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FINAL

January 2018 Update to the Texas Water Quality Management Plan

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Prepared by the
Office of Water
Water Quality Division

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WQMP updates are also available on the TCEQ web site at:

< *http://www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html* >

Developed in accordance with Sections 205(j), 208,
and 303 of the Federal Clean Water Act
and applicable regulations thereto.

Texas Commission on Environmental Qualit

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Introduction

The Texas Water Quality Management Plan (WQMP) is the product of a wastewater treatment facility planning process developed and updated in accordance with provisions of Sections 205(j), 208, and 303 of the federal Clean Water Act (CWA), as amended. The WQMP is an important part of the State's program for accomplishing its clean water goals.[1]

The Texas Department of Water Resources, a predecessor agency of the Texas Commission on Environmental Quality (TCEQ), prepared the initial WQMP for waste treatment management during the late 1970s. The Clean Water Act mandates that the WQMP be updated as needed to fill information gaps and revise earlier certified and approved plans. Any updates to the plan need involve only the elements of the plan that require modification. The original plan and its subsequent updates are collectively referred to as the State of Texas Water Quality Management Plan.

The WQMP is tied to the State's water quality assessments that identify priority water quality problems. The WQMPs are used to direct planning for implementation measures that control and/or prevent water quality problems. Several elements may be contained in the WQMP, such as effluent limitations of wastewater facilities, total maximum daily loads (TMDLs), nonpoint source management controls, identification of designated management agencies, and ground water and source water protection planning. Some of these elements may be contained in separate documents which are prepared independently of the current WQMP update process, but may be referenced as needed to address planning for water quality control measures.

This document, as with previous updates[2], will become part of the WQMP after completion of its public participation process, certification by the TCEQ and approval by the United States Environmental Protection Agency (EPA).

The materials presented in this document revise only the information specifically addressed in the following sections. Previously certified and approved water quality management plans remain in effect.

The January 2018 WQMP update addresses the following topics:

1. Projected Effluent Limits Updates for water quality planning purposes
2. Service Area Population for Municipal Wastewater Facilities
3. Designation of Management Agencies for Municipal Wastewater Facilities
4. Total Maximum Daily Load Update

[1] A formal definition for a water quality management plan is found in 40 Code of Federal Regulations (CFR) 130.2(k).

[2] Fiscal Years 1974, 1975, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984/85, 1986/88, 1989, 1990, 1991, 1992, 1993/94, 1995, 1996, 1997/98, 02/1999, 05/1999, 07/1999, 10/1999, 01/2000, 04/2000, 07/2000, 10/2000, 01/2001, 04/2001, 07/2001, 10/2001, 01/2002, 04/2002, 07/2002, 10/2002, 01/2003, 04/2003, 07/2003, 10/2003, 01/2004, 04/2004, 07/2004, 10/2004, 01/2005, 04/2005, 07/2005, 10/2005, 01/2006, 04/2006, 07/2006, 10/2006, 01/2007, 04/2007, 07/2007, 10/2007, 01/2008, 04/2008, 07/2008, 10/2008, 01/2009, 04/2009, 07/2009, 10/2009, 01/2010, 04/2010, 07/2010,10/2010, 01/2011, 04/2011, 07/2011, 10/2011, BPUB 2011, 01/2012, 04/2012, 07/2012,10/2012, 01/2013, 04/2013, 07/2013,10/2013, 01/2014, 04/2014, 07/2014, 10/2014, 01/2015, 04/2015, 07/2015, 10/2015, 01/2016, 04/2016, 07/2016, 10/2016, 01/2017, 04/2017, 07/2017, and 10/2017.

The public comment period for the January WQMP update was from February 9, 2018, through March 12, 2018.

The Projected Effluent Limit Update section provides information compiled from November 1, 2017 through January 31, 2018, and is based on water quality standards, and may be used for water quality planning purposes in Texas Pollutant Discharge Elimination System (TPDES) permit actions.

The Service Area Population and Designation of Management Agency sections for municipal wastewater facilities has been developed and evaluated by the TCEQ in cooperation with the Texas Water Development Board (TWDB) and regional water quality management planning agencies.

The Total Maximum Daily Load (TMDL) Update section provides information on proposed wasteload allocations for new dischargers and revisions to existing TMDLs and has been developed by the Water Quality Planning Division, TMDL Program.

Projected Effluent Limit Updates

Table 1 reflects proposed effluent limits for new dischargers and preliminary revisions to original proposed effluent limits for preexisting dischargers (MGD-Million Gallons per Day, $CBOD_5$ – 5 Day Carbonaceous Biochemical Oxygen Demand, NH_3-N – Ammonia-Nitrogen, BOD_5 – 5 Day Biochemical Oxygen Demand and DO – Dissolved Oxygen).

Effluent flows indicated in Table 1 reflect future needs and do not reflect current permits for these facilities. These revisions may be useful for water quality management planning purposes. The effluent flows and constituent limits indicated in the table have been preliminarily determined to be appropriate to satisfy the stream standards for dissolved oxygen in their respective receiving waters. These flow volumes and effluent sets may be modified at the time of permit action. These limits are based on water quality standards (WQS) effective at the time of the TCEQ production of this update. WQS are subject to revision on a triennial basis.

