probable number
MS4	municipal separate storm sewer system
MSGP	Multi-Sector General Permit
MUD	municipal utility district
NCTCOG	North Central Texas Council of Governments
NELAC	National Environmental Laboratory Accreditation Conference

NELAP	National Environmental Laboratory Accreditation Program
NPDES	National Pollutant Discharge Elimination System
NPS	nonpoint source
NRCS	Natural Resources Conservation Service
NTTA	North Texas Tollway Authority
OSSF	onsite sewage facility
P2	pollution prevention
POTW	publicly owned treatment work
QAPP	quality assurance project plan
RSWMP	Regional Stormwater Management Program
RSWMCC	Regional Stormwater Management Coordinating Council
RWWCP	Regional Wet Weather Characterization Program
SEP	supplemental environmental project
SSO	sanitary sewer overflow
SSOI	sanitary sewer overflow initiative
SSS	sanitary sewer system
STATSGO	State Soil Geographic Database
SWCD	soil and water conservation district
SWMP	Stormwater Management Plan
SWPPP	stormwater pollution prevention plan
TAC	Texas Administrative Code
TEA	Texas Education Agency
TCEQ	Texas Commission on Environmental Quality
TMDL	total maximum daily load
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TRA	Trinity River Authority
TREC	Texas Real Estate Commission
TREES	Trinity River Environmental Education Society
TSSWCB	Texas State Soil and Water Conservation Board
TxDOT	Texas Department of Transportation
USACE	United States Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USGS	United States Geological Survey
WBD	Watershed boundary dataset
WLA	Wasteload allocation
WATER	Wastewater And Treatment Education Roundtable
WQMP	Water Quality Management Plan
WWF	wet weather facility
WWTF	wastewater treatment facility
x	occurrences — as in 5x/week (5 occurrences per week)

Executive Summary

In 1996 portions of the Upper Trinity River and Lower West Fork Trinity River were listed as impaired for elevated bacteria in the *Texas Water Quality Inventory and 303(d) List* (now known as *Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d))*. In 2006, two tributaries of the Elm Fork Trinity River and multiple tributaries of the Lower West Fork Trinity were also added to the 303(d) list of impaired water bodies (TCEQ, 2010a). These bacteria-impaired segments cover the heart of the Dallas-Fort Worth metropolitan area and impact 1.33 million people. (Figure 1)

On May 11, 2011, the Texas Commission on Environmental Quality (TCEQ) adopted *Two Total Maximum Daily Loads for Indicator Bacteria in the Upper Trinity River, Dallas, Texas (*Segment 0805, Assessment Units 0805_03 and 0805_04). The Total Maximum Daily Loads (TMDLs) were approved by the U.S. Environmental Protection Agency (EPA) on August 3, 2011. On September 21 of that same year, the TCEQ adopted *Two Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Branch and Grapevine Creek* (Segments 0822A and 0822B, Assessment Units 0822A_02 and 0822B_01). The EPA approved them on May 30, 2012. The TMDLs for the Lower West Fork Trinity River, Segment 0841 and its tributaries, were adopted September 24, 2013. On November 2, 2016 the TCEQ adopted *Four Total Maximum Daily Loads for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watershed Upstream of Mountain Creek Lake* (Segments 0841F, 0841K, 0841N, and 0841V, Assessment Units 0841f_01, 0841K_01, 0841N_01, and 0841V_01). The EPA approved them on December 7, 2016. On January 16, 2019, TCEQ adopted *One Total Maximum Daily Load for Indicator Bacteria in Sycamore Creek* (Segment 0806E, Assessment Unit 0806E_01). The EPA approved it on March 27, 2019. On December 13, 2019, TCEQ adopted *Addendum One to Four Total Maximum Daily Loads for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake* in the *October 2019 Update to the Texas Water Quality Management Plan* that included the TMDL for Nork Fork Fish Creek, Segment 0841Q, Assessment Unit 0841Q_01.

This implementation plan (I-Plan) describes the steps watershed stakeholders and the TCEQ will take toward achieving the pollutant reductions identified in the TMDLs and technical reports and outlines the schedule for implementation activities. The I-Plan uses an adaptive management approach where measures will be periodically assessed for efficiency and effectiveness. This iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals, and expresses stakeholder commitment to the process. At annual meetings, the I-Plan's managing body, the Coordination Committee (Appendix A), will assess progress using the schedule of implementation, interim measurable milestones, water quality data, and the communication plans included in this document. If these assessments find that insufficient progress has been made or that implementation activities have improved water quality, the implementation strategy will be adjusted.

Many of the implementation strategies in this I-Plan are directed towards meeting bacteria loading (Appendix B) from possible point and nonpoint sources identified by the TCEQ during development of the TMDLs. The activities are intended to achieve the goals identified in the TMDL reports necessary to comply with established water quality standards. The possible sources of bacteria identified include permitted storm sewer sources, dry weather discharges (illicit discharges), sanitary sewer overflows, and unregulated sources such as wildlife, unmanaged feral animals, and pets.

The ultimate goal of this I-Plan is to restore the primary contact recreation use in the 25 bacteria impaired segments (Appendix C) in the Project area by reducing concentrations of the indicator bacteria *Escherichia coli (E. coli)* to levels established in the TMDLs. Based on the TMDL reports and the technical

support document, the following reduction goals are identified for the segments to meet the criteria defined in the state water quality standards:

- For the Upper Trinity TMDL bacteria loading reductions of 44 percent to 67 percent;
- For Cottonwood Creek and Grapevine Branch TMDL bacteria loading reductions of 64 percent to 84 percent;
- For the Lower West Fork Trinity and associated impaired tributaries TMDL bacteria loading reductions of 25 percent to 98 percent;
- For the Mountain Creek Lake tributaries TMDL bacteria loading reductions of 41 percent to 83 percent; and
- For the Sycamore Creek TMDL bacteria loading reductions of 45 percent to 96 percent.

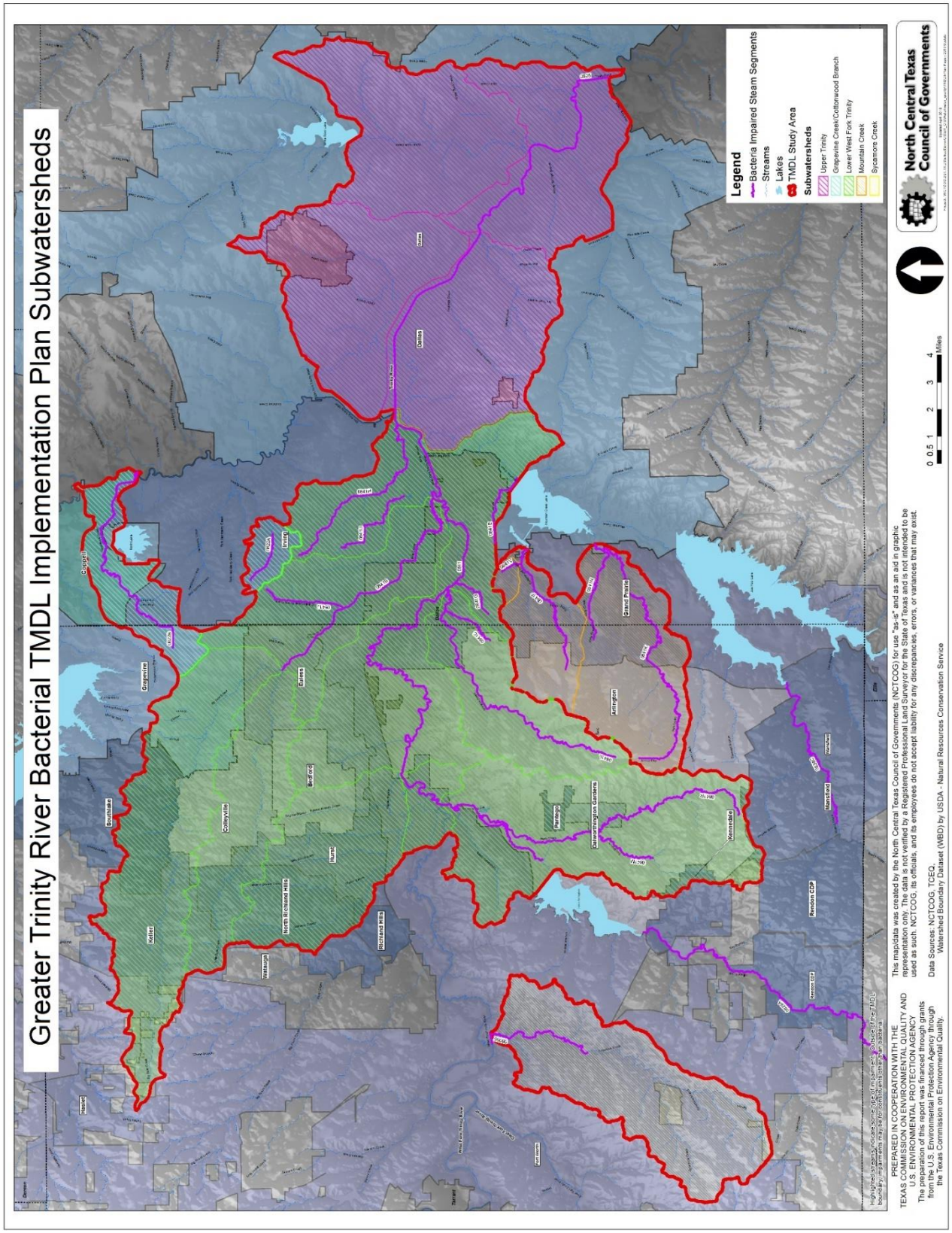
With these goals in mind, the implementation strategies in this I-Plan are presented in sections describing the various sources of bacterial pollution identified through stakeholder and TMDL processes. These include a description of activities, identification of the parties responsible for implementing the activities, a schedule for implementation, the goals associated with the activities, and a process for tracking, evaluating, and reporting progress. A process of implementation, monitoring, analyses, adaptation, and review is also outlined so the I-Plan is intended for regular updates. The I-Plan provides a pragmatic and scientifically based approach to meet water quality goals within a reasonable timeframe. A broad summary of the implementation activities in each section can be found in Table 1.

Table 1. Summary of Implementation Strategies

I-Plan Section	Activity Category	Focus of Implementation Activities*
Implementation Strategy 1.0	Wastewater	SSO prevention, effluent monitoring, FOG program participation, liquid waste programs, and infrastructure funding and management.
Implementation Strategy 2.0	Stormwater	BMP pilot projects and funding, regional stormwater management program participation, local SEPs, and land use and business operation risk analysis.
Implementation Strategy 3.0	Planning and Development	Green infrastructure and low impact development standards adoption by municipalities for internal projects and ordinances, municipal ordinance evaluation, and construction site standards.
Implementation Strategy 4.0	Pets, Livestock and Wildlife	Feral hog management, livestock evaluation, pet and livestock waste control measures, avian management plan, and public outreach.
Implementation Strategy 5.0	Onsite Sewage Facilities	OSSF education for homeowners and real estate agents, funding for and conversion from failing OSSFs, and ATU maintenance.
Implementation Strategy 6.0	Monitoring Coordination	Routine sampling and data assessment for BMP efficacy, source identification, and monitoring coordination forum.
Implementation Strategy 7.0	Education and Outreach	Modification of existing programs for bacteria-specific information, online BMP library, TEA curriculum, funding and partnerships, and bacteria-specific outreach.
Implementation Strategy 8.0	Best Management Practices Library	Online BMP Library for stakeholders including provisions for Implementation Strategies 1.0 – 7.0.
Implementation Strategy 9.0	Implementation Strategy Evaluation	Annual review by technical subcommittees of respective Implementation Strategies with recommendations to Coordination Committee for potential changes, additions, or deletions to I-Plan.

*See pages 15-16, table of acronyms, for full acronym definitions.

Figure 1. Greater Trinity Bacteria TMDL Project Area



Introduction

The Clean Water Act requires that states identify uses for the state's surface waters such as aquatic life, recreation, and sources of public water supply. The criteria or standard for evaluating support of those uses include dissolved oxygen, bacteria, and toxic substances, among others. The primary contact recreation use is designed to ensure that water is safe for swimming, waterskiing, wading by children, or other activities that involve direct contact with the water. Most water bodies in Texas and in the Dallas-Fort Worth area have a presumed primary contact recreation use. The TCEQ determines whether water quality in a water body meets the primary contact recreation use by measuring the levels of indicator bacteria. *E. coli* are the preferred indicator bacteria for assessing for recreational use in fresh water, and were used for analysis to support TMDL development on water bodies in this region. High concentrations of indicator bacteria have been associated with an increased risk of becoming ill from recreational activities.

When a waterway is determined to be impaired (Category 5a of the 303(d) List), a TMDL is developed. As defined by the EPA, a TMDL "is a calculation of the maximum amount of a pollutant that a water body can receive and still safely meet water quality standards." In addition to the TMDL, an I-Plan is developed, which describes the regulatory and voluntary management measures necessary to improve water quality and restore the water body to its designated use. TMDLs are developed at the assessment unit (AU) level to focus on the areas of impairment. An AU is a sub-area of a segment and is the smallest geographic area of use support reported in the Texas Integrated Report. Thus, some waterways may have more than one AU but not all may be listed as impaired.

This I-Plan is the result of work by the stakeholders convened by the North Central Texas Council of Governments (NCTCOG) for the Greater Trinity River Bacteria TMDL Implementation Project (frequently referred to in this I-Plan as 'the Project') and in particular the efforts and input of the Project Coordination Committee and the Technical Subcommittees of Stormwater; Wastewater; and the Monitoring Coordination Forum. The I-Plan originally outlined 8 technical subcommittees. As engagement and coordination of the project developed, the technical subcommittees evolved to support the implementation strategies through the remaining appropriate technical subcommittees. The flexibility within the technical subcommittees allows for the stakeholders to convene on topics as deemed necessary by the Coordination Committee's annual review. The Coordination Committee and subcommittee members represent city and county governments, resource agencies, business and agriculture interests, transportation interests, conservation organizations, water supply and treatment agencies, and recreational interests (see Appendix A).

Because several of the waterways within, near, or adjacent to the Greater Trinity Project Area are either listed or may be listed on the 303(d) list for bacteria impairments, this I-Plan has been developed with the flexibility to allow for the addition of segments and watersheds in the event that new TMDLs are adopted by the TCEQ in the future.

Watershed Summary

The watershed(s) for the Greater Trinity River Bacteria TMDL Implementation Project encompass a total area of about 406 square miles. The total human population is 1.33 million with a population density of approximately 3,232 people per square mile. The Project addresses watersheds covered by five separate TCEQ TMDL projects:

- Upper Trinity River Segment 0805,
- Elm Fork River Tributaries of Grapevine Creek and Cottonwood Branch,
- Lower West Fork Trinity River Segment 0841 and 11 of its tributaries,
- Upstream of Mountain Creek Lake Segments 0841F, 0841K, 0841N, and 0841V, and
- Sycamore Creek Segment 0806E.

Appendix C details the segment descriptions and years listed for the 23 segments included in this I-Plan.

Located in central Dallas County, the Upper Trinity River (Segment 0805) flows through the center of the City of Dallas. It continues in a southeasterly direction through Ellis, Kaufman, Navarro, and Henderson Counties. Encompassing a large portion of the City of Dallas, the overall watershed drains an area of about 1,045 square miles, although the impaired portion covers only about 129 square miles.

Two of the five AUs of the Upper Trinity (Segment 0805) are addressed by a TMDL, covering the area from the confluence of the Elm Fork Trinity River and Lower West Fork Trinity River, downstream to the confluence of the Upper Trinity River with Five Mile Creek. Both impaired AUs (0805_03 and 0805_04) lie entirely within Dallas County in highly urbanized watersheds. The cities within the watershed include the cities of Dallas, Cockrell Hill, and University Park and the Town of Highland Park TCEQ, 2011a). (Figure 2)

Cottonwood Branch and Grapevine Creek (Segments 0822A and 0822B) are urban creeks located in the north central portion of the Dallas-Fort Worth Metroplex. Both are tributaries of the Elm Fork Trinity River below Lake Lewisville (Segment 0822). Grapevine Creek (0822B) is the larger of the two creeks with a drainage area of about 15 square miles, while Cottonwood Branch (0822A) has a drainage area of about three square miles. Cottonwood Branch is divided into two AUs while Grapevine Creek consists of a single AU. Only the upper AU of Cottonwood Branch (0822A_02) is impaired. The drainage area of both AUs for Cottonwood Branch and the single AU for Grapevine Creek lie within Dallas County with the exception of the upstream portion of the AU for Grapevine Creek that lies within Tarrant County. The cities within the Grapevine Creek watershed include Irving, Coppell, and Grapevine in addition to the presence of the Dallas-Fort Worth International Airport (DFW). The Cottonwood Branch watershed lies largely within the City of Irving. A small portion lies within DFW Airport property, and a portion of the unimpaired downstream AU is also within the jurisdiction of the Dallas County Utility and Reclamation District (TCEQ, 2011b). (Figure 3)

The Lower West Fork Trinity River (Segment 0841) is located in Dallas and Tarrant Counties and begins at the confluence of the Lower West Fork Trinity and Village Creek in Arlington and continues downstream to the confluence with the Elm Fork Trinity River. The Lower West Fork Trinity River is divided into two AUs (0841_01 and 0841_02). The watershed of the Lower West Fork Trinity and the 11 impaired tributaries addressed in this I-Plan — Arbor Creek, Bear Creek, Copart Branch Mountain Creek, Dalworth Creek, Delaware Creek, Estelle Creek, Johnson Creek, Kee Branch, Rush Creek, Village Creek,

and West Irving Branch are located within the urbanized area of the Metroplex's mid cities and Fort Worth. Each of the impaired tributaries of the Lower West Fork Trinity River consists of a single AU.

The watershed for Segment 0841 — which includes the individual watersheds of the 11 tributaries — is the largest of the four TMDLs and encompasses parts or all of the cities of Arlington, Bedford, Colleyville, Dallas, Dalworthington Gardens, Euless, Fort Worth, Grand Prairie, Grapevine, Haslet, Hurst, Irving, Keller, Kennedale, North Richland Hills, Richland Hills, and Southlake, and Town of Pantego. The total area covered for this segment is about 259 square miles (TCEQ, 2013). (Figure 4)

Cottonwood Creek (Segment 0841F) and Fish Creek (Segment 0841K) are adjacent water bodies located upstream of Mountain Creek Lake, both of which flow into the Lower West Fork of the Trinity River (Segment 0841) via Mountain Creek Lake and Mountain Creek. Kirby Creek (Segment 0841N) is a tributary of Fish Creek, and Crockett Branch (Segment 0841V) is a tributary of Cottonwood Creek. The eastern part of the TMDL area is in Dallas County, and the western part is in Tarrant County. The cities within the watershed include Grand Prairie and Arlington. The total drainage area for the impaired segments within the watersheds is about 15 square miles (TCEQ, 2017). (Figure 5)

Sycamore Creek (Segment 0806E) is a water body that flows roughly south to north to its confluence with the West Fork Trinity River in Fort Worth. The cities within the watershed include Fort Worth, Edgecliff Village, and Forest Hill. The total drainage area for the watershed is 37 square miles entirely located within Tarrant County. (Figure 6)

Figure 2. Segment 0805, Upper Trinity Area

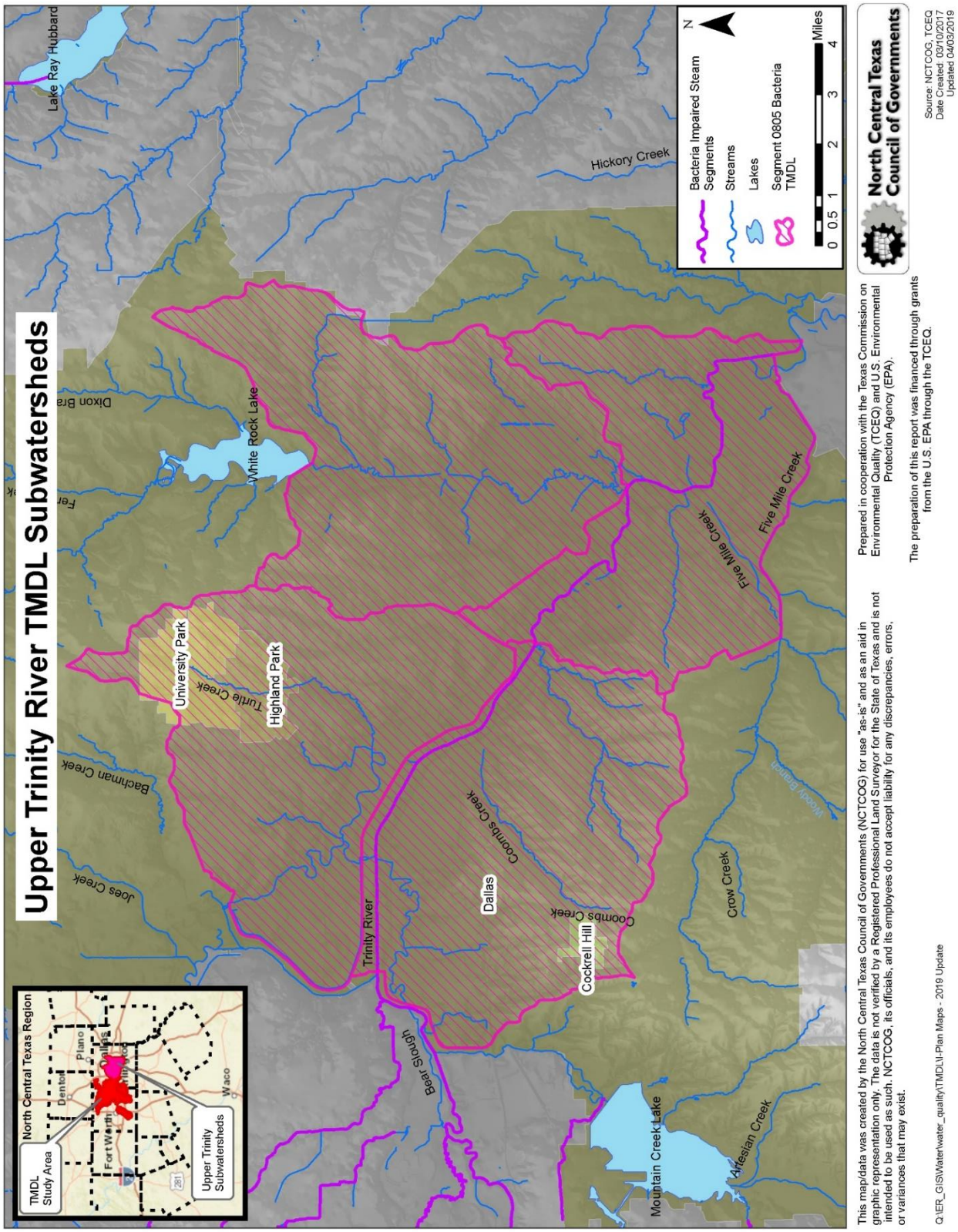


Figure 3. 0822 Segments, Cottonwood Branch and Grapevine Creek

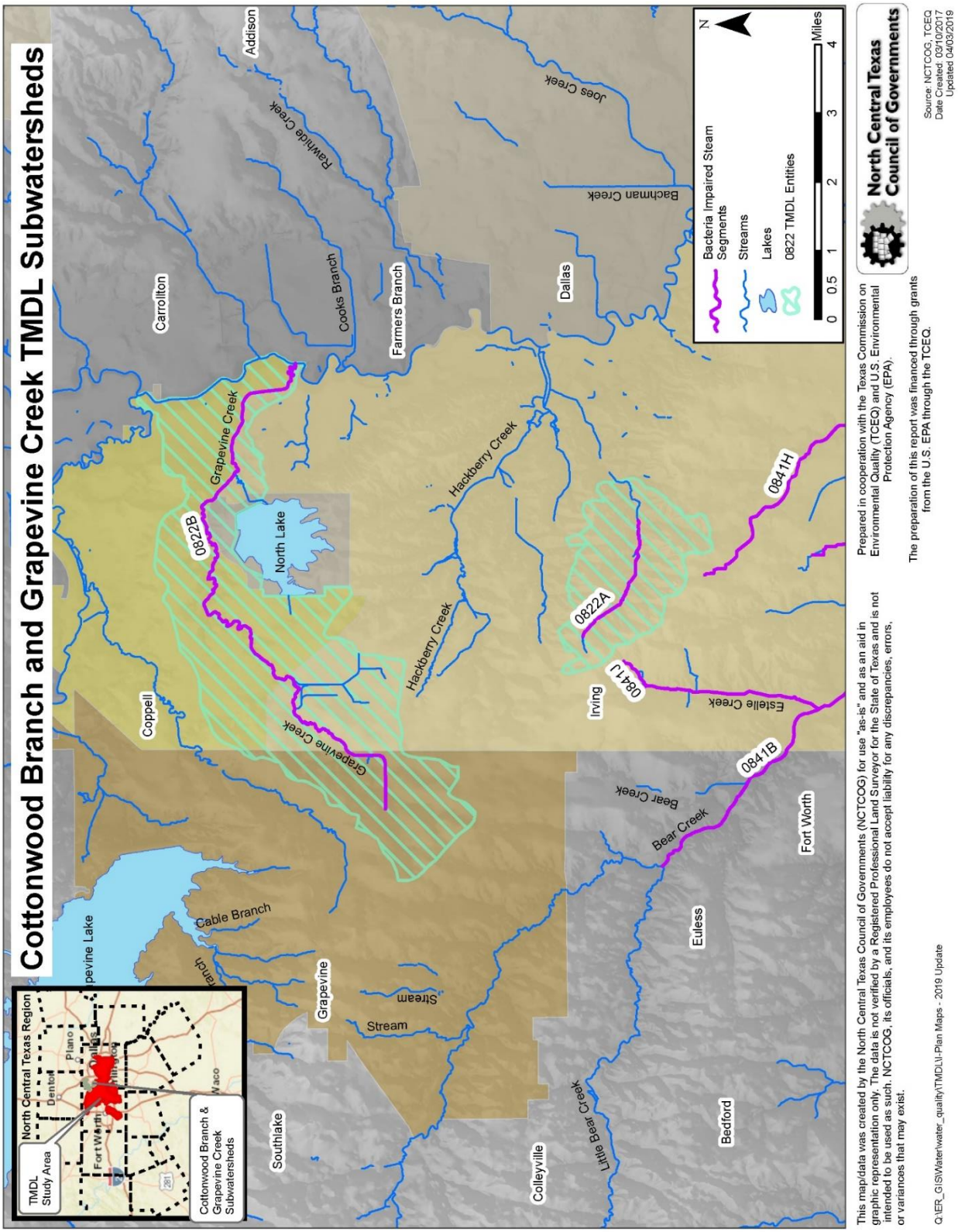


Figure 4. 0841 Segments, Lower West Fork Trinity with Impaired Tributaries

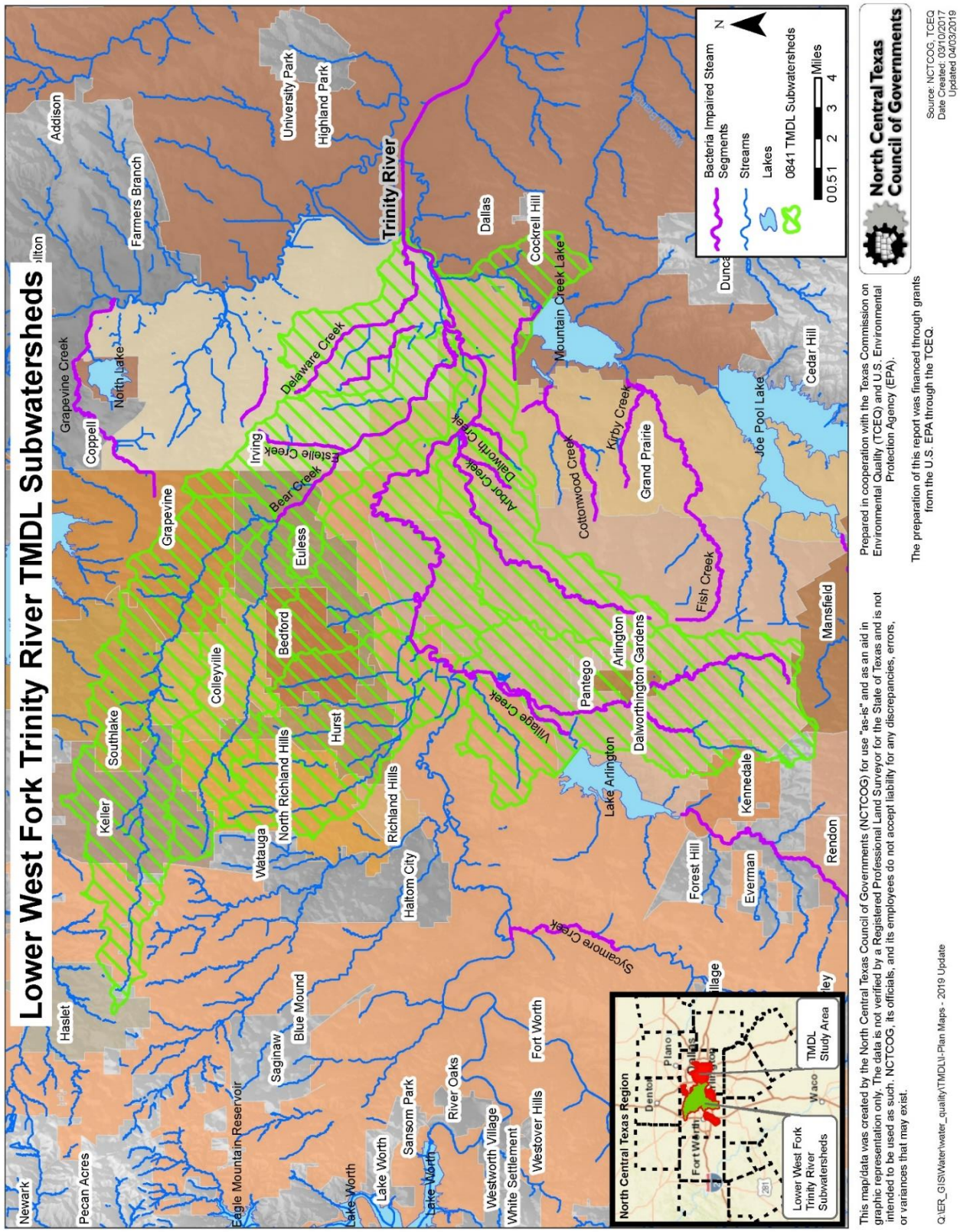


Figure 5: Segments 0841F, 0841K, 0841N, and 0841V Upstream of Mountain Creek Lake Tributaries

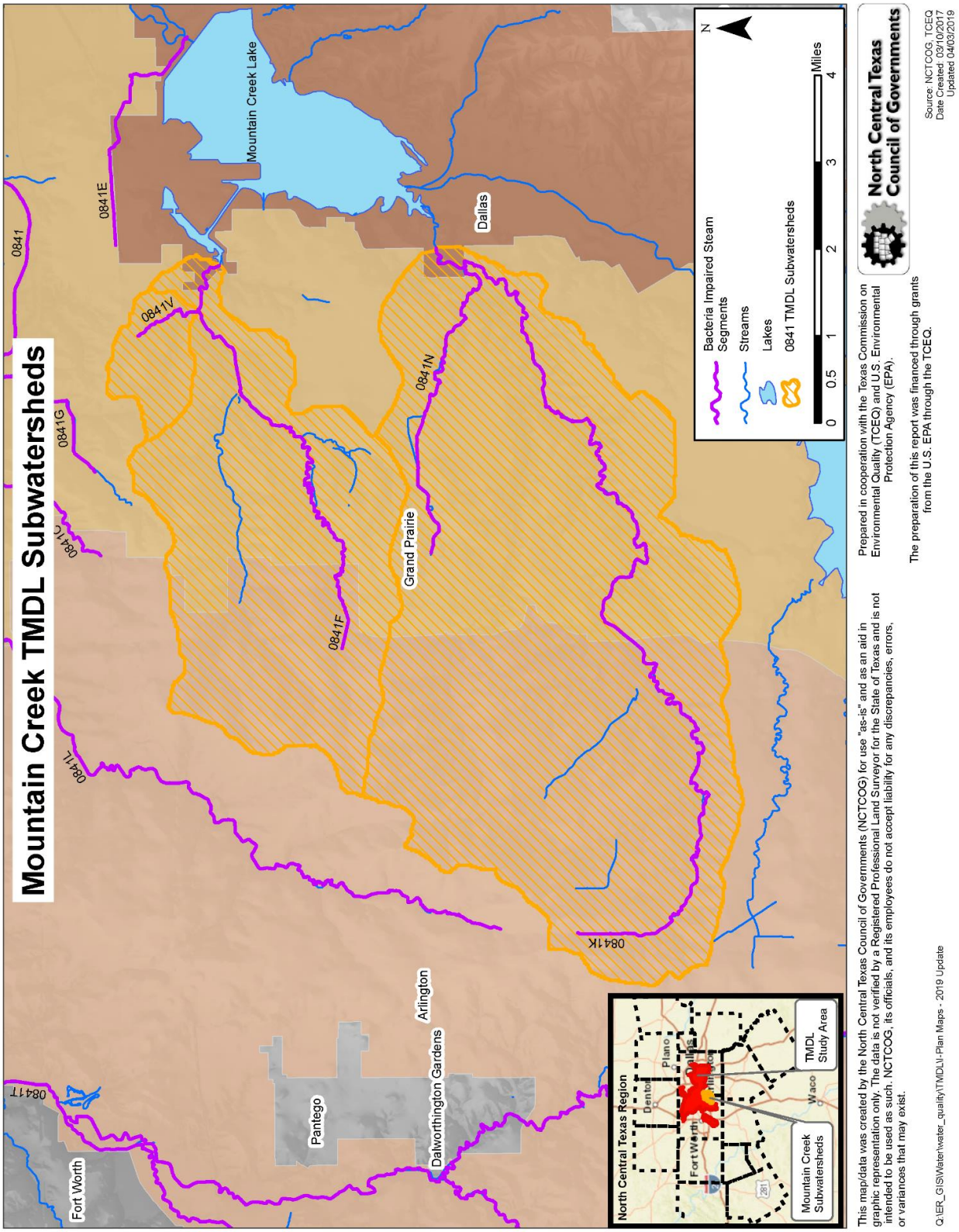
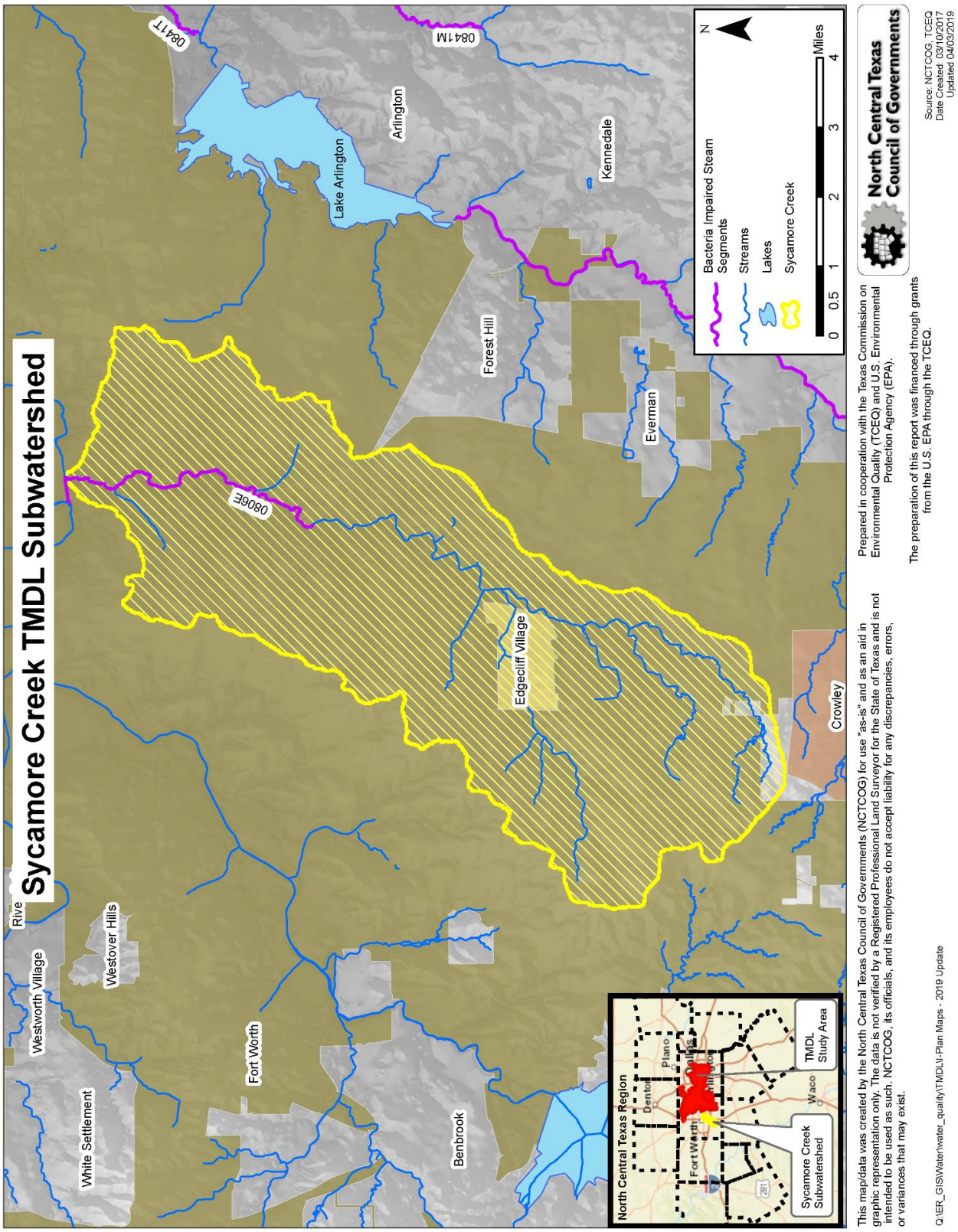


Figure 6: Segment 0806E Sycamore Creek



Designated Uses and Water Quality Standards

The basis for assessing attainment of the primary contact recreation use is expressed as the number (or 'counts') of *E. coli* bacteria, given as the most probable number (MPN). In order to meet numeric criterion defined in the TCEQ water quality standards for support of the primary contact recreation use, the geometric mean of *E. coli* in freshwater should not exceed 126 MPN per 100 milliliters (mL).

Although this criterion represents the standards for primary contact recreation adopted by the TCEQ on June 30, 2010 (TCEQ, 2010b), other criteria may have been in place prior to that date that led to a stream initially being identified as impaired for bacteria.

Seasonal Variation

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs account for seasonal variation in watershed conditions and pollutant loading. According to TCEQ in their adopted TMDLs for the Upper Trinity (Segment 0805) (TCEQ, 2011a) and Cottonwood Branch and Grapevine Creek (Segments 0822A and 0822B) (TCEQ, 2011b), and Lower West Fork Trinity (Segment 0841), and impaired tributaries (TCEQ, 2013), Fish Creek (Segment 0841K), and Kirby Creek (0841N), no statistically significant seasonal variation was found in *E. coli* data examined. Cottonwood Creek (0841F), Crockett Branch (0841V), and Sycamore Creek (0806E) experienced a statistically significant difference in indicator bacteria between cool and warm water seasons. The TMDLs for the segments Upstream of Mountain Creek Lake were developed after the creation of the I-Plan.

Summary of the TMDLs

Upper Trinity Segment 0805 TMDL

According to TCEQ's TMDL for Segment 0805, *Two Total Maximum Daily Loads for Indicator Bacteria in the Upper Trinity River, Dallas, Texas,* adopted in 2011, impairment to the primary contact recreation use for this segment was first listed in the 1996 303(d) List. The impairments were identified more precisely as AUs 0805_03 and 0805_04 in the *2008 Texas Water Quality Integrated Report for Clean Water Sections 305(b) and 303(d).* The goal, or endpoint, for the Upper Trinity River TMDL is to maintain concentrations of *E. coli* below the geometric mean criterion of 126 MPN/100 mL.

Table 2 presents a historical summary of ambient indicator bacteria data from the TCEQ surface water database, Surface Water Quality Monitoring Information System (SWQMIS), from February 2001 through November 2008 for all AUs in Segment 0805. As indicated in Table 2, only TCEQ stations 10937 (in AU 0805_04) and 10934 (in AU 0805_03) exceeded the geometric mean criterion of 126 MPN/100 mL (TCEQ, 2011a).

Table 2. Sampling Data, Segment 0805

AU	Station ID	Location	No. of Samples (02/2001-11/2008)	Range of measured *E. coli* (MPN/100mL)	Geometric mean
0805_04	10937	Mockingbird Ln./ Dallas Co.	75	12 – 24,200	224
0805_03	10934	South Loop 12/ Dallas Co.	75	17 – 39,700	384
0805_06	10932	Dowdy Ferry Rd./ Dallas Co.	13	11 – 980	85
0805_06	10930	Belt Line Rd./ Dallas Co.	60	3 – 1,540	54
0805_02	10925	Downstream of SH 34/ Kaufman Co.	82	2 – 4,840	122
0805_01	10924	Near FM 85/ Henderson Co.	6	8 – 770	56

Elm Fork Tributaries Segments 0822A and 0822B TMDL

In TCEQ's TMDL for the Elm Fork tributaries, *Two Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Branch and Grapevine Creek,* impairment to the primary contact recreation use for Cottonwood Branch (Segment 0822A) and Grapevine Creek (Segment 0822B) were first identified in the 2006 *Texas Water Quality Integrated Report for Clean Water Sections 305(b) and 303(d)*. All or part of each water body was subsequently included on the 2008 and 2010 303(d) Lists. The impaired AUs in Segments 0822A and 0822B on the 303(d) List are 0822A_02 and 0822B_01. The goal, or endpoint, for the Cottonwood Branch and Grapevine Creek TMDL is to maintain concentrations of *E. coli* below the geometric mean criterion of 126 MPN/100 mL.

Table 3 presents a historical summary of ambient indicator bacteria data from the TCEQ SWQMIS database for November 2001 through October 2004. All AUs in Segments 0822A and 0822B are included in the data summary. As indicated in Table 3, only the AUs associated with TCEQ stations 17165 and 17166 in AU 0822A_02 and stations 17531 and 17939 in AU 0822B_01 exceeded the geometric mean criterion of 126 MPN/100 mL (TCEQ, 2011b).

Table 3. Sampling Data, 0822 Segments

AU	Station ID	Location	No. of Samples (02/2001-11/2008)	Range of measured *E. coli* (MPN/100mL)	Station Geometric Mean (MPN/100mL)	AU Geometric Mean (MPN/100mL)
0822A_01	18359	433 m upstream of N. MacArthur Blvd / Dallas Co	76	2 – 2,600	37	47
0822A_01	17167	N. MacArthur Blvd / Dallas Co.	7	3 – >2,400	154	47
0822A_01	17168	Spur 348 (Northwest Hwy) / Dallas Co.	31	<1 – 977	41	47
0822A_02	17165	N. Beltline Rd. / Dallas Co.	32	19 – >4,838	764	786
0822A_02	17166	N. Story Rd. / Dallas Co.	30	99 – >4,840	811	786
0822B_01	17531	Airfield North upstream of bridge / Tarrant Co.	12	21 – >2,419	121	411
0822B_01	17939	210 m upstream of Regent Blvd. and 535 m upstream of I-635 / Dallas Co.	22	48 – 4,838	799	411

Lower West Fork Trinity, Segment 0841 and Tributaries

The bacteria impairments within the Lower West Fork Trinity River were first identified in the 1996 and each subsequent version through 2012 of the *Texas Water Quality Integrated Report for Clean Water Sections 305(b) and 303 (d).* Bacteria impairments within Bear Creek, Arbor Creek, Copart Branch Mountain Creek, Dalworth Creek, Delaware Creek, Estelle Creek, Johnson Creek, Kee Branch, Rush Creek, Village Creek, and West Irving Branch were all first identified in the 2006 303(d) List and each subsequent List through 2012 (TCEQ, 2013).

Table 4, based on the *Thirteen Total Maximum Daily Loads for Indicator Bacteria in the Lower West Fork Trinity River Watershed* (TCEQ, 2013), presents the historical data for Lower West Fork Trinity Segment 0841 and its tributaries. The goal or endpoint for the Lower West Fork Trinity TMDL is to maintain concentrations of *E. coli* below the geometric mean criterion of 126 MPN/100 mL.

Table 4. Sampling Data, 0841 Segments

Water Body	AU	Station	No. of Samples	Data Date Range	Station Geometric Mean (MPN/100 mL)	AU Geometric Mean (MPN/100 mL)
Lower West Fork Trinity	0841_01	11079	4	2002	36	177
Lower West Fork Trinity	0841_01	11080	33	2001-2004	170	177
Lower West Fork Trinity	0841_01	11081	71	2001-2008	216	177
Lower West Fork Trinity	0841_01	11089	7	2005-2006	70	177
Lower West Fork Trinity	0841_02	17669	90	2001-2008	164	135
Lower West Fork Trinity	0841_02	11084	11	2001-2002	56	135
Lower West Fork Trinity	0841_02	11087	1	2002	97	135
Lower West Fork Trinity	0841_02	17160	4	2002	23	135
Bear Creek	0841B	10864	5	2002	224	152
Bear Creek	0841B	10865	27	2005-2008	78	152
Bear Creek	0841B	10866	31	2001-2004	225	152
Bear Creek	0841B	10867	81	2001-2008	209	152
Bear Creek	0841B	10868	27	2001-2007	77	152
Bear Creek	0841B	10869	12	2005-2008	66	152
Bear Creek	0841B	17663	83	2001-2008	192	152
Bear Creek	0841B	18313	25	2002-2004	136	152
Bear Creek	0841B	18315	25	2002-2004	106	152
Arbor Creek	0841C	17666	68	2001-2007	139	139
Copart Branch Mountain Creek	0841E	17672	79	2001-2008	156	156
Dalworth Creek	0841G	17671	52	2001-2008	720	720
Delaware Creek	0841H	10871	7	2001-2002	1,055	383
Delaware Creek	0841H	17175	31	2001-2004	1,120	383
Delaware Creek	0841H	17176	32	2001-2004	227	383
Delaware Creek	0841H	17177	30	2001-2004	504	383
Delaware Creek	0841H	17178	43	2001-2008	178	383
Delaware Creek	0841H	18314	25	2002-2004	405	383
Estelle Creek	0841J	17174	32	2001-2004	342	342
Johnson Creek	0841L	17174	32	2001-2004	342	128
Johnson Creek	0841L	10719	37	2001-2008	179	128
Johnson Creek	0841L	10721	26	2002-2008	291	128

Water Body	AU	Station	No. of Samples	Data Date Range	Station Geometric Mean (MPN/100 mL)	AU Geometric Mean (MPN/100 mL)
Johnson Creek	0841L	17664	80	2001-2008	136	128
Johnson Creek	0841L	17665	22	2001-2005	93	128
Johnson Creek	0841L	18311	57	2003-2008	73	128
Kee Branch	0841M	10792	26	2002-2008	188	196
Kee Branch	0841M	15103	6	2007-2008	261	196
Kee Branch	0841M	16896	6	2007-2008	173	196
Rush Creek	0841R	10791	25	2002-2008	101	148
Rush Creek	0841R	17190	25	2002-2008	207	148
Rush Creek	0841R	17191	24	2002-2008	156	148
Village Creek	0841T	10778	5	2005	142	137
Village Creek	0841T	17189	27	2002-2008	136	137
West Irving Branch	0841U	17179	35	2002-2008	357	357

Upstream of Mountain Creek Lake, Segments 0841F, 0841K, 0841N, and 0841V

The TCEQ first identified the bacteria impairments within Cottonwood Creek, Fish Creek, and Kirby Creek in 2006 and within Crockett Branch in 2010 in the *Texas Integrated Report for Surface Water Quality For Clean Water Act Sections 305(b) and 303(d).* They are found in each subsequent edition of the report through 2014. The impaired AUs in segments 0841F, 0841K, 0841N, and 0841V are 0841F_01, 0841K_01, 0841N_01, and 0841V_01. The goal, or endpoint for the segments Upstream of Mountain Creek Lake is to maintain concentrations of *E. coli* below the geometric mean criterion of 126 MPN/100 mL (TCEQ, 2016). Table 5, based on the *Four Total Maximum Daily Loads for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake* (TCEQ, 2016) presents the historical data for segments upstream of Mountain Creek Lake.

Table 5: Sampling Data, 0841F, 0841K, 0841N, and 0841V

Water Body	Segment	Parameter	Station(s)	Integrated Report Year	No. of Samples	Data Date Range	Geometric Mean (MPN/100 mL)
Cottonwood Creek	0841F	*E. coli*	10723, 17674, 17676	2012	200	2003-2010	275
				2014	229	2005-2012	252
Fish Creek	0841K	*E. coli*	10724*, 10725, 17677, 17679, 20342	2012	199	2003-2010	249
				2014	193	2005-2012	215
Kirby Creek	0841N	*E. coli*	17675	2012	99	2003-2010	621
				2014	100	2005-2012	582
Crockett Branch	0841V	*E. coli*	15295, 17683	2012	80	2003-2010	740
				2014	79	2005-2012	689

Sycamore Creek Segment 0806E TMDL

The TCEQ first identified the bacteria impairments of Sycamore Creek in 2014 in the *Texas Integrated Report for Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)*. The impaired AU for segment number 0806E is 0806E_01. The goal, or endpoint for the Sycamore Creek segment 0806E is to maintain concentrations of *E. coli* below the geometric mean criterion of 126 MPN/100 mL (TCEQ, 2019).

Table 6 presents a historical summary of ambient indicator bacteria data from the TCEQ SWQMIS database for December 1, 2005 through November 30, 2012 (TCEQ, 2019).

Table 6: Sampling Data, 0806E_01

Water Body	Segment	AU	Parameter	Station(s)	Integrated Report Year	No. of Samples	Data Date Range	Geometric Mean (MPN/100 mL)
Sycamore Creek	0806E	0806E_01	*E. coli*	17369	2014	48	2003-2010	213

Potential Sources of Bacteria

According to the 2011 *Two Total Maximum Daily Loads for Indicator Bacteria in the Upper Trinity River, Dallas, Texas*, the 2011 *Two Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Branch and Grapevine Creek*, the 2013 *Thirteen Total Maximum Daily Loads for Indicator Bacteria in the Lower West Fork Trinity River Watershed*, the 2016 *Four Total Maximum Daily Loads for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake*, and the 2019 *One Total Maximum Daily Load for Indicator Bacteria in Sycamore Creek*, the potential sources of E. coli pollution can be divided into two primary categories: regulated and unregulated. Pollution sources that are regulated have permits under the Texas Pollutant Discharge Elimination System (TPDES) and the National Pollution Discharge Elimination System (NPDES). Examples of regulated sources include:

Commonly used abbreviations:

AU = assessment unit
cms = cubic meters per second
Criterion = 126 MPN/100 mL
FDA_{SWP} = fractional proportion of drainage area under jurisdiction of stormwater permits
FG = future growth loads from potential permitted facilities
gpcd = gallons per capita per day
LA = allowable load from unregulated sources (predominately nonpoint sources)
LA_{USL} = upstream load allocations entering the AU
LA_{AU}= allowable loads from unregulated sources within the AU
MGD = millions of gallons per day
MOS = margin of safety load
MPN = most probable number of bacteria forming units
Q_{inlet} = median value of the high flow regime entering the AU
Q_{Trib} = median value of the very high flow regime at the tributary or upstream AU outlet(s) to an impaired AU
TMDL = total maximum daily load
WL_{ASW} = waste load from all permitted stormwater sources
WLA_{WWTF} = waste load allocation from WWTFs

- municipal and private domestic wastewater treatment facility (WWTF) discharges;
- industrial facilities with individual stormwater permits and/or discharging treated industrial wastewater and/or groundwater; and
- stormwater discharges from industries, construction, and municipal separate storm sewer systems (MS4s).

Unregulated sources of pollution are generally nonpoint. Nonpoint source pollution originates from multiple locations and is usually carried to surface waters by rainfall runoff. It is not regulated by permit under the TPDES or NPDES. Nonpoint sources include pets, livestock, and wildlife, and failing onsite sewage facilities (OSSFs).

Methods for Estimating Bacteria Loads

Establishing the relationship between instream water quality and the source of loadings is an important component in developing a TMDL. It allows for the evaluation of management options that will achieve the desired endpoint — in this case attaining *E. coli* concentrations below 126 MPN/100 mL. The relationship may be established through a variety of techniques.

Generally, if high bacteria concentrations are measured in a water body at low to median flow in the absence of runoff events, the main contributing sources are likely to be point sources or direct deposition. During ambient flows, these constant inputs to the system will increase pollutant concentrations depending on the magnitude and concentration of the sources. As flows increase in

magnitude, the effect of point sources is typically diluted, therefore making point sources a smaller part of the overall concentration.

Bacteria contributions from regulated and unregulated stormwater sources are greatest during runoff events. Rainfall runoff, depending upon the severity of the storm, has the capacity to carry indicator bacteria from the land surface into the receiving stream. Generally, this loading follows a pattern of low concentration in the water body just before the rain event, followed by a rapid increase in bacteria concentrations in the water body as the first flush of storm runoff enters the receiving stream. Over time, the concentrations diminish because the sources of indicator bacteria are attenuated as runoff washes them from the land surface and the volume of runoff decreases following the rain event (TCEQ, 2011a).

Pollutant Sources and Loads

The TMDL represents the maximum amount of a pollutant that the stream can receive in a single day without exceeding water quality standards. Detailed load allocation analysis can be found in Appendix C.

As stated in 40 CFR, 130.2(1), TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures. For *E. coli*, TMDLs are expressed as MPN/day. The TMDLs developed use the same methodologies.

- Load Duration Curves (LDCs) were developed for the outlet of each AU. The estimated maximum allowable loads of *E. coli* for each of the AUs was determined as that corresponding to the median flow within the high flow regime.
- An explicit Margin of Safety (MOS) was incorporated by setting a target for indicator bacteria loads that is 5 percent lower than the geometric mean criterion. For primary contact recreation, this equates to a geometric mean target of 120 MPN/100 mL of *E. coli*. The net effect of the TMDL with MOS is that the assimilative capacity or allowable pollutant loading of each water body is slightly reduced.
- Median flows were derived using the median flow (or 5% flow) within the very high flow regime of the LDC developed for the outlet of each AU.

The pollutant load allocation for the selected scenarios was calculated using the following equation:

TMDL = ΣWLA + ΣLA + ΣFG + MOS

Where:

WLA: wasteload allocation, the amount of pollutant allowed by permitted or regulated dischargers

LA: load allocation, the amount of pollutant allowed by unregulated sources

FG: loadings associated with future growth from potential permitted facilities

MOS: margin of safety load

Waste Load Allocations

The WLA is the waste load allocation for regulated source contributions in the watershed. The WLA component is generally split into a WLA_{WWTF} for discharges from wastewater treatment facilities (WWTFs), and a WLA_{SW} for regulated stormwater.

There are 12 permitted wastewater dischargers in the Greater Trinity TMDL Project area (Table 7). Of those, only four, all domestic WWTFs, may discharge bacteria as part of normal operations (highlighted in grey in Table 7).