Table 1. Projected Effluent Limit Updates

State Permit Number	Segment Number	EPA ID Number	Permittee Name County	Flow (MGD)	$CBOD_5$ (mg/L)	$CBOD_5$ (lbs/day)	NH_3-N (mg/L)	NH_3-N (lbs/day)	BOD_5 (mg/L)	BOD_5 (lbs/day)	DO (mg/L)	Months/ Comments
10401-005	2484	TX0047066	City of Corpus Christi Nueces	8.0					20	1334.40	3	Outfall 002
10518-001	1006	TX0021261	Sunbelt FWSD Harris	0.45	7	26.27	3	11.26			6	Apr-Oct
				0.45	7	26.27	5	18.77			4	Nov-Mar
10671-002	2421	TX0137952	City of Seabrook Harris	2.5	10	208.50	3	62.55			4	
14476-001	1009	TX0126161	Harris County MUD No. 418 Harris	7.5	5	312.75	2	125.10			6	
15222-002	1014	TX0138002	Harris County MUD No. 495 Harris	0.98	10	81.73	2	16.35			6	
15582-001	1108	TX0137804	Patel, Niranjan Shantilal Fort Bend	0.075	10	6.26	3	1.88			4	
15586-001	2494	TX0137812	Dishman, Hill McKnight Cameron	0.04					20	6.67	2	
15611-001	0838	TX0137987	Pool Brothers, L.L.C. Johnson	0.030					20	5.00	2	
15616-001	1004	TX0138011	Montgomery County MUD No. 111 Montgomery	1.35	10	112.59	3	33.78			4	

Planning Information Summary

The Water Quality Planning Division of the TCEQ coordinated with the TWDB and regional planning agencies to compile the wastewater facility information in this section. Domestic facility financing decisions under the State Revolving Loan Fund (SRF) program must be consistent with the certified and approved WQMP.

The purpose of this section is to present data reflecting facility planning needs, including previous water quality management plan needs requiring revision. Data are also presented to update other plan information for the TWDB's SRF projects. Table 2 contains the updated Service area population information. The table is organized in alphabetical order and includes the following 10 categories of information:

1. *Planning Area* – Area for which facility needs are proposed. The facility planning areas are subject to change during the facility planning process and any such changes will be documented in a later water quality management plan update. All planning areas listed are also designated management agencies (DMAs) unless otherwise noted in the "Comments" column.

2. *Service Area* – Area that receives the provided wastewater service.

3. *Needs* – A "T" indicates a need for either initial construction of a wastewater treatment plant, additional treatment capacity, or the upgrading of a wastewater treatment plant to meet existing or more stringent effluent requirements. A "C" indicates a need for improvements to, expansion of, rehabilitation of, or the initial construction of a wastewater collection system in the facility planning area. "T/C" indicates a need for both treatment and collection system facilities. More detailed facility planning conducted during a construction project may define additional needs and those needs will be reflected in a future update to the WQMP.

4. *Needs Year* – The year in which the needs were identified for the planning area.

5. *Basin Name* – The river basin or designated planning area where the entity is located. The seven water quality management planning areas designated by the Governor are Corpus Christi [Coastal Bend Council of Governments (CBCOG)], Killeen-Temple [Central Texas Council of Governments (CTCOG)], Texarkana [Ark-Tex Council of Governments (ATCOG)], Southeast Texas [South East Texas Regional Planning Council (SETRPC)], Lower Rio Grande Valley [Lower Rio Grande Valley Development Council (LRGVDC)], Dallas-Fort Worth [North Central Texas Council of Governments (NCTCOG)] and Houston [Houston-Galveston Area Council (H-GAC)]. Basin names are shown for agencies outside one of these areas.

6. *Segment* – The classified stream segment or tributary into which any recommended facility may discharge existing or projected wastewater. In the case of no-discharge facilities, this is the classified stream segment drainage area in which the facilities are located.

7. *County* – The county in which the facility planning area is located.

8. *Date* – The date the planning information was reviewed by the TCEQ.

9. *Comments* – Additional explanation or other information concerning the facility planning area.

10. *Population* – The base year and projected populations for each facility planning area. Population projections presented are consistent with the latest available statewide population projections or represent the most current information obtained from facility planning analyses.

The facility information in this section is intended to be utilized in the preparation of facility plans and the subsequent design and construction of wastewater facilities. Design capacities of the treatment and collection systems will be based upon the population projections contained in this document plus any additional needed capacity established for commercial/industrial flows and documented infiltration/inflow volumes (treatment or rehabilitation). The probable needs shown under the "Needs" heading are preliminary findings; specific needs for an area shall be as established in the completed and certified detailed engineering studies conducted during facility planning under the SRF and other state loan programs.

Specific effluent quality for any wastewater discharges resulting from any of the facilities recommended in this document will be in accordance with the rule on the Texas Surface Water Quality Standards in effect at the time of permit issuance for the specific facility.