Table 7. TPDES Permitted Wastewater Dischargers

Segment Watershed	Discharges to:	TPDES Permit No. (WQ00--)	Permittee*	Effluent Type[a]	Permitted Flow (MGD)[c]
0822B	Grapevine Creek (0822B)	01441-059	Dallas/Fort Worth International Airport	SW	[b]
0841	0841_02	10494-013	City of Fort Worth Village Creek WWTP	WW	166
0841	0841_01	03446-000	Frontera Pressure Pipe	IW/SW	[b]
0841	0841_01	10303-001	Trinity River Authority (TRA) Central WWTP	WW	189
0841	Bear Creek Big Bear Creek Trigg Lake	01441-001 -014, -019, -025, -023	Dallas/Fort Worth International Airport	SW	[b]
0841	Mountain Creek	01250-003	Extex LaPorte LP – Mountain Creek Lake Steam Electric Station	SW	[b]
0805	0805_04	04161-000	Hines Reit 2200 Ross LP (Chase Tower)	GW	0.155
0805	0805_04	04663-001 and -002	Buckley Oil Company	SW	[b]
0805	0805_04	04765-000	2100 Ross Realty LP (San Jacinto Tower)	GW	0.0291
0805	Old Channel of Elm Fork Trinity	14699-001	Dallas County Park Cities MUD Water Treatment Plant	FB	0.72
0805	0805_03	10060-001	City of Dallas Central WWTP	WW	200

[a] WW = domestic wastewater treatment plant; IW = industrial wastewater; SW = stormwater; GW = groundwater; FB = filter backwash water

[b] Flow is permitted as *intermittent and variable* with a requirement to measure and report the actual amount.

[c] MGD=millions of gallons per day

*See Figure 7 for locations

Wastewater Treatment Facilities

TPDES-permitted WWTFs are allocated a daily wasteload (WLAWWTF) calculated as their full permitted discharge flow rate multiplied by one-half of the instream geometric mean criterion. One-half of the water quality criterion (63 MPN/100mL) is used as the WWTF target to provide instream and downstream load capacity.

In segment 0805_03 of the Upper Trinity River, there is only one facility, Dallas Central WWTF (TPDES WQ0010060-001), and it represents the entire WLA_{WWTF} allocation in that AU. AU 0805_04 of the Upper Trinity River contains no WWTFs, but does contain three permitted industrial facilities and one permitted domestic water treatment plant. Based on the effluent type of these facilities, daily waste loads were not allocated for these permits and permit limits for bacteria are not anticipated to be necessary for them (TCEQ, 2011a). The Elm Fork tributaries, Cottonwood Branch and Grapevine Creek have no WWTFs (TCEQ, 2011b).

Equation for daily wasteload allocation for TPDES wastewater treatment facilities:

WLA_{WWTF}= Criterion/2 * flow (MGD) * conversion factor

Where:

Criterion:	126 MPN/100 mL
Flow (MGD):	full permitted flow
Conversion factor:	37,854,000 100 mL /MGD

Three facilities that treat domestic wastewater are located within the Lower West Fork Trinity River watershed. Along the main stem of the Lower West Fork Trinity River is the City of Fort Worth Village Creek WWTF (WQ0010494-013) located within AU 0841_02, and the Trinity River Authority (TRA) Central Regional WWTF (WQ0010303-001) located within AU 0841_01. The Chester Alton Andrews Alta Vista Mobile Home Park WWTF (WQ0011032-001) is located within the watershed of non-impaired Big Bear Creek (0841D), a tributary to Bear Creek (0841B). Loadings arising from the Alta Vista Mobile Home Park WWTF are incorporated into the upstream loading entering Bear Creek rather than allocated as a separate WLA_{WWTF} loading. Loadings arising from the two facilities located in AUs 0841_01 and 0841_02 represent the WLA_{WWTF} allocation in the AU in which each facility is located. The remaining 10 impaired tributary AUs have no facilities regulated for discharge to include in the WLA_{WWTF} term (TCEQ, 2013). See Figure 7 for WWTF areas of service.

There are no regulated wastewater treatment facilities (WWTFs) located in the Cottonwood Creek, Fish Creek, Kirby Creek, Crockett Branch, and Sycamore Creek watersheds. The entire area of the TMDL watersheds is within the service area of the Trinity River Authority (TRA) Central Regional Wastewater System.

Regulated Stormwater

Stormwater discharges from MS4, industrial, and construction areas are considered permitted point sources. Therefore, the WLA calculations must also include an allocation for permitted stormwater discharges (WLA_{SW}). A simplified approach for estimating the WLA for these areas was used in the development of these TMDLs due to the limited amount of data available, the complexities associated with simulating rainfall runoff, and the variability of stormwater loading. The percentage of each watershed that is under the jurisdiction of MS4 stormwater permits is used to estimate the amount of the overall runoff load that should be allocated to the WLA_{SW} as the permitted stormwater contribution.

The allocation of permitted stormwater discharges (WLA_{SW}) is the sum of loads from regulated (or permitted) stormwater sources and is calculated as:

$$\mathbf{\Sigma WLA_{SW}} = (TMDL - \Sigma WLA_{WWTF} - LA_{USL} - \Sigma FG - MOS) * FDA_{SWP}$$

Where:

ΣWLA_{SW}:	sum of all permitted stormwater loads
TMDL:	total maximum allowable load
ΣWLA_{WWTF}:	sum of all WWTF loads
LA_{USL}:	upstream load allocations entering AU (see LA_{USL} formula in text box below)
ΣFG:	sum of future growth loads from potential permitted facilities
MOS:	margin of safety load
FDA_{SWP}:	fractional proportion of drainage area under jurisdiction of stormwater permits

Nonpoint Sources

The load allocation (LA) is the sum of loads from unregulated sources. The LA component of the TMDL corresponds to direct nonpoint runoff and is the difference between the total load from stormwater runoff and the portion allocated to WLA_{SW}. The LA is the sum of the upstream bacteria load (LA_{USL}) entering the AU and all remaining loads in the AU from unregulated sources (LA_{AU}):

$$\mathbf{LA = LA_{AU} + LA_{USL}}$$

Where:

LA = allowable load from unregulated sources (predominately nonpoint sources)

LA_{AU}= allowable loads from unregulated sources within the AU

ΣLA_{USL} = upstream load allocations entering the AU

The LA_{USL} is calculated as:
$LA_{USL} = Q_{inlet}$ * criterion

Where:
Criterion: 126 MPN/100 mL
Q_{inlet}: median value of the high flow regime entering the AU

The LA_{AU} is calculated as:
$LA_{AU} = TMDL - \Sigma WLA_{WWTF} - \Sigma WLA_{SW} - LA_{USL} - \Sigma FG - MOS$

Where:
LA_{AU}: allowable load from unregulated sources within the AU
TMDL: total maximum allowable load
ΣWLA_{WWTF}: sum of all WWTF loads
ΣWLA_{SW}: sum of all permitted stormwater loads
LA_{USL}: upstream load allocations entering AU
ΣFG: sum of future growth loads from potential permitted facilities
MOS: margin of safety load

The TMDL equation can thus be expanded to show the components of WLA and LA:
$TMDL = \Sigma WLA_{WWTF} + \Sigma WLA_{SW} + LA_{AU} + LA_{USL} + \Sigma FG + MOS$

Allowances for Future Growth

The Future Growth component of the TMDL equation addresses the requirement of TMDLs to account for future loadings that may occur as a result of population growth, changes in community infrastructure, and development. The assimilative capacity of streams increases as the amount of flow increases. Increases in flow allow for additional indicator bacteria loads if the concentrations are at or below the primary contact recreation standard.

Future growth was considered in the developing of the TMDL for the Upper Trinity. To account for the probability that additional flows from WWTF discharges may occur in both 0805 AUs, a provision for future growth was included in the TMDL calculations based on the population increase from year 2005 estimates to year 2030 projections and an estimate of the amount of wastewater generated per person per day or gallons per capita per day (gpcd). Wastewater treatment for the City of Dallas is provided by two large facilities—the Central WWTF in AU 0805_03 and the Southside WWTF, which discharges into the Upper Trinity River downstream of the impaired AUs. The sewered collection areas of both facilities include an area greater than the 0805_04 and 0805_03 drainage areas. The collection areas also include a significant area serviced jointly by both facilities, which complicates the estimate of additional WWTF discharges due to future growth.

Using a conservative approach for the TMDL, it is assumed that all estimated future growth associated with the sewered collection area of the Dallas Central WWTF results in future growth in both AUs. The future growth computation includes: calculating the estimated increase in future capacity required for the sewered collection area of the present Dallas Central WWTF using available data; proportioning the

future capacity between AUs 0805_04 and 0805_03; and the final computation to determine an *E. coli* loading for future capacity.

In the next step, the computed future capacity is apportioned to the two impaired AUs based on the fraction of the drainage area of each AU to the combined drainage area of the two AUs resulting in the estimated future growth term (TCEQ 2011a).

Additional stormwater dischargers represent additional flow that is not accounted for in the current allocations. Changes in MS4 jurisdiction or additional development associated with population increases in the watershed can be accommodated by shifting allotments between the WLA and the LA. This can be done without the need to reserve future-capacity WLAs for stormwater. In non-urbanized areas, growth can be accommodated by shifting loads between the LA and the WLA (for stormwater) (TCEQ, 2011b).

Currently, no permitted WWTFs discharge into Segments 0822A, 0822B, 0841F, 0841K, 0841N, and 0841V. Wastewater generated within these watersheds is transported out of the watersheds to the TRA Central Regional WWTF located on the Lower West Fork Trinity River (Segment 0841).

Since the Cottonwood Branch and Grapevine Creek impaired watersheds lie within the much larger wastewater collection service area for the TRA Central Regional WWTF, the approach taken was to determine the service population of the TRA WWTF and the year 2005 average daily discharge for the TRA Central Regional WWTF based on its discharge monitoring reports (DMRs). The wastewater flow per capita was then determined by dividing the TRA Central Regional WWTF 2005 annual daily discharge by its service population giving a wastewater flow of 107 gpcd.

Since the Mountain Creek Lake Tributaries are within 100 percent coverage of wastewater collection by the TRA Central Regional WWTF, and no WWTFs exist in the TMDL study area, no wasteload allocations for WWTFs were established. The future growth component for all four impaired segments is zero.

Upper Trinity River TMDL - Future capacity is calculated as:
FC = $Flow_{2005}$ * $Pop_{05/30}$ * [DC_{permit} / (DC_{permit} + DS_{permit})] * conversion factor

Where:
$Flow_{2005}$= gpcd based on the average combined discharges of Dallas Central and Dallas Southside WWTFs from year 2005 DMR data divided by the year 2005 Dallas wastewater collection area population estimate
Pop $_{05/30}$= Dallas wastewater collection area population increase for 2005 to 2030
DC $_{permit}$= Full permitted discharge of Dallas Central WWTF
DS $_{permit}$= Full permitted discharge of Dallas Southside WWTF
Conversion factor = 0.000001 MGD/gpcd

Cottonwood Branch and Grapevine Creek TMDL - Future growth term is calculated:
FG = Criterion/2 * Flow2005 * (Pop_{30} – Pop_{05})
Where:
Criterion = 126 MPN/100 mL
Flow2005 = 107 gpcd based on the average daily discharge of TRA WWTF from year 2005 DMR data divided by year 2005 TRA WWTF wastewater collection area population estimate
Pop_{30} = estimated watershed population for year 2030
Pop_{05} = estimated watershed population for year 2005
Conversion factor = 37.854 100 mL/gallon

Lower West Fork Trinity Watershed TMDL - Future growth (FG) is calculated as:
FG = Target * [$POP_{2010\text{-}2040}$ * Use] * Conversion Factor
Where:
Target = 63 MPN/100 mL
$POP_{2010\text{-}2040}$ = estimated percent increase in population between 2010 and 2040
Use = 101.777 gpcd
Conversion factor = 37.854 100 mL / gallon

Due to 100 percent coverage of wastewater collection by the City of Fort Worth Village Creek WWTF collection system and the absence of WWTFs in the TMDL study area, the future growth component for the Sycamore Creek TMDL is zero.

Additional stormwater dischargers represent additional flow that is not accounted for in the current allocations. Changes in MS4 jurisdiction or additional development associated with population increases in the watershed can be accommodated by shifting allotments between the WLA and the LA. This can be done without the need to reserve future-capacity WLAs for stormwater. In non-urbanized areas, growth can be accommodated by shifting loads between the LA and the WLA (for stormwater) (TCEQ, 2011b).

Within the Lower West Fork Trinity watershed, there are currently two facilities that treat domestic wastewater and discharge into impaired AUs. The City of Fort Worth Village Creek WWTF discharges into AU 0841_02, and the TRA Central Regional WWTF discharges into 0841_01. The Village Creek WWTF is built out with no capacity for expansion beyond its current size, while the Central Regional WWTF has additional capacity for expansion.

The majority of the Lower West Fork Trinity River watershed is serviced by the TRA Central Regional WWTF (Figure 7). Planned expansions of the TRA Central Regional WWTF will increase the permitted discharge from 189 MGD to 232 MGD based on long term projections to the year 2040, an increase of 43 MGD. This additional 43 MGD serves as the future growth component for those areas serviced by the TRA Central Regional WWTF and is applied to the TMDL of AU 0841_01 since the discharge occurs into that section of the Lower West Fork Trinity River. Since all wastewater collected within the watersheds of AUs 0841C, 0841E, 0841F, 0841G, 0841H, 0841J, 0841K, 0841L, 0841M, 0841N, 0841U, and 0841V are sent to the TRA Central Regional WWTF and subsequently discharged into AU0841_01, the future growth component for these twelve AUs was not explicitly derived and was set to a value of zero (TCEQ, 2013) (TCEQ, 2016).

The future growth term of AU 0841_01 was calculated using the identical equation applied to determine the WLA_{WWTF} term.

To account for the probability that new flows from WWTF discharges may occur in areas within the TMDL watersheds that are outside of the TRA Central Regional WWTF service area, a provision for future growth was included in the TMDL calculations based on population projections and per capita wastewater use. Current population projections for areas not serviced by the TRA Central Regional Facility were obtained from the 2010 U.S. Census (USCB, 2010), and 2040 projected population increases. Per capita wastewater use was obtained from the TRA and represents population projected for the year 2040.

For the remaining four AUs in the Lower West Fork Trinity River watershed (0841_02, 0841B, 0841R, and 0841T), the future growth component for the areas within each AU that are not serviced by the TRA Central Regional WWTF were calculated based on estimated population increases from 2010 to 2040 multiplied by the per capita wastewater usage by the projected population increase. The resulting future wastewater flow was then converted into a loading.

Implementation Strategies

This I-Plan documents nine implementations strategies to reduce bacteria loading in the Project area. The implementation strategies cover a variety of areas and include provisions for:

- wastewater,
- stormwater,
- planning and development,
- pets, livestock and wildlife,
- onsite sewage facilities,
- monitoring coordination,
- education and outreach,
- best management practices library, and
- implementation strategy evaluation.

The strategies include voluntary activities designed to improve water quality while establishing antidegradation procedures through regular evaluation of I-Plan components. Within each of the activities are:

- potential load reductions,
- technical and financial assistance needed,
- an education component,
- schedule of implementation,
- interim milestones,
- progress indicators,
- a monitoring component, and
- responsible entities.

Wastewater Implementation Strategies

Wastewater management encompasses a broad range of efforts that promote effective and responsible water use, treatment, and disposal while encouraging the protection and restoration of the region's — and this Project's — watersheds. Properly designed, operated, and maintained sanitary sewer systems collect and transport all sewage that flows into them to a publicly owned treatment works (POTW). Wastewater treatment facility operators bear a large responsibility for converting the sewage into water that can be safely released back into the Trinity River. Table 8 lists the permitted WWTFs in the Greater Trinity Watershed. For the waste not handled as part of a sanitary sewer system, liquid waste haulers provide services to OSSFs and portable/chemical toilets. Given the bacteria-laden nature of wastewater (Lusk, 2011), broad attention in this I-Plan will be given to the wastewater system. WWTFs, sanitary sewer systems, lift stations, and liquid waste haulers all have the potential to impact bacteria loading in impaired waterways (see Implementation Strategies 5.0 – 5.5 for OSSFs).

Implementation Strategies 1.0: Wastewater treatment facility effluent limits

In November 2009, TCEQ commissioners approved Rule Project No. 2009-005-309-PR. This rule requires the addition of bacteria limits for *E. coli* in freshwater discharges for all TPDES domestic wastewater permits during their next permit amendment or revision. This rule is defined in Title 30 Administrative Code Chapter (TAC) 309.3(h) and the frequency of testing required is defined in 30 TAC Chapter 319.5(b). Through this control action, responsible entities will continue to monitor *E. coli* concentrations in WWTF effluent as required by individual WWTF permits and any subsequent permit amendments or revisions.

Currently, three permitted WWTFs (Table 8) have direct impact in the Greater Trinity Project area watershed(s) and three of those are currently required to monitor *E. coli* levels in their effluent. The remaining plant will be required to monitor for *E. coli* upon renewal of the permit. For TCEQ bacteria TMDLs in the Dallas-Fort Worth area, TPDES-permitted WWTFs are allocated a daily waste load allocation (WLA_{WWTF}) calculated as their full permitted discharge flow rate multiplied by one half the instream geometric mean criterion. One-half of the water quality criterion (63 MPN/100mL) is used as the WWTF target to provide instream and downstream load capacity. Changes to effluent *E. coli* limits will occur following the approval of the TMDLs and during the next amendment or revision to an individual permit. Table 9 summarizes this implementation strategy.

Table 8. Permitted WWTFs in the Greater Trinity Watershed

Facility Name	Permit Number	Permit Daily Average *E. coli*[a]	Permit Effective Date	*E. coli* Permit Monitoring Frequency
Dallas Central WWTF	WQ0010060-001	63 MPN/100 mL	1/12/2017	5x/week
FTW Village Creek WWTF	WQ0010494-013	126 MPN/100 mL[b]	10/27/2014	5x/week
TRA Central Regional WWTF	WQ0010303-001	n/a[c]	2/4/2008	n/a[c]

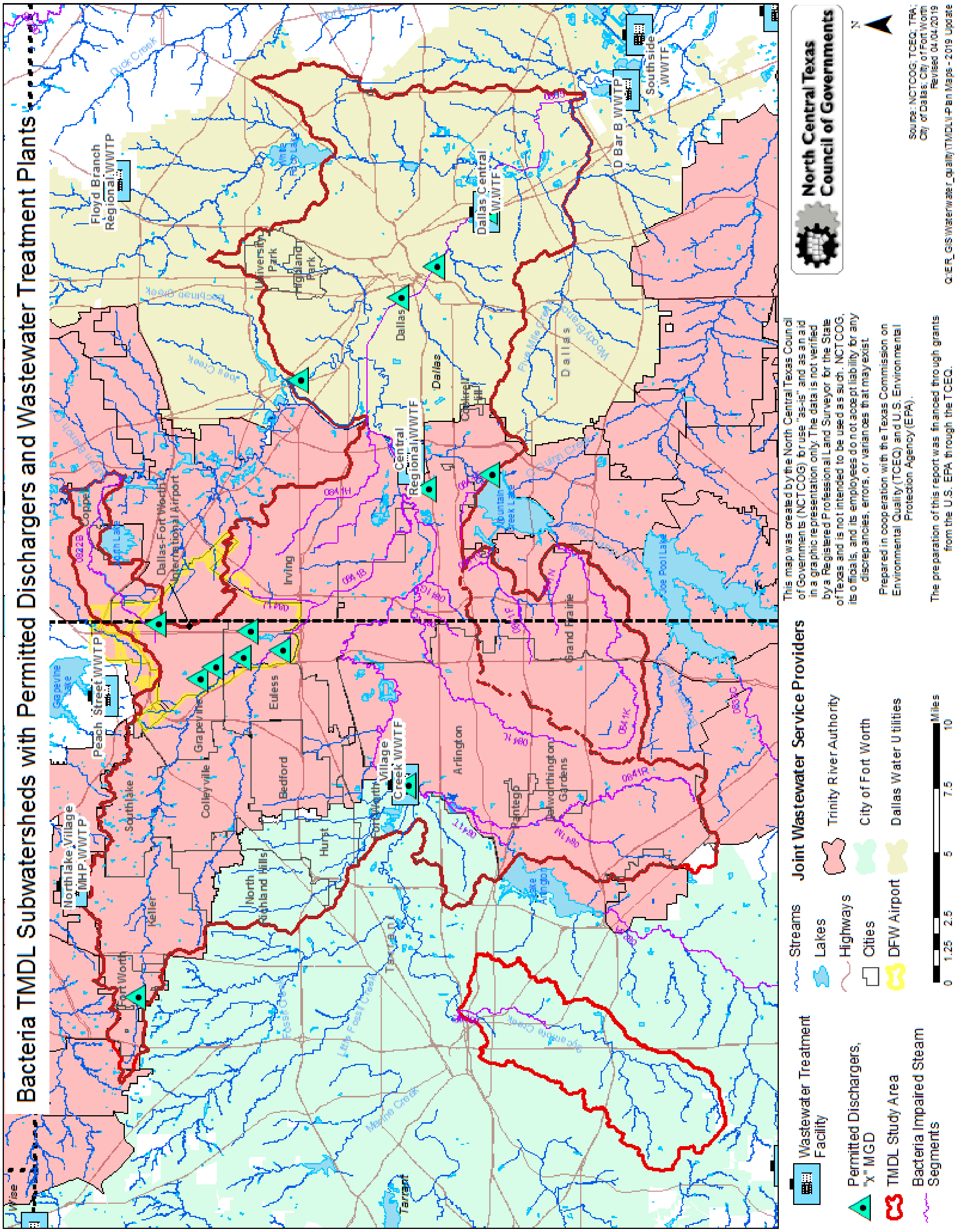
[a] There is also a daily maximum of 394 MPN/100mL.
[b] Subsequent renewals will include an *E. coli* limit of 63 MPN/100mL.
[c] Permit currently in renewal process. Renewed permit will include an *E. coli* limit of 126 MPN/100 mL and a monitoring frequency of 5x/week. Subsequent renewals will include an *E. coli* limit of 63 MPN/100 mL

Each of the entities listed in Table 8 is responsible for adhering to the requirements of their specific permits only. The terms and conditions in each individual permit are agreed upon by both the TCEQ and the permittee. Each permit specifically outlines the effluent constituents that require monitoring as well as the monitoring and reporting frequency to which the permittee must adhere. The TCEQ reviews and documents compliance with individual permits. WWTF permits are issued on a five-year cycle and must be renewed by the permittee. A map of WWTF coverage in the Project area can be found in Figure 7.

Table 9. Implementation Strategy 1.0 Summary — Wastewater treatment facility effluent limits

Targeted Source(s)	WWTF effluent
Estimated Potential Load Reduction	Implementation Strategy (IS) 1.0 may result in a 2% reduction of calculated bacteria loading from WWTF effluent
Technical and Financial Assistance Needed	Technical: none — permit requirements are already being met Financial: none — permit requirements are already being met
Education Component	None
Schedule of Implementation	Immediate. New requirements for WWTF permits would come from TCEQ
Interim, Measurable Milestone	The number of permits requiring bacteria monitoring with reduced daily average limits
Progress Indicators	Allowable daily average will be reduced from 126 MPN/100 mL to no more than 63 MPN/100 mL for all WWTF discharging to impaired waterways
Monitoring Component	An annual report to Coordination Committee from NCTCOG to include information on the progress of implementation strategies, in addition to self-reporting by WWTF to TCEQ
Responsible Entity	WWTFs will meet permit requirements and monitor *E. coli* as appropriate NCTCOG will contact TCEQ to secure the necessary permit information pertaining to bacteria limits NCTCOG will provide Coordination Committee with information on WWTF effluent limits

Figure 7. WWTF Location and Coverage Map with Permitted Dischargers



Implementation Strategy 1.1: Evaluation of non-participants in Sanitary Sewer Overflow Initiative (SSOI) and Capacity Management, Operation, and Maintenance (C-MOM) programs

Sanitary sewer systems that are properly designed, operated, and maintained will collect and transport all the sewage and industrial wastewater that flow into them to a wastewater treatment facility for appropriate treatment. If, however, there is significant inflow/infiltration (I/I) to the collection system; the system is not properly operated and maintained; or its capacity is inadequate, then sanitary sewers can overflow (Figure 8). The goals of the TCEQ SSOI are to reduce the number of sanitary sewer overflows (SSOs) that occur each year in Texas and to address SSOs before they harm human health, safety, or the environment and before they become enforcement issues (TCEQ, 2008).

Wastewater treatment facilities with sanitary sewer systems and subscribers within collection systems are eligible to participate in the TCEQ SSOI which provides benefits in that, a participating facility will not be subject to formal enforcement for most continuing SSO violations, as long as the SSOs are addressed by the SSO plan. Participation also allows the facility to spend resources on correction as opposed to having to pay penalties associated with an enforcement order, in addition to the money required to complete corrective action; and participation ensures that SSOs addressed by the SSO plan will not affect the facility's compliance history rating.

C-MOM is a self-adopted program for owners and operators of sanitary sewer systems and involves proper management, operations, and maintenance of the collection system. Additionally, C-MOM programs ensure adequate capacity for peak flows, and take steps to prevent or mitigate SSOs.

Both SSOI and C-MOM programs have the potential to decrease bacteria loading by reducing SSOs. Table 10 lists SSOI participants and non-participants as of July 2019. As summarized in Table 11, the Coordination Committee or their appointees will evaluate the entities that do not participate in either the SSOI or C-MOM programs and as appropriate, encourage participation in one of those two programs.

Table 10. SSOI Participants

Current and Past Participants as of 7/22/2019	Not Currently Participating
City of Arlington	City of Cockrell Hill
City of Bedford	City of Colleyville
City of Dallas	City of Coppell
City of Euless	City of Dalworthington Gardens
City of Fort Worth	City of Haslet
City of Grand Prairie	City of Keller
City of Grapevine	City of Kennedale
City of Hurst	City of Mansfield
City of Irving	City of Richland Hills
City of North Richland Hills	City of Southlake
Trinity River Authority – Central WWTP System	City of University Park
	Town of Highland Park
	Town of Pantego

Table 11. Implementation Strategy 1.1 Summary — Evaluation of non-participants in SSOI and C-MOM programs

Targeted Source(s)	Sanitary sewer system (SSS) failures and SSOs
Estimated Potential Load Reduction	IS 1.1, over 25 years, may result in a 35% reduction of calculated bacteria loading from SSSs and SSOs
Technical and Financial Assistance Needed	Technical: non-participants may need some level of technical assistance to begin SSOI and/or C-MOM participation Financial: grant funding, loans, and existing local funding as appropriate
Education Component	Outreach to SSS operators that are non-SSOI/non-C-MOM participants
Schedule of Implementation	By 2018, all non-participating MS4s will have been contacted by Coordination Committee members, either as a whole or individually By 2028, SSOI/C-MOM participation will increase by 15%
Interim, Measurable Milestone	By 2018, 100% contact of non-participants
Progress Indicators	The number of participants in SSOI and/or C-MOM
Monitoring Component	An annual report to Coordination Committee from NCTCOG to include information on the progress of implementation strategies
Responsible Entity	NCTCOG will gather and distribute information about SSOI and C-MOM participation and use to the Coordination Committee Wastewater subcommittee and Coordination Committee will conduct outreach to non-participants NCTCOG will contact TCEQ Office of Compliance and Enforcement Program Support Section annually to obtain a current list of SSOI participants for use in education and outreach efforts

Implementation Strategy 1.2: Lift station evaluation

For a variety of reasons, lift stations may occasionally cease functioning and may discharge sewage into waterways. One example is lift stations ceasing to function during extensive power outages following severe weather. Lift stations may also fail to function during circumstances other than power outages, such as due to mechanical failure or during repair. However, unlike many SSOs, lift station failures can result in the discharge of large volumes of untreated wastewater into waterways.

The stakeholders encourage entities with lift stations to survey and evaluate existing stations by 2018 to determine the appropriateness of implementing best management practices (BMPs) to prevent SSOs caused by lift stations. Using this information, the Coordination Committee will re-evaluate the need for identifying or developing lift station BMPs for the BMP Library (see Implementation Strategy 8.0). Table 12 provides a summary of components necessary for lift station evaluation.

Table 12. Implementation Strategy 1.2 Summary—Lift station evaluation

Targeted Source(s)	SSS failures and SSOs from lift station failures
Estimated Potential Load Reduction	IS 1.2 may result in a 2% reduction in bacteria loading
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary for lift station assessment and any potential repairs or alternations Financial: if technical assistance is not available internally to lift station owners and/or operators, then grant, loans, or local funding may be necessary for both evaluation and any potential repairs or alternations
Education Component	Outreach to SSS lift station operators
Schedule of Implementation	By 2018, all entities with lift stations will have evaluated the need for maintenance programs to reduce SSOs caused by non or malfunctioning lift stations
Interim, Measurable Milestone	None
Progress Indicators	Number of lift stations being evaluated by station owners and/or operators
Monitoring Component	Reports containing lift station owners and/or operators and their progress on evaluation will be made available to Wastewater technical subcommittee and Coordination Committee annually
Responsible Entity	Lift station owners and/or operators will evaluate lift stations and report progress to NCTCOG NCTCOG will report on progress indicator to the Wastewater technical subcommittee and Coordination Committee

Implementation Strategy 1.3: Regional participation in Fats, Oils, and Grease program

Fats, oils, and grease (FOG) are considered the leading cause of blockages in sanitary sewers, and the EPA estimates that blockages account for nearly 50 percent of all SSOs (USEPA, 2007). North Texas Grease Abatement Council, now known since 2015 as the Wastewater And Treatment Education Roundtable (WATER), and NCTCOG have partnered to provide the cities and other agencies with public education materials related to FOG. Many organizations within the bacteria TMDL watersheds, such as Arlington, Colleyville, Dallas, Irving, North Richland Hills, and the TRA already use these materials to reduce FOG in the SSS and with it, SSOs. As summarized in Table 13, the stakeholders encourage organizations and wastewater plant operators to continue participation in the regional FOG education program. As resources are available, WATER is encouraged to expand educational materials to include the impact of FOG and SSOs on bacteria levels.

Table 13. Implementation Strategy 1.3 Summary — Regional participation in Fats, Oils, and Grease program

Targeted Source(s)	SSO and SSS failures
Estimated Potential Load Reduction	IS 1.3 may result in a 20% reduction in bacteria loading from SSOs and SSS failures
Technical and Financial Assistance Needed	Technical: technical assistance with FOG is available through existing programs Financial: participation in some FOG programs may require cost sharing, in addition to costs associated with educational materials; training for grease trap operators may also be necessary through grant funding, loans, and existing local funding as appropriate
Education Component	Outreach to RSWMP participants to ensure participation and outreach to non-RSWMP participants to encourage participation in regional FOG program(s) Public education is a primary component in FOG programs and an existing program is already in place Separate education programs may be necessary for grease trap operators
Schedule of Implementation	Existing FOG public education participants will begin immediately and continue their programs as feasible. By 2018, outreach will be conducted to all MS4s with SSSs not participating in the regional FOG program
Interim, Measurable Milestone	Over 25 years, all SSS owners and/or operators will actively participate in FOG programs
Progress Indicators	Number of FOG program participants
Monitoring Component	NCTCOG will collect FOG participant information and report to Wastewater technical subcommittee and Coordination Committee

Responsible Entity	NCTCOG will gather and distribute information of FOG program participation and report results to the Coordination Committee and Wastewater technical subcommittee Wastewater technical subcommittee and Coordination Committee will conduct outreach to non-participants

Implementation Strategy 1.4: Sanitary sewer overflow reporting

State law and TCEQ regulations specify reporting requirements for SSOs in Texas Water Code Chapter 26.039 and 30 TAC 305.125(9). Without accurate and available information on SSOs, gauging the effectiveness of SSO BMPs becomes difficult. Figure 8 provides a four-year representation of SSOs in the Project area categorized by the amount of released sewage. Table 14 summarizes the implementation strategies for SSOs.

1.4.1: Wastewater and wastewater collection licensing

The Coordination Committee recommends TCEQ increase understanding of reporting requirements for SSOs and SSO mitigation by ensuring such information is included in wastewater licensing classes, including those for wastewater collection.

1.4.2: Electronic reporting

The Coordination Committee encourages TCEQ to adopt electronic SSO reporting in addition to maintaining current methods. The TCEQ should further develop its system to allow electronic collection, analysis, and dissemination of this information. This action is not intended to increase the data-entry requirements for TCEQ staff; instead, it is intended to streamline reporting and analysis. Given technological disparities, however, the Committee encourages TCEQ to maintain the existing faxed SSO report for some time while electronic reporting is instituted.

1.4.3: Reporting form changes

Current “source” descriptions on TCEQ’s reporting form are subject to interpretation. More accurate source descriptions would provide necessary information in future prevention of SSOs. TCEQ is encouraged to change the reporting form to better reflect actual cause of SSOs, for example specifying cause of blockage, and provide some type of education for those entities reporting.

Table 14. Implementation Strategy 1.4 Summary — Sanitary sewer overflow reporting

Targeted Source(s)	SSOs
Estimated Potential Load Reduction	IS 1.4. – 1.4.3 will contribute to the improved handling of SSOs and may result in a 2% reduction in calculated bacteria loading from SSOs over 25 years

Technical and Financial Assistance Needed	Technical: TCEQ may require technical assistance to develop appropriate database and reporting technologies as well as for wastewater licensing course materials SSS owners and/or operators may need high speed internet access or equivalent Financial: Existing and grant funding and loans as available
Education Component	TCEQ will provide appropriate instructions to SSS operators for using statewide SSO database TCEQ will provide appropriate educational materials for wastewater licensing course participants
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Deployment of an appropriate database for tracking SSOs Wastewater licensing classes emphasizing accurate SSO reporting Reporting form changed for more accurate SSO cause description
Progress Indicators	Creation of a database Wastewater licensing course materials emphasizing SSO reporting Changed reporting form
Monitoring Component	NCTCOG will collect information from TCEQ regarding any updates to educational materials for wastewater licensing course participants, as well as any progress on database improvements
Responsible Entity	NCTCOG will coordinate with TCEQ on exploration of options for developing appropriate materials for use in wastewater licensing courses conducted through the TCEQ. NCTCOG will also coordinate with TCEQ to identify desired modifications to the SSO reporting form that would result in more effective SSO cause identification. SSS owners and/or operators will report SSOs as appropriate and ensure employee SSO reporting training NCTCOG will collect and share information with the Wastewater technical subcommittee and Coordination Committee

Implementation Strategy 1.5: Funding opportunities for repair/replacement of sanitary sewer lines

Summarized below in Table 15, NCTCOG and stakeholders will pursue funding opportunities for rehabilitation or replacement of sanitary sewer lines, including Texas Water Development Board funding and regional supplemental environmental projects (SEPs) to repair, maintain, or extend wastewater infrastructure. NCTCOG will share information on funding opportunities to interested parties by web posting to a new or existing web page.

Table 15. Implementation Strategy 1.5 Summary — Funding opportunities for repair/replacement of sanitary sewer lines

Targeted Source(s)	SSO and SSS failures
Estimated Potential Load Reduction	IS 1.5 may result in a 5% reduction in calculated bacteria loading over 25 years by reducing the portion of the wasteload contributed by leaking or broken sewer lines
Technical and Financial Assistance Needed	Technical: engineering and technical expertise may be necessary Financial: existing or new grants, SEPs, or other funding mechanisms available at the local, state, or federal level
Education Component	NCTCOG will make new funding opportunities known to SSS owners and operators via web postings
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Available funding opportunities identified on a NCTCOG web page
Progress Indicators	Creation of a new or modification of an existing web page for funding opportunities and the number of successful grant or funding applications for wastewater infrastructure received in the Project Area
Monitoring Component	Web page use reports for Coordination Committee and annual Water Quality Management Plan Update, which details some wastewater funding in the Project area
Responsible Entity	NCTCOG will create or modify existing web page and maintain current information SSS stakeholders will utilize information and seek funding opportunities to upgrade wastewater infrastructure

Implementation Strategy 1.6: Relocation of sewer mains from waterways

Although waterways are convenient locations for sewer mains in terms of access rights and elevation, failures in the system in such locations have a direct impact on water quality and bacteria levels. The Coordination Committee encourages MS4s to relocate sewer mains out of waterways as practicable, as part of infrastructure replacement programs. Table 16 outlines the details of this implementation strategy.

Table 16. Implementation Strategy 1.6 Summary — Relocation of sewer mains from waterways

Targeted Source(s)	SSO and SSS failures
Estimated Potential Load Reduction	IS 1.6 may result in a 4% reduction over 25 years of calculated bacteria loading by reducing the potential for additional loading from leaking or collapsed sewer lines
Technical and Financial Assistance Needed	Technical: engineering and other technical expertise will be necessary in order to relocate wastewater lines from waterways Financial: grant funding, loans, and existing local funding as available
Education Component	Public education regarding relocation benefits may be needed Additionally, education for decision-makers, such as city councils, may also be necessary
Schedule of Implementation	Beginning immediately as appropriate, SSS owners and/or operators will consider relocation of sewer lines out of waterways as part of infrastructure repair and replacement
Interim, Measurable Milestone	Over 25 years, as many sewer lines as practicable will be relocated from waterways
Progress Indicators	Number of sewer lines relocated
Monitoring Component	Voluntary reports from SSS owners and/or operators to NCTCOG on relocations
Responsible Entity	SSS owners and/or operators will relocate sewer mains from waterways as feasible

Implementation Strategy 1.7: Liquid waste management and liquid waste hauler program expansion

Waste haulers routinely transport bacteria-laden materials, including septic, grease trap, and grit trap wastes. When this highly concentrated, untreated waste is discharged into waterways instead of being properly disposed of or treated, it may represent a significant local increase in bacterial loading.

NCTCOG and the Coordination Committee encourage MS4 permittees to maintain existing liquid waste hauler permit and inspection programs and expand them if necessary. Because liquid waste hauler regulation also takes place at the state level, the stakeholders request that TCEQ increase educational efforts to haulers, modify the registration form, and change regulations to include local notification. Table 17 summarizes the implementation strategies for liquid waste.

1.7.1: Liquid waste hauler inspection program

Using sample ordinances available through the online BMP Library (see Implementation Strategy 8.0), municipal MS4s are encouraged to evaluate liquid waste hauler operations within their jurisdictions and create or expand inspection programs to include permitting, inspections, and tracking of liquid waste haulers; with a goal of having inspection programs in 100 percent of large MS4s by 2028 and 25 percent of small MS4s by 2033.

1.7.2: TCEQ and liquid waste haulers

The Coordination Committee encourages TCEQ to increase its educational efforts toward liquid waste haulers, especially in regard to operations in areas with bacteria impaired waterways, illegal discharge penalties, and mitigation procedures.

1.7.2.1: Liquid waste hauler registration form addition

The Coordination Committee also requests TCEQ add a check box on liquid waste hauler registration forms for the operator to acknowledge that they know they are operating within an area with bacteria TMDL-listed waterways.

1.7.2.2: Requested change to liquid waste hauler regulations to include municipal notification

Request TCEQ amend regulatory guidance document to have waste haulers notify any municipalities, counties, and other jurisdictions that they are transporting through or where they are serving.

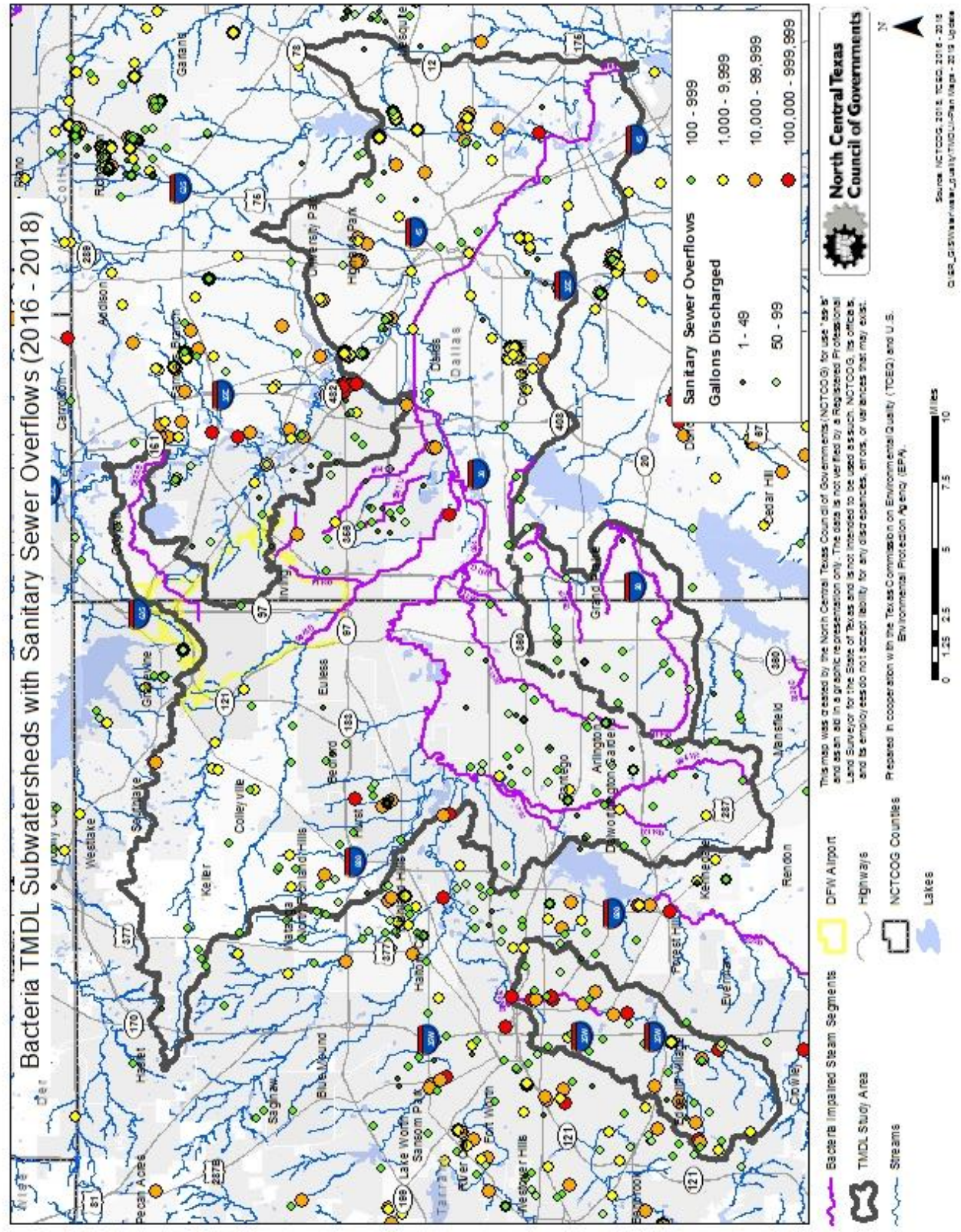
1.7.3: Implementation of standards for portable/chemical toilets

MS4s are encouraged to implement standards concerning waste management on all sites requiring use of portable/chemical toilets to ensure placement as far from stormwater inlets, gutter lines, and water bodies as feasible and to ensure regular service scheduling of onsite waste facilities.

Table 17. Implementation Strategy 1.7 Summary — Liquid waste management and liquid waste hauler program expansion

Targeted Source(s)	Improperly disposed waste from liquid waste haulers
Estimated Potential Load Reduction	IS 1.7 – 1.7.2 may result in a 5% reduction of calculated bacteria loading over 25 years by reducing the portion of the waste load contributed by improper handling, transportation, and disposal of liquid wastes
Technical and Financial Assistance Needed	Technical: some technical assistance may be necessary for MS4s without liquid waste hauler inspection and tracking programs to implement standards for portable and/or chemical toilets Financial: grants and/or existing funding and loans as available
Education Component	Outreach to MS4s without inspection and tracking programs may be necessary Educational efforts by TCEQ for liquid waste haulers regarding operations and any changes to registration form
Schedule of Implementation	100% of large MS4s will have inspection and tracking programs in place by 2028 25% of small MS4s will have inspection and tracking programs in place by 2033 Beginning immediately as feasible, TCEQ will consider changes to liquid waste hauler registration forms and changes to notification requirements
Interim, Measurable Milestone	By 2028, 100% of large MS4s will have liquid waste hauler inspection and tracking programs in place by 2033, 25% of small MS4s will have liquid waste hauler inspection and tracking programs in place
Progress Indicators	Number of MS4s with inspection and tracking programs Number of MS4s with standards for portable and/or chemical toilets Changes to liquid waste hauler registration form(s)
Monitoring Component	Reports to Coordination Committee and Stormwater technical subcommittee regarding MS4 programs and TCEQ program/form changes for liquid waste haulers
Responsible Entity	MS4s will adopt liquid waste hauler inspection and tracking programs NCTCOG will coordinate with stakeholders and TCEQ staff to identify potential changes to the liquid waste hauler registration forms that will enhance their effectiveness. NCTCOG will compile information on programs and forms for annual report to Coordination Committee and Stormwater technical subcommittee

Figure 8. Map — SSOs Occurring between January 2016 – December 2018



Stormwater Implementation Strategies

In the watershed areas covered by the Greater Trinity River Bacteria TMDL I-Plan Project, as in most urban areas, stormwater runoff is a major cause of water pollution. When rain falls on less developed areas, the water is absorbed and filtered by soil and plants. When rain falls on the roofs, streets, and parking lots of the Dallas-Fort Worth metropolitan area, however, the water cannot soak into the ground. Here, like most urban areas, stormwater is drained through engineered collection systems and discharged into nearby lakes and streams. The stormwater carries trash, heavy metals, other pollutants, and notably for this project, bacteria, from the urban landscape, degrading the quality of the receiving waters. Higher flows can also cause erosion and flooding in urban streams, damaging habitat, property, and infrastructure.

Bacteria sources, such as waste from pets, wildlife, and even humans, can be washed into storm drains and then discharged into local waterways. Because stormwater systems are designed to quickly and efficiently remove stormwater from developments, stormwater often bypasses the natural vegetative barriers that filter sheet flow over the land, thus, exacerbating bacteria loading. Infrastructure, such as pipes, inlets, culverts, interceptors, basins, reservoirs, outfalls, and channelized waterways, can also increase direct bacterial loading. The TMDLs for the project area indicate that stormwater from permitted MS4s is thought to be a significant source of bacteria loading (TCEQ 2011a and 2011b).

Effective stormwater management is often achieved from a management systems approach, as opposed to one that focuses on individual practices. That is, the pollutant control achievable from any given management system is viewed as the sum of the parts, taking into account the range of effectiveness associated with each single practice, the costs of each practice, and the resulting overall cost and effectiveness. Some individual practices may not be very effective alone but, in combination with others, may provide a key function in highly effective systems and, in the case of the Dallas-Fort Worth metropolitan area, reduce bacteria levels in area waterways.

About the Regional Stormwater Management Program

NCTCOG works with local governments and other stakeholders to develop and implement a regional strategy to address stormwater quality issues impacting the region. Created in 1999 by the Regional Stormwater Management Coordinating Committee (RSWMCC), the *Regional Policy Position on Managing Urban Stormwater Quality* provides guidance for the regional strategy, setting out the key elements for a cooperative and comprehensive regional approach to stormwater management. Among the goals of the Regional Program are to:

- Protect the health and welfare of citizens and the environment;
- Effectively address state and federal regulations;
- Share professional knowledge and experience; and
- Provide training to governmental staff and the development community.

The program is built upon a series of cooperative initiatives in the following areas:

- Public education;
- Control of construction site stormwater runoff;
- Management of stormwater impacts associated with post-construction;
- Illicit discharge detection and elimination; and
- Municipal pollution prevention.

Once high levels of bacteria are present in a water body, it is more difficult and expensive to restore it to a less impacted condition. The widespread use of BMPs for pollution prevention, illicit discharge detections, and elimination (IDDE), erosion and sediment control, and outreach and education are critical in meeting water quality goals for the Trinity River and its tributaries.

Existing requirements of MS4 permits address some important elements of bacteria loading in stormwater, offering an adaptive rather than prescriptive approach to bacteria reduction. Structural BMPs, such as modifications to stormwater outfalls that may reduce bacteria through aeration, treatment by sunlight, or physical removal of contaminants, have the potential to reduce bacteria loading into waterways. Because there is limited data regarding how well such BMPs might reduce bacteria loading, the Coordination Committee has identified the evaluation of the effectiveness of stormwater implementation activities as one of the top research priorities. Any research, particularly research relevant to the Greater Trinity area, should be reported and shared with Project stakeholders, so that stakeholders can devise appropriate strategies for integrating structural stormwater BMPs into their activities (see Implementation Strategy 8.0).

A map of MS4s in the project area is shown in Figure 9. A list of stormwater permits in the project area is provided in Tables 21, 22, 23, and 24.

Implementation Strategy 2.0: MS4 participation in Regional Stormwater Management Program

Local and state governments along with transportation entities with MS4 permits currently employ extensive and innovative stormwater programs, and many participate in the Regional Stormwater Management Program (RSWMP). The RSWMP already includes several programs relevant to bacteria loading and this I-Plan. The programs include Construction, Illicit Discharge, Monitoring, Pollution Prevention, and Public Education. Additionally, regionally developed initiatives and cooperative purchases are also part of the program. Because of the extensive involvement of the RSWMP in existing stormwater efforts, as well as its regional scope and contacts, partnering with the program and supporting the inclusion of bacteria-specific elements is the logical choice and takes advantage of existing knowledge and infrastructure. A list of RSWMP participants can be found in Table 25, while a summary of this implementation strategy can be found in Table 18.

2.0.1: Request Regional Stormwater Management Coordinating Council include bacteria in RSWMP program efforts and materials

Given the broad scope of RSWMP programs and tools, the Coordination Committee requests the Regional Stormwater Management Coordinating Council (RSWMCC) direct their committees to review each program's materials for inclusion of relevant information on bacteria load reduction.

2.0.1.1: IDDE program participation

An illicit discharge is defined as any discharge to the MS4 that is not composed entirely of stormwater (except for discharges allowed under a TPDES permit). Non-stormwater discharges can originate from direct connections to the storm drain system, from business or commercial establishments (illicit connections), or indirectly as improper surface discharges to the storm drain system.

Illicit plumbing connections may be intentional or may be unknown to a property owner and often are due to the connection of floor drains to the storm sewer system. As a result of these illicit connections, wastewater that should receive treatment from a WWTF directly enters storm drains and local surface waters and subsequently negatively impacts bacteria loading. Additional sources of illicit discharges may come from failing septic systems, illegal dumping

practices, and the improper disposal of sewage from recreational practices such as boating or camping.

NCTCOG and the Coordination Committee encourage all MS4s within the Project area to participate in the RSWMP and continue and expand, where necessary, their programs for IDDE through participation in existing training and educational initiatives. Stakeholders also encourage the RSWMP's IDDE Task Force to introduce or add bacteria-enhancing pollutant detection training and materials with examples from slaughter facilities, pet training/housing, farmers markets, sewage processors, zoos, etc.

2.0.1.2: Inclusion of bacteria load reduction in Pollution Prevention Peer-to-Peer program and evaluation of modified Peer-to-Peer program for five years

Peer-to-Peer is a program of the RSWMP's Pollution Prevention (P2) Task Force. The program provides site visits to assess good housekeeping procedures in MS4s which can result in cost savings in production, materials, and disposal; increase public awareness of local water quality issues; and provide safer working conditions for city/county staff.

The Coordination Committee requests the RSWMCC direct the P2 Task Force to expand the existing Peer-to-Peer review program to include awareness about good housekeeping procedures that may help reduce bacteria loading. Additionally, the Committee requests the P2 Task Force continue the modified Peer-to-Peer program over a five-year permit term allowing for reevaluation of program effectiveness.

Table 18. Implementation Strategy 2.0 Summary — MS4 participation in Regional Stormwater Management Program

Targeted Source(s)	Stormwater
Estimated Potential Load Reduction	IS 2.0 – 2.0.1.2 may result in a 10% reduction over 25 years by contributing to the reduction of the stormwater bacteria load through education and cooperative efforts among various stakeholders
Technical and Financial Assistance Needed	Technical: participation in the RSWMP provides technical assistance for MS4s under several areas including construction, illicit discharge, monitoring, pollution prevention, and public education; some technical assistance may be necessary for the RSWMP to incorporate bacteria in their programs Financial: participation in the RSWMP is based on cost share and varies depending on MS4 size; inclusion of bacteria information is unlikely to exceed existing funding sources
Education Component	Outreach to non-participating MS4s regarding benefits of participation in the RSWMP Outreach to RSWMP's RSWMCC for inclusion of bacteria in their existing programs

Schedule of Implementation	Beginning immediately as appropriate Coordination Committee members, technical subcommittee members, and NCTCOG will conduct outreach to non-participants regarding benefits of RSWMP Beginning immediately as appropriate Coordination Committee and technical subcommittee members already involved in RSWMP and/or the RSWMCC will approach the RSWMCC regarding inclusion of bacteria in existing programs and materials
Interim, Measurable Milestone	Non-RSWMP MS4s approached RSWMCC approached for inclusion of bacteria in materials and programs
Progress Indicators	Number of RSWMP participants increases Bacteria-specific information included in RSWMP programs and materials
Monitoring Component	NCTCOG will collect data on RSWMP participation and programs and materials
Responsible Entity	Coordination Committee and technical subcommittee members with ties to RSWMP and/or RSWMCC will conduct outreach to non-participating MS4s and RSWMCC RSWMCC will consider inclusion of bacteria-specific information in RSWMP outreach materials and programs NCTCOG will assist the Coordination Committee and Stormwater technical subcommittee with outreach and will present participation data and material and program updates annually to the Coordination Committee and Stormwater technical subcommittee

Implementation Strategy 2.1: Local Supplemental Environmental Projects

At the state level, the TCEQ defines supplemental environmental projects (SEPs) as, "[A] project that prevents pollution, reduces the amount of pollution reaching the environment, enhances the quality of the environment, or contributes to public awareness of environmental matters." A respondent in an enforcement action may negotiate an agreement to perform a SEP in return for an offset of the administrative penalty. The proposal to include a particular SEP in an agreed order will be presented to the Commission or Executive Director for consideration and final approval. Potential SEPs include such diverse projects as cleanups of abandoned tire sites or illegal dump sites, community collections of household hazardous waste, and pollution prevention projects that exceed regulatory requirements. SEPs that have a direct benefit allow a respondent to offset one dollar of its penalty for every dollar spent on the SEP (TCEQ, 2012a)."

Detailed in Table 19, the purpose of Implementation Strategy 2.1 is to bring the idea of SEPs to the local level — outside of the scope of the state and solely the purview of the individual local jurisdiction. Local SEPs are intended for watershed improvements and other environmentally beneficial projects that a respondent agrees to undertake in settlement of an enforcement action, but which the respondent is not otherwise legally required to perform, and for which he/she does not receive any other benefit. The

local SEPs can be negotiated through the regulatory enforcement process with the city or other regulated MS4s with enforcement capabilities.