Table 2. Service Area Population Updates

Planning Agency	Service Area	Needs	Needs Year	Basin Name / COG	Segment	County	WQMP Date	Comments	Year	Population
City of Brownsville	City Limits	C	2018	Nueces-Rio Grande / LRGVDC	2494	Cameron	11/9/2017	Stormwater project, DMA is not required.	2017	2,707
									2020	2,707
									2030	2,707
									2040	2,707
City of Cisco	Facilities Planning Area	C	2018	Brazos River	1233	Eastland	7/29/2013		2017	19,374
									2020	19,821
									2030	21,963
									2040	24,184
City of Gatesville	City Limits	T	2018	Brazos River / NCTCOG	1221	Coryell	11/27/2017	Proposed effluent standards are not contained in the WQMP. **A new permit will be required.**	2017	1,000
									2020	1,250
									2030	1,750
									2040	2,250
City of Gunter	City Limits	T	2018	Trinity River	0823	Grayson	11/6/2017		2017	183,823
									2020	211,200
									2030	251,288
									2040	291,955
City of Rogers	City Limits	C	2018	Brazos River / NCTCOG	1213	Bell	11/27/2017		2010	10,820
									2020	12,071
									2030	13,466
									2040	15,023
City of Stephenville	City Limits	C	2018	Brazos River / NCTCOG	1255	Erath	12/4/2017		2016	1,232
									2020	1,241
									2030	1,264
									2040	1,286
City of Taylor	Certificate of Convenience and Necessity	C	2018	Brazos River	1244	Williamson	9/29/2017		2017	3,899
									2020	4,048
									2030	4,136
									2040	4,140
Cypress Creek Utility District	District Boundaries	C	2018	San Jacinto/ H-GAC	1009	Harris	1/5/2017		2017	2,807
									2020	3,908
									2030	5,746
									2040	5,746
North Fort Bend Water Authority	North Fort Bend Water Authority District Boundary	T	2018	San Jacinto/ H-GAC	1014	Fort Bend	N/A	North Fort Bend Water Authority does not provide wastewater services. DMA is not required.	2017	17,992
									2020	19,660
									2030	21,675
									2040	23,987

Designated Management Agencies

In order to be designated as a management agency for wastewater collection or treatment, an entity must demonstrate the legal, institutional, managerial and financial capability necessary to carry out the entity's responsibilities in accordance with Section 208 (c) of the Clean Water Act (see below list of requirements). Before an entity can apply for a state revolving fund loan, it must be recommended for designation as the management agency in the approved WQMP. Designation as a management agency does not require the designated entity to provide wastewater services, but enables it to apply for grants and loans to provide the services. The facilities listed in Table 3 have submitted Designated Management Agencies (DMA) resolutions to the TCEQ. The TCEQ submits this DMA information to the EPA for approval as an update to the WQMP.

Section 208 (c) (2) Requirements for Management Agency:

208(c)(2)(A): to carry out portions of an area-wide waste treatment plan.
208(c)(2)(B): to manage waste treatment works.
208(c)(2)(C): directly or by contract to design and construct new works.
208(c)(2)(D): to accept and utilize grants.
208(c)(2)(E): to raise revenues, including assessment of waste treatment charges.
208(c)(2)(F): to incur short and long term indebtedness.
208(c)(2)(G): to assure community pays proportionate cost.
208(c)(2)(H): to refuse to receive waste from non-compliant dischargers.
208(c)(2)(I): to accept for treatment industrial wastes.

Table 3. Designated Management Agencies

Planning Agency	Service Area	DMA Needs	DMA Date	DMA Area/Comments
City of Brownsville	City Limits	C	N/A	Stormwater Project, DMA is not required.
City of Cisco	Facilities Planning Area	C	7/29/2013	
City of Gatesville	City Limits	T	9/26/2017	Proposed effluent standards are not currently contained in the WQMP. While the proposed effluent standards should be adequate for water quality, **a new permit will be required.**
City of Gunter	City Limits	T	8/28/2017	
City of Rogers	City Limits	C	9/12/2016	
City of Stephenville	City Limits	C	9/21/2017	
City of Taylor	Wastewater Certificate of Convenience and Necessity	C	9/29/2017	
Cypress Creek Utility District	District Boundary	C	7/25/2017	
North Fort Bend Water Authority	North Fort Bend Water Authority District Boundary	T	N/A	North Fort Bend Water Authority does not provide wastewater services. DMA is not required.

Total Maximum Daily Load Updates

The Total Maximum Daily Load (TMDL) Program works to improve water quality in impaired or threatened waters bodies in Texas. The program is authorized by and created to fulfill the requirements of Section 303(d) of the federal Clean Water Act.

The goal of a TMDL is to restore the full use of a water body that has limited quality in relation to one or more of its uses. The TMDL defines an environmental target and based on that target, the State develops an implementation plan with wasteload allocations for point source dischargers to mitigate anthropogenic (human-caused) sources of pollution within the watershed and restore full use of the water body.

The development of TMDLs is a process of intensive data collection and analysis. After adoption by the TCEQ, TMDLs are submitted to the EPA for review and approval.

The attached appendices may reflect proposed wasteload allocations for new dischargers and revisions to TMDLs. To be consistent, updates will be provided in the same units of measure used in the original TMDL document. Also note that for bacteria TMDLs, loads may be expressed in counts per day, organisms per day, colony forming units per day, or similar expressions. These typically reflect different lab methods, but for the purposes of the TMDL program, these terms are considered synonymous.

Appendix I. Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries For Segment Numbers 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E

TMDL Updates to the Water Quality Management Plan (WQMP): Buffalo and Whiteoak Bayous and Tributaries (Segments 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E)

The document Eighteen Total Maximum Daily Loads for Bacteria in Buffalo and Whiteoak Bayous and Tributaries For Segment Numbers 1013, 1013A, 1013C, 1014, 1014A, 1014B, 1014E, 1014H, 1014K, 1014L, 1014M, 1014N, 1014O, 1017, 1017A, 1017B, 1017D, and 1017E was adopted by the TCEQ on 04/08/09 and approved by EPA on 06/11/09, and became an update to the state's WQMP. Twenty subsequent WQMP updates prior to this one have updated the list of individual wasteload allocations (WLAs) found in the original TMDL document. Additionally, two addenda to the original TMDL were submitted through the April 2013 and April 2015 WQMP updates. These addenda added two new assessment units (AUs) to the original TMDL project.

The purpose of this update is to make the following changes to the TMDL, presented in Table 1:

- update the WLA for one facility that has decreased its permitted discharge and
- add one new permit

The change reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for future growth (AFG) in two AUs. This was originally presented in Table 53 in the TMDL document, and the affected AUs are included here as Table 2.

For AU 1014H_02, the existing future growth allocation was insufficient to cover the increased flow to the AU for this update. However, ample loading is available in the $WLA_{StormWater}$ and load allocation (LA) terms. A small amount was taken proportionally from each of those terms and allotted to future growth. This results in no change to the overall TMDL allocation.

In Table 54 of the TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the AFG within each AU. Because a small amount of loading was moved from the $WLA_{StormWater}$ and LA terms to be used for future growth for AU 1014H_02, that AU is updated in Table 3. Again, this results in no change to the overall TMDL allocation. These overall numbers for the other AUs did not change.

Table 1 – Change to Individual Waste Load Allocation (Updates Table 45, pp. 99-103 in the TMDL document.)

State Permit Number	Outfall	EPA Permit Number	Segment Number	Permittee Name	Flow (MGD)	Waste Load Allocation (WLA) – *E. coli* in Billion MPN/day	TMDL Comments
15222-002	001	TX0138002	1014H_02	HARRIS COUNTY MUD NO. 495	0.98	2.337	New permit
14956-001	001	TX0132276	1014L_01	WESTON MUD	1.4	3.339	Decreased discharge

Table 2 - *E. coli* TMDL Summary Calculations (Updates Table 53, pp. 116-117 in the TMDL document.)

AU	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Storm\ Water}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)	Upstream Load (Billion MPN/day)	Future Growth (Billion MPN/day)
1014H_02	175.43	38.05	123.1	13.68	0	0	0.60
1014L_01	69.66	33.20	23.11	2.57	0	0	10.78

Table 3 – Final *E. coli* TMDL Calculations (Updates Table 54, pp. 118-119 in the TMDL document.)

AU	TMDL (Billion MPN/day)	WLA_{WWTF} (Billion MPN/day)	$WLA_{Storm\ Water}$ (Billion MPN/day)	LA (Billion MPN/day)	MOS (Billion MPN/day)
1014H_02	175.43	38.65	123.1	13.68	0

Appendix II. Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston For Segment Numbers 1004E,1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010 and 1011

TMDL Updates to the Water Quality Management Plan (WQMP): Watersheds Upstream of Lake Houston (1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011)

The document *Fifteen Total Maximum Daily Loads for Indicator Bacteria in Watersheds Upstream of Lake Houston For Segment Numbers 1004E, 1008, 1008H, 1009, 1009C, 1009D, 1009E, 1010, and 1011* was adopted by the TCEQ on 04/06/11 and approved by EPA on 06/29/11, and became an update to the state's WQMP. Twenty-three subsequent WQMP updates prior to this one have updated the list of individual wasteload allocations (WLAs) found in the original TMDL document. Additionally, an addendum to the original TMDL was submitted through the October 2013 WQMP update. This addendum added six new assessment units (AUs) to the original TMDL project.

The purpose of this update is to make the following change to the TMDL, presented in Table 1:

- update the WLA for one facility that has increased its permitted discharge.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for future growth in three AUs. This was originally presented in Table 18 in the original TMDL document, and the three affected AUs are included here as Table 2.

In Table 19 of the original TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for future growth within each AU. Therefore, these overall numbers did not change, and Table 19 of the TMDL remains the same.

Table 1 – Changes to Individual Wasteload Allocations (Updates Table 16, pp. 49-56 in the TMDL document.)

State Permit Number	Outfall	EPA Permit Number	Segment Number	Permittee Name	Flow (MGD)	Waste Load Allocation (WLA) – *E. coli* in Billion MPN/day	TMDL Comments
14476-001	001	TX0126161	1009_02	HARRIS COUNTY MUD NO. 418	7.5	17.886	Increased discharge

Table 2 - *E. coli* TMDL Summary Calculations for Lake Houston Assessment Units (Updates Table 18, pp. 61 in the TMDL document.)