The Coordination Committee encourages local municipalities to adopt or continue using local SEPs — separate, but not to the exclusion of the state SEP program — in addition to fines, as part of escalating enforcement programs for unfunded local stormwater projects to reduce bacteria loading. As such, a goal of 75 percent of large municipal MS4s within bacteria-impaired watersheds will have local SEPs as part of stormwater enforcement by 2028 and 25 percent of small municipal MS4s will have such a program by 2033.

Table 19. Implementation Strategy 2.1 Summary — Local Supplemental Environmental Projects

Targeted Source(s)	Stormwater
Estimated Potential Load Reduction	IS 2.1 may result in a 4% reduction over 25 years by providing an additional source of funds that can be used for projects that will reduce bacterial loads. Use of local SEPs may also better engage violators in the process of improving water quality locally
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary for entities to implement their own local SEP program Financial: existing funding as appropriate
Education Component	Information will be made available for local SEP implementation
Schedule of Implementation	75% of large municipal MS4s will have local SEP programs in place by 2028 25% of small municipal MS4s will have local SEP programs in place by 2033
Interim, Measurable Milestone	By 2023, 50% of large municipal MS4s will have local SEP programs in place By 2028, 15% of small municipal MS4s will have local SEP programs in place
Progress Indicators	Number of municipal MS4s with local SEP programs
Monitoring Component	NCTCOG will collect data on municipal MS4 local SEP programs
Responsible Entity	Municipal MS4s will adopt local SEP programs as feasible NCTCOG will compile information on SEP programs for an annual report to Coordination Committee and Stormwater technical subcommittee

Implementation Strategy 2.2: Land use, business, and regulatory review

Analyses by the Project's technical review subcommittee members revealed a potential gap in many existing stormwater codes and regulations with respect to addressing discharges with the potential to carry bacteria. As currently written, many rules, including the base stormwater discharge permits, focus on chemical or physical constituents, such as toxic chemicals or sediment, but may not completely address bacterial sources or discharges. Examples of facilities that may pose a risk for bacterial discharge include but are not limited to: slaughterhouses and meat-processing facilities, stables and pet-boarding facilities, sewage processors, produce packing facilities, and farmer's markets. Implementation strategies for land use and business evaluation are summarized in Table 20.

2.2.1: Business risk evaluation and enforcement

Municipalities will review their respective codes and ordinances and, as feasible, revise as necessary to address the discharge of bacteria, nutrients, and other substances that could contribute to bacterial growth in the environment.

2.2.2: Request to TCEQ for Industrial Stormwater Multi-Sector General Permit classification review and benchmark bacteria monitoring

TCEQ is encouraged to review, and as necessary amend the TPDES No. TXR050000, Multi-Sector General Permit (MSGP) to require facilities located in bacteria-impaired watersheds with operations having the potential to discharge bacteria, (such as the current Sector U, Food and Kindred Products Facilities), to perform benchmark sampling for bacteria.

Table 20. Implementation Strategy 2.2 Summary — Land use, business, and regulatory review

Targeted Source(s)	Businesses/facilities at risk for bacterial discharge
Estimated Potential Load Reduction	IS 2.2 – 2.2.2 may result in a 2% reduction in bacteria loading as problems are identified and corrected over 25 years
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary for MS4s to develop and study their own land use and evaluate businesses with potential to discharge bacteria Financial: loans, grant funding and existing funding as appropriate
Education Component	Outreach to MS4s concerning land use and business evaluation may be necessary Educational efforts by MS4s regarding operations and land use to businesses with potential to discharge bacteria Outreach to impacted businesses should TCEQ amend MSGP requirements
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process

Interim, Measurable Milestone	Number of local evaluations completed Number of site visits to businesses with potential to discharge bacteria
Progress Indicators	Number of reported program expansion and/or modifications to address high risk businesses Changes to MSGP requirements
Monitoring Component	NCTCOG will collect data on local efforts and any changes to the TCEQ MSGP
Responsible Entity	MS4s will evaluate local land use and businesses for potential for bacteria discharges NCTCOG will coordinate dialogue between MS4s, stakeholders and TCEQ to identify potential modifications to the MSGP that will aid in addressing bacteria as a pollutant and benchmark bacteria monitoring NCTCOG will compile data collected on local efforts and any changes to the TCEQ MSGP and present it annually to Coordination Committee and Stormwater technical subcommittee

Table 21. MS4 Permittees by AU for 0805 and 0822 Segments

AU	MS4 Permittees	River System	Segment	TPDES Permit Number
0805_03	City of Dallas	Upper Trinity	Fivemile Creek upstream to the confluence of Cedar Creek	WQ0004396
0805_03	TxDOT – Dallas	Upper Trinity	Fivemile Creek upstream to the confluence of Cedar Creek	WQ0004521
0805_03	North Texas Tollway Authority	Upper Trinity	Fivemile Creek upstream to the confluence of Cedar Creek	WQ0004400
0805_03	Dallas Area Rapid Transit	Upper Trinity	Fivemile Creek upstream to the confluence of Cedar Creek	TXR040000
0805_04	City of Dallas	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	WQ0004396
0805_04	City of Irving and co-permittees: Dallas Co. Flood Control District #1, Dallas County Utility & Reclamation District, Irving Flood Control District Sections I & III	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	WQ0004691
0805_04	TxDOT – Dallas	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	WQ0004521
0805_04	North Texas Tollway Authority	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	WQ0004400
0805_04	City of University Park	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	TXR040000
0805_04	Town of Highland Park	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	TXR040000
0805_04	City of Cockrell Hill	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	TXR040000
0805_04	Dallas Area Rapid Transit	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	TXR040000

AU	MS4 Permittees	River System	Segment	TPDES Permit Number
0805_04	Buckley Oil Company [b]	Upper Trinity	Confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River	WQ0004663
0822A	City of Irving and co-permittees: Dallas Co. Flood Control District #1, Dallas County Utility & Reclamation District, Irving Flood Control District Sections I & III	Cotton Wood Branch	2.5 mile stretch of Cottonwood Branch running upstream from confluence with Hackberry Creek	WQ0004691
0822A	North Texas Tollway Authority	Cotton Wood Branch	2.5 mile stretch of Cottonwood Branch running upstream from confluence with Hackberry Creek	WQ0004400
0822A	DFW International Airport [a]	Cotton Wood Branch	2.5 mile stretch of Cottonwood Branch running upstream from confluence with Hackberry Creek	TXR040000
0822B	City of Irving and co-permittees: Dallas Co. Flood Control District #1, Dallas County Utility & Reclamation District, Irving Flood Control District Sections I & III	Grapevine Creek	Entire water body	WQ0004691
0822B	City of Dallas	Grapevine Creek	Entire water body	WQ0004396
0822B	TxDOT– Dallas	Grapevine Creek	Entire water body	WQ0004521
0822B	City of Coppell	Grapevine Creek	Entire water body	TXR040000
0822B	DFW International Airport [a]	Grapevine Creek	Entire water body	TXR040000

[a] Includes five outfalls covered under an individual industrial stormwater permit (WQ0001441).
[b] Individual industrial stormwater permit included as part of the MS4 allocation.

Table 22. MS4 Permittees by AU for 0841 Segments

AU	MS4 Permittees	River System	Segment	TPDES Permit Number
0841_01	City of Irving and co-permittees: Dallas Co. Flood Control District #1, Dallas County Utility & Reclamation District, Irving Flood Control District Sections I & III	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	WQ0004691
0841_01	City of Arlington and co-permittees: University of Texas at Arlington and TxDOT-Fort Worth	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	WQ0004635
0841_01	City of Dallas	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	WQ0004396
0841_01	City of Fort Worth and co-permittees: Tarrant Regional Water District, and TxDOT-Fort Worth	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	WQ0004350
0841_01	North Texas Tollway Authority	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	WQ0004400
0841_01	TxDOT – Dallas	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	WQ0004521
0841_01	City of Grand Prairie	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	City of Keller	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	City of Colleyville	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	City of Southlake	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	City of Grapevine	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000

AU	MS4 Permittees	River System	Segment	TPDES Permit Number
0841_01	City of Euless	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	City of North Richland Hills	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	City of Bedford	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	City of Hurst	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	Tarrant County	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	Dallas County	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	TxDOT – Fort Worth	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	DFW International Airport [a]	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	Dallas Area Rapid Transit	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	North Texas Tollway Authority	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	Dallas Co. Flood Control Dist. No. 1	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	TXR040000
0841_01	Extex LaPorte LP [b]	Lower West Fork Trinity River	Confluence of the Elm Fork Trinity River to the confluence with Johnson Creek	WQ0001250

[a] Includes five outfalls covered under an individual industrial stormwater permit (WQ0001441).

[b] Individual industrial stormwater permit included as part of the MS4 allocation.

AU	MS4 Permittees	River System	Segment	TPDES Permit Number
0841_02	City of Arlington and co-permittees: University of Texas at Arlington and TxDOT-Fort Worth	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	WQ0004635
0841_02	City of Fort Worth and co-permittees: Tarrant Regional Water District, and TxDOT-Fort Worth	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	WQ0004350
0841_02	TxDOT – Dallas	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	WQ0004521
0841_02	City of North Richland Hills	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	City of Hurst	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	City of Bedford	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	City of Grand Prairie	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	City of Euless	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	City of Dalworthington Gardens	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	Town of Pantego	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	City of Kennedale	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	City of Colleyville	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000

AU	MS4 Permittees	River System	Segment	TPDES Permit Number
AU	**MS4 Permittees**	**River System**	**Segment**	**TPDES Permit Number**
0841_02	Tarrant County	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	Tarrant County College NE	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	TxDOT-Fort Worth	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000
0841_02	Dallas Area Rapid Transit	Lower West Fork Trinity River	From the confluence with Johnson Creek upstream to the confluence of Village Creek.	TXR040000

Table 23. TPDES and NPDES MS4 Permits associated with Segments 0841F, 0841K, 0841N, and 0841V

AU	MS4 Permittees	River System	Segment	TDPES Permit Number
0841K_01	City of Arlington	Fish Creek	From the confluence with Mountain Creek Reservoir in Grand Prairie, Dallas Co, to the upper end of the creek in Arlington, Tarrant Co.	TXS000301
0841V_01	City of Dallas	Crockett Branch	From the confluence with Cottonwood Creek to the upper end of the creek.	TXS000701
0841F_01	City of Grand Prairie	Kirby Creek	From the confluence with Fish Creek in Grand Prairie, Dallas Co. to just upstream of Great Southwest Parkway in Arlington, Tarrant Co.	TXR040065
0841N_01	Dallas County	Cottonwood Creek	6.5 mile stretch of Cottonwood Creek running upstream from approx. 1 mi. upstream of Mountain Creek Reservoir in Dallas Co. to SH 360 in, Tarrant Co.	TXR040120
0841K_01	Tarrant County	Fish Creek	From the confluence with Mountain Creek Reservoir in Grand Prairie, Dallas Co, to the upper end of the creek in Arlington, Tarrant Co.	TXR040052

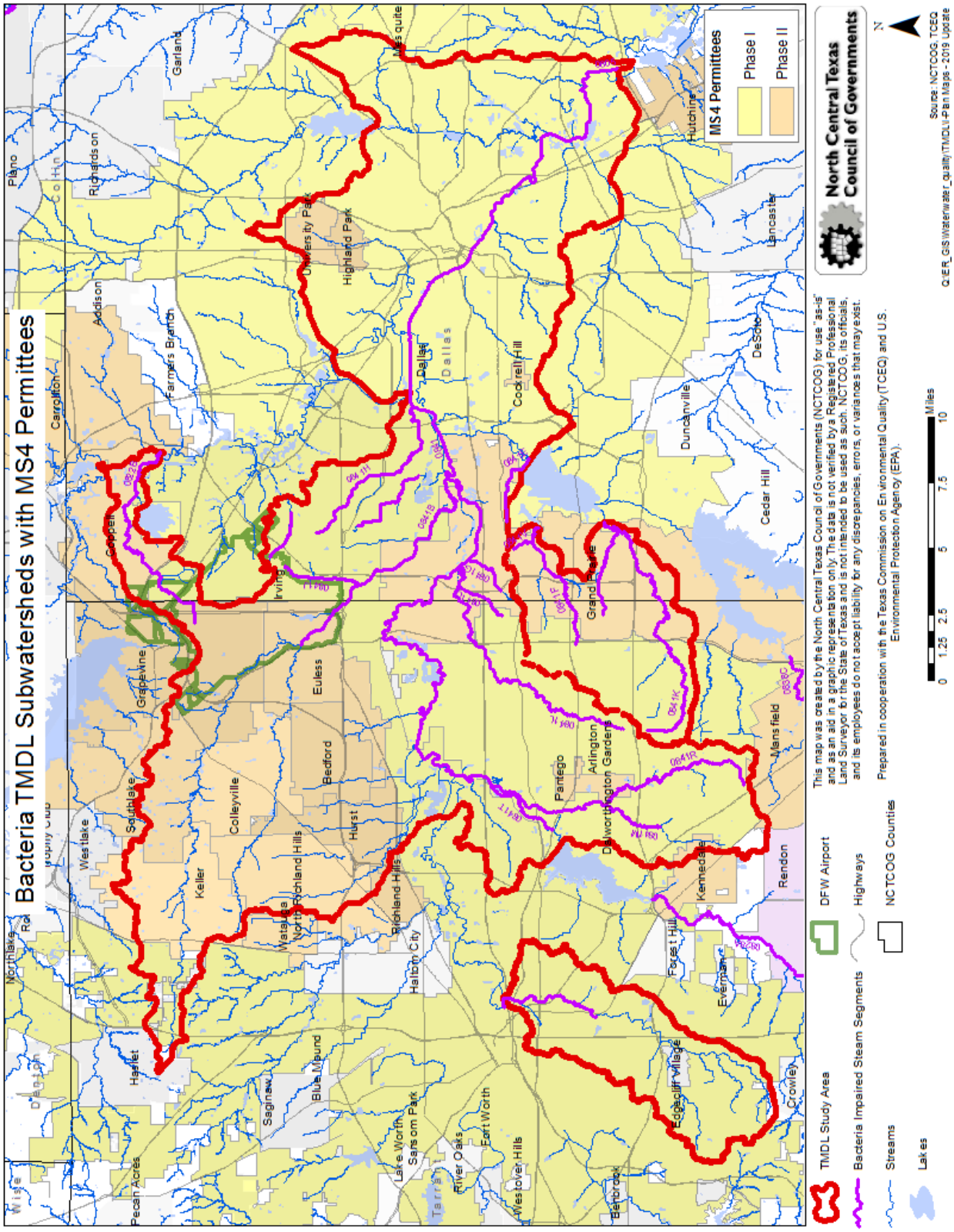
Table 24. TPDES and NPDES MS4 Permits associated with Segment 0806E

AU	MS4 Permittees	River System	Segment	NDPES Permit Number
0806E_01	City of Fort Worth, Tarrant Regional Water District	Sycamore Creek	A 5 mile stretch of Sycamore Creek running upstream from the confluence with the West Fork Trinity River to the confluence with Echo Lake Tributary in Fort Worth.	TXS000901
0806E_01	Texas Department of Transportation	Sycamore Creek	A 5 mile stretch of Sycamore Creek running upstream from the confluence with the West Fork Trinity River to the confluence with Echo Lake Tributary in Fort Worth.	TXS002101
0806E_01	Town of Edgecliff Village	Sycamore Creek	A 5 mile stretch of Sycamore Creek running upstream from the confluence with the West Fork Trinity River to the confluence with Echo Lake Tributary in Fort Worth.	TXR040595
0806E_01	Tarrant County	Sycamore Creek	A 5 mile stretch of Sycamore Creek running upstream from the confluence with the West Fork Trinity River to the confluence with Echo Lake Tributary in Fort Worth.	TXR040052

Table 25. RSWMP Participation in Project Area as of FY2019

Cost Share Regional Stormwater Management Program (RSWMP) Participants	Non-Participants
City of Arlington	City of Cockrell Hill
City of Bedford	City of Dalworthington Gardens
City of Colleyville	City of Haslet
City of Coppell	City of Keller
City of Dallas	North Texas Tollway Authority
City of Euless	TxDOT Dallas District
City of Fort Worth	Town of Pantego
City of Grand Prairie	
City of Grapevine	
City of Hurst	
City of Irving	
City of Kennedale	
City of North Richland Hills	
City of Southlake	
City of University Park	
Dallas Area Rapid Transit	
DFW Airport	
Dallas County	
Tarrant County	
TxDOT Fort Worth District	
Town of Highland Park	

Figure 9. MS4s in Project Area



Planning and Development Implementation Strategies

The Greater Trinity River Bacteria TMDL I-Plan Project area has experienced rapid population growth resulting in increased land development, which in turn has led to challenges in maintaining waterways as areas for recreation. According to the 2010 US Census, the project area is home to 1.33 million people and given its mostly urban, suburban, and industrial land uses, the aggregate impact of so many people and impervious surfaces has the ability to impact bacteria levels in the waterways. Figure 10 shows land use in the Project area based on 2015 data, Figure 11 shows land cover and Figure 12 shows population density based on 2010 US Census information (NCTCOG, 2012a).

Concerns about population growth, the associated stormwater from development, and the impact on stormwater quality must be addressed as part of reducing bacteria levels. Green infrastructure (GI) uses vegetation, soils, and natural processes to manage water and create healthier urban environments. At the scale of a city or county, GI refers to the patchwork of natural areas that provides habitat, flood protection, lowered bacteria loading, and cleaner water. Brought to the scale of a neighborhood or site, GI refers to stormwater management systems that mimic nature by soaking up and storing water (USEPA, 2012a).

Similar, although not identical to GI, is low impact development (LID). LID is an approach to land development (or redevelopment) that works with nature to manage stormwater as close to its source as possible. LID employs principles, such as preserving and recreating natural landscape features, and minimizing effective imperviousness to create functional and appealing site drainage that treats stormwater as a resource rather than a waste product. There are many practices that have been used to adhere to these principles such as bioretention facilities, rain gardens, vegetated rooftops, rain barrels, and permeable pavements. By implementing LID principles and practices, water can be managed in a way that reduces the impact of built areas and promotes the natural movement of water within an ecosystem or watershed. Applied on a broad scale, LID can maintain or restore a watershed's hydrologic and ecological functions. LID has been characterized as a sustainable stormwater practice by the Water Environment Research Foundation and others (USEPA, 2012b).

Another tool for reducing stormwater impact is the *integrated* Stormwater Management (iSWM) Program for Construction and Development, a cooperative initiative through NCTCOG that assists cities and counties to achieve their goals of water quality protection, stream bank protection, and flood mitigation, while also helping communities meet their construction and post-construction obligations under state stormwater permits.

iSWM considers that development and redevelopment by their nature increase the amount of imperviousness in the surrounding environment. This increased imperviousness translates into loss of natural areas, more sources for pollution, such as bacteria, in runoff, and heightened flooding risks. To help mitigate these impacts, more than 60 local governments in the NCTCOG region are cooperating to proactively create sound stormwater management guidance for the region through the iSWM Program (NCTCOG, 2012b).

Figure 10. Land Use in Project Area

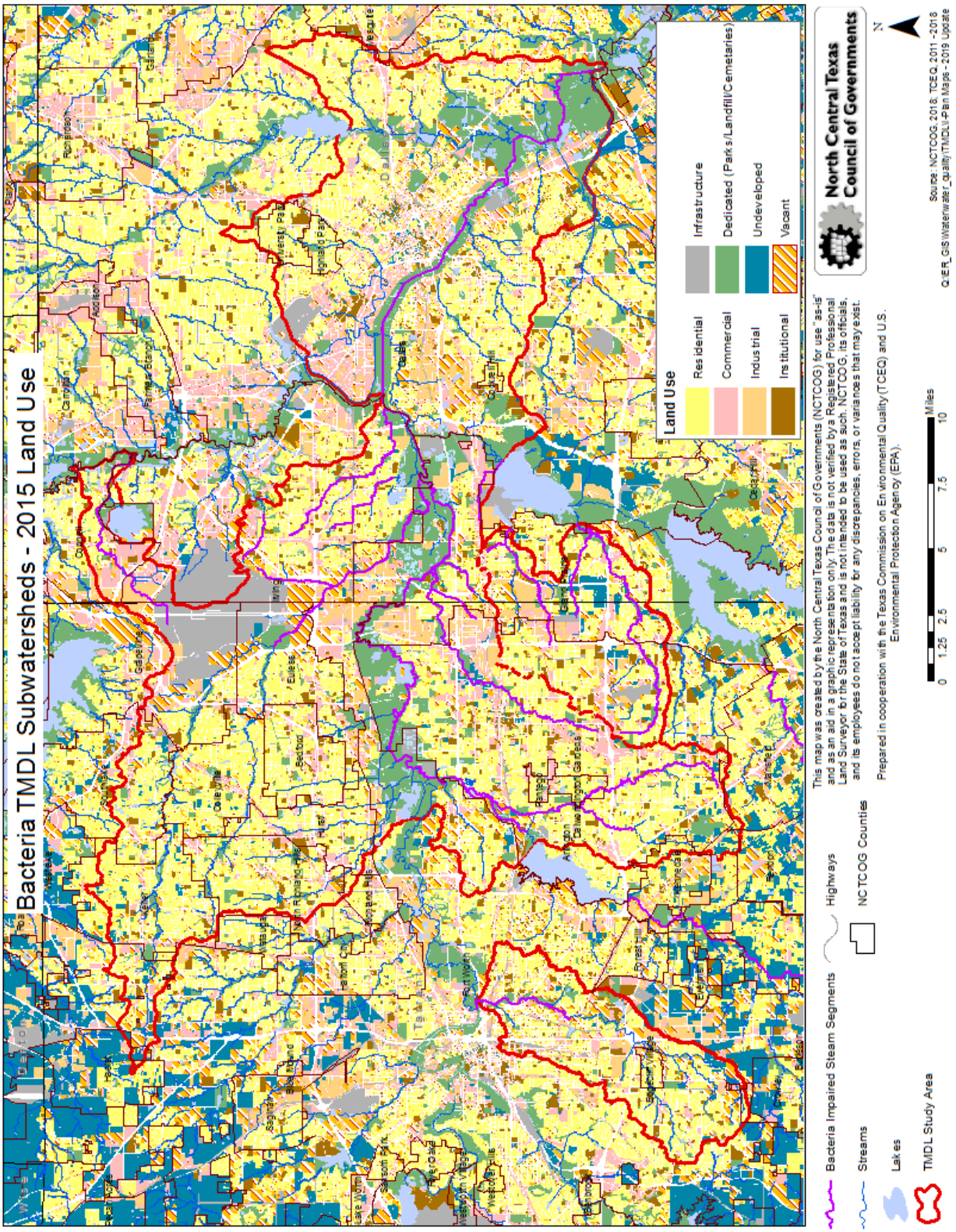


Figure 11. Land Cover in Project Area

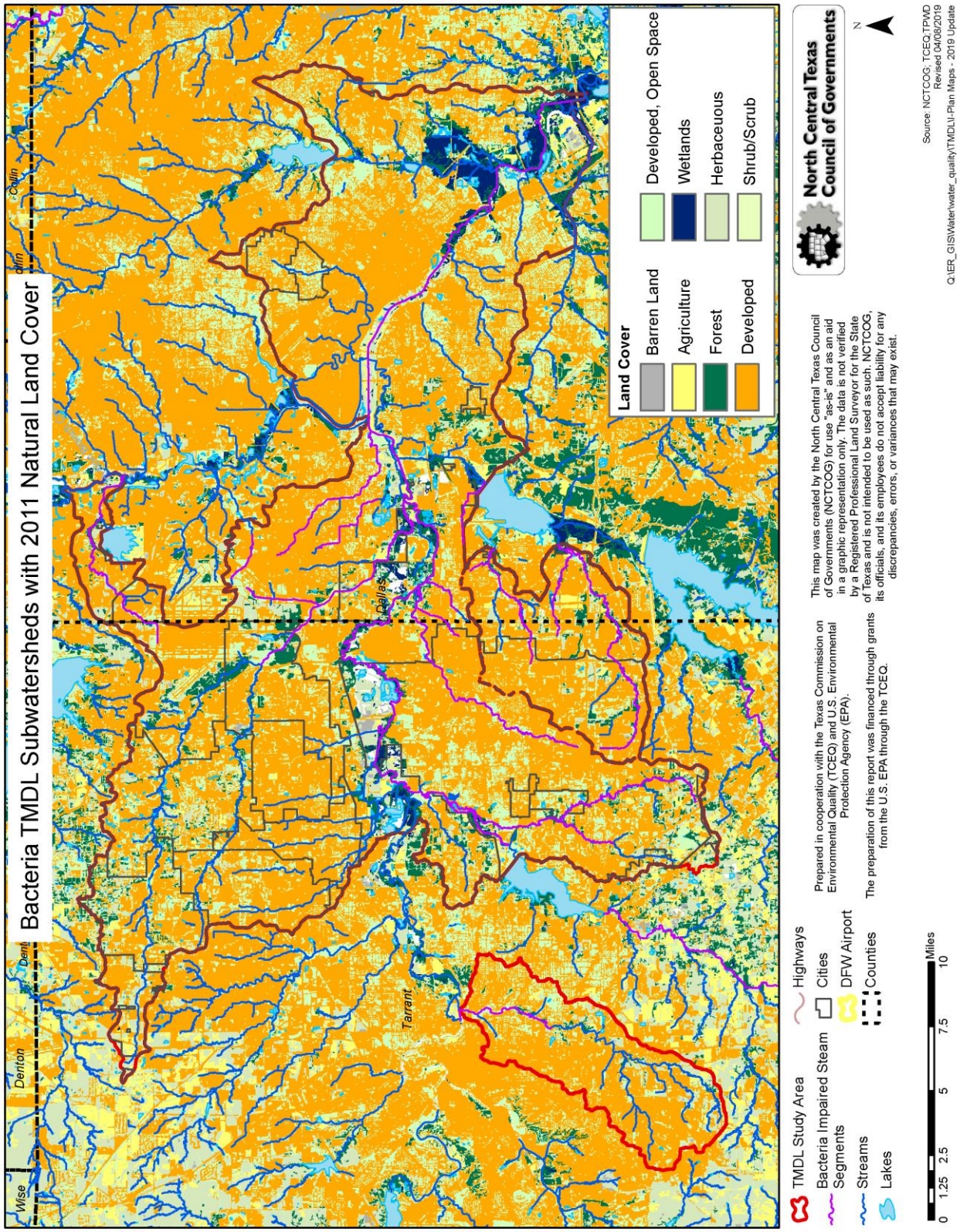
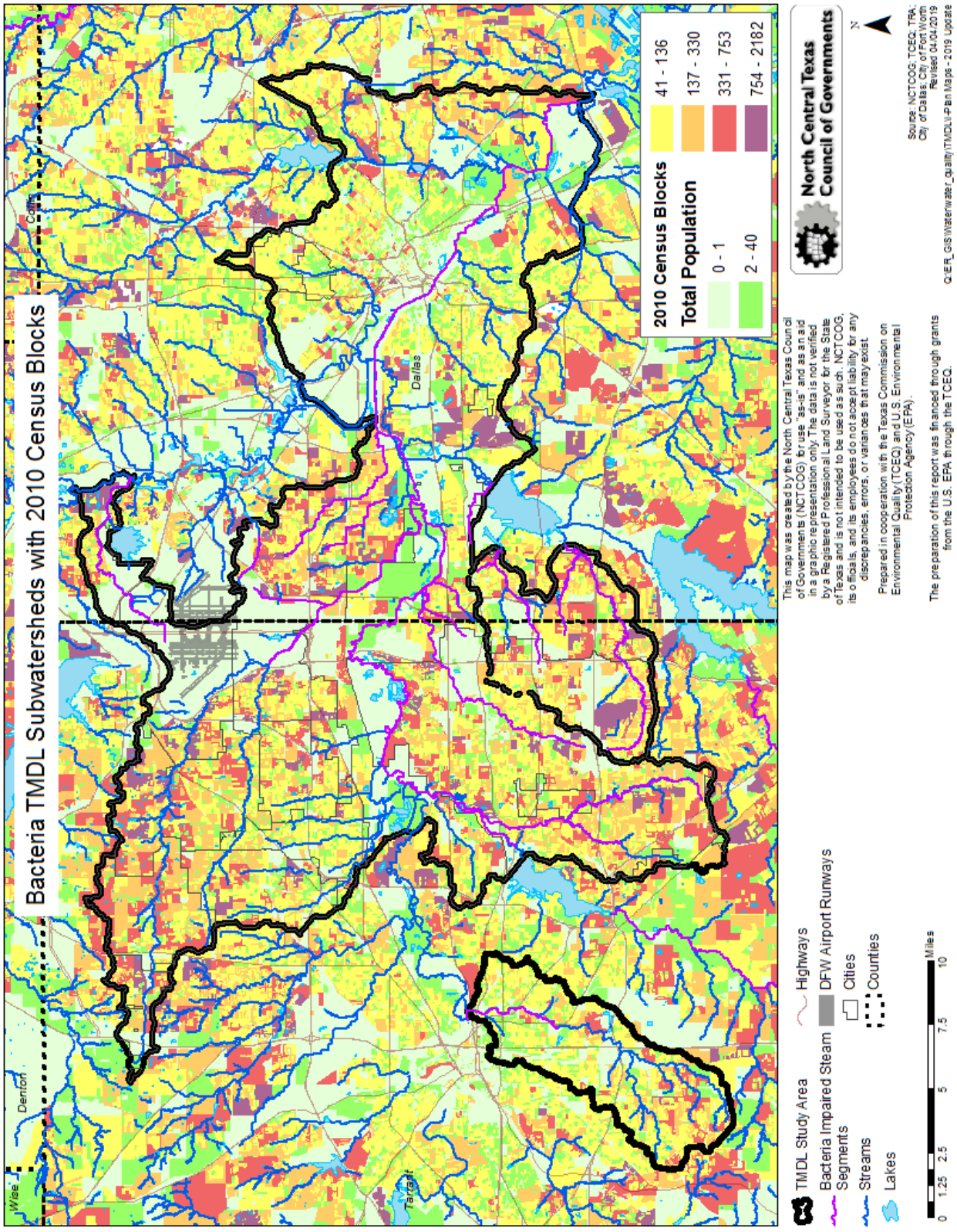


Figure 12. Population Density from 2010 US Census Data



Implementation Strategy 3.0: Adoption of green infrastructure and low impact development standards by municipalities

Stakeholders are committed to expanding the use of GI, LID, and iSWM throughout the Project area. Although none of these practices focuses specifically on bacteria, measures slowing stormwater flow and increasing filtration will reduce bacteria carried by sheet flow into storm drains, creeks, and lakes thereby helping to reduce bacteria loading in the watersheds of the Project area. The Coordination Committee encourages 25 percent of municipalities within bacteria-impaired watersheds to adopt GI and/or LID standards for all sizes of development in their comprehensive plans by 2023 and 50 percent of cities do so by 2038. Implementation strategies for GI and LID are summarized in Table 26.

3.0.1: Reevaluation of development standards based on monitoring data

The lack of applicable data makes it difficult to assess the impact of implementation of practices like LID and GI and programs like iSWM. The current lack of information makes it even more important for stakeholders to do their own internal study of the effectiveness of development standards using stream monitoring data. Municipal stakeholders are encouraged to reevaluate development standards based on monitoring data no less than every five years in conjunction with the MS4 permit cycle.

3.0.2: Municipal ordinance evaluation for water quality impediments

By 2017, 25 percent of municipal stakeholders will evaluate their ordinances for impediments that discourage homeowners and businesses from actions or practices that may improve water quality. Fifty percent of municipalities will do so by 2023. Examples of impediments may include prohibitions on cisterns, rain barrels, or permeable pavement.

3.0.3: Internal policy and procedure integration and improved communication for municipalities

Municipal stakeholders are encouraged to evaluate city departmental structure and internal operations to better integrate policies and practices and improve communication between related departments. Additionally, municipalities are encouraged to evaluate internal practices and procedures for impediments to cooperation among stormwater-related divisions and departments with related goals, such as parks and recreation, public works, planning and development, and environmental management.

Table 26. Implementation Strategy 3.0 Summary — Adoption of GI and LID standards by municipalities

Targeted Source(s)	Construction, development, and redevelopment
Estimated Potential Load Reduction	IS 3.0 – 3.0.3 may result in a 40% reduction in bacteria loading if GI and LID are implemented to the fullest extent possible over the next 25 years

Technical and Financial Assistance Needed	Technical: engineering and/or technical assistance may be necessary to implement changes including the adoption of LID/GI standards, reevaluating development standards based on monitoring data, inclusion of construction BMPs, post construction review, and demonstration projects Financial: loans, grants, local SEPs, and existing funding as appropriate
Education Component	Sample ordinances will be developed as resources are available Outreach to local entities as to the importance of measuring BMP results Sample SOPs for evaluating internal procedures will be developed as resources are available Online resources will include pertinent materials
Schedule of Implementation	25% of municipalities will evaluate their ordinances for impediments that discourage actions or practices that may improve water quality by 2017 with 50% doing so by 2023 25% of municipalities encouraged to adopt LID/GI standards by 2023 with 50% adopting such standards by 2038 Other provisions for sample ordinances, sample SOPs, and online resources to be implemented immediately as resources are available
Interim, Measurable Milestone	Municipalities evaluating their ordinances Municipalities with LID/GI requirements in their ordinances Municipalities measuring BMP results Municipalities using LID/GI in demonstration projects
Progress Indicators	Number of ordinances evaluated Number of ordinances containing LID/GI requirements Results from BMP monitoring available in BMP Library (see IS 8.0) Number of pilot project results available in the BMP Library
Monitoring Component	NCTCOG and the Stormwater technical subcommittee will collect information regarding ordinances and projects

Responsible Entity	Municipalities will evaluate their respective ordinances, adopt LID/GI as feasible, measure BMP results, and make those results available for inclusion in BMP Library Municipalities will adopt LID/GI as feasible, measure BMP results, and make those results available for inclusion in BMP Library NCTCOG and Stormwater technical subcommittee will collect information on ordinances and projects for inclusion in an annual report to Coordination Committee

Implementation Strategy 3.1: Recognition program participation

Recognition programs that provide awards for GI and LID development increase awareness of the benefits of these practices and help promote adoption throughout the Project area. Stakeholders and NCTCOG encourage voluntary participation in existing recognition programs. Several voluntary programs that promote land development and stormwater have been developed or are being developed, including, but not limited to: Celebrating Leadership in Development Excellence, Leadership for Energy & Environmental Design for Neighborhood Development Rating System; International Green Construction Code; and National Green Building Standard. Although these programs do not focus specifically on bacteria reduction, they do contain elements that promote uses of GI and LID that may help reduce bacteria loading. As summarized in Table 27, the Coordination Committee encourages local governments and land developers to promote these programs and similar programs as appropriate.

3.1.1: Local policy and regulation evaluation for impediments for participation

Local governments should analyze their own regulations and programs in an effort to eliminate hurdles to the attainment of the requirements in these programs. For example, zoning density standards, storm sewer connection requirements, and minimum parking and road widths, can limit opportunities for GI.

3.1.2: Promotional efforts for recognition programs

NCTCOG and stakeholders will make an effort to publicize programs and winning projects in order to further educate the general public, elected officials, and private sector businesses about the benefits of LID and GI.

Table 27. Implementation Strategy 3.1 Summary — Recognition program participation

Targeted Source(s)	Construction, development, and redevelopment
Estimated Potential Load Reduction	IS 3.1 – 3.1.2 may result in a 4% reduction over 25 years and is intended to encourage greater use of GI and LID, which should assist in reducing stormwater bacteria loads

Technical and Financial Assistance Needed	Technical: no technical assistance is necessary for this activity Financial: financial assistance through loans, grant and local funding and SEPs
Education Component	NCTCOG and participating stakeholders will promote and encourage participation in voluntary recognition programs that encourage GI/LID Stakeholders will evaluate ordinances, policies, and procedures for impediments for participation in such programs
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Increased local participation in LID/GI building contests and programs
Progress Indicators	Number of participants Fewer impediments to participation
Monitoring Component	Number of participants and number of programs identified
Responsible Entity	Participating stakeholders and NCTCOG will work to promote participation in voluntary recognition programs for GI/LID as feasible

Implementation Strategy 3.2: Construction sites

Continued population growth in the Greater Trinity River Bacteria TMDL I-Plan Project area creates a demand for new structures and expanded infrastructure. Construction sites for residential, commercial, and linear projects are common throughout the region. Although construction sites are not generally viewed as significant sources of bacteria, they can contribute sediment and nutrients through runoff and erosion and poorly managed portable toilet facilities (as detailed in Implementation Strategy 1.7.2). Bacteria may be found at construction sites in products used for fertilization and landscaping and from improper disposal of on-site sanitary wastes. Bacteria may also attach to sediment. Runoff from construction sites may contain constituents, such as nutrients, solids, fine particles, and other solid material, which could potentially influence bacteria levels in waterways.

When a construction site complies with the TCEQ Construction General Permit (CGP), TXR150000, as well as local stormwater management regulations, sediment and bacteria in runoff can be minimized. Problems arise when construction sites do not have adequate erosion and sediment controls. The Coordination Committee believes construction site regulations are adequate, in that they require sediment be retained on-site to the extent practicable. It is the small number of state or local enforcement staff, faced with an overwhelming number of construction sites at any given time, which accounts for the inadequate enforcement of and, subsequently, limited compliance with the CGP in some areas. Table 28 summarizes the implementation strategies for construction sites.

3.2.1: Construction site inspection programs

As applicable, enforcement at construction sites should be intensified by increasing the percentage of sites inspected. TCEQ, through implementation of Minimum Control Measure (MCM) 4, local governments or other MS4 operators, will evaluate the need for staffing an appropriate construction inspection program. Additional inspectors will be obtained if needed and as resources are available.

3.2.2: Educational materials for contractors, site owners, developers, and MS4 operators

As resources are available, NCTCOG and stakeholders will develop and distribute to MS4s educational material to inform contractors, construction site owners, developers, and MS4 operators of proper construction site practices. These educational materials are intended to encourage conformance with requirements by regulated entities. Educational materials will also have specific components to address contractors, construction site owners, and MS4 operator education. The material will discuss why it is important to prevent sediment from leaving construction sites, outline general regulations to which a construction site must adhere, and provide contact information for reporting suspected violations. Examples of publications that might be used as models are those in the iSWM Program: iSWM Criteria Manual, iSWM Technical Manual, iSWM Tools, and iSWM Program Guidance.

3.2.3: Citizen participation and education efforts

As resources allow, educational materials will also be used to foster active citizen participation in improving water quality through the reporting of construction sites with poor housekeeping and sediment control practices. This public education effort may be combined with efforts described in other sections of the I-Plan to expand homeowner education efforts throughout the region to take advantage of economies of scale. Increasing citizen knowledge may increase the likelihood of stormwater violations being reported and subsequently may increase the number of construction sites being brought into compliance.

3.2.4: Training workshops

As resources are available, NCTCOG will conduct training workshops for contractors, construction site owners, developers, and MS4 operators regarding stormwater management BMPs and encourage them to require training of their crews. Contractors, construction site owners, developers, and MS4 operators are responsible for ensuring compliance. Therefore, it is in their best interest to ensure that construction workers under their supervision are properly trained in the installation and maintenance of erosion and sediment controls. As resources are available, NCTCOG will develop training workshops about existing and emerging construction site BMPs and requirements. The workshops will be designed to help operators communicate requirements to employees. Private construction operations should not be the only target of this activity. Local government departments, municipal districts, and other government entities involved in construction, and their contractors and subcontractors, also must properly install and maintain erosion and sediment controls and educate their personnel. Training local government inspectors is also essential in the effort to improve compliance.

3.2.5: Use of BMPs for infrastructure maintenance

MS4s engaged in infrastructure maintenance should utilize BMPs to reduce discharge that may contain sediment.

3.2.6: Reevaluation of construction site education programs and possible voluntary certification program

The Coordination Committee, through the recommendations of the Stormwater Technical Subcommittee, will evaluate construction site training programs every five years in conjunction with the MS4 permit term for possible inclusion into a voluntary certification program.

Table 28. Implementation Strategy 3.2 Summary — Construction sites

Targeted Source(s)	Construction, development, and redevelopment
Estimated Potential Load Reduction	IS 3.2 – 3.2.6 may result in a 4% reduction in bacteria loading implemented to the fullest extent possible over the next 25 years
Technical and Financial Assistance Needed	Technical: the expertise and assistance of stormwater management professionals will be necessary to develop educational and training materials Financial: salaries for additional inspectors for local communities, and financial support for educational materials and training will be funded through a mixture of state, local, and grant funding
Education Component	Educational materials explaining proper construction site practices will be developed and distributed to contractors, construction site owners, MS4 operators, developers, and citizens Training workshops will be held for contractors, construction site owners and operators, developers, and MS4 operators regarding stormwater management BMPs
Schedule of Implementation	As resources are available, the implementation of these activities will begin immediately and will continue for the entire implementation process At five year intervals efficacy of the strategies will be reevaluated
Interim, Measurable Milestone	Evaluations conducted regarding the need or requirement for staffing an appropriate construction inspection program and subsequent increases in staffing levels as needed Development, distribution, and offering of educational materials and trainings

Progress Indicators	Increases in inspection capacity Number of educational materials distributed and number of groups receiving educational materials Number of trainings offered and number of attendees Number of Strategies reevaluated
Monitoring Component	Annual report on progress indicators to the Coordination Committee from NCTCOG
Responsible Entity	MS4s will evaluate the need or requirement for staffing for appropriate construction inspection programs, increase staffing as needed and as resources are available, and report progress indicators to NCTCOG NCTCOG and stakeholders will develop and distribute educational materials and develop and offer trainings as resources are available NCTCOG will report to Coordination Committee on progress indicators NCTCOG will coordinate a dialogue between the stakeholders and TCEQ targeting opportunities for enhancing the effectiveness of construction site inspections by TCEQ where feasible, through enhanced resources or inspection management strategies

Pets, Livestock, and Wildlife Implementation Strategies

E. coli bacteria are common inhabitants of the intestines of all warm-blooded animals, including mammals and birds. As such, the potential for bacteria loading in waterways from pets, livestock, wildlife, and unmanaged feral animals was an important consideration in the development of this I-Plan. Wildlife and feral hogs are naturally attracted to riparian corridors of streams and rivers. With direct access to the stream channel, the direct deposition of wildlife waste can be a concentrated source of bacteria loading to a water body. Fecal bacteria from wildlife are also deposited onto land surfaces, where it may be washed into nearby streams by rainfall runoff. Like wildlife, livestock can also be concentrated around riparian areas. In the Dallas-Fort Worth metropolitan area, there is little open space for the housing of livestock — with the notable exception of the floodplain. This close proximity to the Trinity River and major tributaries and the direct deposition of livestock waste as its own concentrated source cannot be ignored as a potential contributor to *E. coli* levels in the Project area.

For the sake of this I-Plan, pets are defined exclusively as cats and dogs. Table 29 details pet populations by impaired stream segment. With a cat and dog population well over a half million within the Project area, the probable contribution of their waste to *E. coli* levels makes them too important to ignore even with the difficulties in estimating actual loading levels.

Table 29. Dog and Cat Population by Impaired Segment

AU	Est. number of households	Estimated number of Dogs and Cats*	
		Dogs	Cats
0805_03	93,765	59,259	66,854
0805_04	94,475	59,709	67,361
0822A_02	5,602	3,540	3,994
0822B_01	11,673	7,377	8,323
0841_01	5,935	3,751	4,232
0841_02	35,089	22,176	25,018
0841B_01	32,344	20,441	23,061
0841C_01	1,410	891	1,006
0841E_01	321	203	229
0841F_01	9,454	5,521	6,032
0841G_01	2,823	1,784	2,013
0841H_01	18,254	11,537	13,015
0841J_01	3,941	2,490	2,810
0841K_01	22,422	13,094	14,305
0841L_01	25,612	16,187	18,261
0841M_01	10,425	6,589	7,433
0841N_01	3,342	1,952	2,132
0841R_01	32,278	20,399	23,014
0841T_01	16,437	10,388	11,719
0841U_01	7,508	4,745	5,353
0841V_01	1,850	1,081	1,180
0806E_01	55,857	32,463	35,464
TOTAL	**490,817**	**305,577**	**342,809**

*0805 segment information from 2011 TCEQ report, *Two Total Maximum Daily Loads for Indicator Bacteria in the Upper Trinity River, Dallas, Texas*; 0822 segment information from 2011 TCEQ report, *Two Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Branch and Grapevine Creek*; and 0841 data from 2013 TCEQ report, *Thirteen Total Maximum Daily Loads for Indicator Bacteria in the Lower West Fork Trinity River Watershed* and 2016 TCEQ report, *Four Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake; and 0806E segment information from 2019 TCEQ Report, One Total Maximum Daily Load for Indicator Bacteria in Sycamore Creek.*

Implementation Strategy 4.0: Feral hog management

According to the Texas Parks and Wildlife Department (TPWD), feral hogs are listed as a nuisance species in Texas, which means they can be taken anytime with no season or quotas. Feral hogs are domestic hogs that either escaped or were released for hunting purposes. Hogs have four continuously growing tusks (two on top, two on bottom) and their contact causes a continuous sharpening of the lower tusks — making them a formidable weapon. They have relatively poor eyesight but have keen senses of hearing and smell. Feral hogs are distributed throughout much of Texas, frequently sharing the same habitat as white-tailed deer. Populations in Texas are thought to be on the rise and that increase in population and distribution is due in part to intentional releases, improved habitat, increased wildlife management, and improved animal husbandry through disease eradication, limited natural predators,

and high reproductive potential. There appear to be very few inhibiting factors to curtail the feral hog's population growth and distribution although extreme arid conditions may impede it.

Feral hogs compete directly with livestock as well as game and nongame wildlife species for food. However, the main damage caused to livestock and wildlife is indirect destruction of habitat and agriculture commodities. Rooting and trampling activity for food can damage agricultural crops, fields, and livestock feeding and watering facilities. Critical to bacteria control efforts, feral hogs also destabilize wetland areas, springs, and creeks by excessive rooting and wallowing, and their waste contributes to bacteria loading (TPWD, 2003). Implementation strategies for feral hogs are summarized in Table 30.

4.0.1: Annual feral hog management workshop

With continuous effort, feral hogs can be managed. The Texas Wildlife Services, formerly the Texas Wildlife Damage Management Service, a division of the Texas AgriLife Extension Service, and TPWD are valuable resources for training, technical assistance, and direct control in wildlife damage management including feral hog populations. As resources allow, NCTCOG will take advantage of the services provided by the Texas Wildlife Services and TPWD by arranging one feral hog management workshop for stakeholders annually for five years beginning in 2014. If interest in workshops remains strong after five years, NCTCOG will continue to arrange workshops within the area covered by this I-Plan.

4.0.2: Feral hog management forum

With the intent of promoting coordinated control efforts, NCTCOG will facilitate a twice-yearly forum of local municipalities and other agencies focused on feral hog control and education efforts, evaluating BMPs, and discussing existing programs regionally and nationally.

4.0.3: Feral hog management program

With the widespread impact of feral hogs, their breeding success, and their ability to travel long distances using riparian corridors (TPWD, 2003), the Coordination Committee encourages all municipalities to adopt feral hog control programs and to communicate and cooperate on feral hog control and education efforts, including participation in the feral hog management forum.

4.0.4: Feral hog management funding opportunities

NCTCOG and stakeholders will seek funding opportunities, including grants and SEPs, for municipalities with financial need for a feral hog control program.

Table 30. Implementation Strategy 4.0 Summary — Feral hog management

Targeted Source(s)	Feral hogs
Estimated Potential Load Reduction	IS 4.0 – 4.0.4 may result in a 5% reduction in bacteria loading contributed by increasing numbers of feral hogs over 25 years

Technical and Financial Assistance Needed	Technical: existing resources such as feral hog management trainings offered by TPWD, Texas Wildlife Services, and others Financial: grant funding and existing program funding
Education Component	An annual training workshop will be offered to stakeholders A feral hog forum will be initiated for control effort coordination
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue in five-year increments pending evaluation
Interim, Measurable Milestone	One workshops per year for five years Number of feral hog forum meetings
Progress Indicators	Number of attendees at annual workshop Number of stakeholders reached Number of stakeholders participating in coordinated control efforts
Monitoring Component	NCTCOG will collect information regarding number of trainings and participants, and forum participation
Responsible Entity	Wildlife agencies will conduct feral hog management training Appropriate stakeholders will attend and participate in feral hog forum meetings and efforts NCTCOG will coordinate trainings and forum meetings and provide an annual report to Coordination Committee

Implementation Strategy 4.1: Ordinance evaluation for livestock waste management, stocking rates, and related measures

There is only one concentrated animal feeding operation (CAFO) within the Project area. Lone Star Park, a horse racing facility near the Lower West Fork Trinity River (Segment 0841_01), is not authorized to discharge wastewater and is not thought to be a contributor to *E. coli* levels in the Lower West Fork. Other livestock in the watershed are maintained on pasture or in small horse stables that do not meet the regulatory definition of a CAFO.

In Chapter 4E, Grazing Management of the 2003 *National Management Measures to Control Nonpoint Pollution from Agriculture* report (EPA 841-B-03-004), the impact of livestock waste is discussed, including that livestock generate microorganisms in waste deposits as they graze on pasture and rangelands and these wastes contain fecal bacteria in numbers on the order of $10^5 – 10^8$ organisms per gram of waste, or $10^9 – 10^{10}$ excreted per animal per day. In addition to such indicator organisms, livestock can also serve as an important reservoir of pathogens such as *E. coli* O157:H7. The extent of

manure and microorganism deposition on grazing land typically depends on livestock density or stocking rate.

Release of microbes from manure deposited on grazing land is influenced by time, temperature, moisture, and other variables. Enhanced survival of microorganisms in fecal deposits on grazing land has been documented and the bacterial pollution potential of fecal deposits on grazing land is significant. Research has shown that fecal coliforms may survive in soil only 13 days in summer and 20 days in winter, but that cow fecal deposits provide a protective medium that permit microorganisms to survive for more than a year. Runoff from grazed land can contain high numbers of indicator microorganisms — in one study, fecal coliform (FC) counts of $10^3 – 10^5$ organisms/100 mL in pasture runoff. Another study reported that fecal coliform in runoff from simulated grazing plots were always higher ($2.4 \times 10^5 – 1.8 \times 10^6$ FC/100 mL) than counts from the ungrazed control plots (1.5×10^3 FC/100 mL). It is worth noting, however, that microorganism counts in runoff from grazing land are typically several orders of magnitude lower than numbers from land where manure is deliberately applied (USEPA, 2003).

Ordinance requirements among the municipalities in the Project area vary greatly and few of the cities have livestock registration programs making it difficult to assess livestock numbers and stocking rates. This kind of information is important not only because of the frequent proximity of livestock to water bodies but also because of the potential for overstocking and the resulting inability of the land to properly allow for enough infiltration of bacteria-laden stormwater.

As summarized in Table 31, the Coordination Committee recommends that all municipal MS4s in the Project area with livestock define and identify properties, including small commercial horse stables, and estimate those livestock numbers to distinguish land use for non-point sources by 2028. Additionally, municipalities with livestock should evaluate their ordinances and if necessary, amend them to include provisions for management of livestock waste, including stocking rates, and other measures restricting bacteria loading by 2033.

Table 31. Implementation Strategy 4.1 Summary — Ordinance evaluation for livestock waste management, stocking rates, and related measures

Targeted Source(s)	Livestock
Estimated Potential Load Reduction	IS 4.1 may result in a 4% reduction over 25 years through changes that reduce direct and stormwater-related bacteria loads contributed by livestock
Technical and Financial Assistance Needed	Technical: some technical assistance regarding livestock may be needed to undertake this activity Financial: existing local and grant funding as available
Education Component	As resources are available, NCTCOG and the Pets, Livestock, and Wildlife technical subcommittee will develop educational materials for livestock owners and property owners housing livestock and provide information to municipalities on stocking rates and livestock waste management

Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Livestock defined and numbers estimated Number of ordinances amended
Progress Indicators	By 2028, municipalities will have evaluated land use, defined and estimated livestock numbers By 2033 ordinances will be evaluated and amended as necessary for proper management of livestock waste
Monitoring Component	NCTCOG will collect information regarding municipal activities
Responsible Entity	Municipalities will define livestock and estimate livestock numbers, evaluate ordinances with regards to livestock waste and amend as necessary NCTCOG and Stormwater technical subcommittee will develop or find educational materials for livestock owners etc., develop/alter and provide information on stocking rates and livestock waste management to municipalities NCTCOG will collect information on progress indicators and provide an annual report to the Coordination Committee

Implementation Strategy 4.2: Pet waste control measures

Most, if not all, municipalities in the Project area have some type of provisions concerning pet waste; however, some may be too broad or general to be applied to public education and/or enforcement. Pet waste can contribute to *E. coli* levels in impaired waterways and highlight the importance of control measures (USEPA, 2003). By 2033 all municipal MS4s within the bacteria-impacted watersheds are encouraged to have provisions for pet waste pickup within their respective ordinances and active enforcement and public education programs in place. Table 32 below details the control measure for pet waste.

Table 32. Implementation Strategy 4.2 Summary — Pet waste control measures

Targeted Source(s)	Pets
Estimated Potential Load Reduction	IS 4.2 may result in a 3% reduction over 25 years by assisting in reducing bacteria loads contributed by pets
Technical and Financial Assistance Needed	Technical: some technical assistance regarding pet waste may be needed to undertake this activity Financial: existing local and grant funding as available

Education Component	NCTCOG will utilize existing pet waste public education programs NCTCOG and the Stormwater technical subcommittee will develop or adapt educational materials on pet waste if needed
Schedule of Implementation	All municipalities are encouraged to have pet waste control measures within their ordinances by 2033
Interim, Measurable Milestone	Ordinances changed to include pet waste control Municipalities with active pet waste enforcement and education programs
Progress Indicators	The number of ordinances including pet waste control measures
Monitoring Component	NCTCOG will collect information regarding municipal activities
Responsible Entity	NCTCOG and Stormwater technical subcommittee will develop or modify educational materials on pet waste management NCTCOG will use and distribute existing pet waste education materials and report on progress indicators to the Coordination Committee Municipalities will include pet waste control provisions in their ordinances, have active enforcement/public education efforts, and report progress indicators to NCTCOG

Implementation Strategy 4.3: Avian management plan

Feeding of avian species in ponds and other waterways promotes higher avian populations than would exist without feeding (Abulreesh, 2004). Excess nutrients in ponds caused by such high numbers of avian and their droppings can result in water-quality problems including increased *E. coli* counts. All municipal MS4s within the bacteria-impaired waterways are encouraged to evaluate the need for an avian management plan, with a focus on measures to discourage avian feeding rather than population control measures. Table 33 expands on the details of a waterfowl management plan.

Table 33. Implementation Strategy 4.3 Summary —Avian management plan

Targeted Source(s)	Waterfowl
Estimated Potential Load Reduction	IS 4.3 may result in a 2% reduction over 25 years by reducing overloading of water bodies by avian populations, and thereby reducing bacteria loads contributed by waterfowl
Technical and Financial Assistance Needed	Technical: some technical assistance regarding avian may be needed to undertake this activity Financial: existing local and grant funding as available

Education Component	As resources allow, existing or new educational materials will be developed for municipalities to educate their citizens on feeding of avian.
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	MS4s will evaluate the need for avian management plans
Progress Indicators	Number of evaluations conducted by MS4s of the need for avian management plans Number of avian management plans or educational programs implemented Number of educational materials distributed
Monitoring Component	NCTCOG will provide a report to the Coordination Committee on progress indicators
Responsible Entity	MS4s will evaluate the need for an avian management plan, implement educational programs as needed, and report progress indicators to NCTCOG NCTCOG will collect information from MS4s and report progress to the Coordination Committee

Implementation Strategy 4.4: Model ordinance development

As detailed in Table 34, NCTCOG and stakeholders will, as resources allow, develop a model ordinance for inclusion in the BMP Library (see Implementation Strategy 8.0) which will include provisions for pet and livestock waste removal and stocking rates.