AU	Sampling Location	Stream Name	TMDL (Billion MPN /day)	WLA_{WWTF} (Billion MPN /day)	$WLA_{StormWater}$ (Billion MPN /day)	LA (Billion MPN /day)	MOS (Billion MPN /day)	Future Growth (Billion MPN /day)
1009_02	11331	Cypress Creek	615	96.30	196	270	30.8	21.90
1009_03	11328	Cypress Creek	1340	181.75	415	574	67.0	102.25
1009_04	11324	Cypress Creek	1550	220.27	469	648	77.4	135.33

Appendix III. Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds (1002, 1003, 1004, and 1004D)

TMDL Updates to the WQMP: Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds (1002, 1003, 1004, and 1004D)

The document *Seven Total Maximum Daily Loads for Indicator Bacteria in Lake Houston, East Fork San Jacinto River, West Fork San Jacinto River, and Crystal Creek Watersheds For Segments 1002, 1003, 1004, and 1004D* was adopted by the TCEQ on 08/24/16 and approved by EPA on 10/07/16, and became an update to the state's Water Quality Management Plan (WQMP). It has had one previous WQMP update prior to this one.

The purpose of this update is to make the following change to the TMDL, presented in Table 1:

- add one new permit.

The changes reflected in this update resulted in the shifting of allocations between the sum of the individual WLAs and the allowance for future growth in two AUs. This was originally presented in Table 17 in the original TMDL document, and the two affected AUs are included here as Table 2.

In Table 18 of the original TMDL, the WLAs for permitted facilities are the sum of the individual WLAs and the allowance for future growth within each AU. Therefore, these overall numbers did not change, and Table 18 of the TMDL remains the same.

Table 1 – Changes to Individual Wasteload Allocations (Updates Table 13, pp. 54-55 in the TMDL document.)

State Permit Number	Outfall	EPA Permit Number	Segment Number	Permittee Name	Flow (MGD)	Waste Load Allocation (WLA) – *E. coli* in Billion MPN/day	TMDL Comments
15616-001	001	TX0138011	1004_01	MONTGOMERY COUNTY MUD NO. 111	1.35	3.220	New permit

Table 2 - *E. coli* TMDL Summary Calculations for Lake Houston Assessment Units (Updates Table 17, p. 59 in the TMDL document.)

All loads expressed as billion MPN/day.

AU	Segment Name	TMDL	MOS	WLA_{WWTF}	WLA_{SW}	LA_{AU}	LA_{TRIB}	LA_{RES}	LA_{TOTAL}	Future Growth
1002_06	Lake Houston	6,197	106.57	90.20	288.17	1,535.70	3,106.9	958.7	5,601.30	110.76
1004_01	West Fork San Jacinto River	2,779	88.77	86.98	196.81	1,294.21	44.86	958.7	2,297.77	108.67

Appendix IV. Addendum One to One Total Maximum Daily Load for Bacteria in the Guadalupe River Above Canyon Lake

Two Total Maximum Daily Loads for Indicator Bacteria in Quinlan Creek and Town Creek

For Segments 1806D and 1806E
Assessment Units 1806D_01 and 1806E_01

Introduction

The Texas Commission on Environmental Quality (TCEQ) adopted *One Total Maximum Daily Load for Bacteria in the Guadalupe River Above Canyon Lake: For Segment 1806* (TCEQ, 2007) on July 25, 2007. The total maximum daily loads (TMDLs) were approved by the United States Environmental Protection Agency (EPA) on September 25, 2007. This document represents an addendum to the original TMDL document.

This addendum includes information specific to two additional assessment units (AUs) located within the watershed of the approved TMDL project for bacteria in the Guadalupe River Above Canyon Lake. Concentrations of indicator bacteria in these AUs exceed the criteria used to evaluate attainment of the water quality standard for contact recreation. This addendum presents the new information associated with the two additional AUs. For background or other explanatory information, please refer to the *Technical Support Document for Total Maximum Daily Loads for Indicator Bacteria in Quinlan Creek and Town Creek: Segments 1806D and 1806E* (Brady and Hauck, 2017). Refer to the original, approved TMDL document for details related to the overall Guadalupe River Above Canyon Lake watershed as well as the methods and assumptions used in developing the original and addendum TMDLs.

The addendum watersheds, including the regulated facility within one of them, were addressed in the original TMDL or in subsequent updates to the state's Water Quality Management Plan (WQMP). This addendum provides the details related to developing the TMDL allocations for these additional AUs, which were not specifically addressed in the original TMDL document.

Problem Definition

The TCEQ first identified the bacteria impairments within the Quinlan Creek and Town Creek segments included within this addendum in the *2010 Texas Integrated Report of Surface Water Quality for Clean Water Act Sections 305(b) and 303(d)* (2010 Integrated Report; TCEQ, 2010a). These impairments have been included in subsequent iterations of this report, including the 2014 Integrated report, which is the most recently approved version (Table 1). The impaired AUs are Quinlan Creek (1806D_01) and Town Creek (1806E_01), as shown in Figure 1. Both creeks have a single AU. The project watershed is located in Kerr and Gillespie counties.

The Texas Surface Water Quality Standards (TSWQS; TCEQ, 2010b) provide numeric and narrative criteria to evaluate attainment of designated uses. The basis for water quality targets for all TMDLs developed in this report will be the numeric criteria for bacterial indicators from the 2010 TSWQS. *Escherichia coli* (*E. coli*) are the preferred indicator bacteria for assessing contact recreation use in freshwater.

Table 1. Synopsis of the 2014 Integrated Report for the addendum water bodies.

Source: (TCEQ, 2015a)

Water Body	Segment	AU	Parameter	Contact Recreation Use	Year First Impaired	Category
Quinlan Creek	1806D	1806D_01	*E. coli*	Nonsupport	2010	5a
Town Creek	1806E	1806E_01	*E. coli*	Nonsupport	2010	5a

Table 2 summarizes the ambient water quality data for the TCEQ surface water quality monitoring (SWQM) stations on each impaired water body, as reported in the 2014 Integrated Report. The 2014 assessment data indicate nonsupport of the primary contact recreation use for the two addendum AUs, because the geometric mean concentrations exceed the geometric mean criterion of 126 most probable number (MPN)/100 milliliters (mL) *E. coli*. Figure 2 shows the location of the SWQM and Upper Guadalupe River Authority (UGRA) monitoring stations as well as the only wastewater treatment facility (WWTF) in the project watershed, Hill Country Camp.

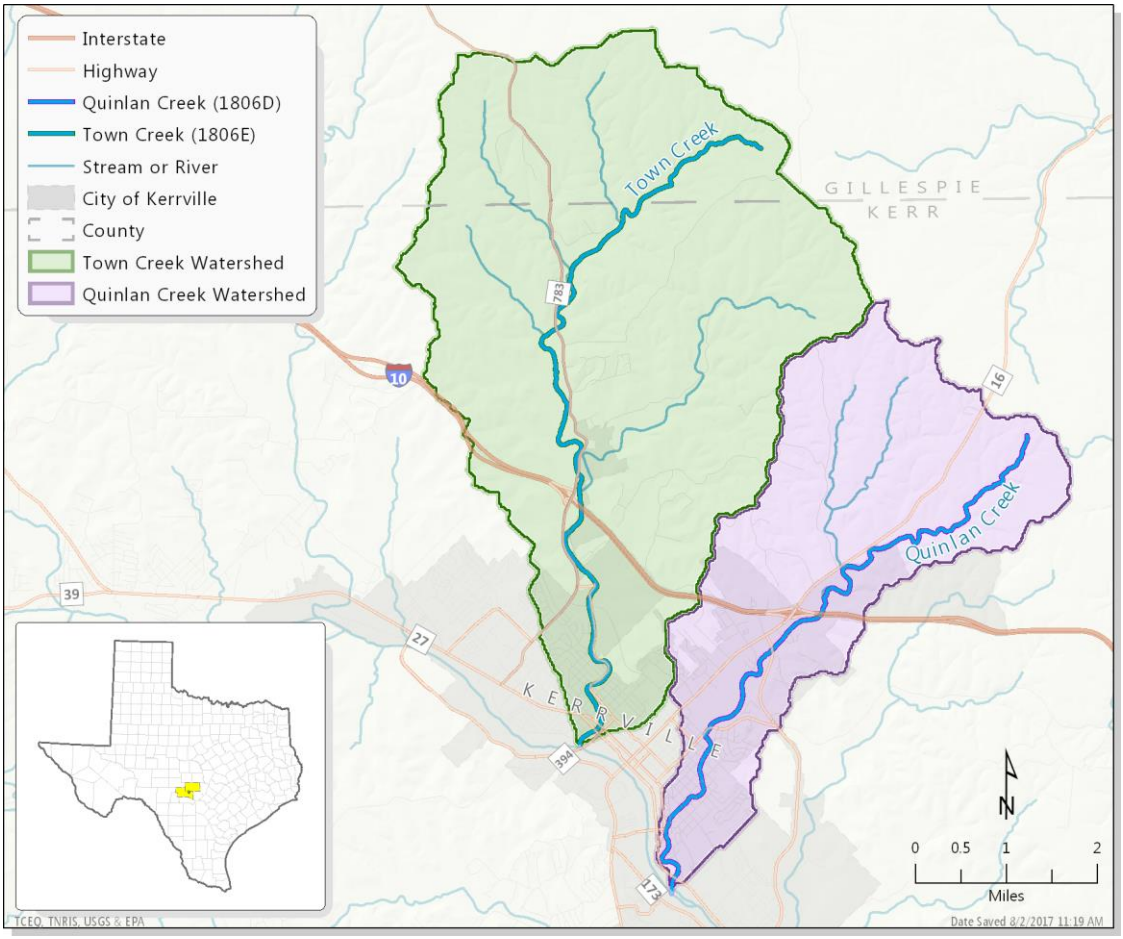

Figure 1. Overview map showing the watersheds for Quinlan Creek and Town Creek.

Source: (USGS and EPA, 2012)

Table 2. 2014 Integrated Report summary for the addendum TMDL AUs
(The geometric mean criterion for primary contact recreation use is 126 MPN/100 mL of *E. coli*.)