Table 34. Implementation Strategy 4.4 Summary — Model ordinance development

Targeted Source(s)	Pets and livestock
Estimated Potential Load Reduction	IS 4.4 may result in a 2% reduction over 25 years through the implementation of improved ordinances by MS4s that lead to a reduction in bacteria loading
Technical and Financial Assistance Needed	Technical: no technical assistance will be necessary Financial: grants and/or existing funding as appropriate
Education Component	Once model ordinance is developed, NCTCOG will refer stakeholders to the BMP Library

Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and NCTCOG and the Pets, Livestock, and Wildlife technical subcommittee will begin work on developing or adapting a model ordinance
Interim, Measurable Milestone	Ordinances evaluated for pet waste control and livestock waste control provisions
Progress Indicators	Model ordinance developed
Monitoring Component	NCTCOG will collect information on availability of model ordinance in BMP Library
Responsible Entity	NCTCOG and Stormwater technical subcommittee will develop or modify a model ordinance for pet waste control and livestock waste control NCTCOG place model ordinance in the BMP Library

Implementation Strategy 4.5: Pet waste collection stations and BMPs at parks

Increasing stormwater retention time over natural soils allows for greater infiltration of bacteria. In areas of parks with heavy use by dogs, horses, and other animals and the resulting potential for bacteria loading in nearby waterways, the use of BMPs can be particularly important. The Coordination Committee encourages the use of BMPs such as buffer strips, swales, and other methods to reduce bacteria loading from dog parks and other parks with concentrated animal presence to reduce bacteria loading from these sources. Furthermore, the Coordination Committee encourages all municipal MS4s within bacteria-impaired watersheds ensure adequate placement of pet waste collection stations in parks with the greatest potential to contribute to bacteria loading, such as those adjacent to waterways and parks with significant use by dogs, horses, or other animals. The details of implementation strategy 4.5 can be found in Table 35.

Table 35. Implementation Strategy 4.5 Summary — Pet waste collection stations and BMPs at parks

Targeted Source(s)	Pets and horses
Estimated Potential Load Reduction	IS 4.5 may result in a 4% reduction in bacteria loading from parks with substantial animal use over 25 years
Technical and Financial Assistance Needed	Technical: some technical assistance may be necessary regarding park BMPs and pet waste collection stations Financial: grants and/or existing funding as appropriate
Education Component	As resources are available, NCTCOG and the Stormwater technical subcommittee will develop or modify educational materials for park goers regarding pet waste collection and park BMPs

Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and NCTCOG and the Stormwater technical subcommittee will begin work on developing or adapting public education materials for park goers regarding pet waste and park BMPs MS4s with parks used by pets will use BMPs in parks to help reduce bacteria loading
Interim, Measurable Milestone	Park BMPs implemented Pet waste collection stations installed
Progress Indicators	Number of park BMPs implemented Number of pet waste collection stations installed
Monitoring Component	NCTCOG will collect information from MS4s regarding park BMPs and pet waste collection stations
Responsible Entity	MS4s with parks used by pets will implement BMPs and install pet waste collection stations as feasible, and report those measurements to NCTCOG NCTCOG will collect BMP and collection station data and report those findings to Coordination Committee

Implementation Strategy 4.6: Distribution of pet waste education materials

Doo the Right Thing is an existing public education program through the RSWMCC's Public Education Task Force. *Doo the Right Thing* helps MS4s participating in the RSWMP educate their citizens on issues such as the potential health risks from pet waste, the impact of pet waste on water quality, and tips for dealing with pet waste. There are also posters, flyers, pledge forms, bag holders, and other education items available for distribution through the cooperative purchase program. In addition to maximizing distribution of pet waste education materials to their respective populations as a whole, the Coordination Committee encourages municipalities with pet adoption and/or pet registration programs to include distribution of pet waste education materials, such as those from *Doo the Right Thing*, as part of the pet adoption or registration process. Table 36 further explains the distribution of pet waste education materials.

Table 36. Implementation Strategy 4.6 Summary — Distribution of pet waste education materials

Targeted Source(s)	Pet waste
Estimated Potential Load Reduction	IS 4.6 may result in a 2% reduction over 25 years through more responsible management and disposal of pet waste, thereby reducing pet waste available for transport to waterways

Technical and Financial Assistance Needed	Technical: no additional technical assistance is necessary Financial: grants and/or existing funding as appropriate
Education Component	Use existing pet waste education materials and distribute to general public When possible, include these educational materials with pet adoption and/or pet registration
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Increase in ordering of *Doo the Right Thing* materials through RSWMP Cooperative Purchase
Progress Indicators	Number of education items distributed
Monitoring Component	NCTCOG will collect information on number of pet waste materials purchased
Responsible Entity	MS4s will distribute pet waste education materials to general public, using existing contact opportunities such as pet registrations and adoptions NCTCOG will collect pet waste education material purchase records and report to the Coordination Committee

On-site Sewage Facility Implementation Strategies

An on-site sewage facility (OSSF — a term which encompasses all septic and aerobic systems) does not send waste through a system of pipes to be treated elsewhere. Instead, it uses a combination of physical and chemical methods to treat the waste at the owner's location. Estimates based on OSSF permit records suggest the Project area has at least 19,000 systems. However, the actual number and distribution of OSSFs in the region is unknown, and inventories of OSSFs are piecemeal.

Enforcement varies throughout the region and, depending on jurisdiction, is handled by several authorized agents — the Tarrant County Public Health Department, cities of Arlington and Grand Prairie, and the TCEQ Region 4 Office. A distribution map of OSSFs can be found in Figure 13. Furthermore, enforcement efforts can be ineffective if owners of failing OSSFs do not have the resources to repair or replace their systems or to pay fines associated with violations. Because properly functioning and maintained OSSFs contribute little to no bacteria to waterways, this I-Plan primarily focuses on OSSFs that are in danger of — or already are — unpermitted, failing, or poorly maintained. The following implementation activities are intended to address these systems.

Implementation Strategy 5.0: Funding for failing OSSFs

As explained in Table 37, stakeholders and NCTCOG will seek funding to address failing OSSFs, through income-qualified programs to subsidize OSSF repair or connection to sanitary sewer systems. Possible funding sources may include American Dream Downpayment Initiative; USDA Home Repair Grant; Specially Adapted Housing Grants; USDA Rural Development Housing and Community Facilities Programs; the Rural Housing Insurance Fund grants; and TCEQ SEP-directed funds.

Table 37. Implementation Strategy 5.0 Summary — Funding for failing OSSFs

Targeted Source(s)	Failing OSSFs
Estimated Potential Load Reduction	IS 5.0 may reduce the potential for bacteria loading from failing OSSFs by 2% reduction over 25 years
Technical and Financial Assistance Needed	Technical: some technical assistance may be necessary regarding identifying failing OSSFs and potential repairs Financial: grants, loans, SEPs and existing funding as appropriate
Education Component	Authorized agents and NCTCOG will collect and distribute information on funding availability
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Grants and other funding sources sought
Progress Indicators	Number of OSSF repaired, replaced, or eliminated due to connections with sanitary sewer systems
Monitoring Component	NCTCOG will collect reports from authorized agents

Responsible Entity	NCTCOG and authorized agents will collect and distribute funding information as appropriate for their organization NCTCOG will collect information on funding availability and report to Wastewater technical subcommittee and Coordination Committee

Implementation Strategy 5.1: Aerobic treatment unit maintenance

According to the National Environmental Services Center of the West Virginia University Research Corporation, aerobic treatment units (ATUs) are similar to septic systems in that they both use natural processes to treat wastewater. But unlike septic systems, which use anaerobic processes, the aerobic treatment process requires oxygen. ATUs use a mechanism to inject and circulate dissolved oxygen inside the treatment tank. This mechanism requires electricity to operate. As a result, the basic unit tends to be more expensive to own and operate than a septic tank and requires more maintenance. The solids must be pumped out at much more frequent intervals, and the electrical-mechanical parts must be maintained (NESC, 2005). Most ATUs are sold with a two-year service contract, covering inspections and maintenance; however, manufacturers recommend that such a contract be extended for the life of the unit. The added complexity and need for homeowner attentiveness help make ATUs more likely to malfunction and impact bacteria loading in nearby waterways.

The TCEQ, Tarrant County, and the cities of Arlington and Grand Prairie are encouraged to develop policies to increase maintenance of ATUs, including mandatory lifetime maintenance contracts, more inspections on systems, and increased monitoring in areas with high concentrations of ATUs. The strategies for ATUs are detailed in Table 38.

5.1.1: Request to TCEQ for enforcement

TCEQ's role as a state regulator makes the agency a significant partner in this I-Plan's OSSF efforts. The TCEQ is encouraged to suspend or revoke licenses and registrations of poorly performing installers and maintenance providers.

5.1.2: Continuing education opportunities

As resources are available, NCTCOG and other stakeholders will work to develop outreach efforts and continuing education opportunities specific to district attorneys and justices of the peace with the goal of increasing prosecution of OSSF violations. Such efforts will focus on the impact of OSSF violations on water quality.

5.1.3: Sample ordinance development

As resources are available, NCTCOG will provide sample ordinances for municipal authorized agents wishing to mandate OSSF maintenance and make the information available on the BMP Library.

5.1.4: Standardized service maintenance contract and inspection form

Although TCEQ is already required by 30 TAC 285.10 to provide a model order, ordinance, and resolution that can be used by authorized agents to meet the minimum requirements of OSSF laws and rules, that requirement does not address service maintenance contracts or inspection forms.

The Coordination Committee encourages TCEQ to develop a standardized service maintenance contract and inspection forms to serve as guidelines for authorized agents and municipalities.

Table 38. Implementation Strategy 5.1 Summary — Aerobic treatment unit maintenance

Targeted Source(s)	Aerobic treatment units (ATU)
Estimated Potential Load Reduction	IS 5.1 -5.1.4 may reduce the potential for bacteria loading from failing ATUs by 2% reduction over 25 years
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary Financial: grant funding and existing program funding
Education Component	Public education efforts for ATU owners regarding maintenance contract requirements Educational efforts geared toward district attorneys and justices of the peace regarding environmental impact of malfunctioning OSSFs
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Maintenance contracts for ATUs mandated as feasible by Authorized Agents Educational materials developed or modified for enforcement decision makers Sample ordinance development for Authorized Agents
Progress Indicators	Maintenance contract requirements in the majority of Authorized Agent jurisdictions Number of educational opportunities for justices of the peace and district attorneys
Monitoring Component	NCTCOG will report on progress of contract requirements and educational opportunities
Responsible Entity	Wastewater technical subcommittee and NCTCOG will develop or modify appropriate educational materials, and create or modify a model ordinance that addresses service maintenance contracts and instruction forms NCTCOG will report progress to the Coordination Committee NCTCOG will coordinate with TCEQ to explore options for developing standardized service maintenance contract and inspection forms if feasible, to improve OSSF management and monitoring

Implementation Strategy 5.2: OSSF education efforts for real estate agents, property inspectors, and homeowners

Further detailed in Table 39, NCTCOG, Authorized Agents, and other entities will, as resources are available, provide education opportunities to real estate agents, property inspectors, and consumers about identifying failing OSSFs and the consequences of inadequate maintenance and failure of OSSFs.

5.2.1: H-GAC curriculum

As resources are available, NCTCOG will pursue an agreement with the Houston-Galveston Area Council of Governments (H-GAC) regarding the use of H-GAC's Texas Real Estate Commission (TREC) approved curriculum for OSSF inspector training.

5.2.2: Training module evaluation and regional availability

By 2014, the OSSF Subcommittee will investigate potential training modules, including those available from H-GAC and other sources, with the goal of ensuring the regional availability of OSSF inspector training for property inspectors.

Table 39. Implementation Strategy 5.2 Summary — OSSF education efforts for real estate agents, property inspectors, and homeowners

Targeted Source(s)	OSSFs
Estimated Potential Load Reduction	IS 5.2 – 5.2.2 may reduce the potential for bacteria loading from failing OSSFs due to poor homeowner, realtor, and inspector education by 2% reduction over 25 years
Technical and Financial Assistance Needed	Technical: technical assistance from H-GAC will be sought Financial: grant funding and existing program funding
Education Component	NCTCOG, authorized agents, and other entities will, as resources are available, provide education opportunities to real estate agents, property inspectors, and consumers about identifying failing OSSFs and the consequences of inadequate maintenance and failure of OSSFs
Schedule of Implementation	As resources are available, NCTCOG will immediately pursue an agreement with the H-GAC regarding the use of HGAC's Texas Real Estate Commission (TREC) approved curriculum for OSSF inspector training By 2014, the OSSF technical subcommittee will investigate potential training modules with the goal of ensuring the regional availability of OSSF inspector training
Interim, Measurable Milestone	NCTCOG agreement with H-GAC Potential training modules investigated

Progress Indicators	H-GAC curriculum in use in NCTCOG region Other training modules used if appropriate
Monitoring Component	NCTCOG will report progress on obtaining the H-GAC curriculum and its use as well as use of other curricula
Responsible Entity	NCTCOG and Authorized Agents will provide educational opportunities for those involved in real estate transactions Wastewater technical subcommittee will investigate potential training modules NCTCOG will pursue agreement with H-GAC to use their curriculum

Implementation Strategy 5.3: Property inspections and document review

Pre-sale real estate inspections should include a complete review of OSSF maintenance documents and system history. These documents are typically available through the homeowner and Authorized Agent and that information should be provided to the prospective home buyer. The prospective home buyer should also be made aware of the absence of OSSF maintenance documents. TREC requires property inspections at the time of sale, specifies education and certification requirements for licensed real estate salespersons and inspectors, and develops forms for use during sales and inspections. The Coordination Committee requests that the TREC use these forms to their full potential and modify each to provide additional resources for homeowners related to their OSSFs. To aid in home buyer education, materials selected and/or modified by the OSSF technical subcommittee will be made available online by NCTCOG. Expanded detail on property inspection and document review can be found in Table 40.

Table 40. Implementation Strategy 5.3 Summary — Property inspections and document review

Targeted Source(s)	OSSFs
Estimated Potential Load Reduction	IS 5.3 may reduce the potential for bacteria loading from failing OSSFs due to homeowner ignorance or inexperience by 2% reduction over 25 years
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary Financial: grant funding and existing program funding
Education Component	Development or modification of homebuyer educational materials including where to find OSSF maintenance documents and system history, and the potential consequences of the absence of OSSF maintenance documents Outreach to TREC regarding pre-sale inspections and OSSFs
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process

Interim, Measurable Milestone	Creation or modification of homebuyer education materials
Progress Indicators	Availability of education material through BMP Library (see IS 8.0)
Monitoring Component	NCTCOG will report on the progress of educational material creation and web availability
Responsible Entity	Wastewater technical subcommittee and NCTCOG will develop or modify appropriate educational materials and ensure their availability online Wastewater technical subcommittee and NCTCOG will determine the best approach for outreach to TREC and implement NCTCOG will report progress to Coordination Committee

Implementation Strategy 5.4: Services to annexed areas

The expansion of city boundaries frequently provides municipalities and homeowners alike with the opportunity to enjoy the benefits of sanitary sewer systems and wastewater treatment facilities. Detailed in Table 41, the Coordination Committee encourages municipalities to meet stated timelines for providing services when areas are annexed, especially regarding connection with sanitary sewer systems.

Table 41. Implementation Strategy 5.4 Summary — Services to annexed areas

Targeted Source(s)	OSSFs
Estimated Potential Load Reduction	IS 5.4 may reduce the potential for bacteria loading from failing OSSFs by 1% reduction over 25 years
Technical and Financial Assistance Needed	Technical: technical and engineering assistance may be necessary Financial: grant funding and existing program funding
Education Component	Outreach to municipal MS4s regarding providing services to annexed areas
Schedule of Implementation	As resources are available, expanding sanitary sewer service to annexed areas within stated timelines will begin immediately and will continue throughout the entire implementation process
Interim, Measurable Milestone	Municipalities contacted
Progress Indicators	Annexed areas transitioning from OSSFs to sanitary sewer lines
Monitoring Component	Progress indicators reported to NCTCOG

Responsible Entity	Municipalities with annexed areas on OSSFs will transition to sanitary sewer systems as required and report progress to NCTCOG

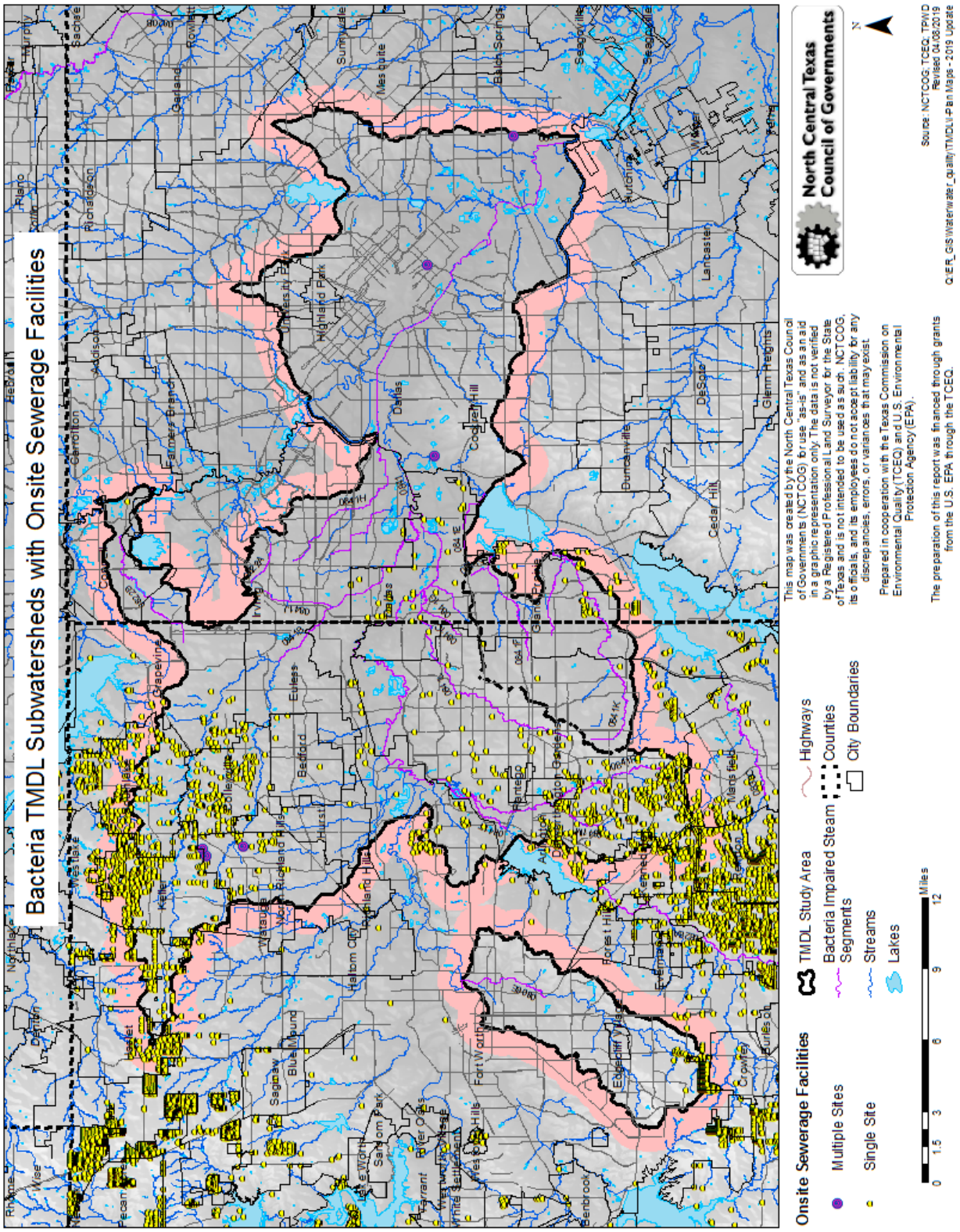
Implementation Strategy 5.5: Replacement and conversion of poorly functioning OSSFs

MS4s with their own aging OSSFs are encouraged to convert any that are poorly functioning, including vault toilets associated with park and recreational facilities, to sanitary sewer, grinder pump systems, or upgraded OSSFs. Table 42 expands on the implementation strategy for replacing and converting poorly functioning OSSFs.

Table 42. Implementation Strategy 5.5 Summary — Replacement and conversion of poorly functioning OSSFs

Targeted Source(s)	OSSFs
Estimated Potential Load Reduction	IS 5.5 may reduce the potential for bacteria loading from failing OSSFs by 1% reduction over 25 years
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary Financial: grant funding and existing program funding
Education Component	Outreach to municipal MS4s regarding replacement or conversion of poorly functioning OSSFs
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Municipalities contacted
Progress Indicators	Number of OSSFs replaced or converted
Monitoring Component	Number of OSSFs replaced or converted reported to NCTCOG
Responsible Entity	MS4s with their own aging OSSFs will replace or convert those systems as feasible and report those results to NCTCOG

Figure 13. OSSF Distribution Map with Impaired Segments



Monitoring Coordination Implementation Strategies

The Project area is home to approximately 390 miles of rivers and streams as defined by U.S. Census Bureau's TIGER/Line (Topologically Integrated Geographic Encoding and Referencing) data set (USCB, 2012). One hundred and fifty-three of those miles are impaired by elevated *E. coli* levels. Understanding the condition of rivers and streams in the region through monitoring and analyzing monitoring data is critical for developing effective plans for maintaining, managing, and restoring the waterways.

There are several different surface water monitoring programs with data that help demonstrate the effectiveness of BMPs and other implementation strategies discussed in this I-Plan. One of the best known is the Clean Rivers Program (CRP). Established in 1991, the Texas Clean Rivers Program is a state fee-funded, non-regulatory program created to provide a framework and forum for managing water quality issues in a more holistic manner. The focus of the program is to work at the watershed level, within each river basin, by coordinating the efforts of diverse organizations. CRP is comprehensive — collecting samples region-wide and should remain one of the primary sources of data for ambient water quality. This monitoring network includes dozens of sites and provides long-term data accredited through the National Environmental Laboratory Program (NELAP) for the evaluation of ambient conditions in the region's waterways. Monitoring sites are strategically chosen to give the greatest degree of coverage while also attempting to isolate individual waterways or their smaller units to allow for the accumulation of data with direct relevance to local conditions. Monitoring is conducted under a regional Quality Assurance Project Plan (QAPP) (TCEQ, 2012b).

The Regional Wet Weather Characterization Program (RWWCP) is a NCTCOG-coordinated program for Phase I MS4 regulated entities with stormwater permit requirements to monitor stormwater during wet weather (rainfall) events. NCTCOG assists local entities through a cooperative regional monitoring program designed to meet these requirements. The regional program includes the cities of Dallas, Fort Worth, Arlington, Garland, Irving, Plano, and Mesquite; and the North Texas Tollway Authority (NTTA). Data is gathered quarterly, analyzed by a NELAP-accredited laboratory, and an annual report is provided to participants. The program operates in five-year terms in conjunction with the TPDES permit term.

Sampling resulting from an IDDE investigation can be useful in determining and eliminating some bacterial sources. An illicit discharge is any discharge to the MS4 not composed entirely of stormwater, except for discharges allowed under a TPDES permit. Non-stormwater discharges can originate from direct connections to the storm drain system from business or commercial establishments (illicit connections), or indirectly as improper surface discharges to the storm drain system.

Another potential source of information is effluent monitoring. Since 2010, new and renewed WWTF permits include an effluent monitoring requirement for *E. coli*. Currently required monitoring frequency is detailed in Table 8.

Texas Stream Team is a network of trained volunteers and supportive partners working to gather information about surface water quality in the state and ensure the information is publicly available. Established in 1991, Texas Stream Team is administered through a cooperative partnership between Texas State University, TCEQ, and the EPA. For the purpose of this I-Plan, Stream Team volunteers are stakeholders in the Project area committed to helping fill gaps in monitoring data wherever possible.

The Coordination Committee encourages all feasible use of monitoring programs and the collective analysis of their respective data to help determine the efficacy of the implementation strategies within this I-Plan.

Implementation Strategy 6.0: Routine sampling

Stakeholders currently participating in voluntary or permit-required monitoring programs, such as CRP, RWWCP, and WWTF effluent monitoring, will continue routine sampling as feasible. For voluntary programs such as CRP, the routine sampling will occur at the monitoring stations detailed in the QAPP and as resources allow. To help determine the efficacy of implementation strategies, the Monitoring Coordination Technical Subcommittee will provide analysis of routine sampling results for the Coordination Committee. Figure 14 shows the CRP monitoring locations on impaired segments in the Project area, while Table 43 summarizes the implementation strategy for routine sampling.

Table 43. Implementation Strategy 6.0 Summary — Routine sampling

Targeted Source(s)	All potential sources
Estimated Potential Load Reduction	IS 6.0 will allow tracking and verification of bacteria load reductions and may result in a 2% reduction over 25 years
Technical and Financial Assistance Needed	Technical: some technical assistance may be necessary should entities new to monitoring wish to participate Financial: grants or existing funding as appropriate
Education Component	Some education of governing bodies may be necessary to start, maintain, or expand monitoring programs
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Collective analysis of monitoring data
Progress Indicators	Number of results analyzed Ability to compare results to efficacy of BMPs
Monitoring Component	Monitoring Coordination technical subcommittee will report analytical results to NCTCOG
Responsible Entity	Monitoring Coordination Forum will collectively analyze data to determine efficacy of implementation strategies NCTCOG will compile results into a report for the Coordination Committee

Implementation Strategy 6.1: Monitoring coordination forum

A coordinated, regional approach to monitoring and data analysis is a key component of this implementation strategy. As resources are available, NCTCOG will facilitate a forum of monitoring participants, including those involved with CRP, RWWCP, IDDE, wastewater treatment effluent monitoring, and the Texas Stream Team. The schedule for forum meetings will be determined by forum participants, although meetings will take place at least annually. Table 44 details the strategies for the monitoring coordination forum.

6.1.1: Existing *E. coli* monitoring network evaluation

As part of the monitoring forum, the stakeholders will evaluate the existing *E. coli* monitoring network in the impaired subwatersheds and refine it based upon data gaps. Data considered may include CRP, RWWCP, IDDE monitoring, wastewater treatment facility effluent monitoring, and data collected by Texas Stream Team.

6.1.2: New source review for data

The monitoring forum will identify sources of data and existing monitoring which may not be appropriate for screening, for example monitoring data that are not collected under a QAPP or analyzed under a NELAP-accredited program, but that could be helpful in identifying bacteria sources.

6.1.3: Data assessment of overall trends for BMP efficacy

As monitoring results become available, the forum participants will evaluate CRP and RWWCP data to assess overall trends in water quality within the impaired water segments in the Greater Trinity River basin. These analyses may be used to determine efficacy of BMPs, overall improvement or degradation within the applicable sub-basins, and the potential need to implement additional BMPs. Data analysis results will be shared with the Coordination Committee annually.

6.1.4: Funding in relation to gaps in sampling data

Monitoring forum participants, including TRA, may work with TCEQ to address available funding in response to gaps in sampling data.

6.1.5: Reevaluating monitoring technologies for pilot projects and/or research partnerships

Monitoring forum participants will continue to reevaluate monitoring technologies, such as surrogate testing, no less than every five years for use in pilot projects or partnerships with researchers in local universities.

6.1.6: Evaluate need for online data consolidation and access

Accessing monitoring data online remains difficult for those without technical backgrounds in the monitoring field. Monitoring forum participants and the Coordination Committee will periodically evaluate the need for online data consolidation and access.

Table 44. Implementation Strategy 6.1 Summary — Monitoring coordination forum

Targeted Source(s)	All potential sources
Estimated Potential Load Reduction	IS 6.1 – 6.1.6 will allow tracking and verification of bacteria load reductions and may result in a 2% reduction over 25 years
Technical and Financial Assistance Needed	Technical: some technical assistance may be necessary should entities new to a given type of monitoring wish to participate Financial: grants or existing funding as appropriate
Education Component	Some internal education may be necessary for some forum participants on new or existing monitoring methods or programs
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process with forum meetings taking place annually at a minimum
Interim, Measurable Milestone	Existing *E. coli* monitoring networks evaluated New source review for data Data assessment of overall trends for BMP effectiveness Reevaluation of monitoring technologies Online data consolidation and access evaluation
Progress Indicators	Number of existing monitoring sites evaluated Number of data gaps identified Number of new non-traditional monitoring sources identified Number of data assessments (reports) in relation to BMP effectiveness Number of pilot projects evaluated
Monitoring Component	NCTCOG will collect results of evaluations, assessments, and other results from the Monitoring Coordination Forum
Responsible Entity	Monitoring Coordination Forum will evaluate existing E. *coli* monitoring and new sources for data, reevaluate monitoring technologies, evaluate online data access, and assess data for BMP effectiveness NCTCOG will compile results into a report for the Coordination Committee

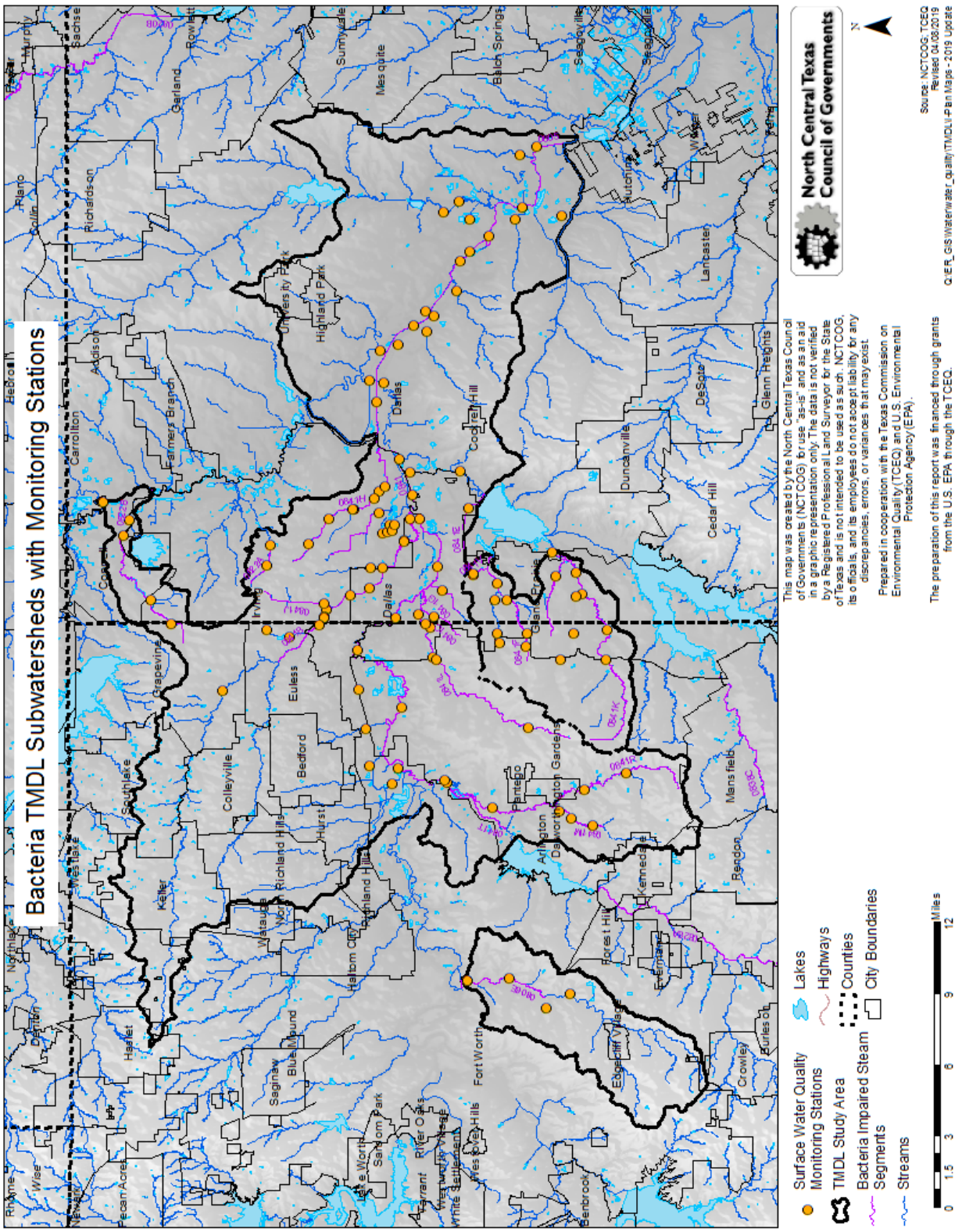
Implementation Strategy 6.2: Source identification and monitoring review

Accurate identification and quantification of *E. coli* sources in the project area is needed. Without this information it is difficult to accurately assess the impact of any one implementation strategy, or for that matter, the impact of any one source. As explained in Table 45, in 2018 the Coordination Committee will review monitoring techniques and determine whether it is appropriate, in terms of financial and technical viability, to request the TCEQ make changes in their monitoring with particular regard to source identification.

Table 45. Implementation Strategy 6.2 Summary — Source identification and monitoring review

Targeted Source(s)	Species-specific and/or human versus non-human contributors to bacteria loading
Estimated Potential Load Reduction	IS 6.2 may result in a 10% reduction over 25 years of calculated bacteria loading by allowing better identification and targeting of bacterial sources, with consequent reductions in loading
Technical and Financial Assistance Needed	Technical: assistance from experts in source identification may be necessary to assist Coordination Committee in decision-making Financial: new source identification methods may have different costs than known methods
Education Component	The Coordination Committee and TCEQ will need to be aware of technological and cost changes of source identification
Schedule of Implementation	In 2018 the Coordination Committee will review monitoring techniques and technologies to see if requesting source identification by TCEQ is appropriate
Interim, Measurable Milestone	New source identification methods and costs identified
Progress Indicators	Greater source identification results available to better target effectiveness of implementation strategies
Monitoring Component	Report to the Coordination Committee on new source identification availability and costs
Responsible Entity	Monitoring Coordination Forum will identify and evaluate new methods, techniques, and costs for source identification NCTCOG will prepare a report of the results from the technical subcommittee for the Coordination Committee The Coordination Committee will evaluate new methods and determine if a request to TCEQ for guidance or approval on the new method or type of test is warranted NCTCOG will coordinate dialogue between stakeholders and TCEQ to facilitate TCEQ consideration, and possible adoption or use of new source identification methods.

Figure 14. Monitoring Locations on Impaired Segments Map



Education and Outreach Implementation Strategies

The North Central Texas region is fortunate to benefit from the existence of many water-focused public education efforts. In addition to NCTCOG-coordinated programs such as *Doo the Right Thing*, yard waste efforts, cooperative purchase for stormwater education materials, and Texas SmartScape, there is also a partnership regarding fats, oils, and grease (FOG) with the Wastewater And Treatment Education Roundtable, the RSWMP's Public Education Task Force, and the efforts of the Trinity River Environmental Education Society (TREES). The implementation of the Education and Outreach Implementation Strategies were assumed by the Regional Stormwater Management Program's (RSWMP) Public Education Task Force (PETF) in 2015.

Implementation Strategy 7.0: Ongoing stormwater public education participation and inclusion of bacteria-specific materials

NCTCOG and municipal MS4 stakeholders will continue their participation in and support of existing stormwater education campaigns such as *Doo the Right Thing*, Texas SmartScape, FOG, and others through the RSWMP. A list of RSWMP participants can be found in Table 25. As funding is available, NCTCOG and stakeholders will develop or expand the availability of more bacteria-specific public education materials to RSWMP participants. Support will also continue for the existing stormwater education web page, www.dfwstormwater.com, and as funding and technology become available, NCTCOG will continue to enhance web site functions. The stormwater public education strategy is summarized in Table 46.

Table 46. Implementation Strategy 7.0 Summary — Ongoing stormwater public education, participation, and inclusion of bacteria-specific materials

Targeted Source(s)	Nonpoint sources
Estimated Potential Load Reduction	IS 7.0 may result in a 4% reduction over 25 years by providing resources for the implementation of other ISs and for education and outreach to the public in an effort to gain widespread cooperation for bacteria load reduction activities
Technical and Financial Assistance Needed	Technical: some technical assistance may be necessary to include bacteria-specific information into existing materials Financial: grants or existing funding as appropriate
Education Component	Some educational components are already in place and in use NCTCOG and the RSWMP PETF will adapt or develop appropriate educational materials for inclusion in existing stormwater educational programs and products Outreach to RSWMCC and the Public Education Task Force for their support in adapting existing materials

Schedule of Implementation	Depending on resource availability, gathering bacteria-specific stormwater information will begin immediately and continue throughout the project
Interim, Measurable Milestone	MS4s and NCTCOG will continue existing public education programs as funding allows
Progress Indicators	Number of educational materials altered to include bacteria Number of educational materials purchased Number of educational materials distributed Web page hits
Monitoring Component	NCTCOG will report on the progress of educational materials and education efforts Existing MS4 reporting on stormwater public education efforts provided to NCTCOG for the collective annual report
Responsible Entity	The RSWMP PETF and NCTCOG will develop or adapt materials to include bacteria-specific topics in stormwater education NCTCOG will compile MS4 public education efforts and the progress of development of bacteria-specific information for the Coordination Committee

Implementation Strategy 7.1: Education and outreach forum

As further detailed in Table 47, some or all of the members of the Education and Outreach subcommittee will form an education and outreach forum that will interface with the RSWMP's Public Education Task Force, and other possible groups and organizations, such as the Wastewater And Treatment Education Roundtable and TREES, as necessary to facilitate greater regional understanding of the impact of bacteria on water quality. Additionally, the forum will work with the other technical subcommittees to coordinate public education messages.

Table 47. Implementation Strategy 7.1 Summary — Education and outreach forum

Targeted Source(s)	Nonpoint sources
Estimated Potential Load Reduction	IS 7.1 may result in a 2% reduction over 25 years by providing resources for the implementation of other ISs and for education and outreach to the public in an effort to gain widespread cooperation for bacteria load reduction activities
Technical and Financial Assistance Needed	Technical: no technical assistance will be necessary Financial: grants or existing funding as appropriate

Education Component	Some internal education may be necessary for some forum participants on existing public education programs
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Partnerships formed with RSWMP's Public Education Task Force, Wastewater And Treatment Education Roundtable, and other relevant organizations
Progress Indicators	Number of partnerships or relationships formed
Monitoring Component	Number of partnerships or relationships formed and reported to NCTCOG
Responsible Entity	The Education and Outreach Forum or technical subcommittee will form partnerships with existing educational programs whose purposes align with the implementation strategies in this I-Plan and report on such progress to NCTCOG NCTCOG will report on partnerships to the Coordination Committee

Implementation Strategy 7.2: Curriculum for Texas Education Agency

The Education and Outreach Forum will, as resources are available, coordinate with the Texas Education Agency (TEA) and local school districts to provide curriculum and tools for teachers and students, including an educator's 'tool box' with programs that may include Waters to the Sea, Real School Gardens, and Green Teacher, that educate children about water quality. Emphasis will be placed on keeping costs as low as possible to enhance the potential of a curriculum being widely used. The strategies for TEA materials are summarized in Table 48.

7.2.1: Local school district outreach

As TEA-approved materials become available, the Forum will educate/outreach to local school districts and teachers about their availability.

7.2.2: Reevaluation of TEA materials and effectiveness

The Forum will reevaluate the program in five years, in conjunction with the MS4 permit term, for the ability to get programs and materials approved by TEA, the ability to conduct outreach locally, and local use of materials; and will communicate those results to the Coordination Committee.

Table 48. Implementation Strategy 7.2 Summary — Curriculum for Texas Education Agency

Targeted Source(s)	Nonpoint sources
Estimated Potential Load Reduction	IS 7.2 may result in a 2% reduction over 25 years by providing educational resources regarding bacteria loading to educators within the Project area
Technical and Financial Assistance Needed	Technical: some technical assistance may be necessary to develop materials for TEA approval Financial: grants or existing funding as appropriate
Education Component	The NCTCOG and RSWMP PETF will, as resources are available, coordinate with TEA and local school districts to provide curriculum, modules, and tools for teachers and students, including an educator's 'tool box' with emphasis on keeping costs as low as possible to enhance the potential of a curriculum being widely used Once curricula are in place, outreach to local schools is necessary
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Requirements for TEA acceptance researched Existing curriculum identified or new curriculum/modules developed Curriculum/modules approved by TEA Outreach to local schools
Progress Indicators	Number of modules available Number of curriculum available Number of students reached Number of teachers or administrators contacted
Monitoring Component	NCTCOG will report on progress of educational materials
Responsible Entity	The NCTCOG and RSWMP PETF will coordinate with TEA and local school districts to provide curriculum, modules, and tools to educate children about stormwater and water quality, and will reevaluate materials and relationship with TEA every five years in conjunction with the MS4 permit term NCTCOG will provide an annual report to the Coordination Committee

Implementation Strategy 7.3: Education and outreach funding

As resources are available and with stakeholder input, NCTCOG will seek natural partnerships for long term funding of education and outreach efforts. These partnerships may include grants and other government-related funding sources. NCTCOG will serve as the primary contact on collaborative grants; working with stakeholders and the Stormwater Public Education Task Force for distribution. Non-governmental TMDL stakeholders may seek out additional funding sources such as sponsorships and donations for educational efforts. Table 49 summarizes the strategy for funding.

Table 49. Implementation Strategy 7.3 Summary — Education and outreach funding

Targeted Source(s)	Nonpoint sources
Estimated Potential Load Reduction	IS 7.3 may result in a 2% reduction over 25 years by providing resources for the implementation of other ISs and for education and outreach to the public in an effort to gain widespread cooperation for bacteria load reduction activities
Technical and Financial Assistance Needed	Technical: no technical assistance is necessary Financial: grants or existing funding as appropriate
Education Component	None
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Possible funding sources identified
Progress Indicators	The number of potential sources identified and number of applications for grants or other funding sources
Monitoring Component	NCTCOG will report on funding efforts
Responsible Entity	NCTCOG will seek natural partnerships for long term funding of education and outreach efforts The non-governmental RSWMP PETF members and stakeholders may seek out additional funding sources such as sponsorships and donations for educational efforts

Implementation Strategy 7.4: Partnerships

The Coordination Committee encourages MS4s to seek out partnerships with environmentally-focused organizations, such as Keep Texas Beautiful/Keep America Beautiful, TREES, or other appropriate groups to further water quality outreach efforts via web links, etc. As further explained in Table 50, the Coordination Committee encourages municipalities to develop and increase the number of partnerships with local businesses, local volunteer groups, and service organizations to promote park stewardship and public education and to report the number of volunteer hours on their MS4 annual report.

Table 50. Implementation Strategy 7.4 Summary — Partnerships

Targeted Source(s)	Nonpoint sources
Estimated Potential Load Reduction	IS 7.4 may result in a 2% reduction over 25 years by providing resources for the implementation of other ISs and for education and outreach to the public in an effort to gain widespread cooperation for bacteria load reduction activities
Technical and Financial Assistance Needed	Technical: no technical assistance is necessary Financial: grants or existing funding as appropriate
Education Component	As resources are available, the Education and Outreach Forum or technical subcommittee will modify or develop public education materials for use by partnering organizations for use in parks MS4s are encouraged to seek out and maintain partnerships with environmentally-focused organizations and utilize them as sources and distributors of information
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Materials developed and potential partnerships identified
Progress Indicators	Number of materials distributed Number of partnerships formed or maintained Number of parks with stewardship groups with educational efforts
Monitoring Component	NCTCOG will report on partnership efforts
Responsible Entity	MS4s will seek out and maintain partnerships to help disseminate water quality related education messages to targeted groups such as park visitors The NCTCOG and RSWMP PETF will modify or develop park-specific educational materials NCTCOG will report on progress to the Coordination Committee

Implementation Strategy 7.5: Development of river-specific bacteria TMDL materials

National focus on bacteria TMDLs and loading has been primarily on the impacts to coastal waters and lake beaches. While these are important concerns, the methods for limiting bacteria loading for inland streams differ greatly and should be of equal concern. The Coordination Committee encourages the EPA to develop more river-specific bacteria TMDL procedures and educational materials and recognize the inherent differences between coastal and inland waters. Table 51 summarizes implementation strategy 7.5.

Table 51. Implementation Strategy 7.5 Summary — Development of river-specific bacteria TMDL materials

Targeted Source(s)	All potential sources
Estimated Potential Load Reduction	IS 7.5 may result in a 5% reduction over 25 years by providing resources for the implementation of other ISs and for education and outreach to the public in an effort to gain widespread cooperation for bacteria load reduction activities
Technical and Financial Assistance Needed	Technical: EPA may require some technical assistance in order to develop or add to materials with river-specific TMDL information Financial: grants or existing funding as appropriate
Education Component	As resources are available, the EPA should modify or develop more public education materials focused on river-specific causes and sources of bacterial contamination in waterways
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	River-specific TMDL causes investigated
Progress Indicators	Number of river-specific TMDL materials developed
Monitoring Component	River-specific materials will be available on EPA's web site
Responsible Entity	The NCTCOG and RSWMP PETF will formulate a letter from the Coordination Committee to the EPA formalizing the request for river-specific bacteria TMDL materials NCTCOG will encourage EPA to develop, if feasible, river-specific TMDL materials for use by municipalities and others to use in attaining the contact recreation standard for water bodies

Implementation Strategy 7.6: Bacteria-specific outreach to volunteer service groups

Volunteer service groups already focused on tangentially-related quality of life projects, such as the Master Gardener, Composter, and Naturalist programs, are a natural fit with the TMDL I-Plan outreach efforts. Those involved with such programs have already expressed a desire to be more involved and more informed about plant selection, reducing fertilizer use, and knowing more about their local environment. Some practices, however, such as placing compost materials too close to waterways can exacerbate bacteria loading, making it as important to partner with such groups as it is to educate them about the causes of high bacteria levels in the region's waterways. As detailed in Table 52, the Coordination Committee encourages bacteria specific outreach by the MS4s and Education and Outreach Forum or technical subcommittee to volunteer service groups such as Master Gardeners, Master Composters, and Master Naturalists.

Table 52. Implementation Strategy 7.6 Summary — Bacteria-specific outreach to volunteer service groups

Targeted Source(s)	Nonpoint sources
Estimated Potential Load Reduction	IS 7.6 may result in a 2% reduction over 25 years by providing resources for the implementation of other ISs and for education and outreach to the public in an effort to gain widespread cooperation for bacteria load reduction activities
Technical and Financial Assistance Needed	Technical: no technical assistance is necessary Financial: grants or existing funding as appropriate
Education Component	As resources are available, the Education and Outreach Forum or technical subcommittee will modify or develop public education materials focused on the impact of certain activities on bacteria levels in waterways and geared toward volunteer service groups MS4s and the NCTCOG and RSWMP PETF will conduct outreach to volunteer service organizations regarding the region's bacteria TMDL and its causes
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Materials developed Volunteer service organizations identified
Progress Indicators	Number of materials distributed Number of service groups contacted and engaged
Monitoring Component	NCTCOG will report on outreach efforts

Responsible Entity	NCTCOG and RSWMP PETF will develop or modify educational materials for volunteer service groups MS4s and RSWMP PETF will conduct outreach to service organizations and report progress of the outreach to NCTCOG NCTCOG will compile an annual report for the Coordination Committee

Best Management Practices Library Implementation Strategies

Implementation Strategy 8.0: Best management practices library

BMPs, whether they are structural, procedural, or educational, are a major component of this I-Plan. In order for stakeholders to maximize limited funds, minimize implementation of ineffective projects, and take full advantage of the depth of regional knowledge and experience, a clearinghouse for BMPs is necessary. An online BMP library will provide avenues for knowledge and experience sharing, cost effectiveness, training tools, sample ordinances, research results, and virtually any additional type of information deemed appropriate by the stakeholders. The BMP library can be found at this link: https://www.nctcog.org/envir/watershed-management/stormwater/bmp-library. As funding is available, NCTCOG will develop and maintain the online comprehensive BMP library including topics important to the implementation strategies detailed in this I-Plan. The strategies for the BMP Library are detailed in Table 53.

8.0.1: Stormwater

The Coordination Committee will annually review new projects and their BMPs through the TPDES-required Annual Report for stormwater permit holders for possible inclusion in the I-Plan as pilot projects and for inclusion in the online BMP Library. Other stormwater related topics may include the effectiveness of aeration/fountains, permeable pavement, cost/benefit analysis, and riparian buffers. Links or information on applicable city ordinances, sample ordinances addressing topics such as, impervious surfaces, stormwater fees, IDDE, waste hauler permitting and regulation, and stormwater enforcement will also be included. Additionally, information will be available on lessons learned from pilot projects, studies, and regionally developed initiatives.

8.0.1.1: BMP pilot projects and funding

Daily municipal operations and special projects provide natural opportunities to incorporate and study BMP effectiveness. Similarly, the Dallas-Fort Worth area is home to multiple universities with high academic standards and students in need of research projects. As such, stakeholders will investigate potential BMPs for bacteria load reduction, such as street sweeping and aeration, potentially using local pilot and demonstration projects funded by grants, or through the Texas AgriLife Extension, and local universities such as the University of Texas at Arlington, Texas Christian University, University of North Texas, and others. Stakeholders will also establish a list of potential pilot projects for outside evaluation and bacteria mitigation projects for state SEP funds, grant funds, or other sources.

8.0.2: Construction BMPs

8.0.2.1: Inclusion of construction BMPs in ordinances, including LID, GI, and iSWM

The Coordination Committee encourages municipalities within bacteria-impaired watersheds to adopt BMPs for development including adoption of ordinances specifying no net discharge of stormwater during a storm event resulting in 0.5 inches or greater within a 24-hour period from new developments and redevelopments, utilizing GI, iSWM, or LID in all pertinent construction projects, smarter use of buffers and green space, and provisions for tree removal and replacement.

8.0.2.2: Post construction BMP review in conjunction with MS4 permit requirements

Reevaluation and review of BMPs does not end when construction is completed. Stakeholders are encouraged to review post construction BMPs following changes in MS4 permit requirements or with direction from TCEQ or EPA.

8.0.3: Online resource for construction and development-related BMPs, including cost/benefit information and educational materials

As resources are available, NCTCOG will include in the online BMP Library development-related BMPs for permeable pavement, no net discharge sample ordinances, information on buffers and green space, and GI, iSWM, and LID construction. Educational materials with information on costs and economic benefits for municipalities to use for citizens, city councils, and business interests will also be available. As resources are available, NCTCOG will also create or make available development-related educational resources for the general public.

8.0.4: Use of demonstration projects and GI in municipal projects

MS4s and stakeholders are encouraged to use demonstration projects and incorporate GI, LID, or iSWM into their own developments whenever feasible as pilot projects and report those findings for inclusion in the BMP Library.

8.0.5: BMPs for animal-related topics

As resources are available, NCTCOG will make available the Library BMPs and animal-related topics including pet waste public education efforts such as *DOO the Right Thing*, sample ordinances for feral hog control, wildlife/avian feeding prohibition, success stories, and livestock waste control and stocking rates.

8.0.5.1: Educational materials

As resources are available, educational materials regarding wildlife feeding, and waste management for commercial stable operators, livestock owners, and other groups will be provided.

8.0.5.2: Pilot project evaluation

The City of Dallas is currently constructing the Texas Horse Park stable near the Upper Trinity River. The stable project plans to use horse manure for the production of biogas. The City of Dallas will evaluate their biogas project from Texas Horse Park stable waste by 2018 and provide that information to NCTCOG for inclusion in the BMP Library so that other jurisdictions may then evaluate the project for potential expansion.

8.0.6: Park-specific BMPs

As resources are available, NCTCOG will include in the BMP Library park-specific BMPs such as cost effective techniques, effectiveness of no mow areas, mowing height, use of permeable pavement in parking lots, erosion minimization practices, and riparian buffers. As resources are available, sample signage, lessons learned from other cities, success stories, BMP affordability, and public education

materials on park BMPs will also be provided. The Coordination Committee encourages municipalities using BMPs to educate park users regarding the intent and necessity of the BMPs as well as ways in which citizens can help. One example is adding appropriate signage regarding impacts of pet waste at parks with intensive use by pets and owners. The Committee also recommends municipalities consider park usage data in deciding sign need and location.

8.0.7: OSSF BMPs

As resources are available, NCTCOG will include OSSF BMPs in the online BMP Library and stakeholders will conduct outreach to municipalities most impacted by OSSFs including information on retirement/closure procedures.

8.0.7.1: Web-based homeowner education

Authorized agents and other stakeholders are concerned that homeowners do not know enough about maintaining an OSSF to identify problems and solutions in order to prevent failures. As resources are available, NCTCOG will create or adapt a website to provide homeowner education on OSSFs. As technology and resources are available, a possible interactive function of this website could encourage OSSF owners to sign up for automatic reminders of required maintenance activities. The interaction has the potential to not only benefit the homeowner, but also serve as an information gathering tool for NCTCOG and the stakeholders regarding ownership, permitting, and maintenance of OSSFs. Other possible elements of the website may include an online pump-out and maintenance log for homeowners, information on grey water recapture systems for homeowners as well as for system builders and installers, lists of licensed maintenance providers, a list of Authorized Agents and contact information, and educational materials on septic-appropriate detergents, water softeners, and legal requirements concerning OSSF modifications. Municipalities, counties, communities, homeowner associations and other interested parties would be able to post a link to the website from their websites, creating a familiar portal for residents.

8.0.7.2: Additional educational materials

As resources are available NCTCOG will create or adapt collateral material, such as flyers, advertisements, mailers, and other marketing pieces for distribution at schools, in newspapers and publications, and to real estate agents, property inspectors, and OSSF builders/installers that address the aforementioned topics for homeowners.

8.0.8: Monitoring coordination BMPs

As resources are available, NCTCOG will make available a BMP Library, which will include monitoring-specific topics such as BMP cost information, success stories, testing surrogates, potential new testing methods and materials, and examples of successful monitoring program implementation.

8.0.9: Public education BMPs

Although the benefits may be hard to quantify, public education is an important part of reducing bacteria loading in the Project area's waterways through public awareness, buy in, and behavior change. Public education is also part of the TPDES Phase I and Phase II permits and there is

considerable knowledge within the area regarding successful projects and techniques, volunteer organization, school curricula, and available materials. The public education section of the BMP Library will provide a clearing house of that information. Included in the BMP Library will be materials from stakeholders on educational efforts such as the City of Irving's Night Hikes and the Dallas Downriver Club's Moonlight Floats, in order to encourage public awareness and stewardship of area waterways. Other items that could be included are guides for citizens on how to become involved in the decision-making process or in local efforts such as river clean-ups or Stream Team. As available, case studies showing benefits, economic and otherwise, from improved water quality and public education and participation will also be included. The web presence will be reevaluated annually by the Education and Outreach subcommittee.