Source: (TCEQ, 2015a)

Water Body	AU	Parameter	Number of Samples	Data Range	Station *E. coli* Geometric Mean (MPN/100 mL)
Quinlan Creek	1806D_01	*E. coli*	81	2005–2012	306.69
Town Creek	1806E_01	*E. coli*	66	2005–2012	251.20

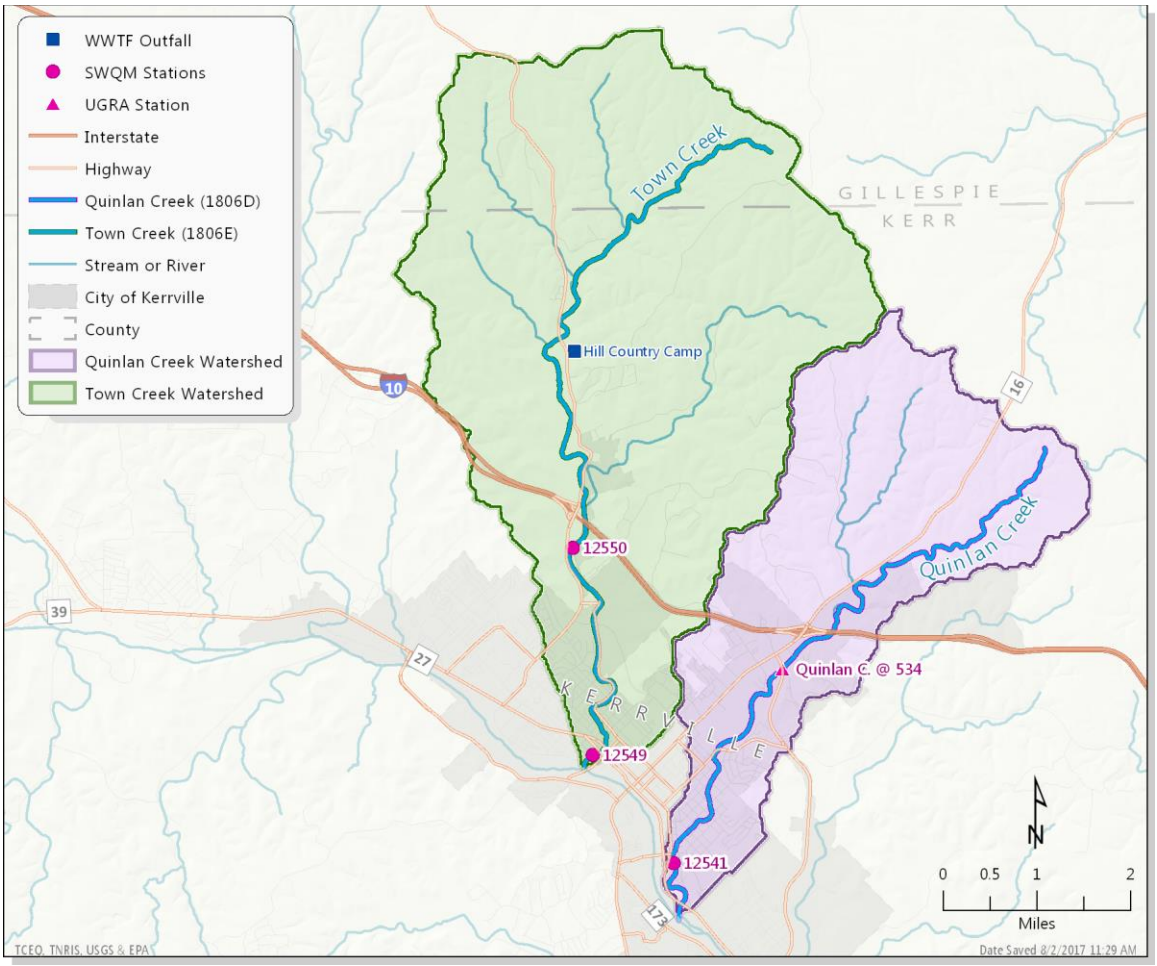

Figure 2. Map showing monitoring stations and the Hill County Camp WWTF outfall within the Quinlan Creek and Town Creek watersheds.

Source: (EPA, 2017)

Watershed Overview

Description of the Study Area

Quinlan Creek and Town Creek are adjacent water bodies and tributaries of the Guadalupe River Above Canyon Lake (Segment 1806). Both water bodies are located within the portion of the watershed of the Guadalupe River Above Canyon Lake addressed in the original TMDL document, as shown in Figure 3. This addendum incorporates a watershed approach where the drainage area of each creek is considered.