Table 53. Implementation Strategy 8.0 Summary — Best management practices library

Targeted Source(s)	All potential sources
Estimated Potential Load Reduction	IS 8.0 – 8.0.9 may result in a 5% reduction of bacteria loading over 25 years by providing a venue for the widespread dissemination of materials on the efficacy, cost effectiveness, and appropriateness of BMPs in the Project area
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary Financial: grant funding and existing program funding
Education Component	NCTCOG will work with existing RSWMP and TMDL groups to raise awareness of BMP Library
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Creation or modification of existing web page(s)
Progress Indicators	The number of portions of the BMP Library available online
Monitoring Component	Annual reports to the Coordination Committee regarding materials available online Annual review by Coordination Committee and all technical subcommittees of web pages and contents
Responsible Entity	NCTCOG, as funding is available, will create or modify existing web page(s) for the online BMP Library All technical subcommittees will provide NCTCOG with appropriate topic BMPs and other related information, including pilot project results for posting The Coordination Committee will review new pilot projects annually for inclusion in BMP Library

Implementation Strategy 8.1: BMP project funding and evaluation

As resources are available, NCTCOG and stakeholders will identify low-interest loans, grant opportunities, and other funding sources, and facilitate BMP projects benefitting the region. As feasible, NCTCOG will also develop a method for sharing funding opportunities with interested parties. NCTCOG and stakeholders will seek funding opportunities, including grants and the TCEQ's SEPs, for MS4s with financial need for BMP implementation and evaluation of BMP effectiveness. NCTCOG and stakeholders will also pursue funding opportunities for a regional stormwater media campaign that specifically addresses bacteria and will be facilitated through the existing RSWMP Stormwater Public Education Task Force. The summary for implementation strategy 8.1 can be found in Table 54.

Table 54. Implementation Strategy 8.1 Summary — BMP project funding and evaluation

Targeted Source(s)	All potential sources
Estimated Potential Load Reduction	IS 8.1 may result in a 10% reduction of bacteria loading over 25 years by providing funding and a venue for the widespread dissemination of information that is not currently available on the effectiveness of BMPs
Technical and Financial Assistance Needed	Technical: technical and engineering assistance may be necessary Financial: grant funding and existing program funding
Education Component	Stakeholders and NCTCOG will collect and distribute information on funding availability
Schedule of Implementation	As resources are available, the implementation of this activity will begin immediately and will continue for the entire implementation process
Interim, Measurable Milestone	Number of grants and/or other funding sources awarded Number of BMPs installed
Progress Indicators	Number of BMPs evaluated and results of those evaluations posted to the BMP Library
Monitoring Component	MS4s will report on BMP funding received to NCTCOG MS4s will collect data on BMP effectiveness

Responsible Entity	MS4s will seek funding opportunities for the purpose of evaluating BMP effectiveness MS4s will collect data on BMP effectiveness and report results to NCTCOG NCTCOG will develop a method for sharing information on funding opportunities NCTCOG will report on funding received by stakeholders and BMP information shared to the Coordination Committee NCTCOG will make information on BMP evaluations available on the BMP Library

Implementation Strategy Evaluation

Implementation Strategies 9.0: Implementation strategy evaluation

This I-Plan is a multi-year document with numerous implementation strategies intended to reduce bacteria loading in the waterways of the Project area. Given the broad scope of the I-Plan and the difficulties in attributing numeric values to the various bacteria sources, regular review of the implementation strategies is necessary for ongoing successful results. As such, all implementation strategies will be reevaluated on a regular basis. Current provisions call for each strategy to be reevaluated by its respective subcommittee annually. Any recommendations for changes will then be forwarded to the Coordination Committee, which will also meet annually to assess any proposed changes and edit the I-Plan if necessary, either through modifications, adoptions, or deletions of provisions or even entire strategies. The Coordination Committee may choose at a later date to modify the evaluation schedule for any given implementation strategy. The details of implementation strategy evaluation can be found in Table 55.

Table 55. Implementation Strategy 9.0 Summary — Implementation strategy evaluation

Targeted Source(s)	All potential sources
Estimated Potential Load Reduction	IS 9.0 may result in a 5% reduction over 25 years by evaluating the efficacy of all implementation strategies and bacteria load reduction activities and adjusting the I-Plan as appropriate
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary to evaluate some implementation strategies Financial: existing funding as appropriate
Education Component	None
Schedule of Implementation	The technical subcommittees will evaluate their area-appropriate implementation strategies annually or as appropriate for a given strategy The Coordination Committee will evaluate implementation strategies annually or as appropriate for a given strategy
Interim, Measurable Milestone	Over 25 years, all implementation strategies will be evaluated annually or as deemed appropriate by the technical subcommittees and Coordination Committee
Progress Indicators	The number of Implementation strategies evaluated
Monitoring Component	Annual status report to the Coordination Committee from the technical subcommittees through NCTCOG

Responsible Entity	Technical subcommittees will evaluate the implementation strategies under their area of expertise and provide recommendations to the Coordination Committee through NCTCOG NCTCOG will compile an annual program summary for the Coordination Committee with the results of activities conducted each calendar year for the technical subcommittees NCTCOG will compile a five-year report for the Coordination Committee with the results from the implementation strategy evaluations conducted by the technical subcommittees The Coordination Committee will evaluate the analysis of the implementation strategies by the technical subcommittees and if warranted, make adjustments to the I-Plan

Implementation Strategies 9.1: Expanding the geographic scope of the I-Plan as appropriate.

Communities and stakeholders within the region are encouraged to participate in the I-Plan activities, either informally and voluntarily, or formally upon incorporation by the Coordination Committee in the I-Plan. Voluntary action is particularly encouraged in those watersheds with streams that are impaired for bacteria, but do not yet have adopted TMDLs. From time to time, watersheds outside the Project area or segments within the Project area will undergo bacteria TMDLs. In certain instances, there may be the desire to incorporate watersheds outside the Project area or add the segments within the project area to the Greater Trinity I-Plan. A summary of the implementation strategy can be found in Table 56.

9.1.1 Watersheds Outside of the Original Seventeen TMDLs Project Area

As other watersheds in the vicinity of the Project area have TMDLs, currently in-progress or adopted by the TCEQ, stakeholders from those watersheds may request the Coordination Committee to consider incorporating those watersheds into the I-Plan. The Coordination Committee may elect to formally approve the request through a vote during the annual meeting or may decide through a vote taken up by email.

Should the request be accepted by the Coordination Committee, the I-Plan will be updated to reflect the new watershed. The updated plan, via addendum, will be approved during the Coordination Committee annual meeting. NCTCOG will send a letter on behalf of the Coordination Committee to the TCEQ reflecting the results of the vote of the Coordination Committee on adding the watershed.

9.1.2 Segments Inside of the Project Area

The TCEQ will notify the Coordination Committee that new TMDLs have been scheduled or completed for segments within the Project Area. The Coordination Committee may ask the TCEQ to provide a formal presentation on these new TMDL segments during the next Coordination Committee meeting. The Coordination Committee may choose to conduct public outreach within these new segments. The Coordination Committee will formally approve the changes to the I-Plan to address new segments during the annual meeting or may decide through a vote taken up by email.

Once approved by the Coordination Committee the I-Plan will be updated to reflect the additional segments(s) via addendum attached to the I-Plan.

Table 56. Implementation Strategy 9.1 Summary - Expanding the geographic scope of the I-Plan

Targeted Source(s)	All potential sources
Estimated Potential Load Reduction	IS 9.1 may result in a 5% reduction over 25 years by incorporating additional segments receiving implementation strategies and bacteria load reduction activities and adjusting the I-Plan as appropriate
Technical and Financial Assistance Needed	Technical: technical assistance may be necessary to incorporate some TMDL watersheds Financial: existing funding as appropriate
Education Component	None
Schedule of Implementation	The Coordination Committee will formally approve the changes to the I-Plan to address new segments during the annual meeting or may decide through a vote taken up by email.
Interim, Measurable Milestone	Once approved by the Coordination Committee the I-Plan will be updated to reflect the additional segments(s) via addendum attached to the I-Plan.
Progress Indicators	The number voluntary or formal participation occurring
Monitoring Component	Annual status report to the Coordination Committee from the technical subcommittees through NCTCOG
Responsible Entity	NCTCOG will compile an annual report for the Coordination Committee with the results from the formally approved changes to the I-Plan

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Appendices

Appendix A: Coordination Committee and Technical Subcommittee Membership

Coordination Committee

Member	Organization
Kelly Albus	Texas Stream Team
Nixalis Benitez	City of Fort Worth
Robert Berndt	Tarrant County
Ibiso Charles	Tarrant County Public Health
David Cowan	North Texas Municipal Water District
Glenn Clingenpeel	Trinity River Authority
Heather Firn	City of Plano
Brigette Gibson	City of Arlington
Joe Gildersleeve	City of Arlington
Becca Grassl-Petersen	Tarrant County Public Health
Sarah Grella	Tarrant Regional Water District
Dania Grundmann	Texas Commission on Environmental Quality
Tad Heimburger	Dallas Area Rapid Transit
Aaron Hoff	Tarrant Regional Water District
Kevin Hurley	City of Dallas
Fouad Jaber	Texas A&M AgriLife Extension
Brian Kelm	Upper Trinity Regional Water District
Angela Kilpatrick	Trinity River Authority
Jerry Laverty	City of Bedford
Rob McCormic	Park Cities Municipal Utilities District
Cindy Mendez	City of Grand Prairie
Kayla Miller	City of Fort Worth
Nusrat Munir	City of Dallas
Casey Nettles	City of Fort Worth
Jon Pasley	City of Dallas
Jerry Pressley	City of Fort Worth
Chandani Rana	City of Grand Prairie
Jeff Shiflet	City of Irving
Stacy Walters	City of Fort Worth
Samantha Webster	City of Fort Worth
Michelle Wood-Ramirez	Tarrant Regional Water District

Technical Subcommittee Members

Note: Technical support and expertise provided at each subcommittee meeting by TCEQ Region 4.

Education and Outreach

(Suspended meetings in May 2015 – See Regional Stormwater Management Program Public Education Task Force)

Member	Organization
Bonnie Bowman	Greater Fort Worth Sierra Club
Bob Horton	TREES
Frank Librio	City of Dallas
Amitis Meshkani	North Texas Tollway Authority (NTTA)
Tiffany Moss	DFW Airport
Eric Neilsen	Dallas Downriver Club
Karen Siddall	City of Irving

Monitoring Coordination Forum

Member	Organization
Alexis Ackel	DFW Airport
Heather Firn	City of Plano
Brigette Gibson	City of Arlington
Aaron Hoff	Tarrant Regional Water District
Angela Kilpatrick	Trinity River Authority
Nusrat Munir	City of Dallas
Jon Pasley	City of Dallas
Jeff Shiflet	City of Irving

Onsite Sewage Facilities

(Suspended meetings in May 2014 – See Wastewater technical subcommittee)

Member	Organization
Becca Grassl-Petersen	Tarrant County
Chris Hughes	DFW Airport
Werner Rodriguez	City of Grand Prairie
Jeff Shiflet	City of Irving

Parks and Recreation

(Suspended meetings in February 2012 – See Stormwater technical subcommittee)

Member	Organization
Bonnie Bowman	Greater Fort Worth Sierra Club
Timothy Hamilton	City of Grapevine
Louise Hanson	City of Dallas
Eric Neilsen	Dallas Downriver Club
Tammy Walters	DFW Airport
Mark Woolsey	City of Forth Worth

Pets, Wildlife, and Livestock

(Suspended meetings in May 2015 – See Stormwater technical subcommittee)

Member	Organization
Bonnie Bowman	Greater Fort Worth Sierra Club
Don Burns	City of Dallas
John Hart	TxDOT
Tad Heimburger	DART
Virgil Helm	Dalworth SWCD
Brett Johnson	Texas Parks and Wildlife Department (TPWD)
Danny Kocurek	Arlington Conservation Council
Suzanne Tuttle	City of Forth Worth
David Waidler	AgriLife
Tammy Walters	DFW Airport

Planning and Development

(Suspended meetings in May 2015 – See Stormwater technical subcommittee)

Member	Organization
Greg Ajemian	City of Dallas
Peter Blanchette	City of Dallas
Bill Brown	City of Arlington
Fred Guerra	Dallas Regional Chamber
Mark Rauscher	City of Forth Worth
Rachel Roberts	City of Kennedale

Stormwater

Member	Organization
Alexis Ackel	DFW Airport
Randy Bright	City of Colleyville
Heather Firn	City of Plano
Brigette Gibson	City of Arlington
Becca Grassl-Petersen	Tarrant County Public Health
Tad Heimburger	Dallas Area Rapid Transit
Aaron Hoff	Tarrant Regional Water District
Angela Kilpatrick	Trinity River Authority
Rob McCormic	Park Cities Municipal Utilities District
Kayla Miller	City of Fort Worth
Nusrat Munir	City of Dallas
Jon Pasley	City of Dallas
Chandani Rana	City of Grand Prairie
Jeff Shiflet	City of Irving
Stacy Walters	City of Fort Worth

Wastewater

Member	Organization
Ignacio Beltran	City of Irving
Nizalis Benitez	City of Fort Worth
Elijah Dorminy	City of Irving
Joe Gildersleeve	City of Arlington
Becca Grassl-Petersen	Tarrant County Public Health
Jon Pasley	City of Dallas
Jerry Pressley	City of Fort Worth
Stacy Walters	City of Fort Worth
Samantha Webster	City of Fort Worth

Upper Trinity River Basin Coordinating Committee

Member	Organization
Kelly Albus	Texas Stream Team
Nixalis Benitez	City of Fort Worth
Robert Berndt	Tarrant County
Ibiso Charles	Tarrant County Public Health
David Cowan	North Texas Municipal Water District
Heather Firn	City of Plano
Brigette Gibson	City of Arlington
Joe Gildersleeve	City of Arlington
Becca Grassl-Petersen	Tarrant County Public Health
Sarah Grella	Tarrant Regional Water District
Dania Grundmann	Texas Commission on Environmental Quality
Tad Heimburger	Dallas Area Rapid Transit
Aaron Hoff	Tarrant Regional Water District
Kevin Hurley	City of Dallas
Fouad Jaber	Texas A&M AgriLife Extension
Brett Johnson	City of Dallas
Brian Kelm	Upper Trinity Regional Water District
Angela Kilpatrick	Trinity River Authority
Jerry Laverty	City of Bedford
Rob McCormic	Park Cities Municipal Utilities District
Kayla Miller	City of Fort Worth
Nusrat Munir	City of Dallas
Casey Nettles	City of Fort Worth
Jon Pasley	City of Dallas
Jerry Pressley	City of Fort Worth
Chandani Rana	City of Grand Prairie
Jeff Shiflet	City of Irving
Stacy Walters	City of Fort Worth
Samantha Webster	City of Fort Worth
Michelle Wood-Ramirez	Tarrant Regional Water District

Committee rosters were last updated in April 2020. Rosters are updated on an annual basis. The most up-to-date rosters are available online at:
< www.nctcog.org/envir/committees/bacteria-total-maximum-daily-load-program>.

Appendix B: Allocated Loads for TMDLs

The information included in the following tables was taken directly from TMDL reports and technical support documents for the TMDL projects covered by this I-Plan: *Two Total Maximum Daily Loads for Indicator Bacteria in the Upper Trinity River, Dallas, Texas (2011); Two Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Branch and Grapevine Creek (2011); Technical Support Document for Total Maximum Daily Loads for Indicator Bacteria in the Lower West Fork Trinity River Watershed (2012); Four Total Maximum Daily Loads for Indicator Bacteria in Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake; One Total Maximum Daily Load for Indicator Bacteria in Sycamore Creek.*

Commonly used abbreviations:

AU = assessment unit
Cfs = cubic feet per second
cms = cubic meters per second
Criterion = 126 MPN/100 mL
FDA_{SWP} = fractional proportion of drainage area under jurisdiction of stormwater permits
FDC=flow duration curve
FG = future growth loads from potential permitted facilities
gpcd = gallons per capita per day
LA = allowable load from unregulated sources (predominately nonpoint sources)
LA_{USL} = upstream load allocations entering the AU
LA_{AU}= allowable loads from unregulated sources within the AU
LDC=load duration curve
MGD = millions of gallons per day
MOS = margin of safety load
MPN = most probable number of bacteria forming units
Q_{inlet} = median value of the high flow regime entering the AU
Q_{Trib} = median value of the very high flow regime at the tributary or upstream AU outlet(s) to an impaired AU
TMDL = total maximum daily load
WL_{ASW} = waste load from all permitted stormwater sources
WLA_{WWTF} = waste load allocation from WWTFs

Upper Trinity River, Segments 0805_03 and 0805_04

TMDL Calculations

The TMDL was calculated based on the median flow in the 0-20 percentile range (highest flow regime) from the LDC developed for the outlet of each AU. Each term in the TMDL equation was determined based on the equations provided previously.

Table 57 summarizes the calculation of the TMDL and LA_{USL} terms for each AU. Table 58 summarizes the WLA_{WWTF} for the TPDES-permitted facility within the study area. Compliance is achieved when the discharge limits are met. Table 58 does not provide wasteload allocations for permitted facilities not expected to contribute bacteria loadings. The future growth component for AU 0805_04 of the TMDL will be available to the permitted facilities if future in-steam monitoring indicates the need for specific wasteload allocations. Because the entire drainage areas of both 0805_04 and 0805_03 are under the jurisdiction of stormwater permits, stormwater loadings originating from unregulated areas within each AU (LA_{UA}) are zero, and all stormwater loadings are assigned to WLA_{SW}.

Table 59 summarizes the computation of future capacity for the combined AUs. The computation of future growth for AUs 0805_04 and 0805_03 is summarized in Table 60. Table 61 summarizes the TMDL calculations for AUs 0805_04 and 0805_03. In Table 61, the future capacity for WWTF has been added to the WLA_{WWTF} and LA_{AU} and LA_{USL} have been added to give LA. The allocations for WLA_{WWTF} are based on one-half of the water quality criterion for *E. coli* in freshwater of 126 MPN/100 mL.

Table 57. Summary of TMDL and upstream load allocation calculations for each AU

(loading expressed in billion MPN/day)

AU	Receiving Water	Upstream Allowable Loading Q_{inlet}[a] (cms) | LA_{USL}[b]		Downstream Allowable Loading Outlet Flow[c] (cms) |TMDL[d]	
0805_04	Upper Trinity River	195.75 (6913 cfs)	21,310	210.23 (7424 cfs)	22,890
0805_03	Upper Trinity River	210.23 (7424 cfs)	22,890	235.54 (8318 cfs)	25,640

[a] Inlet median value from highest flow regime
[b] Inlet allowable loading; median value from highest flow regime
[c] Outlet median value from highest flow regime
[d] Outlet allowable loading; median value from highest flow regime

Table 58. Wasteload allocations for TPDES permitted facilities

Receiving Water	AU	TPDES Number	NPDES Number	Facility Name	Final Permitted Flow (MGD)	WLA_{WWTF} (billion MPN/day)
Upper Trinity River	0805_04[a]	—	—	—	—	0
Upper Trinity River	0805_03	10060-001	TX0047830	Dallas Central	200	477.0

[a] Wasteload allocations are not provided for TPDES WQ0004161-000, WQ0004663-000, WQ0004765-000, and WQ0014699-001.

Table 59. Future capacity calculations for impaired AUs

2005 Wastewater Flow (gpcd)	Population Increase 2005 to 2030	Dallas Central Full Permitted Flow (MGD)	Dallas Southside Full Permitted Flow (MGD)	Future Capacity of Impaired AUs (MGD)
153	151,106	200	110	14.9

Table 60. Future growth calculations for AUs 0805_04 and 0805_03

Receiving Water	AU	Percent of Combined Drainage Area	Apportioned Future Capacity (MGD)	Future Growth (billion MPN/day)
Upper Trinity River	0805_04	46.64%	6.950	16.57
Upper Trinity River	0805_03	53.36%	7.950	18.96

Table 61. *E. coli* TMDL summary calculations for the Upper Trinity River AUs 0805_04 and 0805_03

(all loads expressed as billion MPN/day)

AU	TMDL[a]	WLA_{WWTF}[b,c]	WLA_{SW}[d]	LA_{AU}[e]	LA_{USL}	MOS [h]	Future Growth[i]
0805_04	22,890	0	1,480	0	21,310 [f]	78.79	16.57
0805_03	25,640	477.0	2,123	0	22,890 [g]	137.8	18.96

[a] TMDL = Median flow (high flow regime) * Criterion (126 MPN/100 mL) * Conversion Factor; where the Conversion Factor = 8.64×10^8 100 mL/m^3 * seconds/day.

[b] No WWTF discharges into AU04

[c] Loads from the Dallas Central WWTF calculated as Permitted Flow (MGD) * Conversion Factor * Criterion/2 (63 MPN/day); where Permitted Flow = 200 MGD; Conversion Factor = 3.7854×10^7 100 mL/MGD

[d] WLA_{SW} = (TMDL - WLA_{WWTF} - LA_{USL} - FG - MOS) * FDA_{SWP}; where FG = future growth loads from potential permitted facilities and FDA_{SWP} (fractional proportion of drainage under jurisdiction of stormwater permits) = 1.000

[e] LA_{AU} = TMDL - MOS - WLA_{WWTF} - WLA_{SW} - LA_{USL} - FG; because the entire drainage area of AU04 and AU03 is covered by MS4 permits the LA_{AU} = 0.000

[f] $LA_{USL} = Q_{inlet}$ * Criterion (126 MPN/day) * Conversion Factor = 8.64×10^8 100 mL/m^3 * seconds/day

[g] $LA_{USL} = Q_{inlet}$ * Criterion (126 MPN/day) * Conversion Factor = 8.64×10^8 100 mL/m^3 * seconds/day

[h] MOS = 0.05 * (TMDL - LA_{USL})

[i] Future Growth = surface water quality standard/2 (63 MPN/day) * FC (MGD) * FDA_{AU} * Conversion Factor = 3.7854×10^7 100 mL/MGD

Cottonwood Creek and Grapevine Branch, Segments 0822A_02 and 0822B_01

TMDL Calculations

The TMDL was calculated based on the median flow in the 0-10 percentile range (high flow regime) from the LDC developed for the most downstream station within each AU, which is station 17166 in AU 0822A_02 and station 20311 in AU 0822B_01. Each term in the TMDL equation was determined based on the equations provided previously. Table 62 summarizes the calculation of the TMDL for each AU. Table 63 summarizes the computation of future growth for the combined AUs.

The entire drainage area of AU 0822A_02 is located within jurisdictional areas regulated by stormwater permits, and 84.8% of the drainage area of AU 0822B_01 is located within the jurisdictional areas regulated by stormwater permits (6,437 acres out of 7,593 acres under stormwater permit regulation). Table 64 summarizes the computation of term WLA_{SW}. Since the entire drainage of AU 0822A_02 is within the jurisdictional areas regulated by stormwater permits, the LA associated with this AU is zero. For AU 0822B_01, 1,156 acres (or 15.2% of its drainage area) are not regulated by stormwater permits, and the LA was computed from the value of terms in Table 65.

Table 66 summarizes the TMDL calculations for AUs 0822A_02 and 0822B_01. Table 67 includes the final TMDL allocations including the future growth component designated as WLA_{WWTF}. Allocations to permitted MS4 entities are designated as WLA_{SW}. The allocations are based on the current geometric mean criterion for *E. coli* in freshwater of 126 MPN/100 mL, with the exception of the Future Growth component. The Future Growth component is based on one-half the current geometric mean criterion (63 MPN/100 mL) to provide instream and downstream capacity.

Table 62. Summary of TMDL calculations for Cottonwood Branch and Grapevine Creek

Segment	Stream Name	Station	Median Value of High Flow Regime	TMDL (billion MPN/day)
0822A_02	Cottonwood Branch	17166	0.3402 cms (12.01 cfs)	37.04
0822B_01	Grapevine Creek	20311	1.802 cms (63.65 cfs)	196.22

Table 63. Future growth computations for Cottonwood Branch and Grapevine Creek

Segment	Stream Name	2005 Population	2030 Population	Population Increase 2005 to 2030	Additional Wastewater Production (MGD)	Future Growth (billion MPN/day)*
0822A	Cottonwood Branch	19,499	20,328	829	0.089	.212
0822B	Grapevine Creek	20,807	22,622	1,815	0.195	.464

* Future growth includes a reduction for MOS of 5%

Table 64. Regulated stormwater computations for Cottonwood Branch (0822A_02) and Grapevine Creek (0822B_01)

(all loads expressed as billion MPN/day)

AU	TMDL	WLA_{WWTF}	Future Growth	MOS	FD_{ASWP}	WLA_{SW}
0822A_02	37.04	0.00	0.21	1.85	1.000	34.97
0822B_01	196.22	0.00	0.46	9.81	0.848	157.60

Table 65. Non-regulated stormwater computations for Cottonwood Branch and Grapevine Creek

AU	LA (Billion MPN/day)
0822A_02	0
0822B_01	28.34

Table 66. TMDL allocation summary for Cottonwood Branch and Grapevine Creek

(all units in billion MPN/day)

AU	Stream Name	TMDL[a]	WLA_{WWTF}[b]	WLA_{SW}[c]	LA[d]	MOS[e]	Future Growth[f]
0822A_02	Cottonwood Branch	37.04	0.00	34.97	0	1.85	0.21
0822B_01	Grapevine Creek	196.22	0.00	157.60	28.34	9.81	0.46

[a] TMDL = Median flow (high flow regime) * 126 MPN/100 mL * Conversion Factor; where the Conversion Factor = 8.64E+08 100 mL/m^3 * seconds/day

[b] No WWTF discharges into AUs 0822A_02 and 0822B_01

[c] WLA_{SW} = (TMDL - WLA_{WWTF} - FG - MOS) * FDA_{SWP}

[d] LA = TMDL - WLA_{WWTF} - MOS - WLA_{SW} - FG; because the entire drainage area of 0822A_02 is covered by MS4 permits its LA = 0.000

[e] MOS = 0.05 * TMDL

[f] Future Growth = Criterion /2 (63 MPN/day) *$Flow_{2005}$ * (Pop_{30} – Pop_{05}) * Conversion Factor; where $Flow_{2005}$ = 107 gpcd, Pop_{30} is the estimated population within the watershed for year 2030 and Pop05 is the estimated population within the watershed for year 2005; and Conversion Factor = 37.854 100 ml/gpcd

Table 67. Final TMDL allocations for Cottonwood Branch and Grapevine Creek

(all units in billion MPN/day**)**

AU	Stream Name	TMDL	WLA_{WWTF}*	WLA_{SW}	LA	MOS
0822A_02	Grapevine Creek	37.04	0.21	34.97	0	1.85
0822B_01	Cottonwood Branch	196.22	0.46	157.60	28.34	9.81

* WLA_{WWTF} = WLA_{WWTF} + Future Growth

Lower West Fork Trinity and Impaired Tributaries, Segments 0841, 0841B, 0841C, 0841E, 0841G, 0841H, 0841J, 0841L, 0841M, 0841R, 0841T, and 0841U

TMDL Calculations

Table 68 summarizes the allowable loading of *E. coli* that the 13 water bodies within the 0841 TMDL watersheds can receive on a daily basis was determined based on the median value within the very high flow regime of the FDC (or 5% flow exceedance value) for the outlet of each AU. For each AU with tributary and upstream load allocations, the following approach was taken:

- Lower West Fork Trinity River (0841_01), LA_{USL} = sum of the allowable loading calculated at the outlet of Lower West Fork Trinity River (0841_02), Bear Creek (0841B), Dalworth Creek (0841G), Delaware Creek (0841H), Johnson Creek (0841L), Mountain Creek (0841O), and West Irving Branch (0841U).
- Lower West Fork Trinity River (0841_02), LA_{USL} = the sum of the loading calculated at the outlet of West Fork Trinity River (0806) and Village Creek (0841T).
- Bear Creek (0841B), LA_{USL} = the loading calculated at the outlet of Big Bear Creek (0841D), Dry Branch (0841I), and Estelle Creek (0841J).
- Johnson Creek (0841L), LA_{USL} = the loading calculated at the outlet of Arbor Creek (0841C).
- Rush Creek (0841R), LA_{USL} = the loading calculated at the outlet of Kee Branch (0841M).
- Village Creek (0841T), LA_{USL} = the loading calculated at the outlet of Rush Creek (0841R).

Table 69 details the daily allowable loading of *E. coli* assigned to WLA_{WWTF} was determined based on the full permitted flow of the two WWTFs located in the TMDL watersheds. A WLA_{WWTF} was only applied to AUs that directly receive discharge from a WWTF. The WLA_{WWTF} calculated for the City of Forth Worth Village Creek WWTF was thus applied to the TMDL Lower West Fork Trinity River segment 0841_02, and the WLA_{WWTF} calculated for the TRA Central Regional WWTF was applied to the TMDL for Lower West Fork Trinity River segment 0841_01.

In terms of future growth, the majority of the TMDL watersheds are serviced by the TRA Central Regional WWTF. As shown in Table 70, anticipated expansion of the TRA Central Regional WWTF that will result in an additional 43 MGD capacity was the basis for the future growth allocation within Lower West Fork Trinity River (0841_01). The Future Growth component for Arbor Creek (0841C), Copart Branch Mountain Creek (0841E), Dalworth Creek (0841G), Delaware Creek (0841H), Estelle Creek (0841J), Johnson Creek (0841L), Kee Branch (0841M), and West Irving Branch (0841U), which are serviced by the TRA Central Regional WWTF, were not explicitly derived since all wastewater collected within these AUs is subsequently discharged outside of their watersheds and into Lower West Fork Trinity River (0841_01).

The future growth allocations for AUs within the TMDL watersheds that have portions of their area outside of the TRA Central Regional WWTF service area were calculated based on population projections and per capita wastewater use. The resulting future wastewater flow was then converted into a loading.

Based on the MS4 permitted areas, most of the AUs within TMDL watersheds are completely within the jurisdiction regulated by stormwater permits. The AUs that are not 100% within the urbanized area include Lower West Fork Trinity River (0841_01), Bear Creek (0841B), Copart Branch Mountain Creek (0841E), and Rush Creek (0841R). Table 71 summarizes the computation of term WLA_{SW}.

The LA_{AU} is the allowable bacteria loading assigned to unregulated sources within each TMDL watershed. For most of the AUs within the TMDL watersheds, their entire area is regulated by stormwater permits. Therefore, for most AUs the LA_{AU} term is zero. For Lower West Fork Trinity River (0841_01), 1,727 acres or 24.3% of its drainage area is not regulated by stormwater permits. For Bear Creek (0841B), 432 acres or 0.9% of its drainage area is not regulated by stormwater permits. For Copart Branch Mountain Creek (0841E), 150 acres or 24.7% of its drainage area is not regulated by stormwater permits. For Rush Creek (0841R), 494 acres or 2.8% of its drainage area is not regulated by stormwater permits (Table 72).

Table 73 summarizes the TMDL calculations for the 13 impaired AUs comprising the TMDL watersheds. Each of the TMDLs was calculated based on the median flow in the 0-10 percentile range (very high flow regime) for flow exceedance from the LDC developed for the outlet of each AU. Allocations are based on the current geometric mean criterion for *E. coli* in freshwater of 126 MPN/100 mL for each component of the TMDL.

The final TMDL allocations include the future growth component within the WLA_{WWTF} while allocations to permitted MS4 entities are designated as WLA_{sw} (Table 74). The LA component of the final TMDL allocations includes both tributary and upstream bacteria loadings (LA_{USL}) and loadings arising from within each segment from non-permitted sources (LA_{AU}).

Table 68. Summary of TMDL and load allocations from upstream and tributaries (LA_{USL}) calculations

AU	Segment Name	Upstream Allowable Loading		Downstream Allowable Loading	
		Q_{inleta} [a] (cms)	LA_{USL}[b] (billion MPN/100 mL)	Outlet Flow [c] (cms)	TMDL[d] (billion MPN/100 mL)
0841_01	Lower West Fork Trinity River	139.54	15,191	150.59	16,390
0841_02	Lower West Fork Trinity River	82.70	9,003	105.16	11,448
0841B	Bear Creek	12.66	1,378	23.15	2,520
0841C	Arbor Creek	0	0	0.46	50.10
0841E	Copart Branch Mountain Creek	0	0	0.24	25.92
0841G	Dalworth Creek	0	0	0.55	59.37
0841H	Delaware Creek	0	0	2.21	240.4
0841J	Estelle Creek	0	0	0.79	85.46
0841L	Johnson Creek	0.46	50.10	5.21	567.0
0841M	Kee Branch	0	0	1.78	194.1
0841R	Rush Creek	1.78	194.1	8.57	933.2
0841T	Village Creek	8.57	933.2	12.10	1,317
0841U	West Irving Branch	0	0	0.86	93.17

[a] Inlet median value from very high flow regime for all tributaries and upstream AUs
[b] Inlet allowable loading; median value from very high flow regime for all tributaries and upstream AUs
[c] Outlet median value from very high flow regime
[d] Outlet allowable loading; median value from very high flow regime

Table 69. Regulated wastewater treatment facility computations

AU	TPDES Number	Facility Name	Final Permitted Flow (MGD)	*E. coli* WLA_{WWTF} (billion MPN/day)
0841_01	WQ0010303-001	TRA Central Regional WWTF	189	450.7
0841_02	WQ0010494-013	City of Fort Worth Village Creek WWTF	166	395.9
0841D	WQ0011032-001	Alta Vista Mobile Home Park*	0.008	0.019

* Although the Alta Vista Mobile Home Park does not discharge to an impaired AU, it is in the TMDL watershed. For this reason, the facility has a WLA.

Table 70. Future Wastewater Service Area (WWSA) growth computations for the TMDL watersheds

AU	2010 Population outside the TRA Central WWSA	2040 Population Projection outside the TRA Central WWSA	Population Increase 2010 to 2040 outside the TRA Central WWSA	Per Capita Wastewater Use outside the TRA Central WWSA (gpcd)	Additional Wastewater Production (MGD)	Future Growth (billion MPN/day)
0841_01[a]	0	0	0	0	43	102.5
0841_02	89,631	119,715	30,084	101.77	3.06	7.301
0841B	3,003	3,761	758	101.77	0.077	0.1840
0841C[b]	0	0	0	0	0	0
0841E [b]	0	0	0	0	0	0
0841G [b]	0	0	0	0	0	0
0841H [b]	0	0	0	0	0	0
0841J [b]	0	0	0	0	0	0
0841L [b]	0	0	0	0	0	0
0841M [b]	0	0	0	0	0	0
0841R	4,319	7,873	3,554	101.77	0.362	0.8626
0841T	23,599	53,443	29,844	101.77	3.04	7.243
0841U [b]	0	0	0	0	0	0

[a] Future Growth for 0841_01 is based exclusively on the 43 MGD expansion of the TRA Central WWTF.

[b] Future Growth was not explicitly derived since all wastewater collected within the AU is discharged to 0841_01.

Table 71. Regulated stormwater computation for TMDL Watersheds

(all loads expressed as billion MPN/day)

AU	TMDL (MPN/day)	WLA_{WWTF} (MPN/day)	Future Growth (MPN/day)	LA_{USL} (MPN/day)	MOS (MPN/day)	FDA_{SWP}	WLA_{SW} (MPN/day)
0841_01	16,394	450.7	102.5	15,191	60.15	1.000	589.6
0841_02	11,448	395.9	7.301	9,003	122.3	1.000	1,920
0841B	2,520	0	0.1840	1,378	57.09	1.000	1,085
0841C	50.10	0	0	0	2.505	1.000	47.59
0841E	25.92	0	0	0	1.296	1.000	24.62
0841G	59.37	0	0	0	2.969	1.000	56.41
0841H	240.4	0	0	0	12.02	1.000	228.4
0841J	85.46	0	0	0	4.273	1.000	81.19
0841L	567.0	0	0	50.10	25.84	1.000	491.0
0841M	194.1	0	0	0	9.704	1.000	184.4
0841R	933.2	0	0.8626	194.1	36.95	0.972	681.4
0841T	1,317	0	7.243	933.2	19.22	1.000	357.9
0841U	93.17	0	0	0	4.658	1.000	88.51

Table 72. Computed unregulated stormwater term for AUs within TMDL watersheds

AU	LA_{AU} (billion MPN/day)		AU	LA_{AU} (billion MPN/day)
0841_01	0		0841J	0
0841_02	0		0841L	0
0841B	0		0841M	0
0841C	0		0841R	22.58
0841E	0		0841T	0
0841G	0		0841U	0
0841H	0			

Table 73. TMDL allocation summary for impaired AUs within the Lower West Fork Trinity River Watershed

(all loads expressed as billion MPN/day)

AU	Stream Name	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA_{AU}	LA_{USL}	LA Total	Future Growth
0841_01	Lower West Fork Trinity River	16,394	60.15	450.7	589.6	0	15,191	15,334	102.5
0841_02	Lower West Fork Trinity River	11,448	122.3	395.9	1,920	0	9,003	9,003	7.301
0841B	Bear Creek	2,520	57.09	0.0191	1,085	0	1,378	1,388	0.184
0841C	Arbor Creek	50.10	2.505	0	47.59	0	0	0	0
0841E	Copart Branch Mountain Creek	25.92	1.296	0	24.62	0	0	6.070	0
0841G	Dalworth Creek	59.37	2.969	0	56.41	0	0	0	0
0841H	Delaware Creek	240.4	12.02	0	228.4	0	0	0	0
0841J	Estelle Creek	85.46	4.273	0	81.19	0	0	0	0
0841L	Johnson Creek	567.0	25.84	0	491.0	0	50.10	50.10	0
0841M	Kee Branch	194.1	9.704	0	184.4	0	0	0	0
0841R	Rush Creek	933.2	36.95	0	678.7	22.58	194.1	216.7	0.8626
0841T	Village Creek	1,317	19.22	0	357.9	0	933.2	933.2	7.243
0841U	West Irving Branch	93.17	4.658	0	88.51	0	0	0	0

Table 74. Final TMDL allocations for impaired AUs

(all loads expressed as billion MPN/day)

AU	TMDL	WLA_{WWTF}*	WLA_{SW}	LA	MOS
0841_01	16,394	553.3	589.6	15,191	60.15
0841_02	11,448	403.2	1,920	9,003	122.3
0841B	2,520	0.203	1,085	1,378	57.09
0841C	50.10	0	47.59	0	2.505
0841E	25.92	0	24.62	0	1.296
0841G	59.37	0	56.41	0	2.969
0841H	240.4	0	228.4	0	12.02
0841J	85.46	0	81.19	0	4.273
0841L	567.0	0	491.0	50.10	25.84
0841M	194.1	0	184.4	0	9.704
0841R	933.2	0.8626	678.7	216.7	36.95
0841T	1,317	7.243	357.9	933.2	19.22
0841U	93.17	0	88.51	0	4.658

*WLA_{WWTF} includes the future potential allocation to wastewater treatment facilities.

Upstream of Mountain Creek Lake, Segments 0841F, 0841K, 0841N, and 0841V

TMDL Calculations

Table 75 summarizes the allowable loading of E. coli that the four segments within the TMDL watersheds can receive on a daily basis. This information was based on the median value in the 0-10 percentile range within the high flow regime of the LDC (or 5 percent flow exceedance value) for the most downstream station of each AU.

Each TMDL watershed is covered 100 percent by MS4 Phase II general permits and/or a Phase I individual permit. However, even in highly urbanized areas such as the TMDL study area, there remain small areas of streams within each watershed that are not strictly regulated by stormwater permits and which may receive bacteria loadings from unregulated sources such as wildlife and feral hogs. In order to calculate the amount of overall runoff load that should be allocated to WLASW, the percentage of the watershed drainage area under the jurisdiction of a stormwater permit (FDA_{SWP}) must be estimated. To account for the small unregulated areas in each impaired watershed, the stream length was used to compute an area of unregulated stormwater contribution, summarized in Table 76.

Due to the absence of permitted dischargers in the TMDL study area, the WLA_{WWTF} term is zero. Likewise, since it is unforeseen that any permitted discharges with a human waste component will occur in the TMDL study area, the future growth term is also zero. A summary of the calculation of the WLA_{SW} term is provided in Table 77.

Table 78 summarizes the computation of LA_{AU}, which is the allowable bacteria loading assigned to unregulated sources within each AU watershed. All AUs within the TMDL watersheds were assigned a small area not regulated by stormwater permits as detailed in Table 76.

Table 79 provides a summary of the TMDL calculations for the four TMDL watersheds. Allocations are based on the current geometric mean criterion for E. coli of 126 MPN/100 mL for each component of the TMDL. Table 80 includes the final TMDL allocations needed to comply with the requirements of 40 CFR 130.7 including the future growth component within the $WLA_{WWTF,}$ which for all the TMDL watersheds was zero due to the absence of any permitted discharges and the anticipation of no future permitted discharges with a human waste component. The final TMDL allocations also include allocations to permitted MS4 entities and permitted construction and industrial activities, which are designated as WLA_{SW}. The LA_{TOTAL} component of the final TMDL allocations is the sum of unregulated stormwater loadings arising from within each AU and any loadings associated with TMDL segments that are tributaries to another TMDL segment.

Table 75. Summary of allowable loading calculations for segments within the TMDL watersheds

Water Body	Segment	5% Exceedance Flow (cfs)	5% Exceedance Load = TMDL (Billion MPN/day)
Cottonwood Creek	0841F	16.057	49.498
Fish Creek	0841K	39.327	121.234
Kirby Creek	0841N	3.863	11.910
Crockett Branch	0841V	0.2625	0.809

Table 76. Basis of unregulated stormwater area and computation of FDA_{SWP}

Water Body	Total Watershed Area (acres)	Stream Length (feet)[a]	Estimated Average Stream Width (feet)	Estimated Stream Area (acres)	Fraction Unregulated Area	FDA_{SWP}[b]
Cottonwood Creek	3,798	34,857	23	18.40	0.00485	0.99515
N.F. Cottonwood Creek	3,546	19,808	30	13.64	0.00385	0.99615
Entire Cottonwood Creek (Excluding Crockett Branch)	7,344	54,664	25.5	21005	0.00436	0.99564
Crockett Branch	767	4,920	11	1.24	0.00162	0.99838
Fish Creek	10,993	73,354	30	50.52	0.00460	0.99540
N.F. Fish Creek	3,663	25,328	26	15.12	0.00413	0.99587
Entire Fish Creek (Excluding Kirby Creek)	14,656	98,682	29.0	65.64	0.00448	0.99552
Kirby Creek	1,978	22,114	18	9.14	0.00462	0.99538

[a] Stream lengths were determined by GIS analysis and may not exactly match lengths from AU descriptions in the *Integrated Report*

[b] FDA_{SWP} = fractional drainage area under jurisdiction of stormwater permits

Table 77. Regulated stormwater calculations for the TMDL watersheds

(All loads expressed as billion MPN/day *E. coli*)

Water Body	Segment	TMDL[a]	WLA_{WWTF}[b]	LA_{TRIB}[c]	FG[d]	MOS[e]	FDA_{SWP}[f]	WLA_{SW}[g]
Cottonwood Creek	0841K	49.498	0	0.809	0	2.434	0.99564	46.053
Fish Creek	0841K	121.234	0	11.910	0	5.466	0.99552	103.393
Kirby Creek	0841N	11.910	0	0	0	0.595	0.99538	11.263
Crockett Branch	0841V	0.809	0	0	0	0.040	0.99838	0.768

[a] TMDL = ΣWLA + ΣLA + ΣFG + MOS

[b] WLA_{WWTF} is zero do to the absence of any permitted dischargers in the TMDL watersheds

[c] LA_{TRIB} represents the tributary loading of the Crockett Branch TMDL as a part of the Cottonwood TMDL and the tributary loading of the Kirby Creek TMDL as a part of the Fish Creek TMDL

[d] FG = sum of future growth loads from permitted facilities

[e] MOS = 0.05 * (TMDL – LA_{TRIB})

[f] FDA_{SWP} = fractional drainage area under jurisdiction of stormwater permits

[g] WLA_{SW} = (TMDL – WLA_{WWTF} – LA_{TRIB} – FG – MOS) * FDA_{SWP}

Table 78. Unregulated stormwater calculations for the TMDL watersheds

(Units expressed as billion MPN/day *E. coli*)

Water Body	Segment	TMDL	WLA_{WWTF}	WLA_{SW}	LA_{TRIB}	FG	MOS	LA_{AU}
Cottonwood Creek	0841K	49.498	0	46.053	0.809	0	2.434	0.202
Fish Creek	0841K	121.234	0	103.393	11.910	0	5.466	0.465
Kirby Creek	0841N	11.910	0	11.263	0	0	0.595	0.052
Crockett Branch	0841V	0.809	0	0.768	0	0	0.040	0.001

Table 79. TMDL allocation summary for the TMDL watersheds

(Units expressed as billion MPN/day *E. coli*)

Water Body	Segment	TMDL	WLA_{WWTF}	WLA_{SW}	LA_{AU}	LA_{TRIB}	FG	MOS
Cottonwood Creek	0841K	49.498	0	46.053	0.202	0.809	0	2.434
Fish Creek	0841K	121.234	0	103.393	0.465	11.910	0	5.466
Kirby Creek	0841N	11.910	0	11.263	0.052	0	0	0.595
Crockett Branch	0841V	0.809	0	0.768	0.001	0	0	0.040

Table 80. Final TMDL allocations for the TMDL watersheds

(Units expressed as billion MPN/day *E. coli*)

Water Body	Segment	TMDL	WLA_{WWTF}[a]	WLA_{SW}	LA_{TOTAL}[b]	MOS
Cottonwood Creek	0841K	49.498	0	46.053	1.011	2.434
Fish Creek	0841K	121.234	0	103.393	12.375	5.466
Kirby Creek	0841N	11.910	0	11.263	0.052	0.595
Crockett Branch	0841V	0.809	0	0.768	0.001	0.040

[a] $WLA_{WWTF} = WLA_{WWTF} + FG$

[b] $LA_{TOTAL} = LA_{AU} + LA_{TRIB}$

Sycamore Creek, Segment 0806E

TMDL Calculations

Table 81 summarizes the allowable loading of E. coli that the Sycamore Creek segment within the TMDL watershed can receive on a daily basis. This information was based on the median value in the 0 to ten percentile range (five percent exceedance, high flow regime) for flow exceedance from the LDC developed for TCEQ station 17369 on Sycamore Creek.

The Sycamore Creek watershed is 100 percent covered by MS4 Phase II general permits and Phase I individual permits. However, even in highly urbanized areas such as the TMDL study area, there remain small areas of streams within each watershed that are not strictly regulated by stormwater permits and which may receive bacteria loadings from unregulated sources such as wildlife and feral hogs. In order to calculate the amount of overall runoff load that should be allocated to WLASW, the percentage of the watershed drainage area under the jurisdiction of a stormwater permit (FDA_{SWP}) must be estimated. To account for the small unregulated areas in the Sycamore Creek watershed, the stream length based on the TCEQ definition of AU 0806E_01 and a stream width estimated from measurements recorded as part of a recreational use attainability analysis on Sycamore Creek (TIAER, 2010) was used to compute an area of unregulated stormwater contribution, summarized in Table 82.

Due to the absence of permitted dischargers in the Sycamore Creek watershed, the WLA_{WWTF} term is zero. Likewise, since it is unforeseen that any permitted discharges with a human waste component will occur in the TMDL study area, the future growth term is also zero. A summary of the calculation of the WLA_{SW} term is provided in Table 83.

Table 84 provides a summary of the TMDL calculations for the Sycamore Creek watershed. Allocations are based on the current geometric mean criterion for E. coli of 126 MPN/100 mL for each component of the TMDL. Table 85 includes the final TMDL allocations needed to comply with the requirements of 40 CFR 130.7 including the future growth component within the $WLA_{WWTF,}$ which was zero due to the absence of any permitted discharges and the anticipation of no future permitted discharges with a human waste component. The final TMDL allocations also include allocations to permitted MS4 entities and permitted construction and industrial activities, which are designated as WLA_{SW}.

Table 81. Summary of allowable loading calculations for segments within the TMDL watersheds

Water Body	Segment	5% Exceedance Flow (cfs)	5% Exceedance Load = TMDL (Billion MPN/day)
Sycamore Creek	0806E	65.048	2.00523E+11

Table 82. Basis of unregulated stormwater area and computation of FDA_{SWP}

Water Body	Total Area (acres)	Stream Length (feet)	Estimated Average Stream Width (feet)	Estimated Stream Area (acres)	Fraction Unregulated Area	FDA_{SWP}[a]
Sycamore Creek	23,688	26,400	30.3	18.4	0.00078	0.99922

[a] FDA_{SWP} = fractional drainage area under jurisdiction of stormwater permits

Table 83. Regulated stormwater calculations for the Sycamore Creek watershed

(All loads expressed as billion MPN/day *E. coli*)

Water Body	Segment	TMDL[a]	WLA_{WWTF}[b]	FG[c]	MOS[d]	FDA_{SWP}[e]	WLA_{SW}[f]
Sycamore Creek	0806E	200.523	0	0	10.026	0.99922	190.348

[a] TMDL = ΣWLA + ΣLA + ΣFG + MOS
[b] WLA_{WWTF} is zero do to the absence of any permitted dischargers in the TMDL watersheds
[c] FG = sum of future growth loads from permitted facilities
[d] MOS = 0.05 * (TMDL – LA_{TRIB})
[e] FDA_{SWP} = fractional drainage area under jurisdiction of stormwater permits
[f] WLA_{SW} = (TMDL – WLA_{WWTF} – LA_{TRIB} – FG – MOS) * FDA_{SWP}

Table 84. TMDL allocation summary for the Sycamore Creek watershed (AU 0806E_01)

(Load units expressed as billion MPN/day *E. coli*)

Water Body	Segment	TMDL[a]	MOS[b]	WLA_{WWTF}[c]	WLA_{SW}[d]	LA[e]	FG[f]
Sycamore Creek	0806E	200.523	10.026		190.348	0.149	0

[a] TMDL = Median flow (highest flow regime) * 126 MPN/100 mL * Conversion Factor; where the Conversion Factor = 65.048 100 mL/ft^3 * 86,400 s/d; Median (5 percent exceedance) Flow
[b] MOS = 0.05 * TMDL
[c] WLA_{WWTF} = 0 MPN/100 mL due to an absence of any WWTFs within the Sycamore Creek watershed
[d] WLA_{SW} = (TMDL - ΣWLA_{WWTF} - ΣFG - MOS) * FDA_{SWP}
[e] LA = TMDL - ΣWLA_{WWTF} - ΣWLA_{SW} - ΣFG - MOS
[f] Future Growth = 0 MPN/100 mL since the establishment of WWTFs within the Sycamore Creek watershed is highly unlikely

Table 85. Final TMDL allocations for the Sycamore Creek watershed (AU 0806E_01)

(Units expressed as billion MPN/day *E. coli*)

AU	TMDL	WLA_{WWTF}[a]	WLA_{SW}	LA	MOS
0806E_01	200.523	0	190.348	0.149	10.026

[a] WLA_{WWTF} includes the future growth component

Appendix C: Segments and assessment units in project area

Table 86. Segment (SEG_ID) and assessment unit (AU_ID) with physical description and year listed

SEG_ID	AU_ID	Name	Description	Year listed on 303(d)	Year attaining WQ Standard
0805	0805_03	Upper Trinity River	From the confluence of Fivemile Creek upstream to the confluence of Cedar Creek.	1996	n/a
0805	0805_04	Upper Trinity River	From confluence of Cedar Creek upstream to confluence of Elm Fork Trinity River.	1996	n/a
0822A	0822A_02	Cottonwood Branch	A 3. 5 mile stretch of Cottonwood Branch running upstream from approximately 0.5 miles downstream of N. Story Rd. to Valley View Rd, Dallas, Co.	2006	n/a
0822B	0822B_01	Grapevine Creek	From the confluence with Elm Fork Trinity River in Dallas County upstream to its headwaters west of International Parkway at DFW Airport in Tarrant County.	2006	2016, 2018
0841	0841_01	Lower West Fork Trinity River	Lower West Fork Trinity River from a point immediately upstream of the confluence of the Elm Fork Trinity River in Dallas County to a point immediately upstream of the confluence of Johnson Creek in Dallas County.	1996	n/a
0841	0841_02	Lower West Fork Trinity River	Lower West Fork Trinity River from a point immediately upstream of the confluence of Johnson Creek in Dallas County to a point immediately upstream of the confluence of Village Creek in Tarrant County.	2010	2016, 2018, 2020
0841B	0841B_01	Bear Creek	Bear Creek from confluence with West Fork Trinity River, to the confluence with of Big Bear and Little Bear Creek just upstream of HWY 183 in Euless, Tarrant County, TX.	2006	2012, 2014, 2016, 2018, 2020
0841C	0841C_01	Arbor Creek	Arbor Creek from confluence with Johnson Creek upstream to Duncan Perry Road in Grand Prairie, TX.	2006	2012, 2014

SEG_ID	AU_ID	Name	Description	Year listed on 303(d)	Year attaining WQ Standard
0841E	0841E_01	Copart Branch Mountain Creek	Copart Branch Mountain Creek from confluence with unnamed oxbow (NHD RC 12030102044758) to approximately 0.3 miles upstream of Camden Road on the former Dallas Naval Air Station property, Dallas County.	2006	2012, 2014, 2016, 2018, 2020
0841F	0841F_01	Cottonwood Creek	Cottonwood Creek running upstream of Mountain Creek Reservoir in Dallas County, to SH 360 in Tarrant County.	2006	n/a
0841G	0841G_01	Dalworth Creek	Dalworth Creek from confluence with Lower West Fork Trinity to headwaters area just west of 22nd Street NW in Grand Prairie, Dallas County.	2006	n/a
0841H	0841H_01	Delaware Creek	Delaware Creek from confluence with Lower W. Fork Trinity to Finley Road in Irving.	2006	2016, 2018, 2020
0841I	0841I_01	Dry Branch Creek	A 1.5 mile stretch of Dry Branch Creek running upstream from confluence with Lower West Fork Trinity to Rock Island Road in Irving, Dallas County.	2020	n/a
0841J	0841J_01	Estelle Creek	Estelle Creek from confluence with Bear Creek upstream to Valley View Lane in Irving, Dallas County.	2006	2018, 2020
0841K	0841K_01	Fish Creek	Fish Creek from confluence with Mountain Creek Reservoir in Grand Prairie, Dallas County, to the upper end of the creek (NHD RC 12030102000107) in Arlington, Tarrant County.	2006	n/a
0841M	0841M_01	Kee Branch	Kee Branch from confluence with Rush Creek to upper end of the creek (NHD RC 12030102000165).	2006	n/a
0841L	0841L_01	Johnson Creek	Johnson Creek from confluence with the Arbor Creek to just upstream of I30 in Grand Prairie, Tarrant County.	2010	n/a
0841N	0841N_01	Kirby Creek	Kirby Creek from confluence with Fish Creek in Grand Prairie, Dallas County, to just upstream of Great Southwest Parkway in Arlington, Tarrant County.	2006	n/a

SEG_ID	AU_ID	Name	Description	Year listed on 303(d)	Year attaining WQ Standard
0841P	0841P_01	North Fork Cottonwood Creek	A 4.4 mile stretch of North Fork Cottonwood Creek running upstream from confluence with the South Fork Cottonwood Creek in Grand Prairie, Dallas County, to approximately 0.3 miles upstream of Carter Street in Arlington, Tarrant County.	2020	n/a
0841Q	0841Q_01	North Fork Fish Creek	North Fork Fish Creek from confluence with Fish Creek in Dallas County upstream to State Highway 360 in Tarrant County.	2016	n/a
0841R	0841R_01	Rush Creek	Rush Creek from confluence with Village Creek to headwater area just east of Calendar Road in Arlington, Tarrant County.	2006	2018, 2020
0841T	0841T_01	Village Creek	Village Creek from confluence with West Fork Trinity River to SH 303 approx. 0.75 miles downstream of Lake Arlington.	2010	2018, 2020
0841U	0841U_01	West Irving Branch	West Irving Branch from approx. 0.4 mi. downstream of Oakdale Rd. to headwater area in Wyche Park (NHD RC 12030102044201) in Irving, Dallas County.	2006	n/a
0841V	0841V_01	Crockett Branch	Crockett Branch from confluence with Cottonwood Creek to the upper end of the creek (NHD RC 1203010244745)	2010	n/a
0806E	0806E_01	Sycamore Creek	5 mile stretch of Sycamore Creek running upstream from the confluence with the West Fork of Trinity River to the confluence with Echo Lake Tributary in Fort Worth	2006	n/a

Appendix D: Interim Draft public comments and responses

Commenting Organization or Individual	Date	Comment	Response
Arlington Conservation Council	7/7/2012	4.81 line 5 and 4.10 line 2 seem to be missing a word	Corrected.
Upper Trinity Regional Water District	7/19/2012	Useful tools for bacteria reduction efforts	Copies of *E. coli* reduction strategy for Willamett, OR TMDL I-Plan and Coa, et al 2009 article on optical brighteners will be provided to appropriate technical subcommittee for evaluation.
City of Kennedale	7/28/2012	Consolidated for readability. On p. 50: Add comma after "stormwater." Revise comma placement, add "to." Add comma before "such as." On p. 53: "…adoption of ordinances specifying no net discharge of stormwater during reasonable rain events." I think during the meeting someone suggested making this statement more clear and realistic. That comment may have been addressed by you already by adding the phrase "during reasonable rain events." On p. 61, Item 4.8: Add "to" after "watersheds." Add comma before "such as." On p. 63, Item 5.3: Remove comma after "Grand Prairie." On p. 64, Item 5.5.1: This sentence is a bit long and may be confusing. Perhaps break it into two sentences? On p. 67, Item 6.2.3: sub- basins — is there an extra space between "sub-" and "basins"? On p. 68: Add comma before "which."	Corrections made where appropriate.

Commenting Organization or Individual	Date	Comment	Response
DFW International Airport	7/31/2012	I think it is deceptive to state there is large presence of these impaired water bodies on DFW Airport. The headwaters of these creeks did originate on Airport property, but actually comprise very little of the property itself. Cottonwood Branch portion on DFW Airport includes less than a mile of ephemeral stream channel that is completely dry a majority of the year. I think this statement should be revised to state the Cities within the watersheds for Grapevine Creek and Cottonwood Branch include Irving, Coppell, and Grapevine in addition of Dallas-Fort Worth International Airport.	Wording changed.
City of Dallas	8/8/2012	Graphics: The figures and graphics are really hard to read, especially when converted to black and white PDF format. Please check for graphic contrast for printing in black and white print format, and consider using 11 x 17 sized drawings, especially for illustrating the regional conditions.	Maps will be available online at greater resolution. For ease of printing, the I-Plan is designed for 8 1/2" x 11" paper.
City of Dallas	8/8/2012	Impaired waters versus TMDL-defined waters: There are many streams in North Texas that may be listed on the current Section 303 (d) list as being impaired, but that may not yet have defined TMDLs. While the desire to be able to add to this document at a later date is appreciated, please be careful with respect to labeling of impaired waters versus those stream bodies that have defined TMDLs. As an example, Figure 1 shows the project area: however the impaired waters are not easily discernible graphically with respect to the TMDL segments. Other examples would be Figures 4 and 10 that are labeled across the top as “Impaired Segments/ Impaired Tributaries” and along the bottom as “TMDL subwatersheds.”	Maps have been updated to include only those impaired tributaries with TMDLs addressed in this I-Plan and emphasis added on those segments.
City of Dallas	8/8/2012	Formulas: To enhance the readability of this document, we suggest placing the formulas and related factor descriptions into inset boxes.	Many formulas within the Introduction section have been placed into text boxes for easier reading. Those in Appendix C, Allocated Loads, have not.

Commenting Organization or Individual	Date	Comment	Response
City of Dallas	8/8/2012	Global Categories: Several of the Best Management Practices (BMPs), such as establishing a BMP library, providing outreach, and developing model ordinances are repeated in several categories. To streamline the document, we suggest listing once in the category that most applies (for instance outreach and education), and simply indicating that it covers multiple other categories, or referencing it in the applicable category.	Implementation Strategies (IS) for the BMP Library and IS have been added to the I-Plan and mention of them in other IS sections removed to avoid redundancy.
City of Dallas	8/8/2012	I-Plan Review: We suggest a global one-year reporting period and 5-year I-Plan management measure review process, and to describe that process in one place rather than in each section.	The Coordination Committee determines the review period. As of the July 2012 peer review draft I-Plan, the IS review period was annually.
City of Dallas	8/8/2012	Appendix B Coordination: Please check contents of Appendix B Matrix with the text for consistency.	Appendix B eliminated in favor of individual IS summaries.
City of Dallas	8/8/2012	Units: Please either provide a handy conversion factor from Hectares to Acres, or provide both measures where used; most lay-persons and many professionals in Texas do not use Standard International format as a day-to-day unit of measurement.	Hectares removed and replaced with acres.
City of Dallas	8/8/2012	Grammar: Please use Active-Imperative verb tense, and watch for the use of double negatives. Also, please check that all acronyms and abbreviations (include those from Appendix B) are included in that Table. (e.g. rather than “the Coordinating Committee recommends”…. “Do whatever” (see proposed language in 2.6, below)	Changed where feasible. In some cases, adding imperative verbs may change the intent of an implementation strategy and as such, will need to be referred to the Coordination Committee.
City of Dallas	8/8/2012	Table of Acronyms and Abbreviations: Please check that all acronyms and abbreviations (include those from Appendix B) are included in this Table. Suggest including: *E. coli* as used in lieu of EC as in table, iSWM (integrated Stormwater Management), NELAP (National Environmental Laboratory Accreditation Program…..it is NELAP certification), H-GAC (Houston Galveston Area Council), iSWM (integrated Stormwater Management), CC (????), TSC (Technical Steering Committee?), SWMP (Stormwater Management Plan), SSS (Sanitary Sewer System?), TEA (Texas Education Agency).	Corrected.
City of Dallas	8/8/2012	Executive Summary: Table 1 referenced, but not found.	Table moved and reference corrected.

Commenting Organization or Individual	Date	Comment	Response
City of Dallas	8/8/2012	Introduction: a. Suggest adding the word "primary" before "Contact recreation" wherever it occurs in the first paragraph.	Corrected.
City of Dallas	8/8/2012	Introduction: b. Suggest merging the last two paragraphs so that this watershed description is consistent with the descriptions used for the other watersheds.	Watershed description is consistent with other watersheds. No change made.
City of Dallas	8/8/2012	Introduction: c. Waste Load Allocations, lower page 30: In the Formula that reads "Criterion/2*FC (MGD)*FDA*Conversion Factor", there is no definition for "Criterion" — Can this be clarified?	Inset table of commonly used abbreviations added.
City of Dallas	8/8/2012	Introduction: d. Watershed Summary, pages 15 and 16: It may be helpful to include a table of the designated reaches and stream segments, or include similar information in Tables 8 and 9 under Section 2.0 Stormwater. It makes it easier to figure out the exact limits of impaired waters, and may help streamline some of the text concerning affected stream segments	See Appendix C.
City of Dallas	8/8/2012	4) Section 1.0, Wastewater: Table 5: Please add the permit effective date of 11/08/2007d into the blank cell for Dallas Central WWTF. Add the related footnote <d> that reads: "Permit renewal is pending." Also, there is a superscript with a double ** — however, there are no corresponding footnotes.	Footnote added, superscript corrected.
City of Dallas	8/8/2012	Stormwater a. Section 2.2, Waste Hauler Regulations: We suggest moving this section in its entirety to Section 1.6 and renumbering the other remaining Wastewater and Stormwater sections accordingly. Most municipalities manage their respective liquid waste and waste hauler programs through their wastewater utility programs.	Liquid waste hauler implementation strategies moved to become section 1.7.
City of Dallas	8/8/2012	Stormwater b. Section 2.4, Local SEPs: Please revise last commitment from "100 percent of large municipalities" to 75 percent.	Corrected.

Commenting Organization or Individual	Date	Comment	Response
City of Dallas	8/8/2012	Stormwater c. Section 2.6, Land Use and Business Evaluation: We suggest the following revised text for this section, with associated revisions to Appendix B and in Table 1 on page 32: "Section 2.6, Stormwater Regulatory Review: Analyses by the Project's technical review subcommittee members revealed a potential gap in many existing stormwater codes and regulations with respect to addressing discharges with the potential to carry bacteria. As currently written, many rules, including the base stormwater discharge permits, focus on chemical or physical constituents, such as toxic chemicals or sediment, but may not completely address bacterial sources or discharges. Examples of facilities that may pose a risk for bacterial discharge include, but are not limited to: Slaughter houses and meat-processing facilities, stables and pet-boarding facilities, produce packing facilities and farmer's markets. Municipalities review their respective codes and ordinances and revise as necessary to prohibit the discharge of bacteria, nutrients, and other substances that could contribute to bacterial growth in the environment. TCEQ is encouraged to review, and as necessary amend the TPDES No. TXR050000, Multi-Sector General Permit to require facilities located in bacteria-impaired watersheds with operations having the potential to discharge bacteria, (such as the current Sector U), to perform benchmark sampling for bacteria."	Wording in section 2.2 altered to reflect intent of comments.
City of Dallas	8/8/2012	6) Section 3.0, Planning and Development: Please clarify who measures participation, and how performance on each goal is assessed. (Note, this may be a global comment, however, it was noted for Strategy 3.1.2).	Section 3.0.2 detailed municipal ordinance evaluation. Municipalities will be responsible for evaluating their own ordinances.

Commenting Organization or Individual	Date	Comment	Response
City of Dallas	8/8/2012	Pets, Livestock, Wildlife a. Explore SWM fee programs for animal owners: Consider adding a strategy for communities to explore revisions to existing stormwater fee programs to apply to animal owners. Such a fee could be implemented as a part of the pet registration program, and would be used to implement bacteria-related water quality improvement measures.	Proposed new implementation strategies will be forwarded to the appropriate subcommittee for consideration and may, through them, be referred to the Coordination Committee for adoption.
City of Dallas	8/8/2012	Pets, Livestock, Wildlife b. Explore planting regulations that limit year-round habitat for birds: Consider adding a planning strategy and related development regulations that promote landscaping/re-vegetation with deciduous woody plant species that do not enhance habitat for normally migratory bird species. Plant species that are evergreen year-round provide cover and habitat for birds that would not normally be present year-round. Since previous studies by the TCEQ indicate that a considerable percentage of the identified bacteria may be attributed to avian species, this strategy may help address that source.	Proposed new implementation strategies will be forwarded to the appropriate subcommittee for consideration and may, through them, be referred to the Coordination Committee for adoption.
City of Dallas	8/8/2012	Pets, Livestock, Wildlife c. Strategy 4.5 Waterfowl Management Plan: Suggest rewording last sentence from "with attention to prohibitions on the feeding of waterfowl" to "with a focus on measures to discourage waterfowl feeding rather than…"	Change made.
City of Dallas	8/8/2012	a. OSSF Inventory: Suggesting adding a strategy to develop an inventory of OSSFs that could be implemented in areas with elevated concentrations of bacteria, and poor documentation of existing OSSFs. The inventory could be used to focus other related OSSF strategies such as education, and connection to municipal systems where available.	Proposed new implementation strategies will be forwarded to the appropriate subcommittee for consideration and may, through them, be referred to the Coordination Committee for adoption.

Commenting Organization or Individual	Date	Comment	Response
City of Dallas	8/8/2012	Education, Outreach, a. Outreach to OSSF installers: Incorporate a BMP to provide applicable training to OSSF installers concerning bacterial impacts of failing OSSF systems.	BMPs for the BMP Library (IS 8.0) will be determined at a later date. The suggestion will be forwarded to the appropriate subcommittee.
City of Dallas	8/8/2012	Education, Outreach, b. Yard Waste program: consider adding a BMP to provide outreach and education concerning yard waste impacts including how yard waste can contribute to bacterial loading.	Yard waste education is an existing program through the Regional Stormwater Management Program's Public Education Task Force and relates to IS 7.0.
City of Dallas	8/8/2012	Education, Outreach, c. Alternative Media/Messages: Consider implementing alternative media and messages to reach market sectors that may not be traditionally affected by bacterial sources.	Suggestion will be brought to the Education and Outreach subcommittee.
City of Dallas	8/8/2012	Appendix A, a. We suggest consideration of including a title, or position, so that if the personnel listed under Appendix A leave their position, there is room for another comparable person from that entity to participate in future efforts.	Replacement and succession of Coordination Committee members is addressed in the Coordination Committee Ground Rules and is determined by the appointing agency.
City of Dallas	8/8/2012	Appendix B, a. While Appendix B includes much of the data that is required under an I-Plan, we received several comments that it is not easy for a lay person to follow and understand. If it is possible to simplify this table, it may be easier to comprehend. b. Also — this table needs to be cross-checked against text to make sure the two are consistent. c. 11x17 paper? d. Active imperative verb tense for responsible entity might help stream line; e.g. “TCEQ: provide NCTCOG information concerning permit requirements.”	The Matrix (formerly Appendix B) has been eliminated and this information has been included as a summary after each implementation strategy. Wording has been adjusted to match language in IS narrative section. Active verb tense is used whenever possible without changing the meaning agreed to by the Coordination Committee.
City of Dallas	8/8/2012	Appendix D provides the information I was looking for earlier in the document; suggest either incorporating into one of the tables in the text, or providing a very obvious reference.	References to Appendix C have been included earlier in the I-Plan.

Commenting Organization or Individual	Date	Comment	Response
City of Dallas	8/8/2012	Consider implementing requirements for NELAP certification or other Quality Assurance Protocols on bacterial sampling and analyses so that data sets can be used to support consistent, sound science and decision making.	Laboratories used by CRP and regional wet weather monitoring are currently NELAP certified. Recommendation to consider appropriateness of certification for remaining types of monitoring will be referred to the appropriate subcommittee.

Appendix E: Formal Support for I-Plan

CITY OF IRVING

COUNCIL RESOLUTION NO. RES-2013-329

WHEREAS, the Trinity River is a significant environmental feature in the Dallas-Fort Worth metropolitan area; and

WHEREAS, a swimmable and fishable Trinity River provides considerable economic benefit to the region; and

WHEREAS, the Texas Commission on Environmental Quality and the U.S. Environmental Protection Agency have determined that portions of the Upper Trinity River, tributaries of the Elm Fork Trinity River, and the West Fork Trinity River and many of its tributaries no longer meet standards for water quality for recreational uses such as swimming, due to elevated levels of bacteria; and

WHEREAS, the proposed Implementation Plan for Seventeen Total Maximum Daily Loads (TMDL) for Bacteria in the Greater Trinity River Region developed by the Greater Trinity River Bacteria TMDL Implementation Project's Coordination Committee is a consensus document developed through a stakeholder-driven process; and

WHEREAS, the Implementation Plan is a commonsense approach for reducing bacteria levels in our waterways and providing better services to citizens;

NOW, THEREFORE, BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF IRVING, TEXAS:

SECTION I. THAT the City Council hereby expresses its support for the Regional Implementation Plan (I-Plan) for the Greater Trinity River Bacteria Total Maximum Daily Load (TMDL) Project, formally referred to as the "Implementation Plan for Seventeen Total Maximum Daily Loads for Bacteria in the Greater Trinity River Region" as developed by the Greater Trinity River Bacteria TMDL Project's Coordination Committee and stakeholders and does further encourage other stakeholders to work together and voluntarily participate in the activities described in the Implementation Plan.

SECTION II. THAT this resolution shall take effect from and after its final date of passage, and it is accordingly so ordered.

PASSED AND APPROVED BY THE CITY COUNCIL OF THE CITY OF IRVING, TEXAS, on October 3, 2013.

BETH VAN DUYNE
MAYOR

ATTEST:

Shanae Jennings
City Secretary

APPROVED AS TO FORM:

Charles R. Anderson
City Attorney

Resolution No. 13-258

A resolution in support of the proposed Implementation Plan for the Seventeen Total Maximum Daily Loads for Bacteria in the Greater Trinity River and Tributaries developed by stakeholders for the Greater Trinity River Bacteria Total Maximum Daily Loads Implementation Project

WHEREAS, the Trinity River system is a significant environmental feature in the Dallas-Fort Worth metropolitan area; and

WHEREAS, a swimmable and fishable Trinity River system has the potential to provide considerable economic benefit to the region; and

WHEREAS, the Texas Commission on Environmental Quality (TCEQ) and the U.S. Environmental Protection Agency (EPA) have determined that portions of the Upper Trinity River, tributaries of the Elm Fork Trinity River, and the West Fork Trinity River and many of its tributaries, including Village Creek, Rush Creek, and the Kee Branch, no longer meet standards for water quality for recreational uses such as swimming due to elevated levels of bacteria; and

WHEREAS, the proposed IMPLEMENTATION PLAN FOR SEVENTEEN TOTAL MAXIMUM DAILY LOADS FOR BACTERIA IN THE GREATER TRINITY RIVER AND TRIBUTARIES developed by the Project's Coordination Committee is a consensus document developed through a stakeholder-driven process; and

WHEREAS, the Implementation Plan is a common-sense approach for reducing bacteria levels in our waterways and providing better services to citizens; NOW THEREFORE

BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF ARLINGTON TEXAS:

I.

The City Council of the City of Arlington does hereby express its support for the Implementation Plan for the Seventeen Total Daily Maximum Loads for Bacteria in the Greater Trinity River and Tributaries as developed by the Project's Coordination Committee and stakeholders and does further hereby encourage other stakeholders to work together and voluntarily participate in the activities described in said Implementation Plan.

PRESENTED AND PASSED on this the 15th day of October, 2013, by a vote of 9 ayes and 0 nays at a regular meeting of the City Council of the City of Arlington, Texas.

ROBERT N. CLUCK, Mayor

ATTEST:

MARY W. SUPINO, City Secretary

APPROVED AS TO FORM:
JAY DOEGEY, City Attorney

BY

Appendix F: Addendum One to Four Total Maximum Daily Loads for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake

One Total Maximum Daily Load for Indicator Bacteria in North Fork Fish Creek for Segment 0841Q Assessment Unit 0841Q_01

Introduction

The Texas Commission on Environmental Quality (TCEQ) adopted *Four Total Maximum Daily Loads for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake: Segments 0841F, 0841K, 0841N, and 0841V* (TCEQ, 2016) on November 2, 2016. The total maximum daily loads (TMDLs) were approved by the United States Environmental Protection Agency (EPA) on December 7, 2016. This document represents an addendum to the original TMDL document.

This addendum includes information specific to one additional assessment unit (AU) of one segment located within the watershed of the approved TMDL project for bacteria in segments upstream of Mountain Creek Lake. Concentrations of indicator bacteria in this additional AU exceed the geometric mean criterion used to evaluate attainment of the water quality standard for contact recreation. This addendum presents the new information associated with the additional AU. For background or other explanatory information, please refer to the *Technical Support Document for a Total Maximum Daily Load for Indicator Bacteria for North Fork Fish Creek* (Millican, 2019). Refer to the original, approved TMDL document for details related to the overall Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch watersheds as well as the methods and assumptions used in developing the original TMDLs.

The addendum watershed was included in the original TMDL project area. This addendum provides the details related to developing the TMDL allocation for this additional AU, which was not specifically addressed in the original TMDL document.

Problem Definition

The TCEQ first identified the bacteria impairment for North Fork Fish Creek in the 2016 *Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (2016 Integrated Report; TCEQ, 2018a). Table 1 provides a summary for the EPA-approved 2016 Integrated Report. The impaired AU is 0841Q_01, as shown in Figure 1. The impaired segment is composed of only one AU that encompasses the entire segment. The project watershed is located within Tarrant and Dallas counties. Figure 1 also shows the North Fork Fish Creek watershed in relation to the entire watershed of the original TMDLs.

Table 1. Synopsis of the 2016 Integrated Report for North Fork Fish Creek.

Integrated Report Year	Segment	AU	Parameter	Contact Recreation Use	Category
2016	0841Q	0841Q_01	*E. coli*	Nonsupport	5c

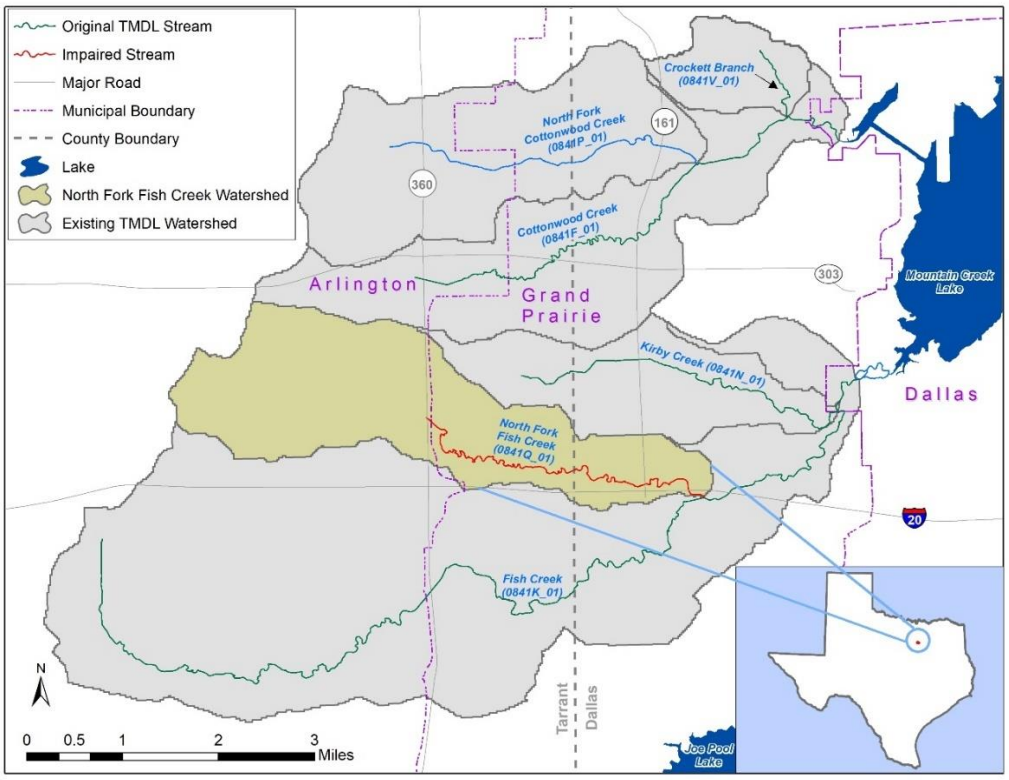

Figure 1. Approved TMDL watersheds and the North Fork Fish Creek watershed.

The Texas Surface Water Quality Standards (TSWQS; TCEQ, 2010) identify uses for surface waters and numeric and narrative criteria to evaluate attainment of those uses. The basis for the water quality target for the TMDL developed in this report is the numeric criterion for indicator bacteria from the 2010 TSWQS. *Escherichia coli* (*E. coli*) is the indicator bacteria for assessing primary contact recreation use in freshwater.

Table 2 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) stations on North Fork Fish Creek, as reported in the 2016 Integrated Report. The data from the assessment indicate nonsupport of the primary contact recreation use for North Fork Fish Creek, because the geometric mean concentration for *E. coli* exceeds the geometric mean criterion of 126 colony forming units (cfu)/100 milliliters (mL) of water. Surface water quality monitoring within the North Fork Fish Creek watershed has occurred at TCEQ SWQM stations 10724, 17678, and 20838 (Figure 2).

Table 2. 2016 Integrated Report summary for the North Fork Fish Creek watershed.

AU	Parameter	Stations	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
0841Q_01	*E. coli*	10724; 17678; 20838	84	2007-2014	183

Description of the Study Area

North Fork Fish Creek (Segment 0841Q) is a tributary to Fish Creek (Segment 0841K) and is approximately five miles in length, with portions in both Tarrant and Dallas counties (Figure 1). North Fork Fish Creek is a perennial, unclassified, freshwater stream. The North Fork Fish Creek watershed drains an area of approximately 3,663 acres.

The 2016 Integrated Report (TCEQ, 2018a) provides the following segment and AU description for North Fork Fish Creek:

- North Fork Fish Creek (AU 0841Q_01): North Fork Fish Creek from confluence with Fish Creek in Dallas County upstream to State Highway 360 in Tarrant County.

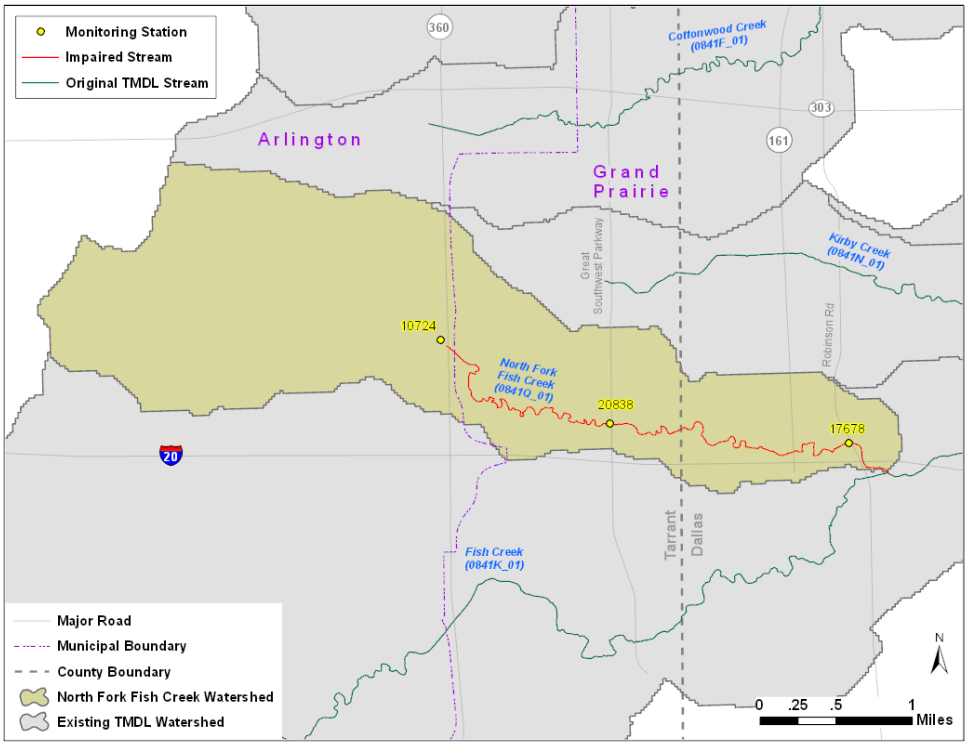

Figure 2. North Fork Fish Creek watershed showing TCEQ SWQM stations.

Watershed Climate

The North Fork Fish Creek watershed is located near the center of the Dallas/Fort Worth metroplex, which is described as having a humid subtropical climate (NOAA, 2009). Weather data spanning a period

from 2003 through 2017 were obtained from the National Climatic Data Center for the Arlington Municipal Airport station located in the western portion of the Fish Creek (Segment 0841K) watershed (NOAA, 2018; Figure 3). The average annual precipitation was 34.9 inches. The wettest month is typically May (4.5 inches), while August (1.7 inches) is normally the driest month, with rainfall occurring throughout the year. The average high temperatures typically peak in August (96.5 °F) with highs above 100 °F occurring from June through August. During winter, the average low temperature reaches a minimum of 35.7 °F in January.

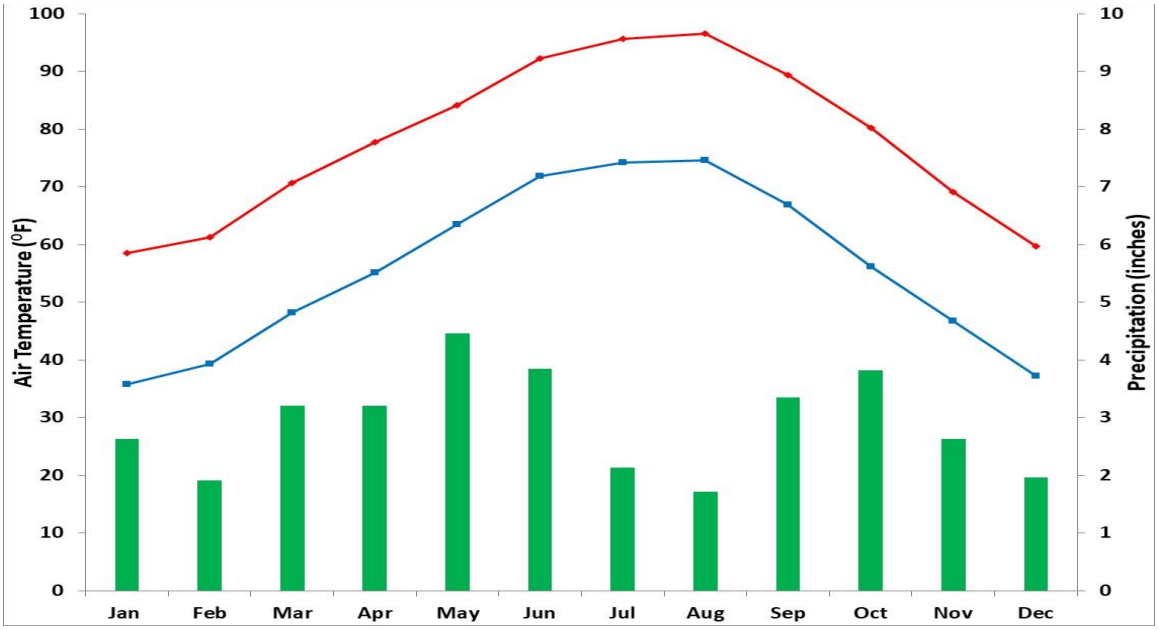

Figure 3. Average minimum and maximum air temperature and total precipitation by month from January 2003 through December 2017 for Arlington Municipal Airport.

Land Use

The land use/land cover data for the North Fork Fish Creek watershed were obtained from the North Central Texas Council of Governments (NCTCOG, 2017a) and represent land use/land cover estimates for 2015. The 2015 land use/land cover data from the NCTCOG for the North Fork Fish Creek watershed is shown in Figure 4. A summary of the land use/land cover data is provided in Table 3 and indicates that residential land use is the dominant land cover, comprising approximately 41 percent of the North Fork Fish Creek watershed.

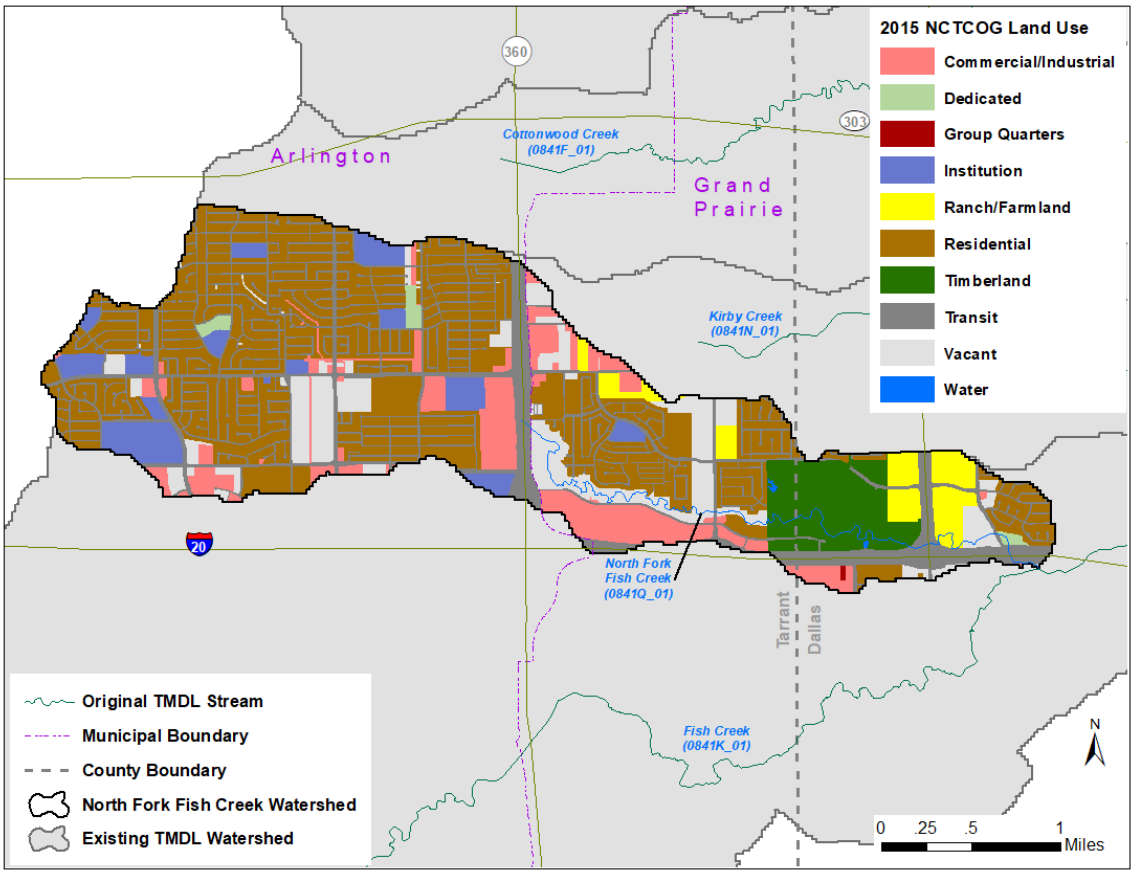

Figure 4. 2015 land use/land cover within the North Fork Fish Creek watershed.

Table 3. Land use/land cover within the North Fork Fish Creek watershed.

Classification	Area (Acres)	Percent of Total
Commercial/Industrial	369.0	10.08%
Group Quarters	1.5	0.04%
Residential	1,509.8	41.22%
Institution	216.1	5.90%
Transit	780.8	21.32%
Dedicated	26.1	0.71%
Vacant	382.8	10.45%
Ranch/Farmland	149.0	4.07%
Timberland	225.5	6.16%
Water	1.9	0.05%
Total	**3,662.5**	**100%**

Watershed Population and Population Projections

As depicted in Figure 1, the North Fork Fish Creek watershed is geographically located within the municipal incorporated boundaries of Arlington and Grand Prairie. Population estimates were developed using 2010 United States Census Bureau (USCB) Block data allocated to the area within the North Fork Fish Creek watershed. Population projections for the year 2045 were developed by the NCTCOG by utilizing traffic survey zone allocations approximated to city boundaries. The projected populations were then allocated based on proportion of the area within the North Fork Fish Creek watershed. The projected population increase was then determined based on the increase from the 2010 population to the projected 2045 population. This indicates that the population within the North Fork Fish Creek watershed is projected to increase by 62.4 percent (Table 4; USCB, 2018 and NCTCOG, 2017b).

Table 4. 2010 Population and 2045 population projection for the North Fork Fish Creek watershed.

Water Body	Segment	2010 U.S. Census Population	2045 Projected Population	Projected Population Increase	Percent Change (2010−2045)
North Fork Fish Creek	0841Q	30,749	49,926	19,177	62.4%

Endpoint Identification

The endpoint for the TMDL is to maintain the concentration of *E. coli* below the geometric mean criterion of 126 cfu/100mL in the 2010 TSWQS.

Source Analysis

Regulated Sources

Permitted sources are regulated under the Texas Pollutant Discharge Elimination System (TPDES) and the National Pollutant Discharge Elimination System (NPDES) programs.

Domestic and Industrial Wastewater Treatment Facilities

There are no permitted domestic wastewater treatment facilities (WWTFs) or industrial dischargers within the North Fork Fish Creek watershed. Domestic wastewater is collected by and transported to the Trinity River Authority (TRA) Central Regional Wastewater System located outside the study area (Figure 5).

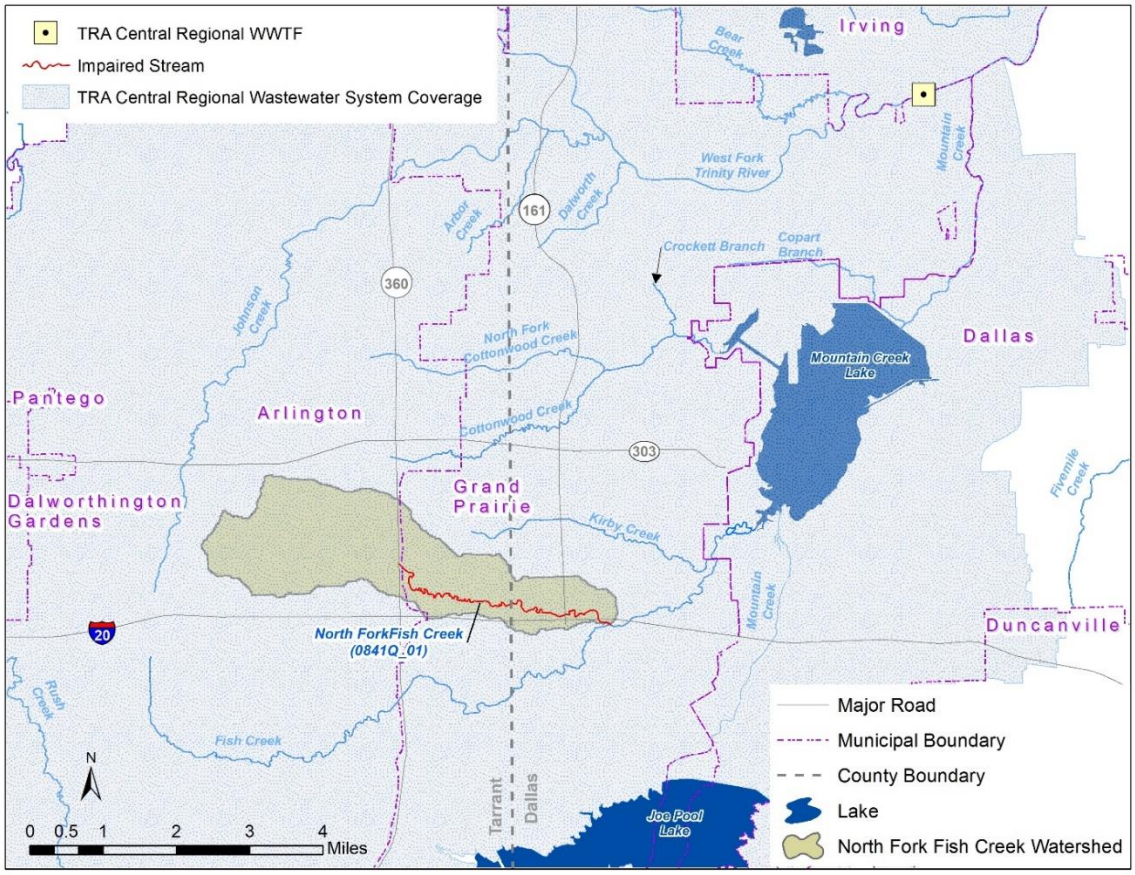

Figure 5. Coverage area of the TRA Central Regional Wastewater System in the TMDL study area.

Sanitary Sewer Overflows

Information regarding reported sanitary sewer overflow (SSO) incidents in the North Fork Fish Creek watershed was acquired through the NCTCOG and represented incidents that occurred from 2007 through 2015. Reported SSO incidents that occurred from 2007 through 2015 were refined by the NCTCOG by assigning latitude and longitude coordinates to each SSO event and plotted using Geographic Information System software in an effort to characterize the frequency and magnitude of SSO events within the North Fork Fish Creek watershed (Figure 6). A summary of the NCTCOG-refined data within the North Fork Fish Creek watershed is shown in Table 5.

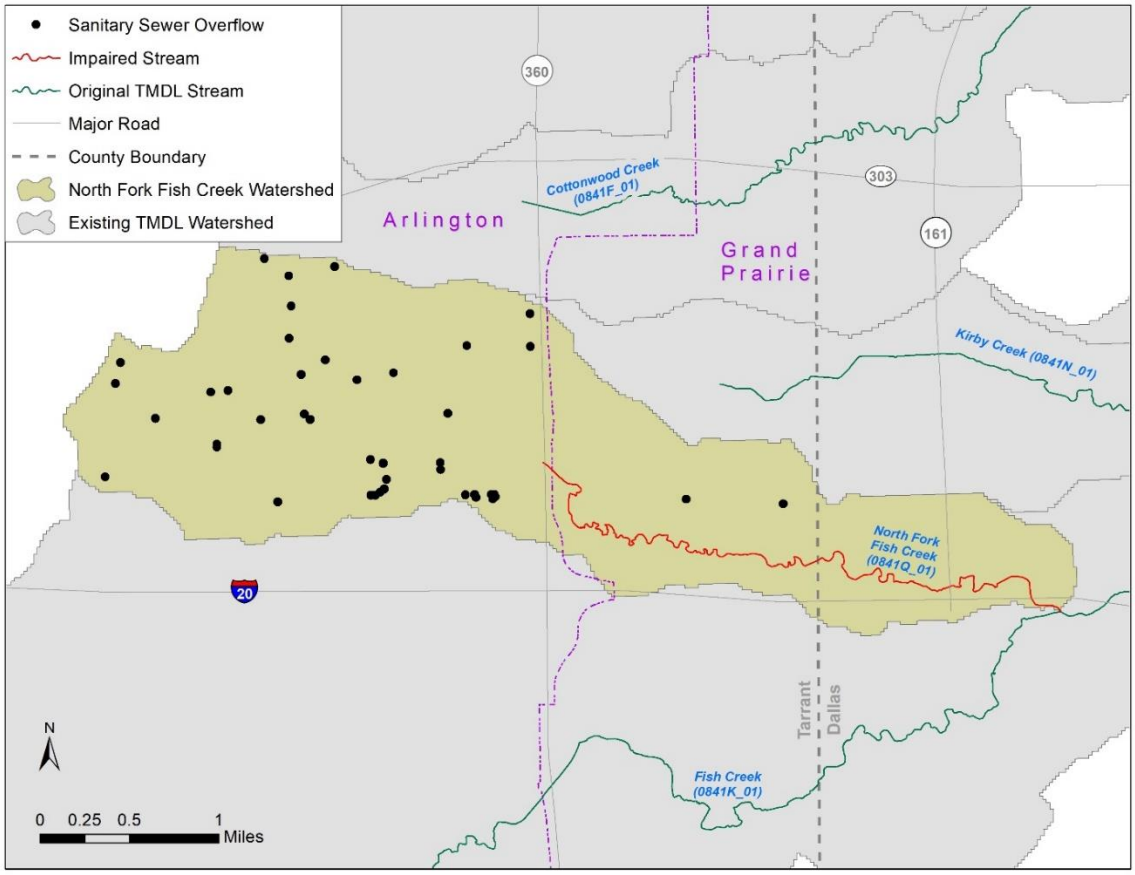

Figure 6. SSOs that occurred from 2007 through 2015 within the North Fork Fish Creek watershed.

Table 5. Summary of SSO incidences reported in the North Fork Fish Creek Watershed from 2007 through 2015.

No. of Incidents	Total Volume (gallons)	Average Volume (gallons)	Minimum Volume (gallons)	Maximum Volume (gallons)
45	22,166	493	7	6,000

TPDES-Regulated Stormwater

When evaluating stormwater for a TMDL allocation, a distinction must be made between stormwater originating from an area under a TPDES- or NPDES-regulated discharge permit and stormwater originating from areas not under a TPDES- or NPDES-regulated discharge permit. Stormwater discharges fall into two categories:

1) stormwater subject to regulation, which is any stormwater originating from TPDES/NPDES regulated municipal separate storm sewer system (MS4) entities, industrial facilities, and construction activities; and
2) stormwater runoff not subject to regulation.

The TPDES/NPDES MS4 Phase I and II rules require municipalities and certain other entities in urban areas to obtain permit coverage for their stormwater systems. A regulated MS4 is a publicly owned

system of conveyances and includes ditches, curbs, gutters, and storm sewers that do not connect to a wastewater collection system or treatment facility. Phase I permits are individual permits for large and medium-sized communities with populations of 100,000 or more based on the 1990 U.S. Census, whereas the Phase II general permit regulates smaller communities within a USCB-defined urbanized area. The purpose of an MS4 permit is to reduce discharges of pollutants in stormwater to the "maximum extent practicable" by developing and implementing a Stormwater Management Program (SWMP). The SWMP describes the stormwater control practices that will be implemented consistent with permit requirements to minimize the discharge of pollutants from the MS4. The permits require that the SWMPs specify the best management practices to meet several minimum control measures (MCMs) that, when implemented in concert, are expected to result in significant reductions of pollutants discharged into receiving waterbodies. Phase II MS4 MCMs include:

1. Public education, outreach, and involvement;
2. Illicit discharge detection and elimination;
3. Construction site stormwater runoff control;
4. Post-construction stormwater management in new development and redevelopment;
5. Pollution prevention and good housekeeping for municipal operations; and
6. Industrial stormwater sources.

Phase I MS4 individual permits have similar MCMs organized a little differently and are further required to perform water quality monitoring.

The geographic region of the TMDL watershed covered by Phase I and II MS4 permits is that portion of the area within the jurisdictional boundaries of the regulated entities. For Phase I permits the jurisdictional area is defined by the city limits and for Phase II permits the jurisdictional area is defined as the intersection or overlapping areas of the city limits and the 2000 or 2010 USCB urbanized area.

The area under the jurisdiction of Phase II general permits and Phase I individual permits was used to estimate the regulated stormwater areas for construction, industrial, and MS4 permits. In this report, the regulated area for the Phase II permits was based on the 2010 urbanized area from the U.S. Census.

A review of active stormwater general permits coverage and a review of the central registry for Phase I MS4 permit coverage (TCEQ, 2018b) in the study area revealed that existing Phase I and Phase II permits (Table 6) provide 100 percent MS4 coverage for the North Fork Fish Creek watershed (Figure 7).

Table 6. TPDES and NPDES MS4 permits associated with the North Fork Fish Creek watershed.

Entity	TPDES Permit	NPDES Permit
City of Arlington	WQ0004635-000	TXS000301
Texas Department of Transportation	WQ0005011-000	TXS002101
City of Grand Prairie	Phase II General Permit (TXR040000)	TXR040065

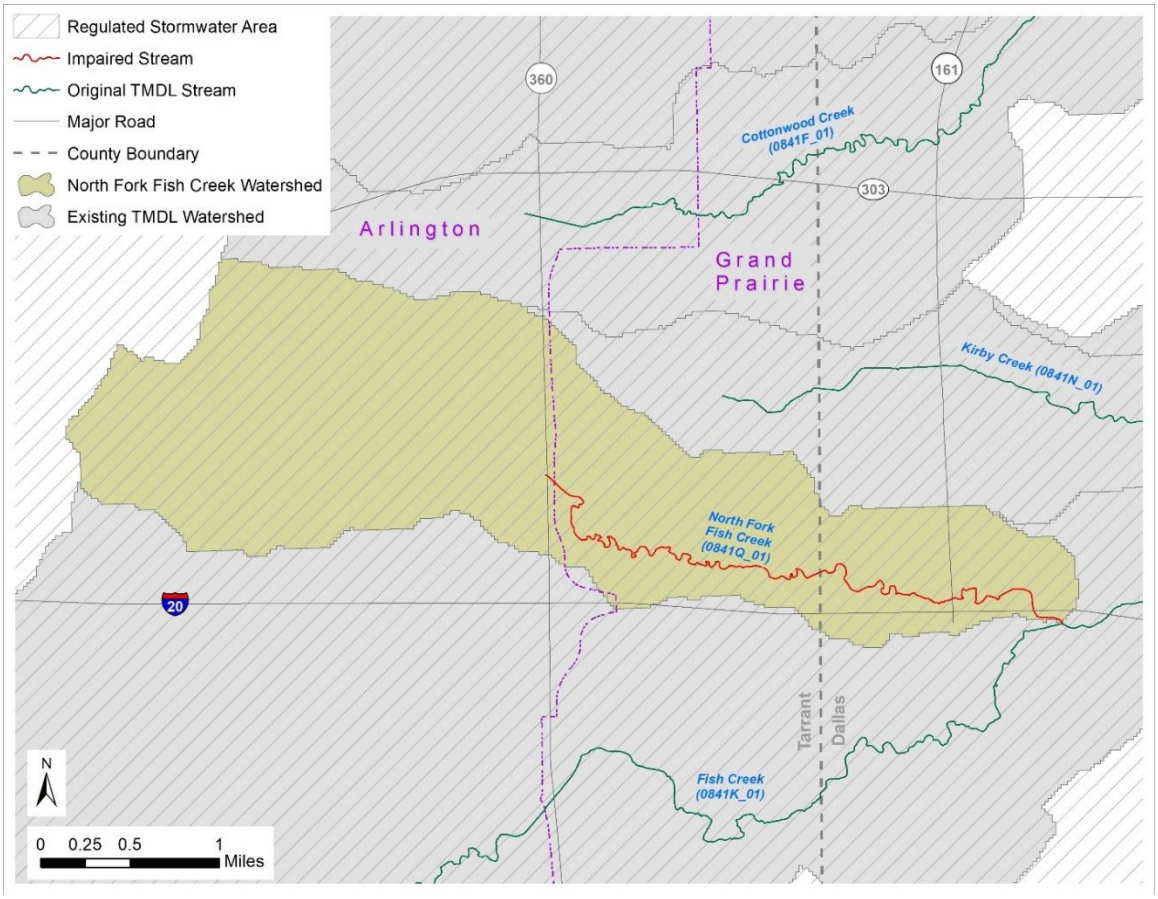

Figure 7. Regulated stormwater area based on Phase I and Phase II MS4 permits within the North Fork Fish Creek watershed.

TPDES General Wastewater Permits

Discharges of processed wastewater from certain types of facilities are required to be covered by one of several TPDES general permits:

- TXG110000 – concrete production facilities
- TXG130000 – aquaculture production facilities
- TXG340000 – petroleum bulk stations and terminals
- TXG500000 – quarries in John Graves Scenic Riverway
- TXG670000 – hydrostatic test water

- TXG830000 – petroleum fuel or petroleum substances
- TXG870000 – pesticides
- TXG920000 – concentrated animal feeding operations
- TXG100000 – wastewater evaporation
- WQG20000 – livestock manure compost operations (irrigation only)

A review of active general permit coverage (TCEQ, 2018b) in the North Fork Fish Creek watershed as of November 6, 2018, found no operations or facilities of the types described above.

Unregulated Sources

Unregulated sources of indicator bacteria are generally nonpoint and can originate from wildlife and feral hogs, various agricultural activities, agricultural animals, land application fields, urban runoff not covered by a permit, failing on-site sewage facilities (OSSFs), and domestic pets.

Wildlife and Unmanaged Animal Contributions

E. coli bacteria are common inhabitants of the intestines of all warm-blooded animals, including feral hogs and wildlife such as mammals and birds. In developing bacteria TMDLs, it is important to identify by watershed the potential for bacteria contributions from wildlife and feral hogs. Wildlife and feral hogs are naturally attracted to the riparian corridors of streams and rivers. With direct access to the stream channel, the direct deposition of wildlife and feral hog waste can be a concentrated source of bacteria loading to a water body. Fecal bacteria from wildlife and feral hogs are also deposited onto land surfaces, where they may be washed into nearby streams by rainfall runoff. The *E. coli* contribution from feral hogs and wildlife in North Fork Fish Creek could not be determined based on existing information.

Domesticated Animals

Due to the highly urbanized nature of the North Fork Fish Creek watershed, livestock were not considered a significant source of bacteria loading. Fecal bacteria from dogs and cats are transported to streams by runoff in both urban and rural areas and can be a potential source of bacteria loading. Table 7 summarizes the estimated number of dogs and cats within the North Fork Fish Creek watershed. Pet population estimates were calculated as the estimated number of dogs (0.584) and cats (0.638) per household according to data from the American Veterinary Medical Association 2012 U.S Pet Statistics (AVMA, 2015). The number of households in the watershed was estimated using 2010 USCB data (USCB, 2018). The actual contribution and significance of bacteria loads from pets in the North Fork Fish Creek watershed is unknown.

Table 7. Estimated households and pet populations for the North Fork Fish Creek watershed.

Estimated Number of Households	Estimated Dog Population	Estimated Cat Population
9,962	5,818	6,356

On-site Sewage Facilities

Failing OSSFs were not considered a major source of bacteria loading in the North Fork Fish Creek watershed, because the entire watershed area is served by TRA. Areas serviced by centralized

treatment and collection systems typically contain very few OSSFs, and this is the situation for the TMDL watershed. NCTCOG information indicates that only two OSSFs exist in the North Fork Fish Creek watershed.

Linkage Analysis

The load duration curve (LDC) method was used to examine the relationship between instream water quality and the source of indicator bacteria loads. Inherent to the use of LDCs as the mechanism of linkage analysis is the assumption of a one-to-one relationship between instream loadings and loadings originating from point sources and the landscape as regulated and non-regulated sources. Further, this one-to-one relationship was also inherently assumed when using LDCs to define the TMDL pollutant load allocation. The LDC method allows for estimation of TMDL loads by utilizing the cumulative frequency distribution of streamflow and measured pollutant concentration data (Cleland, 2003). In addition to estimating stream loads, this method allows for the determination of the hydrologic conditions under which impairments are typically occurring, can give indications of the broad origins of the bacteria (i.e., point source and stormwater), and provides a means to allocate allowable loadings. The technical support document (Millican, 2019) provides details about the linkage analysis and the LDC method and its application.

Margin of Safety

The margin of safety (MOS) is designed to account for any uncertainty that may arise in specifying water quality control strategies for the complex environmental processes that affect water quality. Quantification of this uncertainty, to the extent possible, is the basis for assigning an MOS. The TMDL incorporates an explicit MOS of five percent of the total TMDL allocation.

Pollutant Load Allocation

The TMDL for North Fork Fish Creek was derived using the median flow within the high flow regime (or five percent flow) of the LDC developed for Station 17678, the most downstream station in the watershed (Figure 8).

With historical *E. coli* data added to this LDC, the following broad linkage statements can be made. For the North Fork Fish Creek watershed, the historical *E. coli* data indicate that elevated bacteria loadings occur under all three flow regimes. However, the geometric means of the measured data for each flow regime generally indicate decreasing concentration with decreasing flow. The allowable load at the single sample criterion (399 cfu/100 mL) is included on the LDC for comparison with individual *E. coli* samples, although it is not used for assessment or allocation purposes.

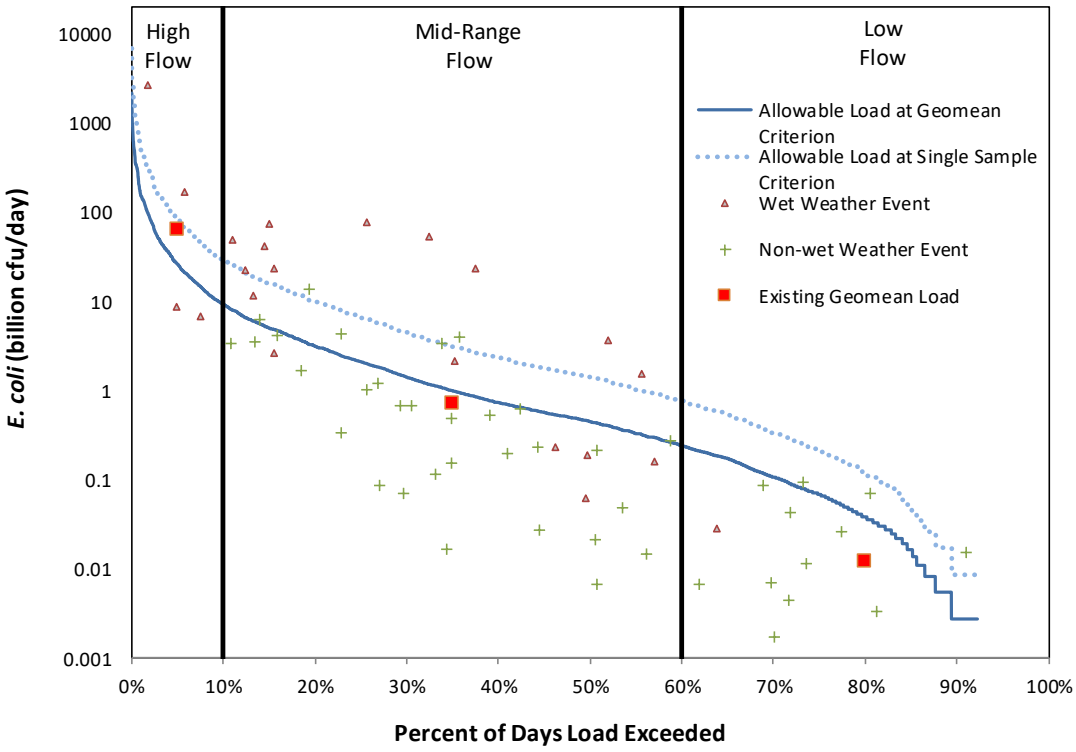

Figure 8. LDC for North Fork Fish Creek (Station 17678).

Wasteload Allocation

The wasteload allocation (WLA) is the sum of loads from regulated sources, which are WWTFs and regulated stormwater.

Wastewater Treatment Facilities

TPDES-permitted WWTFs would be allocated a daily wasteload (WLA_{WWTF}) calculated as their full permitted discharge flow rate multiplied by one-half the instream geometric mean criterion. One-half of the water quality criterion (63 cfu/100 mL *E. coli*) is used as the WWTF target to provide instream and downstream load capacity and to be consistent with previously developed TMDLs. Due to the absence of any permitted dischargers in the North Fork Fish Creek watershed, and to remain consistent with the previous TMDLs, the WLA_{WWTF} component is zero.

Regulated Stormwater

Stormwater discharges from MS4, industrial, and construction sites are also considered regulated point sources. Therefore, the WLA calculations must also include an allocation for regulated stormwater discharges (WLA_{SW}). The percentage of the land area included in the project watershed that is under the jurisdiction of stormwater permits (defined as the area designated as urbanized area in the 2010 U.S. Census) is used to estimate the amount of the overall runoff load that should be allocated as the permitted stormwater contribution in the WLA_{SW} component of the TMDL. As noted earlier, Phase I and Phase II permits provide 100 percent MS4 coverage for the North Fork Fish Creek watershed.

However, even in highly urbanized areas such as the North Fork Fish Creek watershed, there remain small areas of streams within each watershed that are not strictly regulated, and which may receive bacteria loadings from unregulated sources such as wildlife. To account for these small unregulated areas, the stream length based on the TCEQ description of Segment 0841Q and a stream width estimated from measurements recorded as part of a recreational use attainability analysis on North Fork Fish Creek (TIAER, 2010) were used to calculate an area of unregulated stormwater contribution, totaling 4.2 acres. The resulting percentage of land under the jurisdiction of stormwater permits in the North Fork Fish Creek watershed was 99.9 percent.

Load Allocation

The load allocation (LA) component of the TMDL corresponds to runoff from unregulated sources. It is calculated by subtracting the sum of the WLA_{WWTF}, WLA_{SW}, MOS, and future growth (FG) allocations from the total TMDL allocation.

Future Growth

The FG component of the TMDL equation addresses the requirement of TMDLs to account for future loadings that might occur as a result of population growth, changes in community infrastructure, and development. The assimilative capacity of streams increases as the amount of flow increases. Increases in flow allow for additional indicator bacteria loads if the concentrations are at or below the primary contact recreation standard (126 cfu/100 mL).

As noted previously, the North Fork Fish Creek watershed is entirely within the collection system area of the TRA Central Regional Wastewater System. Additionally, there are no WWTFs within the North Fork Fish Creek watershed and there are no plans to build a new WWTF within the watershed (TRA, 2019). Due to 100 percent coverage of wastewater collection by the TRA Central Regional Wastewater System and the absence of WWTFs in the North Fork Fish Creek watershed, the FG component for impaired AU 0841Q_01 is zero. This approach for FG also remains consistent with the previous TMDLs.

The three-tiered antidegradation policy in the TSWQS prohibits an increase in loading that would cause or contribute to degradation of an existing use. The antidegradation policy applies to both point and nonpoint source pollutant discharges. In general, antidegradation procedures establish a process for reviewing individual proposed actions to determine if the activity will degrade water quality. The TMDL in this document will result in protection of existing uses and conform to Texas' antidegradation policy.

TMDL Calculations

Table 8 summarizes the TMDL calculation for North Fork Fish Creek AU 0841Q_01. The TMDL was calculated based on the median flow in the 0-10 percentile range (five percent exceedance, high flow regime) for flow exceedance from the LDC developed for the monitoring station 17678. Allocations are based on the current geometric mean criterion for *E. coli* of 126 cfu/100 mL for each component of the TMDL (although one-half the criterion would have been used to calculate the WLA_{WWTF} and FG terms, had these terms not been zero).

Table 8. TMDL allocation summary for North Fork Fish Creek.

Water Body	AU	TMDL	WLA_{WWTF}	WLA_{SW}	LA	FG	MOS
North Fork Fish Creek	0841Q_01	26.08	0	24.75	0.03	0	1.30

All loads expressed as billion cfu/day *E. coli*

The final TMDL allocations (Table 9) needed to comply with the requirements of 40 Code of Federal Regulations (CFR) Section 103.7 include the FG component within the WLA_{WWTF}.

Table 9. Final TMDL allocations for North Fork Fish Creek.

Water Body	AU	TMDL	WLA_{WWTF}	WLA_{SW}	LA	MOS
North Fork Fish Creek	0841Q_01	26.08	0	24.75	0.03	1.30

All loads expressed as billion cfu/day *E. coli*

Seasonal Variation

Federal regulations in 40 CFR Section 130.7(c)(1) require that TMDLs account for seasonal variation in watershed conditions and pollutant loading. Analysis of the seasonal differences in indicator bacteria concentrations were assessed by comparing *E. coli* concentrations obtained from seventeen years (2001 through 2017) of routine monitoring collected in the warmer months (April through September) against those collected during the cooler months (October through March). Differences in *E. coli* concentrations obtained in warmer versus cooler months were then evaluated by performing a t-test on the natural log transformed dataset. This analysis of *E. coli* data indicated that there was a significant difference (α=0.05) in indicator bacteria between cool and warm weather seasons for North Fork Fish Creek (α=0.008), with the warm season having higher concentrations. Seasonal variation was also addressed by using all available flow and bacteria records (covering all seasons) from the period of record used in LDC development for this project.

Public Participation

The TCEQ maintains an inclusive public participation process. From the inception of the TMDL study, the TCEQ sought to ensure that stakeholders were informed and involved. Communication and comments from the stakeholders in the watershed strengthen TMDL projects and their implementation.

The technical support document for this TMDL addendum (Millican, 2019) was posted on the TCEQ website on July 17, 2019. A presentation on this addendum was given at the annual meeting of the Greater Trinity River Bacteria TMDL Implementation Plan Coordination Committee in Arlington on June 13, 2019. The public will have an opportunity to comment on this addendum during the official Water Quality Management Plan update public comment period (November 8 through December 12, 2019). This is an ongoing process, so notice of the public comment period for this addendum will be sent to the stakeholders and posted on the TCEQ's TMDL Program News webpage, and the document will be posted on the WQMP Updates webpage. TCEQ accepted public comments on the original TMDL from May 27 through June 27, 2016. No comments were submitted related to North Fork Fish Creek.

Implementation and Reasonable Assurance

The segment covered by this addendum is within the existing bacteria TMDL watersheds of Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch. Those TMDL watersheds including North Fork Fish

Creek are within the area covered by the implementation plan developed by the NCTCOG (in collaboration with the Coordination Committee of the Greater Trinity River Bacteria TMDL Implementation Project) for bacteria TMDLs throughout the greater Dallas/Fort Worth area, approved by the TCEQ on December 11, 2013. It outlines an adaptive management approach in which measures are periodically assessed for efficiency and effectiveness. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals and expresses stakeholder commitment to the process. Please refer to the original TMDL document for additional information regarding implementation and reasonable assurance.

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Appendix G. Addendum Two to Four TMDLs for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake
Adding one Total Maximum Daily Load (TMDL) for AU 0841P_01

One Total Maximum Daily Load for Indicator Bacteria in North Fork Cottonwood Creek

Introduction

Texas Commission on Environmental Quality (TCEQ) adopted Four TMDLs for Indicator Bacteria in the Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch Watersheds Upstream of Mountain Creek Lake (TCEQ, 2016) on November 2, 2016. The United States Environmental Protection Agency (EPA) approved the TMDLs on December 7, 2016. This document is the second addendum to the original TMDL report.

This second addendum includes information specific to one additional assessment unit (AU) for North Fork Cottonwood Creek (AU 0841P_01; also referred to in this addendum as the TMDL watershed). This AU is located within the watershed of the approved original TMDLs for watersheds upstream of Mountain Creek Lake. The concentration of indicator bacteria in this additional AU exceeds the criterion used to evaluate support of the primary contact recreation 1 use.

This addendum details the development of the added TMDL allocation for this additional AU, which was not specifically addressed in the original TMDL report. For background or other explanatory information, please refer to the *Technical Support Document for One Total Maximum Daily Load for Indicator Bacteria for North Fork Cottonwood Creek*[1] (Millican and Adams, 2021). Refer to the original, approved TMDL document for details about the overall project watershed as well as methods and assumptions used in developing the original TMDLs.

Problem Definition

TCEQ first identified the bacteria impairment for North Fork Cottonwood Creek in the *2020 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2020), the latest EPA-approved edition of the Texas 303(d) List. North Fork Cottonwood Creek (0841P) contains only one AU, the impaired AU 0841P_01. The TMDL watershed is located in Tarrant and Dallas counties. Figure IX-1 shows the watershed added in this addendum in relation to the entire watershed of the original TMDLs, and also includes the area covered by the first addendum.

The Texas Surface Water Quality Standards (TCEQ, 2018) identify uses for surface waters and numeric and narrative criteria to evaluate attainment of those uses. The basis for the water quality target for the TMDL developed in this addendum is the numeric criterion for indicator bacteria from the 2018 Texas Surface Water Quality Standards. *Escherichia coli* (*E. coli*) is the indicator bacteria for assessing primary contact recreation 1 use in freshwater.

[1] https://www.tceq.texas.gov/downloads/water-quality/tmdl/greater-trinity-recreational-66/66-as-223-north-fork-cottonwood-creek-technical-support-document.pdf

Table IX-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) stations on AU 0841P_01, as reported in the 2020 Texas Integrated Report (TCEQ, 2020). The data from the assessment indicate nonsupport of the primary contact recreation 1 use for the AU, because the geometric mean concentration for *E. coli* exceeds the freshwater geometric mean criterion of 126 colony forming units per 100 milliliters (cfu/100 mL) of water. Figure IX-2 shows the locations of the TCEQ SWQM stations that were used in evaluating water quality in the 2020 Texas Integrated Report for the AU added by this addendum, as well as an additional station with older data.

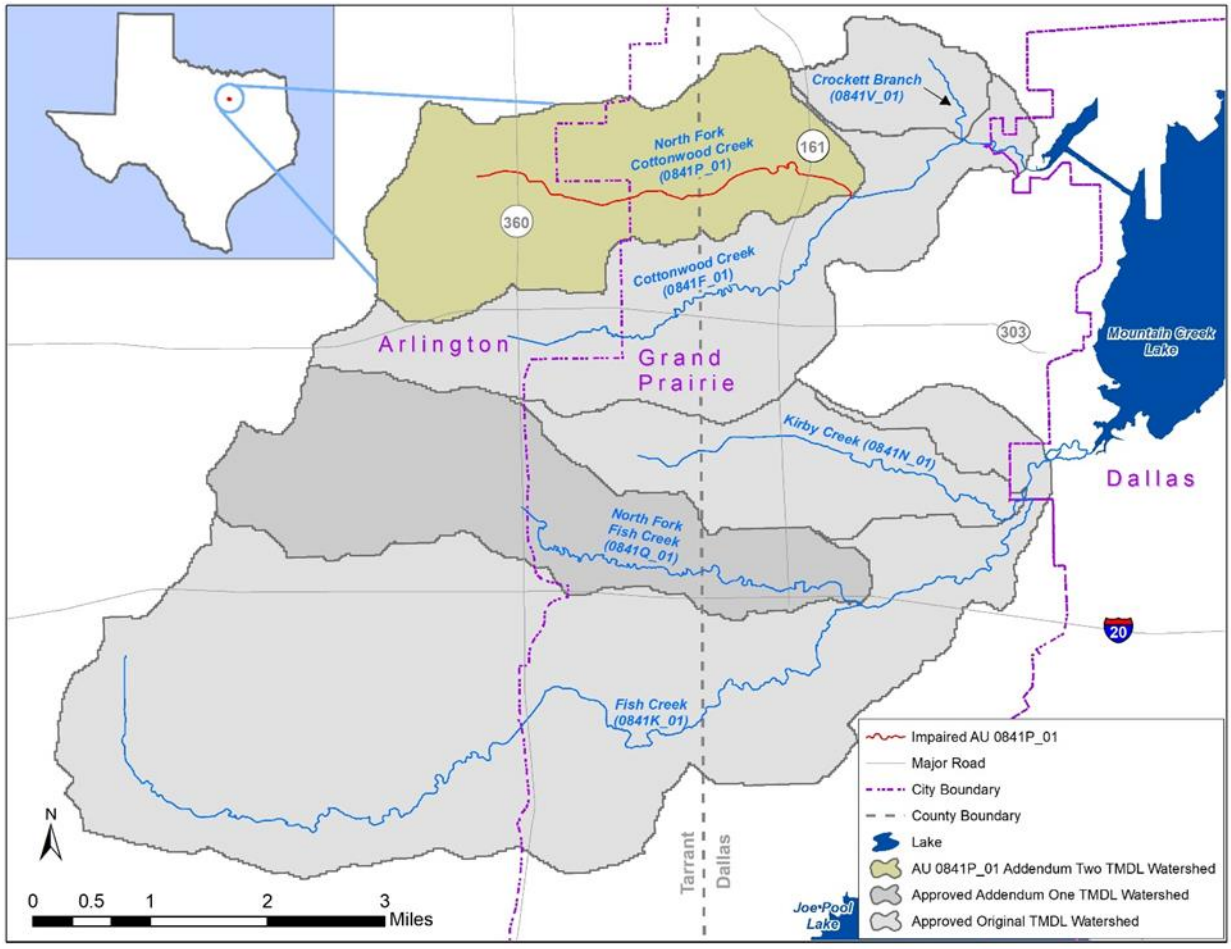

Figure IX-1. Map showing the previously approved TMDL watersheds and the North Fork Cottonwood Creek AU 0841P_01 watershed added by this addendum

Table IX-1. 2020 Texas Integrated Report summary for TMDL addendum watershed

AU	Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
0841P_01	10722, 20836	*E. coli*	49	12/01/2011 – 11/30/2018	258

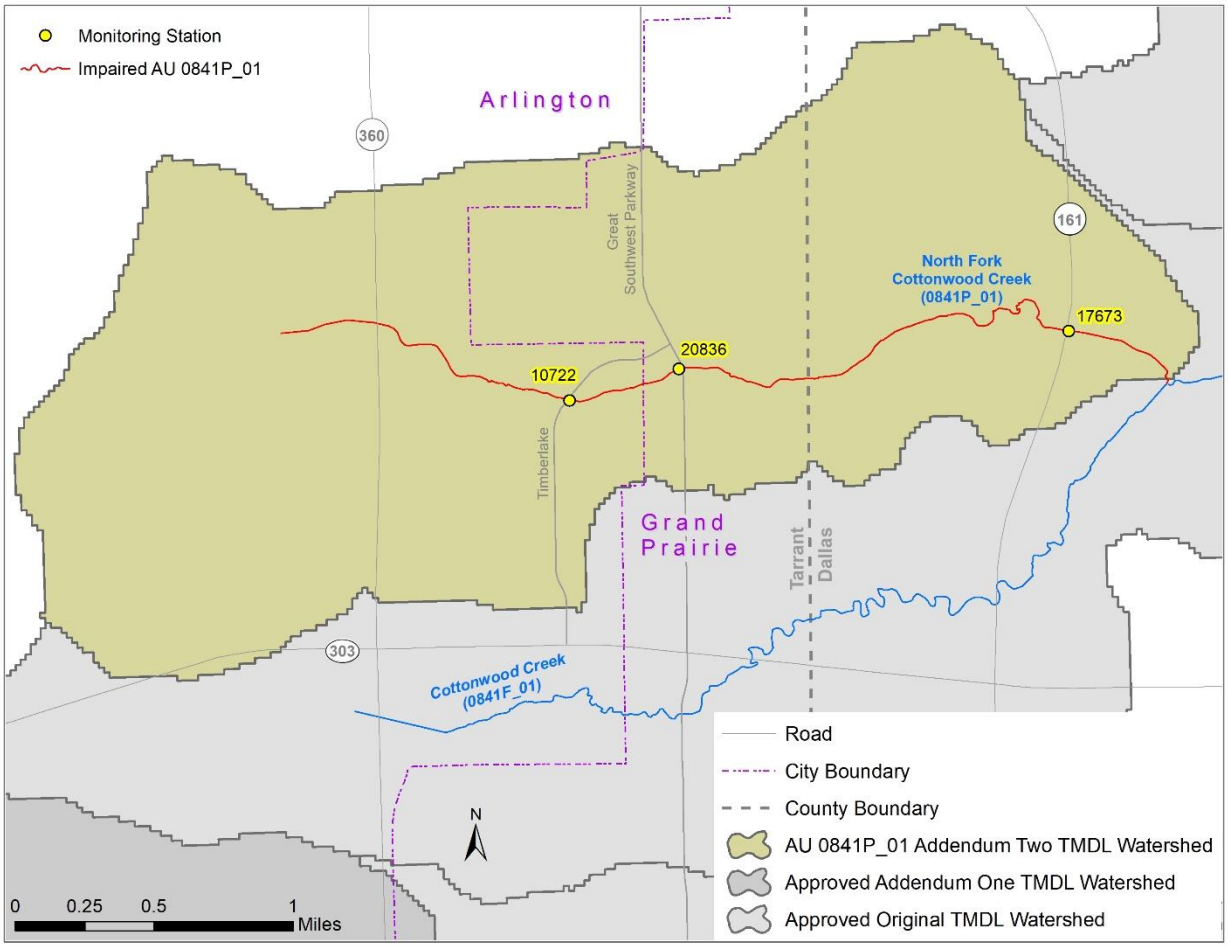

Figure IX-2. AU 0841P_01 watershed showing the TCEQ SWQM stations

Watershed Overview

North Fork Cottonwood Creek (0841P) is a tributary of Cottonwood Creek (0841F) and flows approximately 4.4 miles. The total drainage area for the TMDL watershed is 5.5 square miles.

The 2020 Texas Integrated Report (TCEQ, 2020) provides the following water body and AU description:

- 0841P (North Fork Cottonwood Creek; AU 0841P_01) – A 4.4 mile stretch of North Fork Cottonwood Creek running upstream from confluence with the South Fork Cottonwood Creek in Grand Prairie, Dallas County, to approximately 0.3 miles upstream of Carter Street in Arlington, Tarrant County.

Watershed Climate

Weather data were obtained for the 21-year period from January 1999 through December 2019 from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center Database. The Arlington Municipal Airport weather station (USW00053907) located in the western portion of the

nearby Fish Creek (0841K) watershed was used to retrieve the precipitation and temperature data (NOAA, 2021; Figure IX-3). Data from this 21-year period indicate that the average monthly high temperature typically reaches a maximum of 96.8 °F in August, and the average monthly low temperature reaches a minimum of 35.6 °F in January. Annual rainfall averages 34.3 inches. The wettest month is May (4.4 inches), while August (1.6 inches) is the driest month, with rainfall occurring throughout the year.

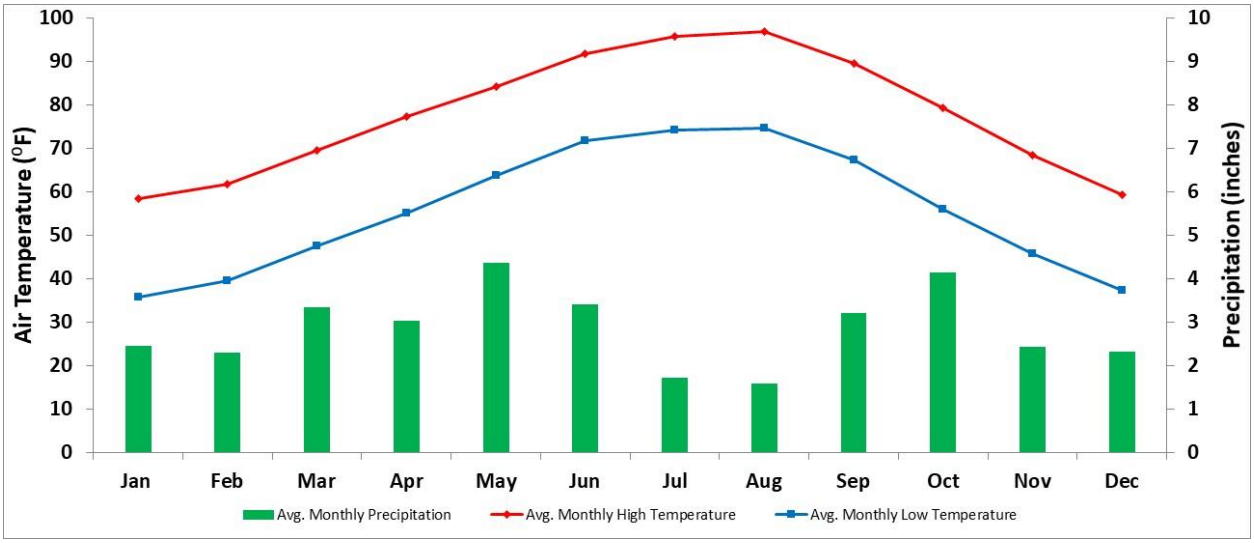

Figure IX-3. Average monthly temperature and precipitation (1999–2019) at the Arlington Municipal Airport weather station

Watershed Population and Population Projections

The TMDL watershed is primarily located within the municipal boundaries of Arlington and Grand Prairie. According to the United States Census Bureau (USCB) 2010 Census (USCB, 2010), the TMDL watershed had an estimated population of 32,252 people in 2010.

The population projection in Table IX-2 was estimated using data developed by North Central Texas Council of Governments (NCTCOG) by using traffic survey zone allocations (NCTCOG, 2017a). Traffic survey zones are planning areas used by NCTCOG to provide for more analysis at a local scale. NCTCOG modeled the 2045 projected populations using inputs such as number of households, household populations, land cover changes, and future land use plans.

Table IX-2. Estimated 2010 population and 2045 population projection for the TMDL watershed

Area	2010 Estimated Population	2045 Projected Population	Projected Population Increase	Percentage Change
North Fork Cottonwood Creek (AU 0841P_01) Watershed	32,252	44,643	12,391	38.4%

The following steps detail the method used to estimate the 2010 and projected 2045 populations in the TMDL watershed.

1. Obtained 2010 U.S. Census data at the block level.
2. Developed 2010 watershed populations using the block level data for the portion of the census blocks located within the watershed.
3. Obtained population projections for the year 2045 from the NCTCOG traffic survey zone allocations.
4. Developed population projections using traffic survey zone data for the portion of the traffic survey zones located within the watershed.
5. Subtracted the 2010 watershed population from the 2045 population projection to determine the projected population increase. Subsequently, divided the projected population increase by the 2010 watershed population to determine the percentage population increase for the North Fork Cottonwood Creek watershed.

Land Cover

The land cover data were obtained from NCTCOG and represent land cover estimates for 2015 (NCTCOG, 2017b). The land cover for the TMDL watershed is shown in Figure IX-4. A summary of the land cover data is provided in Table IX-3 and indicates that the dominant land cover in the TMDL watershed is Residential (34.76%).

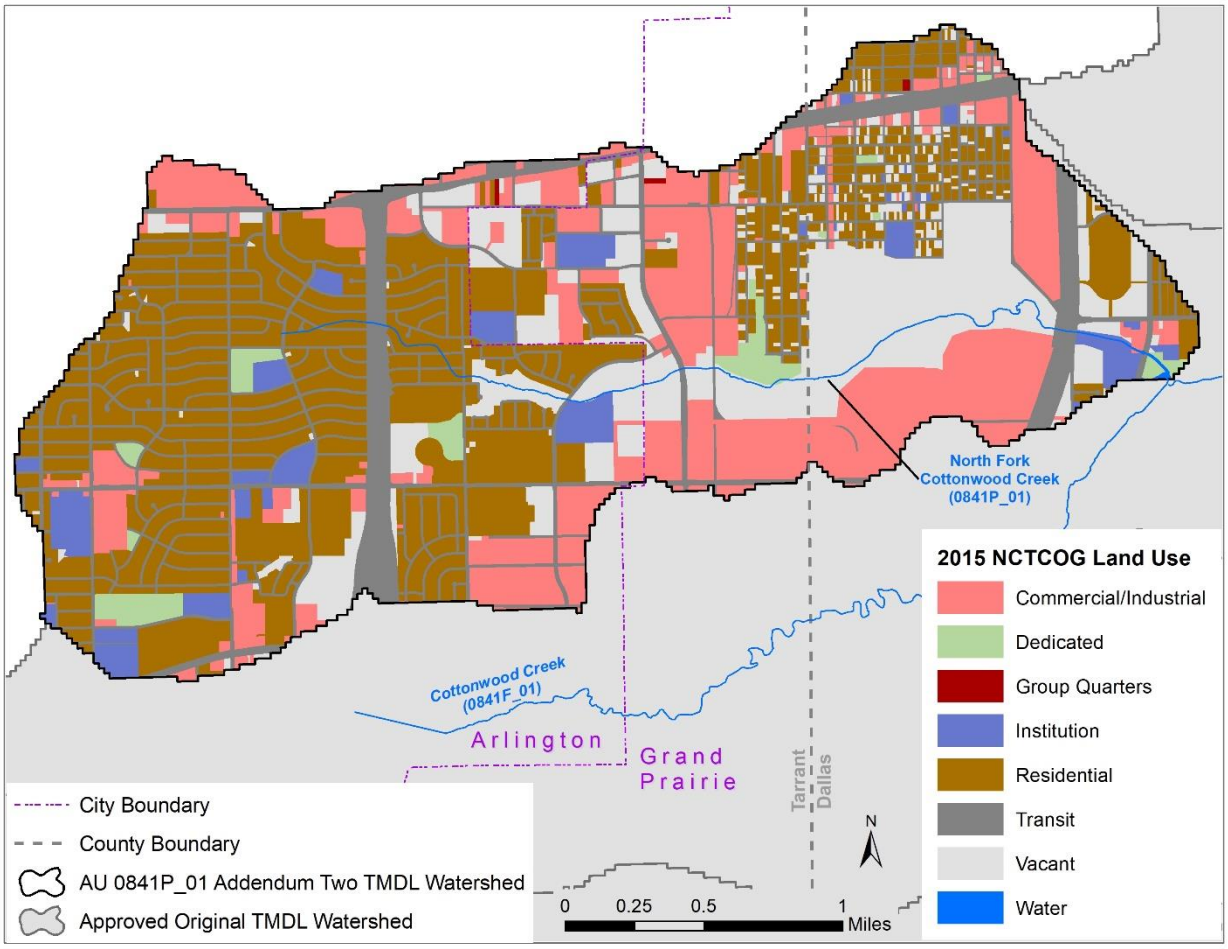

Figure IX-4. 2015 land cover

Table IX-3. Land cover summary

2015 NCTCOG Classification	Area (Acres)	Percentage of Total
Commercial/Industrial	776.9	21.91%
Group Quarters	2.7	0.08%
Residential	1,232.6	34.76%
Institution	163.7	4.62%
Transit	657.9	18.56%
Dedicated	76.4	2.15%
Vacant	633.4	17.86%
Water	2.0	0.06%
Total	**3,545.6**	**100%**

Endpoint Identification

The endpoint for the TMDL is to maintain the concentration of *E. coli* below the geometric mean criterion of 126 cfu/100 mL, which is protective of the primary contact recreation 1 use in freshwater.

Source Analysis

Pollutants may come from several sources, both regulated and unregulated. Pollutants in regulated discharges, referred to as "point sources," come from a single definable point, such as a pipe, and are regulated by permit under the Texas Pollutant Discharge Elimination System (TPDES) program. Wastewater treatment facilities (WWTFs) and stormwater discharges from industries, construction activities, and the separate storm sewer systems of cities are considered point sources of pollution.

Unregulated sources are typically nonpoint source in origin, meaning the pollutants originate from multiple locations and rainfall runoff washes them into surface waters. Nonpoint sources are not regulated by permit.

Except for WWTFs, which receive individual wasteload allocations (WLAs; see the Wasteload Allocation section), the regulated and unregulated sources in this section are presented to give a general account of the different sources of bacteria expected in the watershed. These are not meant to be used for allocating bacteria loads or interpreted as precise inventories and loadings.

Regulated Sources

Regulated sources are controlled by permit under the TPDES program. The regulated sources in the TMDL watershed include stormwater discharges from industries, regulated construction activities, and municipal separate storm sewer systems (MS4s).

Domestic and Industrial WWTFs

No permitted WWTFs exist in the TMDL study area. Domestic wastewater is collected by and transported to the Trinity River Authority (TRA) Central Regional Wastewater System, which is outside the study area (Figure IX-5).

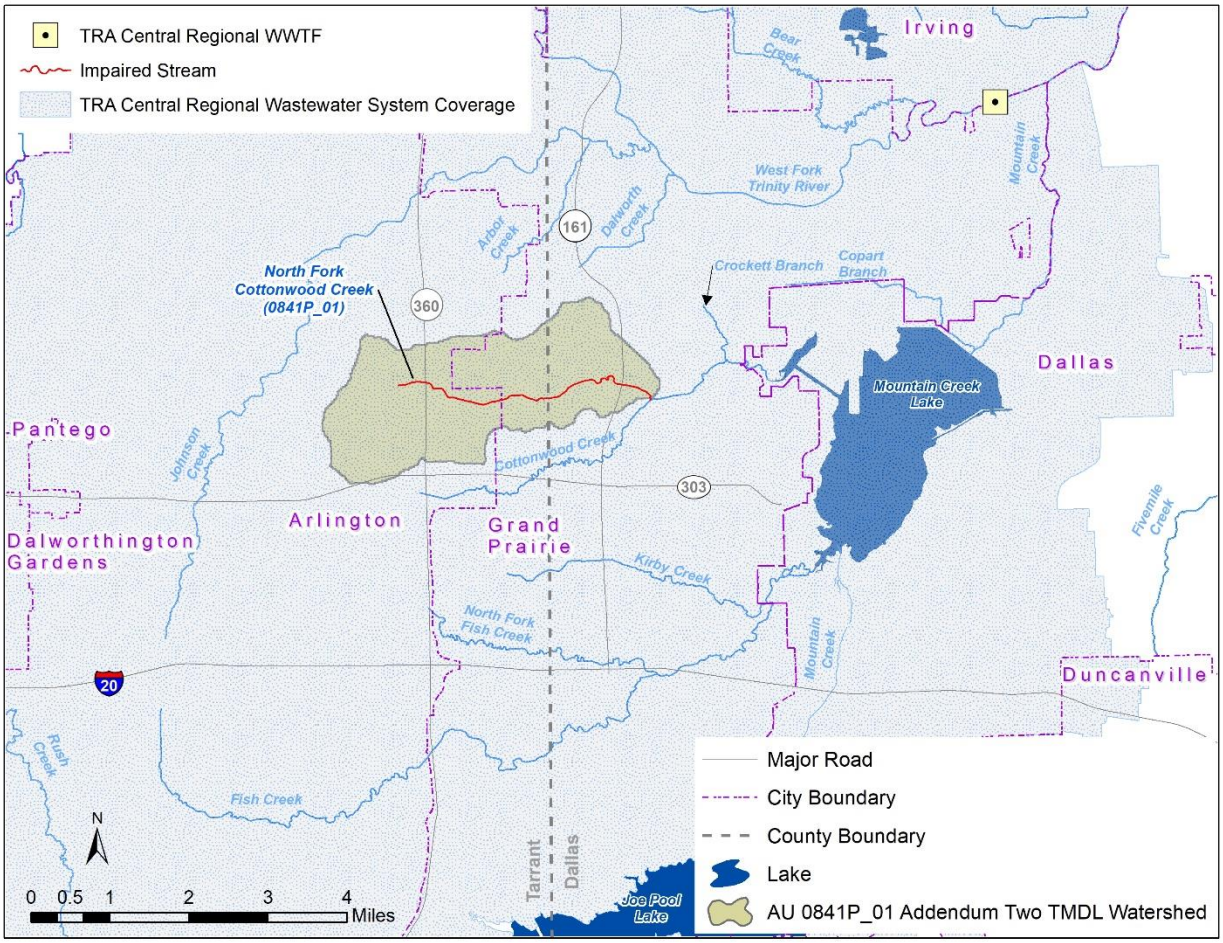

Figure IX-5. Coverage area of the TRA Central Regional Wastewater System within the TMDL study area

TCEQ/TPDES Water Quality General Permits

Certain types of activities are required to be covered by one of several TCEQ/TPDES wastewater general permits:

TXG110000 – concrete production facilities
TXG130000 – aquaculture production
TXG340000 – petroleum bulk stations and terminals
TXG640000 – conventional water treatment plants
TXG670000 – hydrostatic test water discharges
TXG830000 – water contaminated by petroleum fuel or petroleum substances
TXG870000 – pesticides (application only)
TXG920000 – concentrated animal feeding operations
WQG100000 – wastewater evaporation
WQG200000 – livestock manure compost operations (irrigation only)

A review of active general permit coverage (TCEQ, 2021) in the TMDL watershed, as of February 25, 2021, revealed two pesticide permittees covered by the general permit. These pesticide management

areas do not have bacteria reporting requirements or limits in their permits. Pesticide application in the pesticide management areas is assumed to contain inconsequential amounts of indicator bacteria; therefore, it was unnecessary to allocate bacteria loads to them. No other active wastewater general permit authorizations were found in the TMDL watershed.

Sanitary Sewer Overflows

A summary of sanitary sewer overflow (SSO) incidents that occurred during a 10-year period from 2010 through 2019 in the TMDL watershed was obtained from NCTCOG. The SSO data was originally collected by TCEQ Region 4 and was refined by NCTCOG by assigning latitude and longitude coordinates to each SSO event. The summary data indicated 37 SSO incidents had been reported within the TMDL watershed. The SSOs had a total discharge of 17,074 gallons with a minimum of seven gallons and a maximum of 5,560 gallons.

TPDES-Regulated Stormwater

When evaluating stormwater for a TMDL allocation, a distinction must be made between stormwater originating from an area under a TPDES-regulated discharge permit and stormwater originating from areas not under a TPDES-regulated discharge permit. Stormwater discharges fall into two categories:

1. Stormwater subject to regulation, which is any stormwater originating from TPDES-regulated MS4 entities, stormwater discharges associated with regulated industrial activities, and construction activities.
2. Stormwater runoff not subject to regulation.

Discharges of stormwater from a Phase II MS4 area, regulated industrial facility, construction area, or other facility involved in certain activities must be covered under the following TCEQ/TPDES general permits:

TXR040000 – Phase II MS4 General Permit for MS4s located in urbanized areas
TXR050000 – Multi-sector General Permit (MSGP) for industrial facilities
TXR150000 – Construction General Permit (CGP) for construction activities disturbing more than one acre or are part of a common plan of development disturbing more than one acre

A review of active stormwater general permit authorizations (TCEQ, 2021) in the TMDL watershed as of March 30, 2021, found one active MSGP authorization within the watershed and several CGP authorizations. The areas of these were not quantified since MS4s accounted for 100% of the watershed. There are currently one Phase I MS4 permit, one Phase II MS4 authorization, and one combined Phase I/Phase II permit within the TMDL watershed (Table IX-4). Figure IX-6 shows the urbanized area defined by USCB that accounts for MS4 coverage within the North Fork Cottonwood Creek watershed.

Table IX-4. TPDES MS4 permits associated with the TMDL watershed

Entity	TPDES Permit	NPDES Permit	Authorization Type
City of Arlington	WQ0004635000	TXS000301	Phase I
Texas Department of Transportation	WQ0005011000	TXS002101	Combined Phase I/II
City of Grand Prairie	General Permit (TXR040000)	TXR040065	Phase II

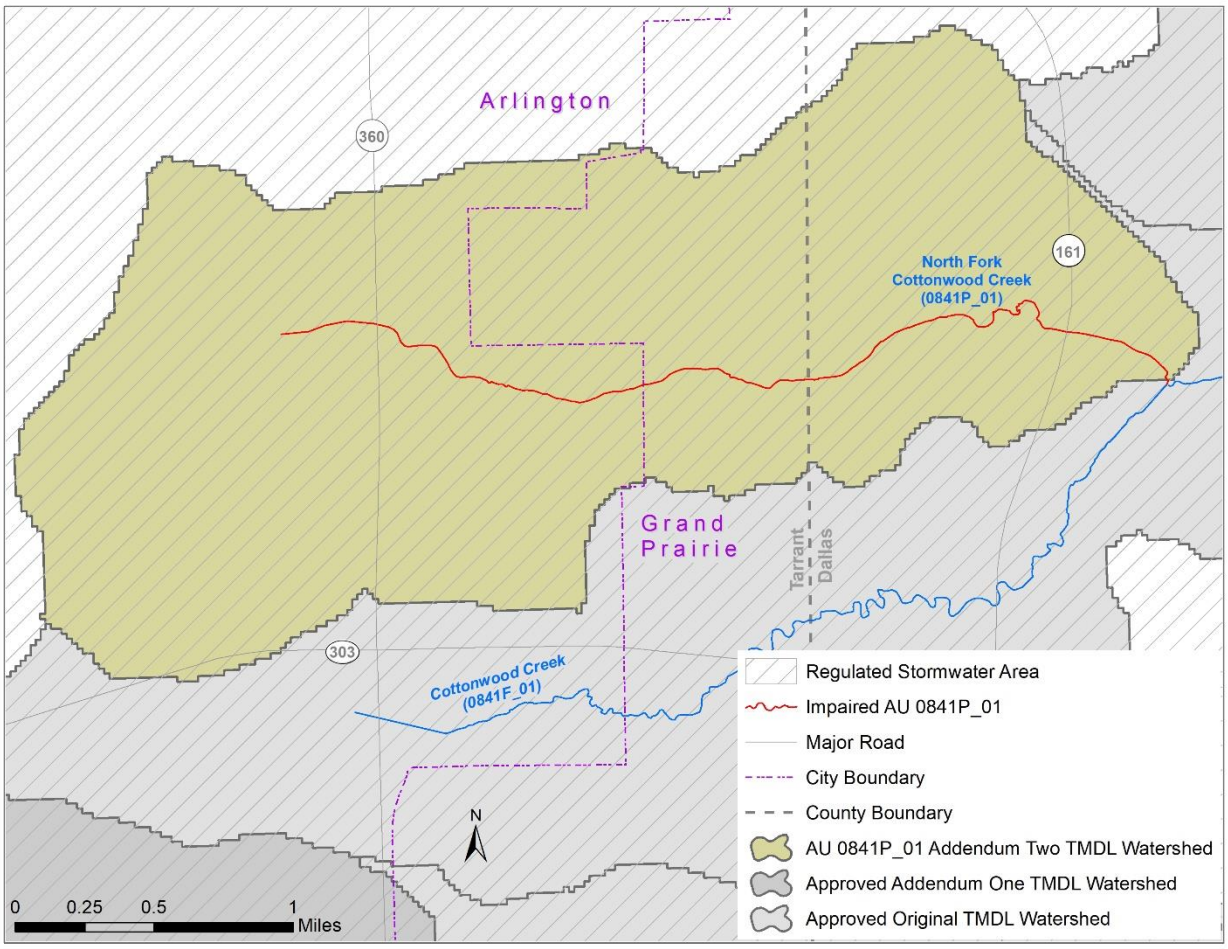

Figure IX-6. Regulated stormwater area based on urbanized area within the TMDL watershed

Illicit Discharges

Pollutant loads can enter water bodies from MS4 outfalls that carry authorized sources as well as illicit discharges under both dry- and wet-weather conditions. The term “illicit discharge” is defined in TPDES General Permit TXR040000 for Phase II or small MS4s as “Any discharge to a municipal separate storm sewer system that is not entirely composed of stormwater, except discharges pursuant to this general permit or a separate authorization and discharges resulting from emergency firefighting activities.” Illicit discharges can be categorized as either direct or indirect contributions.

Unregulated Sources

Unregulated sources of bacteria are nonpoint and can originate from wildlife and feral hogs, various agricultural activities, agricultural animals, land application fields, urban runoff not covered by a permit, failing on-site sewage facilities (OSSFs), and domestic pets

Unregulated Agricultural Activities and Domesticated Animals

A number of agricultural activities that do not require permits can be potential sources of fecal bacteria loading. Agricultural activities were not a source in this highly urbanized watershed.

Fecal bacteria from dogs and cats is transported to streams by runoff in both urban and rural areas and can be a potential source of bacteria loading. Table IX-5 summarizes the estimated number of dogs and cats within the TMDL watershed. Pet population estimates were calculated as the estimated number of dogs (0.614) and cats (0.457) per household (AVMA, 2018). The number of households in the TMDL watershed was estimated using 2010 Census data (USCB, 2010). The actual contribution and significance of bacteria loads from pets reaching the water bodies in the watershed is unknown.

Table IX-5. Estimated households and pet population

Estimated Households	Estimated Dog Population	Estimated Cat Population
10,056	6,175	4,596

Wildlife and Unmanaged Animals

Fecal bacteria are common inhabitants of the intestines of all warm-blooded animals, including wildlife such as mammals and birds. In developing bacteria TMDLs, it is important to identify by watershed the potential for bacteria contributions from wildlife. Wildlife are naturally attracted to riparian corridors of water bodies. With direct access to the stream channel, the direct deposition of wildlife waste can be a concentrated source of bacteria loading to a water body. Fecal bacteria from wildlife are also deposited onto land surfaces, where they may be washed into nearby water bodies by rainfall runoff.

The *E. coli* contribution from feral hogs and wildlife in the TMDL watershed cannot be determined based on existing information. However, due to the urbanized nature of the watershed it is assumed that the contribution is minimal.

Onsite Sewage Facilities

Failing OSSFs were not considered a major source of bacteria loading in the North Fork Cottonwood Creek watershed, because the entire watershed area is served by the TRA wastewater collection and treatment system. A review of OSSF information received from NCTCOG indicates that there are no known OSSFs in the TMDL watershed.

Linkage Analysis

The load duration curve (LDC) method was used to examine the relationship between instream water quality and the source of indicator bacteria loads. Inherent to the use of LDCs as the mechanism of linkage analysis is the assumption of a one-to-one relationship between instream loadings and loadings originating from point sources as regulated and from the landscape as unregulated sources. Further, this one-to-one relationship was also inherently assumed when using the LDC to define the TMDL pollutant load allocation. The LDC method allows for estimation of TMDL loads by utilizing the cumulative frequency distribution of streamflow and measured pollutant concentration data (Cleland, 2003). In addition to estimating stream loads, this method allows for the determination of the hydrologic conditions under which impairments are typically occurring, can give indications of the broad origins of the bacteria (i.e., point or nonpoint source), and provides a means to allocate allowable loadings. The technical support document for this addendum (Millican and Adams, 2021) provides details about the linkage analysis along with the LDC method and its application.

LDCs for the three SWQM stations were developed for informational purposes, while the LDC for the watershed outlet was constructed for developing the TMDL allocation for North Fork Cottonwood Creek. Based on the LDCs developed for the three SWQM station locations with historical *E. coli* data added to the graph, the following broad linkage statements can be made. For this TMDL watershed, the historical *E. coli* data show that elevated bacteria loadings occur under all three flow regimes. The geometric means of the measured data exceed the geomean criterion under all three flow regimes for SWQM Stations 10722 and 20836 (Figures IX-7 and IX-8). Geometric means measured at SWQM Station 17673 (Figure IX-9) indicate a slight moderation of the elevated loadings under Mid-Range and Low Flow conditions; however, this may not represent current conditions since data has not been collected at this station in over 10 years. The allowable load at the single sample criterion (399 cfu/100 mL) is included on the LDCs for comparison with individual *E. coli* samples, although it is not used for assessment or allocation purposes. The LDC for the watershed outlet (Figure IX-10) has no bacteria data plotted on it, as no sampling took place at that location.

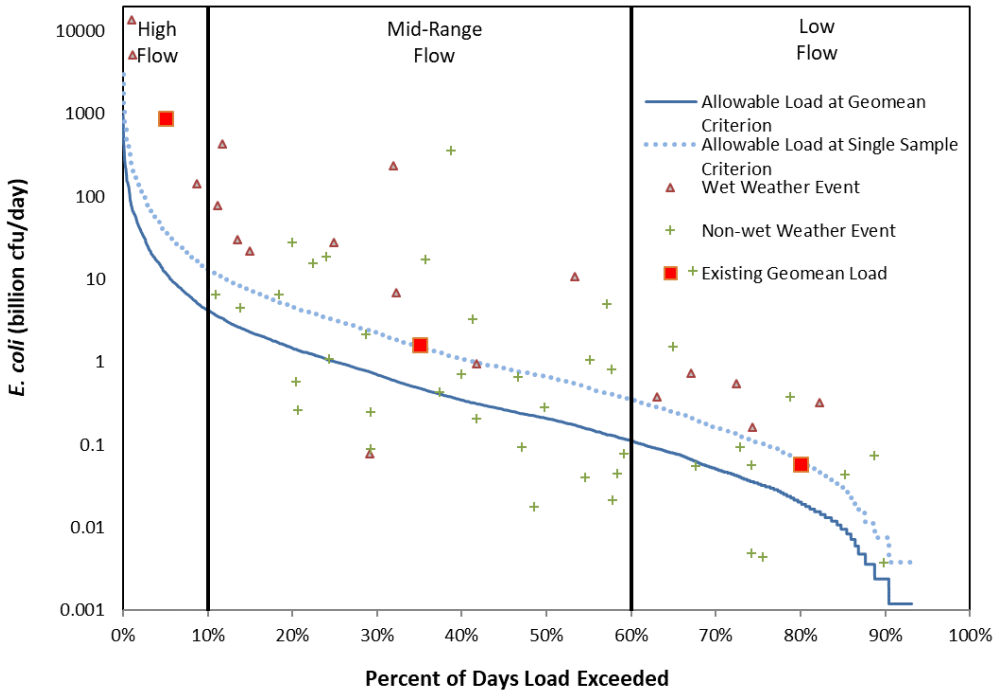

Figure IX-7. LDC at SWQM Station 10722

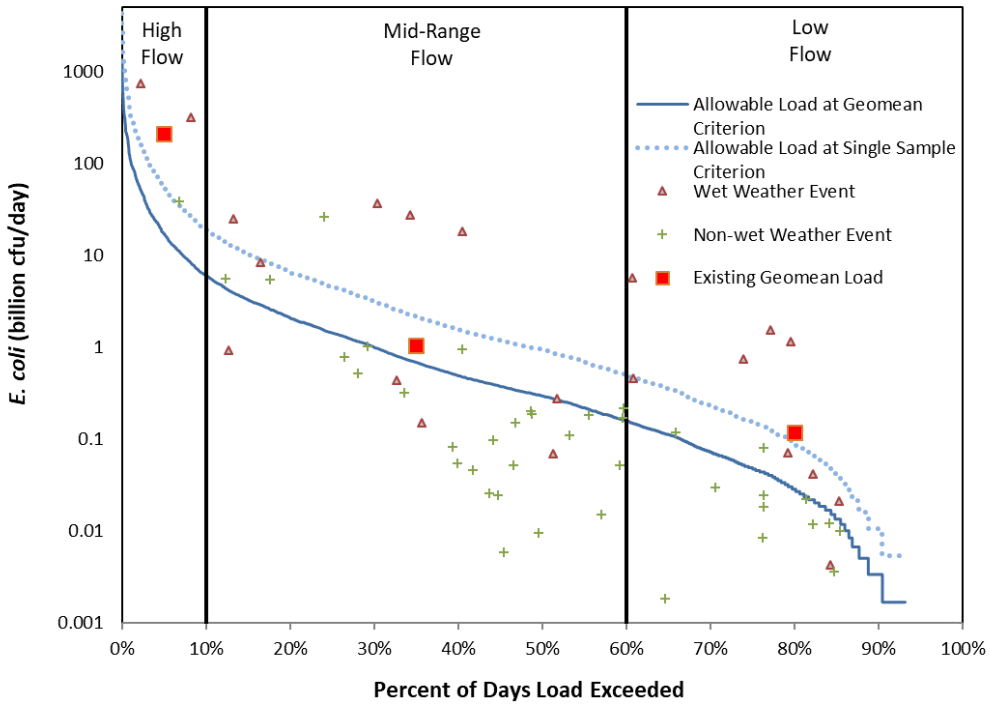

Figure IX-8. LDC at SWQM Station 20836

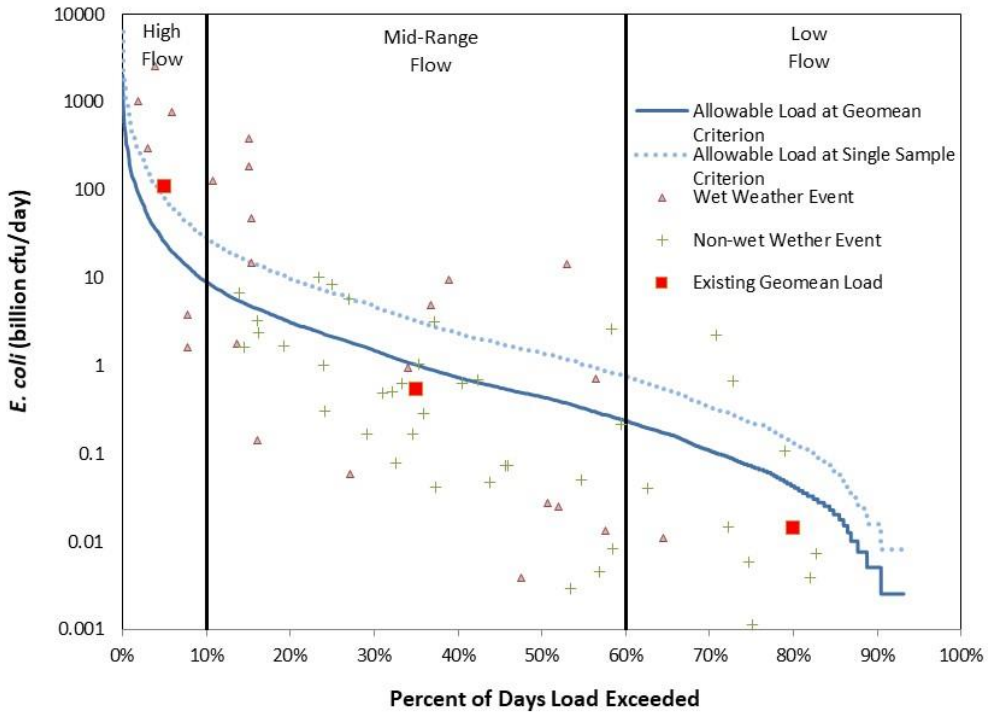

Figure IX-9. LDC at SWQM Station 17673

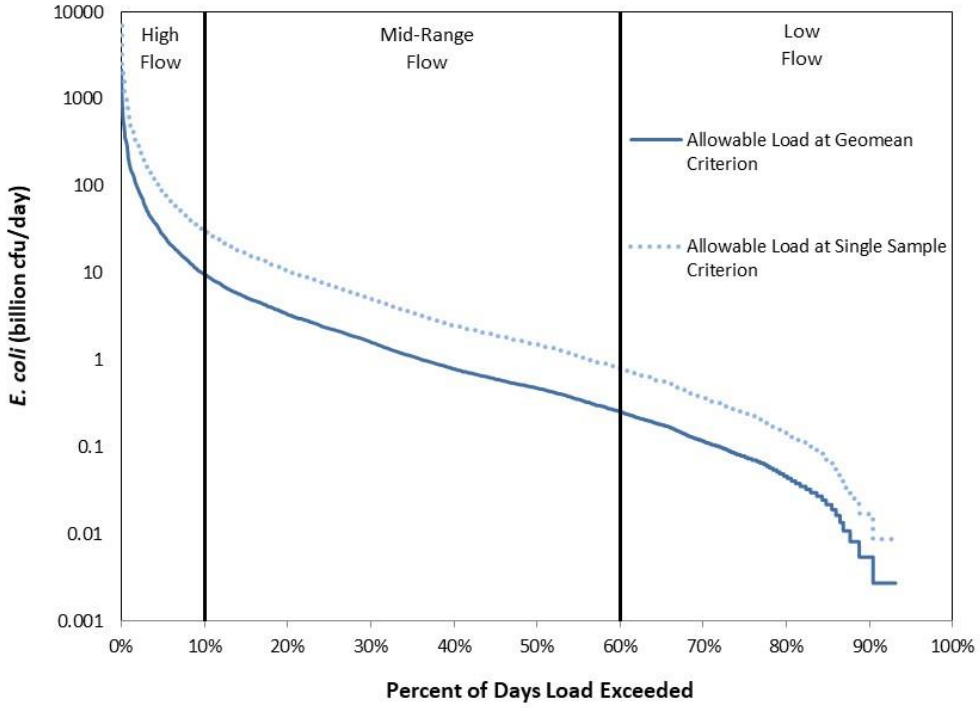

Figure IX-10. LDC for the outlet of North Fork Cottonwood Creek

Margin of Safety

The margin of safety (MOS) is designed to account for any uncertainty that may arise in specifying water quality control strategies for the complex environmental processes that affect water quality. Quantification of this uncertainty, to the extent possible, is the basis for assigning an MOS. The TMDL in this report incorporates an explicit MOS of 5% of the total TMDL allocation.

Pollutant Load Allocation

The TMDL represents the maximum amount of a pollutant that the stream can receive in a single day without exceeding water quality standards. The pollutant load allocations for the selected scenarios were calculated using the following equation:

TMDL = WLA + LA + FG + MOS

Where:

WLA = wasteload allocations, the amount of pollutant allowed by regulated dischargers

LA = load allocations, the amount of pollutant allowed by unregulated sources

FG = loadings associated with future growth from potential regulated facilities

MOS = margin of safety load

AU-Level TMDL Calculation

To be consistent with previously completed TMDLs in the original watershed, the TMDL for North Fork Cottonwood Creek AU 0841P_01 was derived using the median flow within the High Flow regime (or 5% load duration exceedance) of the LDC developed for the watershed outlet. The watershed outlet was used because the most downstream station within North Fork Cottonwood Creek AU 0841P_01 has not had *E. coli* monitoring since 2008.

Margin of Safety Calculation

The TMDL in this report incorporates an explicit MOS of 5%.

Wasteload Allocation

The WLA is the sum of loads from regulated sources, which are WWTFs and regulated stormwater.

Wastewater Treatment Facilities

TPDES-permitted WWTFs are allocated a daily wasteload (WLA_{WWTF}) calculated as their full permitted discharge flow rate multiplied by one-half the instream geometric mean criterion. One-half of the water quality criterion (63 cfu/100 mL *E. coli*) is used as the WWTF target to provide instream and downstream load capacity and to be consistent with the original TMDL report. Due to the absence of any permitted dischargers in the North Fork Cottonwood Creek watershed, the WLA_{WWTF} component is zero.

Regulated Stormwater

Stormwater discharges from MS4, industrial, and construction areas are also considered regulated point sources. Therefore, the WLA calculations must also include an allocation for regulated stormwater discharges (WLA_{SW}). The percentage of the land area included in the TMDL watershed that is under the jurisdiction of stormwater permits is used to estimate the amount of the overall runoff load that should be allocated as the permitted stormwater contribution in the WLA_{SW} component.

The North Fork Cottonwood Creek watershed is covered 100% by MS4 permits. However, even in highly urbanized areas such as the North Fork Cottonwood Creek watershed, there remain some areas of potential direct deposition of bacteria loadings from unregulated sources such as wildlife. To account for these unregulated areas, the stream length based on the TCEQ definition of AU 0841P_01 and average channel width as calculated based on aerial imagery was used to compute an area of unregulated stormwater contribution. The percentage of land under the jurisdiction of stormwater permits in the TMDL watershed is 98.9%.

Load Allocation

The load allocation (LA) component of the TMDL corresponds to runoff or direct deposition from unregulated sources.

Allowance for Future Growth

The future growth (FG) component of the TMDL equation addresses the requirement of TMDLs to account for future loadings that might occur as a result of population growth, changes in community infrastructure, and development. Specifically, this TMDL component takes into account the probability that new flows from WWTF discharges may occur in the future. The assimilative capacity of water bodies increases as the amount of flow increases. The allowance for FG in this TMDL report will result in protection of existing uses and conform to Texas' antidegradation policy.

Due to the absence of any existing WWTFs and the fact that it is highly unlikely that any new WWTFs will be established within the North Fork Cottonwood Creek watershed (TRA, 2021), the FG component is zero.

FG of existing or new point sources is not limited by this TMDL as long as the sources do not cause bacteria to exceed the limits. The assimilative capacity of water bodies increases as the amount of flow increases. Consequently, increases in flow allow for increased loadings. The LDC and tables in this TMDL report will guide determination of the assimilative capacity of the water body under changing conditions, including FG.

Summary of TMDL Calculations

Table IX-6 summarizes the TMDL calculations for the TMDL watershed. The TMDL was calculated based on the median flow in the 0-10 percentile range (5% exceedance, High Flow regime) from the LDC developed for the outlet of the North Fork Cottonwood Creek watershed. Allocations are based on the current geometric mean criterion for *E. coli* of 126 cfu/100 mL for each component of the TMDL (with

the exception of the WLA_{WWTF} and FG terms, which would be based on one-half the criterion if they applied).

Table IX-6. TMDL allocation summary for AU 0841P_01

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
North Fork Cottonwood Creek	0841P_01	27.492	1.375	0	25.830	0.287	0

The final TMDL allocations (Table IX-7) needed to comply with federal requirements include the FG component within the WLA_{WWTF} (40 CFR Section 103.7).

Table IX-7. Final TMDL allocation for AU 0841P_01

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
North Fork Cottonwood Creek	0841P_01	27.492	1.375	0	25.830	0.287

Seasonal Variation

Federal regulations require that TMDLs account for seasonal variation in watershed conditions and pollutant loading [40 CFR Section 130.7(c)(1)]. Analysis of the seasonal differences in indicator bacteria concentrations were assessed by comparing *E. coli* concentrations obtained from 19 years (2001 through 2019) of routine monitoring data collected at three SWQM stations (10722, 20836, and 17673) in the warmer months (May-September) against those collected during cooler months (November-March). The months of April and October were considered transitional between warm and cool seasons and were excluded from the seasonal analysis. Differences in seasonal concentrations were then evaluated with a Wilcoxon Rank Sum test (also known as the "Mann-Whitney" test). The analysis of *E. coli* data indicated that there was no significant difference in indicator bacteria between the cool and warm weather seasons (α=0.05) for North Fork Cottonwood Creek. Seasonal variation was also addressed by using all available flow and *E. coli* records (covering all seasons) from the period of record used in LDC development for this project.

Public Participation

TCEQ maintains an inclusive public participation process. From the inception of TMDL development, the project team sought to ensure that stakeholders were informed and involved. Communication and comments from the stakeholders in the watershed strengthen TMDL projects and their implementation.

The technical support document for this TMDL addendum (Millican and Adams, 2021) was published on the TCEQ website on December 7, 2021. Project staff presented information about this addendum at the annual meeting of the Greater Trinity River Bacteria TMDL Implementation Plan

Coordination Committee hosted by NCTCOG (held online) on July 1, 2021. The public had an opportunity to comment on this addendum during the public comment period (May 6 through June 7, 2022) for the Water Quality Management Plan (WQMP) update in which this addendum is included. Notice of the public comment period for this addendum was emailed to stakeholders and posted on the TCEQ's TMDL Program TMDL Program News webpage.[2] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[3] TCEQ accepted public comments on the original TMDL report from May 27 through June 27, 2016. No comments were submitted.

Implementation and Reasonable Assurance

The AU covered by this addendum is within the existing bacteria TMDL watershed for Cottonwood Creek, Fish Creek, Kirby Creek, and Crockett Branch. That TMDL watershed, including North Fork Cottonwood Creek AU 0841P_01, is within the area covered by the implementation plan (I-Plan) developed by stakeholders for the TMDL watershed, which was approved by the Commission on December 11, 2013. The I-Plan outlines an adaptive management approach in which measures are assessed annually by the stakeholders for efficiency and effectiveness. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals and expresses stakeholder commitment to the process. Please refer to the original TMDL document for additional information regarding implementation and reasonable assurance.

[2] https://www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html
[3] https://www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html

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Appendix H. Addendum One to Thirteen TMDLs for Indicator Bacteria in the Lower West Fork Trinity River Watershed Adding one TMDL for 0841I_01

One Total Maximum Daily Load for Indicator Bacteria in Dry Branch Creek

Introduction

TCEQ adopted *Thirteen TMDLs for Indicator Bacteria in the Lower West Fork Trinity River Watershed* (TCEQ, 2013) on September 24, 2013. EPA approved the TMDLs on November 7, 2013. This document is the first addendum to the original TMDL report.

This first addendum includes information specific to one additional AU for Dry Branch Creek (AU 0841I_01; also referred to in this addendum as the TMDL watershed). This AU is located within the watershed of the approved original TMDLs for the Lower West Fork Trinity River. The concentration of indicator bacteria in this additional AU exceeds the criterion used to evaluate support of the primary contact recreation 1 use.

This addendum details the development of the added TMDL allocation for this additional AU, which was not specifically addressed in the original TMDL report. For background or other explanatory information, please refer to the *Technical Support Document for One TMDL for Indicator Bacteria in Dry Branch Creek*[4] (Millican and Adams, 2022). Refer to the original, approved TMDL document for details about the overall project watershed as well as methods and assumptions used in developing the original TMDLs.

Problem Definition

TCEQ first identified the bacteria impairment for Dry Branch Creek in the *2020 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (Texas Integrated Report; TCEQ, 2020). The impairment was identified again in the subsequent 2022 Texas Integrated Report (TCEQ, 2022a), the latest EPA-approved edition. The impaired AU is 0841I_01. The water body includes only one AU. Figure II-1 shows the watershed added in this addendum in relation to the entire watershed of the original TMDLs, which is located within the Trinity River Basin.

[4] www.tceq.texas.gov/downloads/water-quality/tmdl/greater-trinity-recreational-66/66j-as-475-dry-branch-bacteria-tsd-2022-oct.pdf

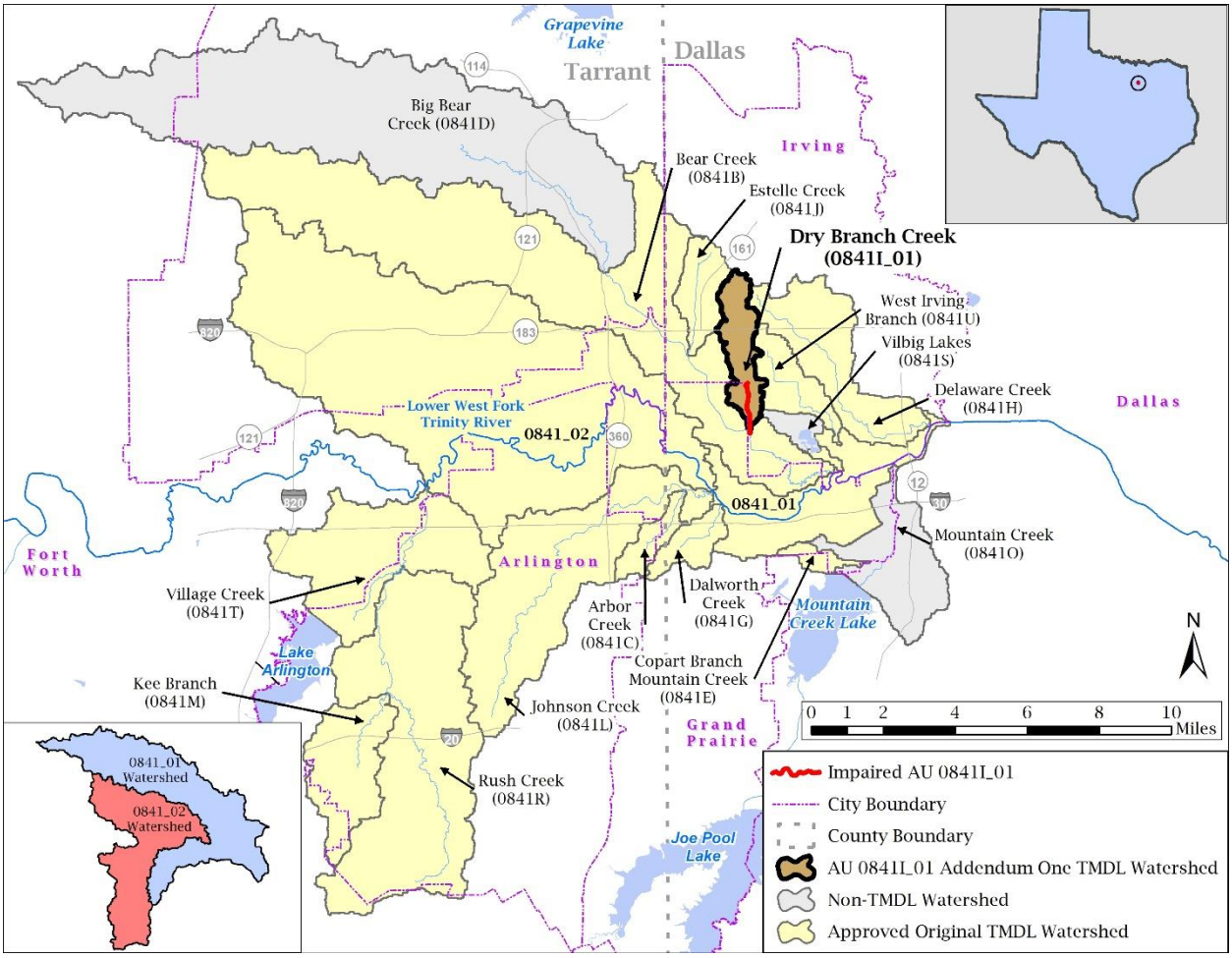

Figure II-1. Map showing the previously approved TMDL watersheds and the Dry Branch Creek 0841I_01 watershed added by this addendum

The Texas Surface Water Quality Standards (TCEQ, 2018) identify uses for surface waters and numeric and narrative criteria to evaluate attainment of those uses. The basis for the water quality target for the TMDL developed in this addendum is the numeric criterion for indicator bacteria from the 2018 Texas Surface Water Quality Standards. *Escherichia coli (E. coli)* is the indicator bacteria for assessing primary contact recreation 1 use in freshwater.

Table II-1 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) station on the water body, as reported in the 2022 Texas Integrated Report (TCEQ, 2022a). The data from the assessment indicate nonsupport of the primary contact recreation 1 use for the AU, because the geometric mean concentration for *E. coli* exceeds the freshwater geometric mean criterion of 126 colony forming units per 100 milliliters (cfu/100 mL) of water. Figure II-2 shows the location of the TCEQ SWQM station that was used in evaluating water quality in the 2022 Texas Integrated Report for the water body added by this addendum.

Table II-1. 2022 Texas Integrated Report summary

AU	TCEQ SWQM Station	Parameter	Number of Samples	Date Range	*E. coli* Geometric Mean (cfu/100 mL)
0841I_01	17173	*E. coli*	37	12/01/2013 – 11/30/2020	416.1

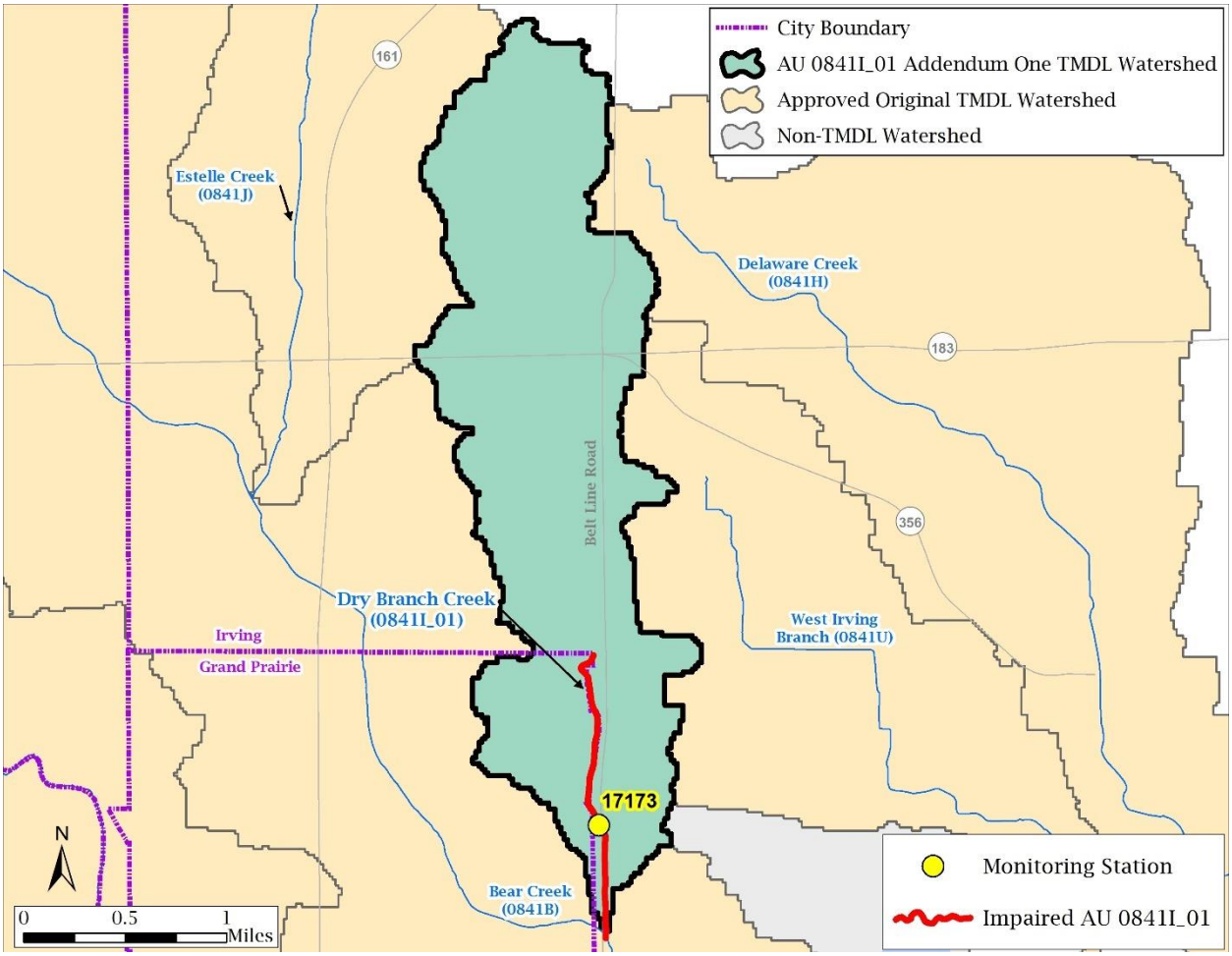

Figure II-2. Active TCEQ SWQM station

Watershed Overview

Dry Branch Creek AU 0841I_01 is a tributary to Bear Creek (0841B), which is a tributary to the Lower West Fork Trinity River (0841). The water body is approximately 1.5 miles long, drains 3.4 square miles (2,171 acres), and is located entirely within Dallas County.

The 2022 Texas Integrated Report (TCEQ, 2022a) provides the following water body and AU description:

> Dry Branch Creek AU 0841I_01 – A 1.5 mile stretch of Dry Branch Creek running upstream from confluence with Lower West Fork Trinity to Rock Island Road in Irving, Dallas County.

The AU description for 0841I_01 that is contained in the 2022 Texas Integrated Report (and in previous integrated reports) is not accurate. Dry Branch Creek (0841I_01) is actually a tributary of Bear Creek (0841B), not Lower West Fork Trinity River. TCEQ will revise the AU description for 0841I_01 in future editions of the Texas Integrated Report to describe the terminus of AU 0841I_01 at the confluence with Bear Creek (TCEQ, 2022b).

Climate

Weather data were obtained for the 20-year period from January 2002 through December 2021 from the the National Climatic Data Center for the Dallas Fort Worth International Airport (NOAA, 2022). Data from this 20-year period indicate that the average monthly high temperature typically reaches a maximum of 96.8 °F in August, and the average monthly low temperature reaches a minimum of 36.6 °F in January (Figure II-3). Annual rainfall averages 36.2 inches. The wettest month is May (4.9 inches) while July (1.9 inches) is the driest month, with rainfall occurring throughout the year.

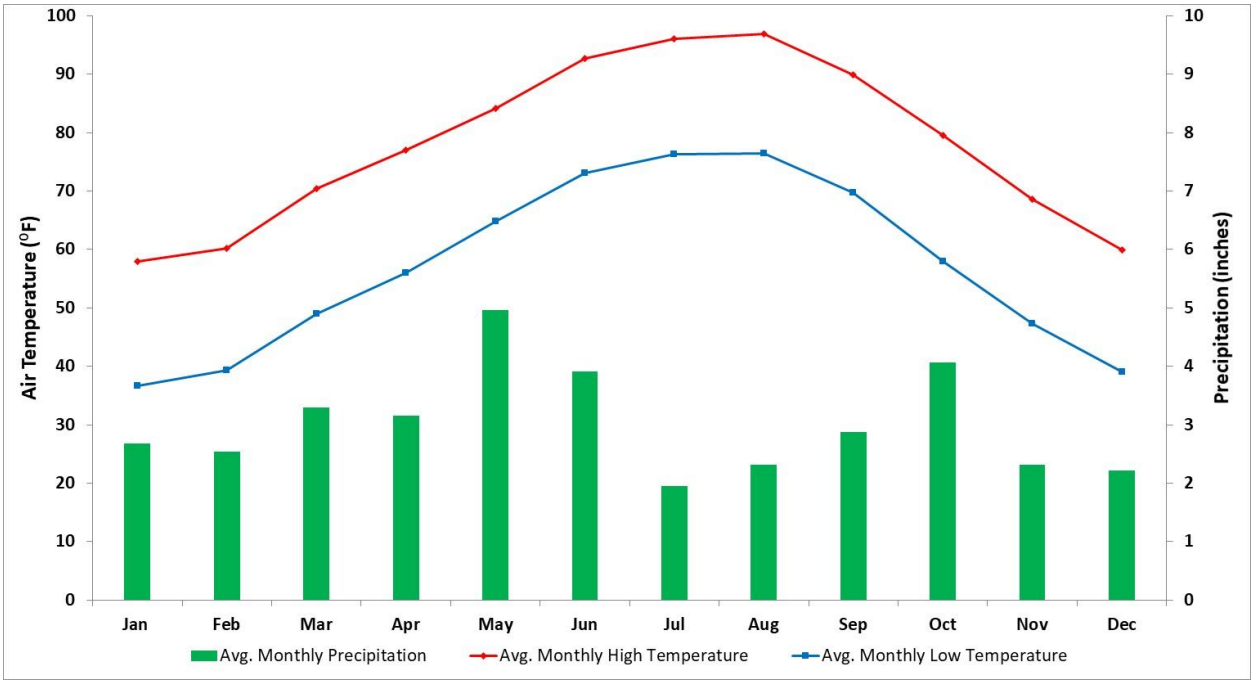

Figure II-3. Average monthly temperature and precipitation (2002-2021) at the Dallas Fort Worth International Airport

Population and Population Projections

The TMDL watershed is located within the municipal boundaries of Irving and Grand Prairie in Dallas County. According to the 2020 United States Census Bureau (USCB) data (USCB, 2021), the TMDL watershed had an estimated population of 20,410 in 2020.

A population projection through 2045 was developed using data from NCTCOG traffic survey zone allocations. Traffic survey zones are planning areas used by NCTCOG to provide for more analysis at a local scale. (NCTCOG, 2017a). Table II-2 provides a summary of the population projection for the TMDL watershed.

Table II-2. 2020 – 2045 population projection

Area	2020 Estimated Population	2045 Projected Population	Projected Population Increase	Percent Change
Dry Branch Creek Watershed	20,410	22,150	1,740	8.5%

The following steps detail the method used to estimate the 2020 and projected 2045 populations in the TMDL watershed.

Obtained 2020 USCB data at the block level.

Developed the 2020 watershed population using the USCB block level data for the portion of census blocks located within the watershed.

For the census blocks that were partially located in the watershed, estimated population by multiplying the block population to the proportion of its area in the watershed.

Obtained population projections for the year 2045 from NCTCOG traffic survey zone allocations (NCTCOG, 2017a).

Developed population projections using traffic survey zone data for the portion of the traffic survey zones located within the watershed.

Subtracted the 2020 watershed population from the 2045 population projection to determine the projected population increase, then divided the projected population increase by the 2020 watershed population to determine the percentage population increase for the TMDL watershed.

Land Cover

The land cover data for the TMDL watershed were obtained from NCTCOG and represent land cover estimates for 2015 (NCTCOG, 2017b). The land cover for the TMDL watershed is shown in Figure II-4. A summary of the land cover data is provided in Table II-3 and indicates that Residential (42.37%) is the dominant land cover in the TMDL watershed.

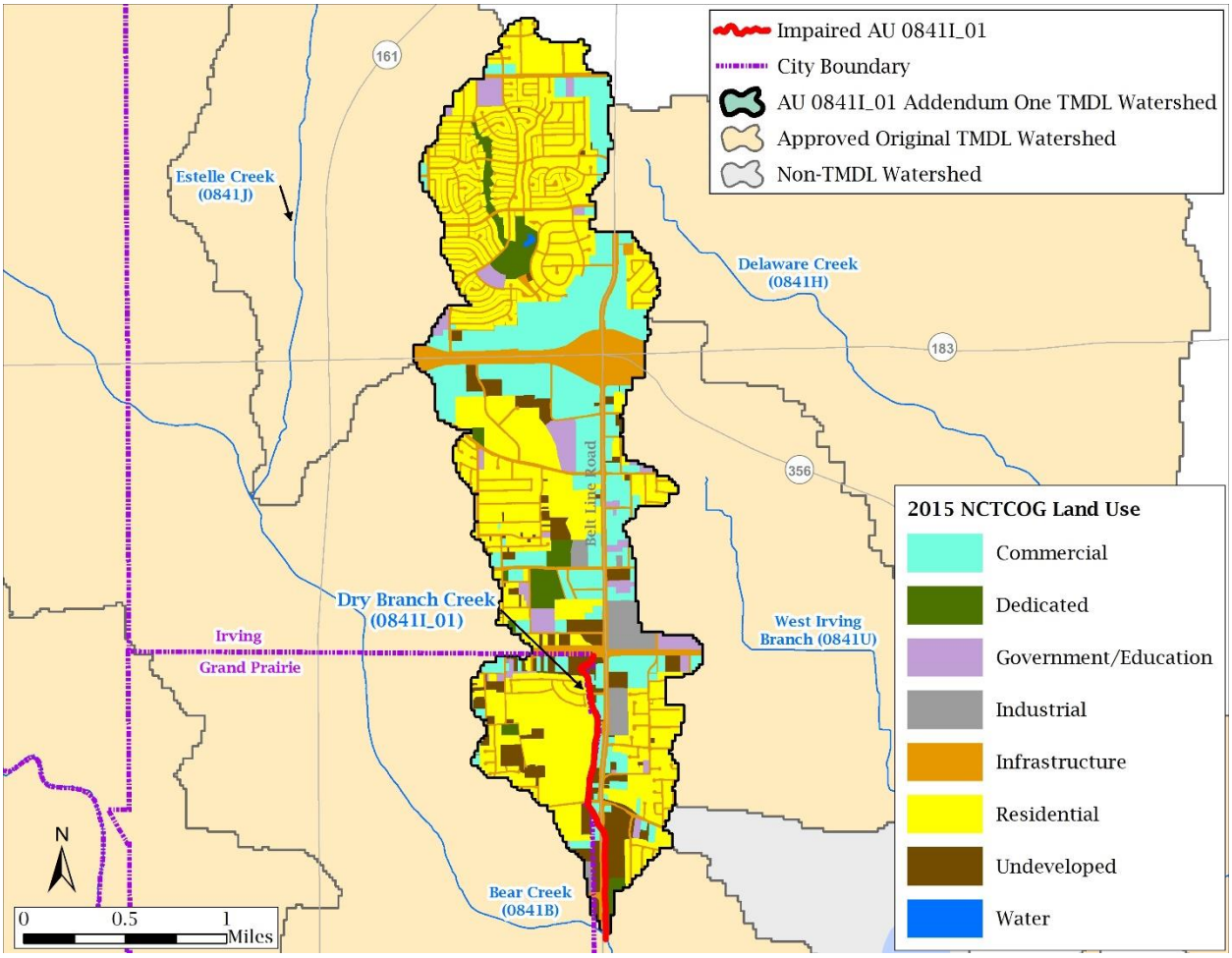

Figure II-4. Land cover map showing classifications

Table II-3. Land cover classification by area and percentage

2015 Land Cover Class Type	Area (Acres)	% of Total
Residential	919.6	42.37%
Commercial/Industrial	493.6	22.74%
Transit	433.5	19.97%
Group Quarters	5.8	0.27%
Institution	82.6	3.81%
Dedicated	77.4	3.57%
Vacant	156.7	7.21%
Water	1.4	0.06%
Total	**2,170.6**	**100%**

Endpoint Identification

The endpoint for the TMDL is to maintain the concentration of *E. coli* below the geometric mean criterion of 126 cfu/100 mL, which is protective of the primary contact recreation 1 use in freshwater.

Source Analysis

Pollutants may come from several sources, both regulated and unregulated. Pollutants in regulated discharges, referred to as "point sources," come from a single definable point, such as a pipe, and are regulated by permit under the TPDES program. WWTFs and stormwater discharges from industries, construction activities, and the separate storm sewer systems of cities are considered point sources of pollution.

Unregulated sources are typically nonpoint source in origin, meaning the pollutants originate from multiple locations and rainfall runoff washes them into surface waters. Nonpoint sources are not regulated by permit.

Except for WWTFs, which receive individual wasteload allocations (WLAs; see the Wasteload Allocation section), the regulated and unregulated sources in this section are presented to give a general account of the different sources of bacteria expected in the watershed. These are not meant to be used for allocating bacteria loads or interpreted as precise inventories and loadings.

Regulated Sources

Regulated sources are controlled by permit under the TPDES program. The regulated sources in the TMDL watershed include stormwater discharges from municipal separate storm sewer systems (MS4s) and regulated construction activities.

Domestic and Industrial WWTFs

No permitted WWTFs exist in the TMDL watershed. Domestic wastewater is collected by and transported to the Trinity River Authority (TRA) Central Regional Wastewater System, which is outside the TMDL watershed (Figure II-5).

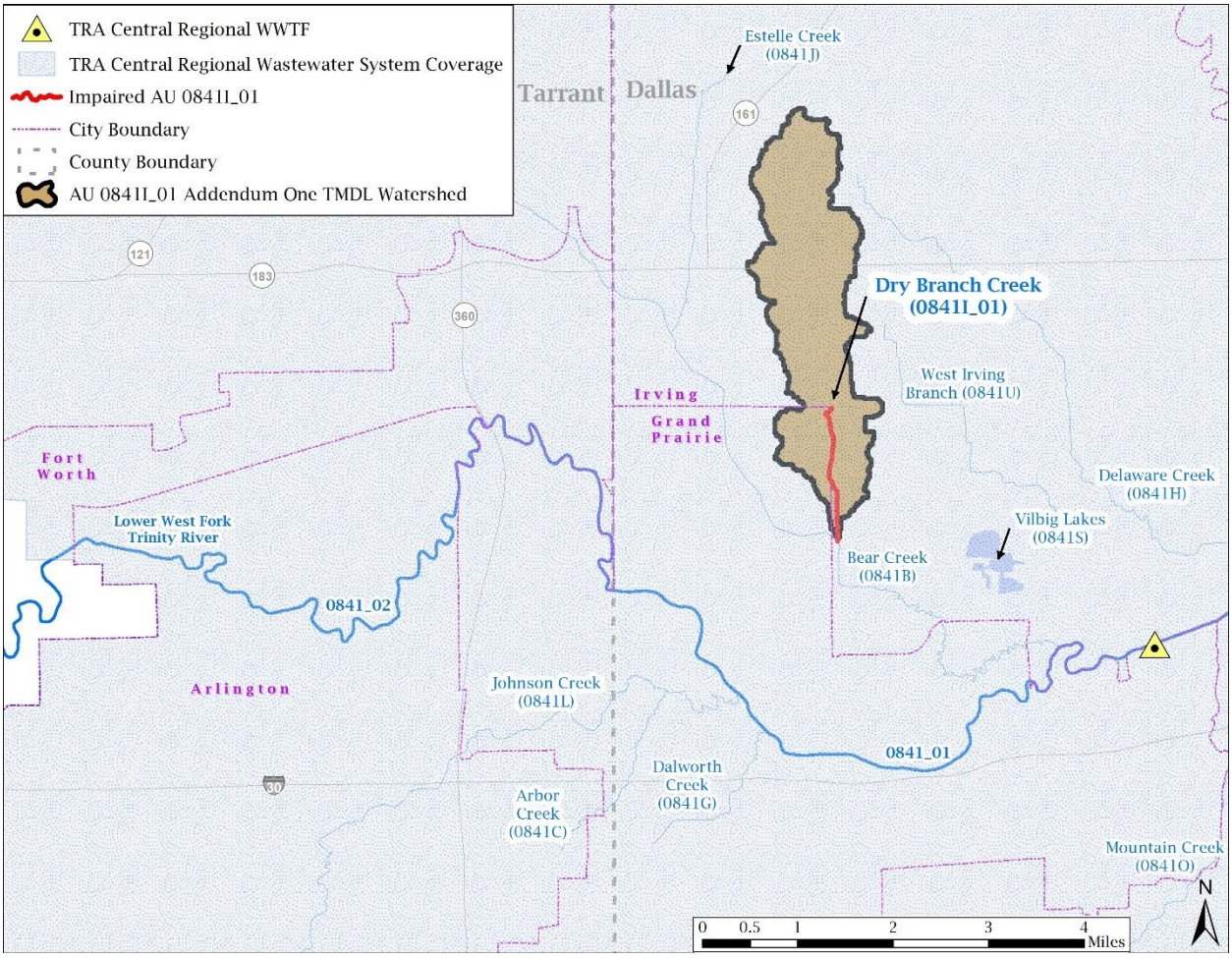

Figure II-5. Coverage area of the TRA Central Regional Wastewater System in the TMDL watershed and surrounding area

TCEQ/TPDES Water Quality General Permits

Certain types of activities are required to be covered by one of several TCEQ/TPDES wastewater general permits:

TXG110000 – concrete production facilities
TXG130000 – aquaculture production
TXG340000 – petroleum bulk stations and terminals
TXG640000 – conventional water treatment plants
TXG670000 – hydrostatic test water discharges
TXG830000 – water contaminated by petroleum fuel or petroleum substances
TXG870000 – pesticides (application only)
TXG920000 – concentrated animal feeding operations
WQG100000 – wastewater evaporation
WQG200000 – livestock manure compost operations (irrigation only)

A review of active general permit coverage (TCEQ, 2022c) in the TMDL watershed as of June 7, 2022, found no active general wastewater permit authorizations of the types described above.

Sanitary Sewer Overflows

A summary of sanitary sewer overflow (SSO) incidents that occurred during a six-year period from 2016 through 2021 in the TMDL watershed was obtained from NCTCOG. The summary data indicated 19 SSO incidents had been reported within the TMDL watershed. The SSOs had a total discharge of 101,187 gallons with a minimum of one gallon and a maximum of 100,000 gallons.

TPDES-Regulated Stormwater

When evaluating stormwater for a TMDL allocation, a distinction must be made between stormwater originating from an area under a TPDES-regulated discharge permit and stormwater originating from areas not under a TPDES-regulated discharge permit. Stormwater discharges fall into two categories:

Stormwater subject to regulation, which is any stormwater originating from TPDES-regulated MS4 entities, stormwater discharges associated with regulated industrial facilities, and construction activities.
Stormwater runoff not subject to regulation.

Discharges of stormwater from a Phase II MS4 area, regulated industrial facility, construction area, or other facility involved in certain activities must be covered under the following TCEQ/TPDES general permits:

TXR040000 – Phase II MS4 General Permit for MS4s located in urbanized areas
TXR050000 – Multi-sector General Permit (MSGP) for industrial facilities
TXR150000 – Construction General Permit (CGP) for construction activities disturbing more than one acre or are part of a common plan of development disturbing more than one acre

A review of active stormwater general permit coverage as of June 7, 2022 (TCEQ, 2022c) found no MSGP authorizations and two CGP authorizations within the TMDL watershed. There are currently one Phase I permit, one combined Phase I/II permit, and one Phase II MS4 authorization found within the urbanized area of the TMDL watershed (Table II-4). The areas covered by CGP authorizations are not discussed further, since MS4 permits cover 100% of the watershed area. Figure II-6 shows the urbanized area defined by USCB that accounts for MS4 coverage within the TMDL watershed.

Table II-4. TPDES MS4 permits associated with the TMDL watershed

Entity	TPDES Permit	EPA ID	Authorization Type
City of Irving	WQ0004691000	TXS001301	Phase I MS4
Texas Department of Transportation	WQ0005011000	TXS002101	Combined Phase I and II MS4
City of Grand Prairie	General Permit (TXR040000)	TXR040065	Phase II MS4

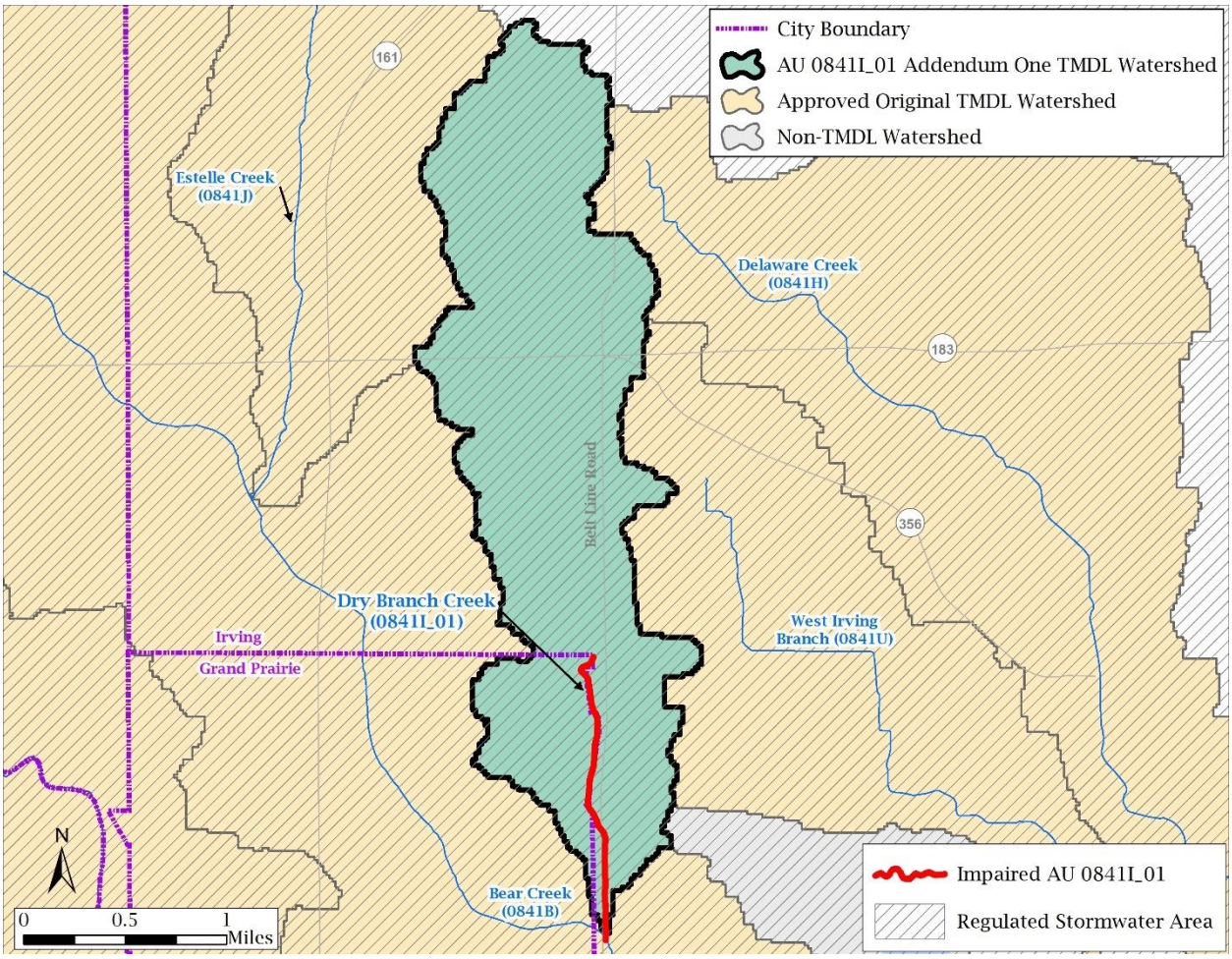

Figure II-6. Regulated stormwater area based on Phase I and Phase II MS4 permits as defined by the urbanized area

Illicit Discharges

Pollutant loads can enter water bodies from MS4 outfalls that carry authorized sources as well as illicit discharges under both dry- and wet-weather conditions. The term “illicit discharge” is defined in TPDES General Permit TXR040000 for Phase II MS4s as “Any discharge to a municipal separate storm sewer system that is not entirely composed of stormwater, except discharges pursuant to this general permit or a separate authorization and discharges resulting from

emergency firefighting activities." Illicit discharges can be categorized as either direct or indirect contributions.

Unregulated Sources

Unregulated sources of bacteria are nonpoint and can originate from wildlife and feral hogs, various agricultural activities, agricultural animals, land application fields, urban runoff not covered by a permit, failing on-site sewage facilities (OSSFs), and domestic pets.

Unregulated Agricultural Activities and Domesticated Animals

A number of agricultural activities that do not require permits can be potential sources of fecal bacteria loading. Agricultural activities are not a source in this highly urbanized watershed.

Fecal bacteria from dogs and cats is transported to water bodies by runoff in both urban and rural areas and can be a potential source of bacteria loading. Table II-5 summarizes the estimated number of dogs and cats within the TMDL watershed. Pet population estimates were calculated as the estimated number of dogs (0.614) and cats (0.457) per household (AVMA, 2018). The number of households in the TMDL watershed was estimated using 2010 Census household and population data (USCB, 2010) to obtain the ratio of people to households. This ratio was applied to the 2020 Dry Branch Creek population data (USCB, 2021) to estimate the number of households in the TMDL watershed. The actual contribution and significance of bacteria loads from pets reaching Dry Branch Creek is unknown.

Table II-5. Estimated households and pet population

AU	Estimated Households	Estimated Dog Population	Estimated Cat Population
0841I_01	6,722	4,127	3,072

Wildlife and Unmanaged Animals

Fecal bacteria are common inhabitants of the intestines of all warm-blooded animals, including wildlife such as mammals and birds. In developing bacteria TMDLs, it is important to identify by watershed the potential for bacteria contributions from wildlife. Wildlife are naturally attracted to riparian corridors of water bodies. With direct access to the stream channel, the direct deposition of wildlife waste can be a concentrated source of bacteria loading to a water body. Fecal bacteria from wildlife are also deposited onto land surfaces, where they may be washed into nearby water bodies by rainfall runoff.

The *E. coli* contribution from feral hogs and wildlife in the TMDL watershed cannot be determined based on existing information. However, due to the urbanized nature of the watershed it is assumed that the contribution is minimal.

Onsite Sewage Facilities

Failing OSSFs were not considered a major source of bacteria loading in the TMDL watershed, because the entire watershed area is served by the TRA wastewater collection and treatment system. A review of OSSF information received from NCTCOG indicates that there are no known OSSFs in the TMDL watershed.

Linkage Analysis

The load duration curve (LDC) method was used to examine the relationship between instream water quality and the source of indicator bacteria loads. Inherent to the use of LDCs as the mechanism of linkage analysis is the assumption of a one-to-one relationship between instream loadings and loadings originating from point sources as regulated and from the landscape as unregulated sources. Further, this one-to-one relationship was also inherently assumed when using the LDC to define the TMDL pollutant load allocation. The LDC method allows for estimation of TMDL loads by utilizing the cumulative frequency distribution of streamflow and measured pollutant concentration data (Cleland, 2003). In addition to estimating stream loads, this method allows for the determination of the hydrologic conditions under which impairments are typically occurring, can give indications of the broad origins of the bacteria (i.e., point or nonpoint source), and provides a means to allocate allowable loadings. The technical support document for this addendum (Millican and Adams, 2022) provides details about the linkage analysis along with the LDC method and its application.

The *E. coli* event data plotted on the LDC for TCEQ SWQM Station 17173 in Figure II-7 show exceedances of the geometric mean criterion have commonly occurred in the “Very High Flow” and “High Flow” regimes. The allowable load at the single sample criterion (399 cfu/100 mL) is included on the LDC for comparison with individual *E. coli* samples, although it is not used for assessment or allocation purposes.

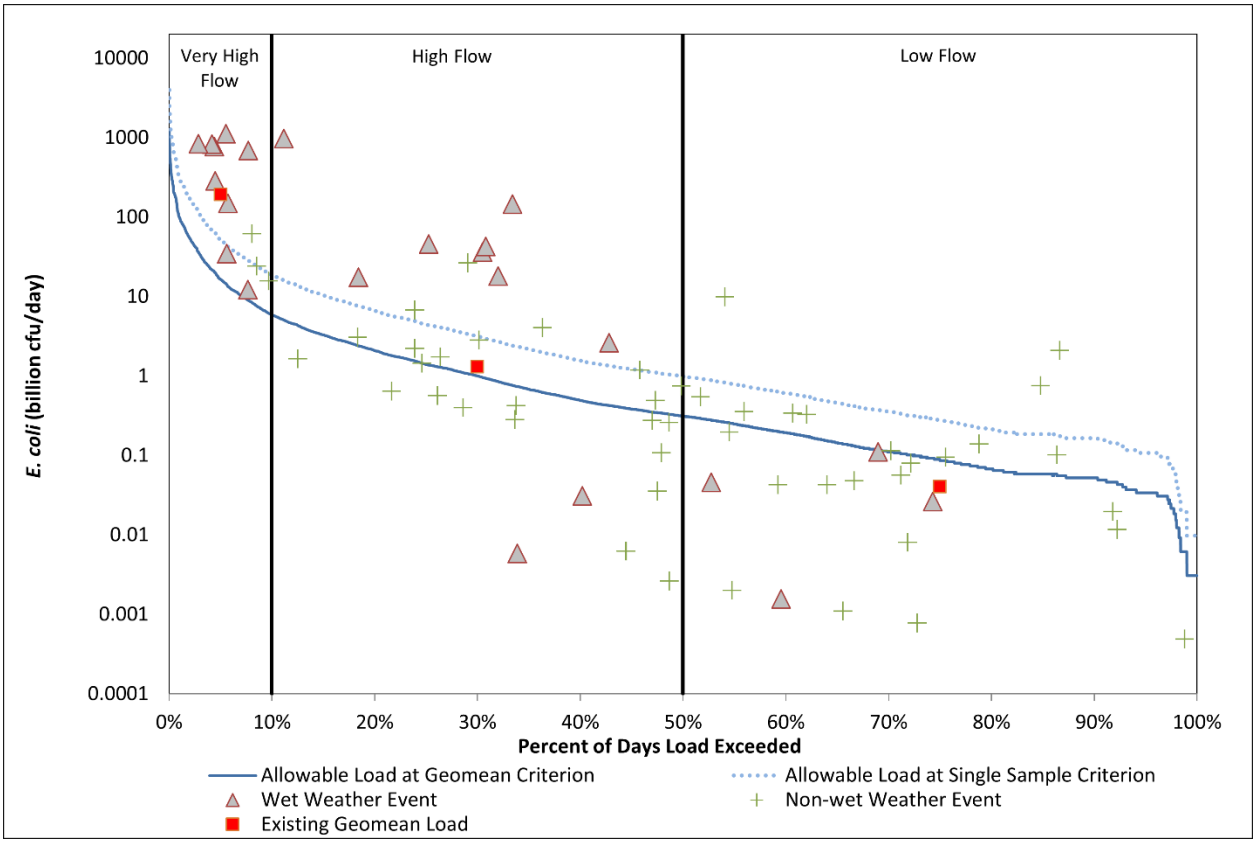

Figure II-7. LDC for TCEQ SWQM Station 17173

Margin of Safety

The margin of safety (MOS) is designed to account for any uncertainty that may arise in specifying water quality control strategies for the complex environmental processes that affect water quality. Quantification of this uncertainty, to the extent possible, is the basis for assigning an MOS. The TMDL in this report incorporates an explicit MOS of 5% of the total TMDL allocation.

Pollutant Load Allocation

The TMDL represents the maximum amount of a pollutant that the stream can receive in a single day without exceeding water quality standards. The pollutant load allocations for the selected scenarios were calculated using the following equation:

TMDL = WLA + LA + FG + MOS

Where:

WLA = wasteload allocations, the amount of pollutant allowed by regulated dischargers

LA = load allocations, the amount of pollutant allowed by unregulated sources

FG = loadings associated with future growth from potential regulated facilities

MOS = margin of safety load

For the remainder of this report some calculations have been rounded and may not lead to the exact final amounts listed in the text, tables, or figures

AU-Level TMDL Calculation

To be consistent with previously completed TMDLs in the original watershed, the TMDL for Dry Branch Creek was derived using the median flow within the "Very High Flow" regime (or 5% load duration exceedance) of the LDC developed for TCEQ SWQM Station 17173. This station represents the location within Dry Branch Creek where an adequate number of *E. coli* samples was collected.

Margin of Safety Calculation

The TMDL in this report incorporates an explicit MOS of 5%.

Wasteload Allocation

The WLA is the sum of loads from regulated sources, which are WWTFs and regulated stormwater.

Wastewater Treatment Facilities

TPDES-permitted WWTFs are allocated a daily wasteload (WLA_{WWTF}) calculated as their full permitted discharge flow rate multiplied by one-half the instream geometric mean criterion. One-half of the water quality criterion (63 cfu/100 mL *E. coli*) is used as the WWTF target to provide instream and downstream load capacity and to be consistent with the original TMDL report. Due to the absence of any permitted dischargers in the TMDL watershed, the WLA_{WWTF} component is zero.

Regulated Stormwater

Stormwater discharges from MS4, industrial, and construction areas are also considered regulated point sources. Therefore, the WLA calculations must also include an allocation for regulated stormwater discharges (WLA_{SW}). The percentage of the land area included in the project watershed that is under the jurisdiction of stormwater permits is used to estimate the amount of the overall runoff load that should be allocated as the permitted stormwater contribution in the WLA_{SW} component.

The Dry Branch Creek watershed is covered 100% by MS4 permits. However, even in highly urbanized areas such as the TMDL watershed, there remain some areas of potential direct deposition of bacteria loadings from unregulated sources such as wildlife. To account for these

unregulated areas, the stream length of Dry Branch Creek (from the confluence with Bear Creek upstream to Rock Island Road in Irving, Dallas County) and average channel width as calculated based on aerial imagery was used to compute an area of unregulated stormwater contribution. The percentage of land under the jurisdiction of stormwater permits in the TMDL watershed is 99.8%.

Load Allocation

The load allocation (LA) component of the TMDL corresponds to direct nonpoint runoff and is the difference between the total load from stormwater runoff and the portion allocated to WLA_{SW}.

Allowance for Future Growth

The future growth (FG) component of the TMDL equation addresses the requirement of TMDLs to account for future loadings that might occur as a result of population growth, changes in community infrastructure, and development. Specifically, this TMDL component takes into account the probability that new flows from WWTF discharges may occur in the future.

The assimilative capacity of water bodies increases as the amount of flow increases. The allowance for FG in TMDL watersheds results in the protection of existing uses and conforms to Texas' antidegradation policy. However, due to the absence of any existing WWTFs and the fact that it is highly unlikely that any new WWTFs will be established within the Dry Branch Creek watershed (TRA, 2022), the FG component is zero for this TMDL. In the event of a new point source being added to the watershed, then it will continue to conform to Texas' antidegradation policy. The three-tiered antidegradation policy in the Texas Surface Water Quality Standards prohibits an increase in loading that would cause or contribute to degradation of an existing use. The antidegradation policy applies to point source pollutant discharges. In general, antidegradation procedures establish a process for reviewing individual proposed actions to determine if the activity will degrade water quality.

FG of existing or new point sources is not limited by this TMDL as long as the sources do not cause bacteria to exceed the limits. The assimilative capacity of water bodies increases as the amount of flow increases. Consequently, increases in flow allow for increased loadings. The LDC and tables in this TMDL report will guide determination of the assimilative capacity of the water body under changing conditions, including FG.

Summary of TMDL Calculations

Table II-6 summarizes the TMDL calculations for the TMDL watershed. The TMDL was calculated based on the median flow in the 0-10 percentile range (5% exceedance, "Very High Flow" regime) from the LDC developed for the TCEQ SWQM Station 17173. Allocations are based on

the current geometric mean criterion for *E. coli* 0f 126 cfu/100 mL for each component of the TMDL (with the exception of the WLA_{WWTF} and FG terms, which would be based on one-half the criterion if they applied).

Table II-6. TMDL allocation summary

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA	FG
Dry Branch Creek	0841I_01	16.545	0.827	0	15.694	0.024	0

The final TMDL allocations (Table II-7) needed to comply with federal requirements include the FG component within the WLA_{WWTF} (40 CFR Section 103.7).

Table II-7. Final TMDL allocation

All loads expressed as billion cfu/day *E. coli*

Water Body	AU	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA
Dry Branch Creek	0841I _01	16.545	0.827	0	15.694	0.024

Seasonal Variation

Federal regulations require that TMDLs account for seasonal variation in watershed conditions and pollutant loading [40 CFR Section 130.7(c)(1)]. Analysis of the seasonal differences in indicator bacteria concentrations were assessed by comparing *E. coli* concentrations obtained from 21 years (2001 through 2021) of routine monitoring data collected in the warmer months (May through September) against those collected during the cooler months (November through March). The months of April and October were considered transitional between warm and cool seasons and were excluded from the seasonal analysis. Differences in *E. coli* concentrations obtained in warmer versus cooler months were then evaluated by performing a Wilcoxon Rank Sum test (also known as the “Mann-Whitney” test). This analysis of *E. coli* data indicated that there was a significant difference (α=0.05) in indicator bacteria between cool and warm weather seasons for Dry Branch Creek (p=0.04), with the warm season having higher *E. coli* concentrations. Seasonal variation was also addressed by using all available flow and *E. coli* records (covering all seasons) from the period of record used in LDC development for this project.

Public Participation

TCEQ maintains an inclusive public participation process. From the inception of TMDL development, the project team sought to ensure that stakeholders were informed and

involved. Communication and comments from the stakeholders in the watershed strengthen TMDL projects and their implementation.

The technical support document for this TMDL addendum (Millican and Adams, 2022) was published on the TCEQ website on January 5, 2023. Project staff presented information about this addendum at the annual meeting of the Greater Trinity River Bacteria TMDL Implementation Plan Coordination Committee hosted by NCTCOG (held online) on June 15, 2022. The public had an opportunity to comment on this addendum during the public comment period (Nov. 10 through Dec. 14, 2023) for the WQMP update in which this addendum is included. Notice of the public comment period for this addendum was emailed to stakeholders and posted on the TCEQ's TMDL Program News webpage.[5] Notice of the comment period, along with the document, was also posted on the WQMP Updates webpage.[6] TCEQ accepted public comments on the original TMDL report from May 24 through June 24, 2013. One comment was submitted, and it did not refer directly to the AU in this TMDL addendum.

Implementation and Reasonable Assurance

The water body covered by this addendum is within the existing bacteria TMDL watershed for the Lower West Fork Trinity River. That TMDL watershed, including Dry Branch Creek, is within the area covered by the implementation plan (I-Plan) developed by stakeholders, which was approved by the commission on December 11, 2013. The I-Plan outlines an adaptive management approach in which measures are assessed annually by the stakeholders for efficiency and effectiveness. The iterative process of evaluation and adjustment ensures continuing progress toward achieving water quality goals and expresses stakeholder commitment to the process. Please refer to the original TMDL document for additional information regarding implementation and reasonable assurance.

[5] www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html
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