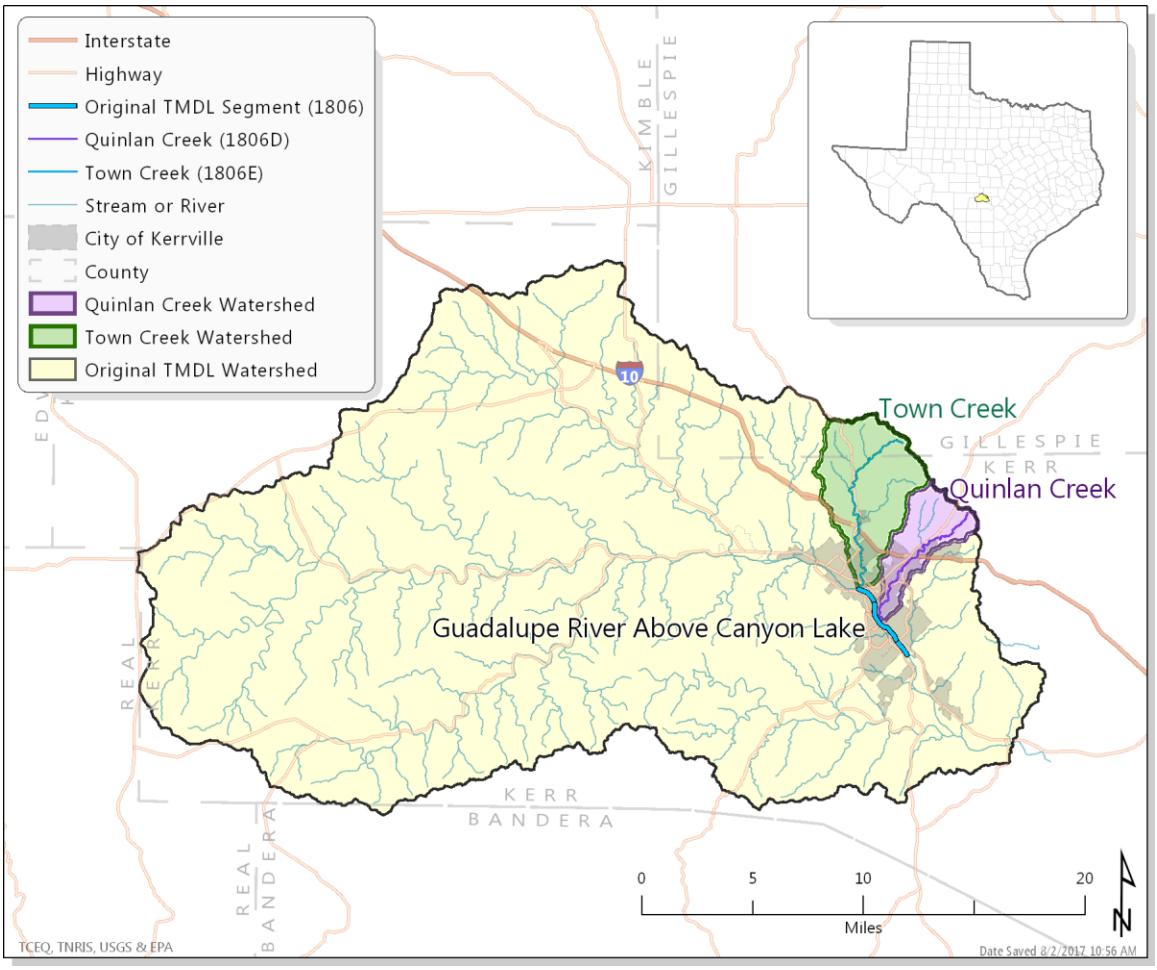

Figure 3 Map showing the Guadalupe River Above Canyon Lake TMDL watershed and the two watersheds considered in this addendum.

Quinlan Creek flows into the Guadalupe River in Kerrville, and is approximately 8.2 miles in length. At its mouth, Quinlan Creek drains an area of 11.7 square miles in Kerr County.

Town Creek flows into the Guadalupe River in Kerrville about two miles upstream of the Quinlan Creek confluence. Town Creek is approximately 9.6 miles long, and drains an area of 23.5 square miles in Kerr and Gillespie counties.

The segment and AU descriptions for the water bodies considered in this document are as follows:

- Quinlan Creek (AU 1806D_01): From the confluence of the Guadalupe River in Kerrville in Kerr County to the upstream perennial portion of the stream north of Kerrville in Kerr County (TCEQ, 2015a)
- Town Creek (AU 1806E_01): From the confluence of the Guadalupe River just upstream of FM 394 in Kerrville in Kerr County upstream to the headwaters in Gillespie County approximately 4.5 miles (7.4 km) north of Kerrville (P. Bohannon, personal communication, March 16, 2017)

Watershed Climate

The watersheds of Quinlan and Town creeks are in the central portion of Texas, classified as the Subtropical Subhumid climate region (Larkin and Bomar, 1983). As in much of the state, the region's subtropical climate is caused by the "predominant onshore flow of tropical maritime air from the Gulf of Mexico," while the increasing moisture content (from west to east) reflects variations in "intermittent seasonal intrusions of continental air" (Larkin and Bomar, 1983).

For the period from 1981–2010, average annual precipitation in the Quinlan Creek watershed was 31.5 inches, which is slightly higher than the average annual total precipitation for the Town Creek watershed of 31.0 inches (PRISM, 2012). This slight increase in precipitation, when moving from west to east, is concurrent with the statewide precipitation pattern, as shown in Figure 4.

In Kerrville, average high temperatures generally reach their peak of 94° Fahrenheit (F) in August (Figure 5), and highs above 100 °F have occurred from May through September (Arguez et al., 2010a). Fair skies generally accompany the highest temperatures of summer when nightly average lows drop to about 69 °F (Arguez et al., 2010a). During winter, the average low temperature reaches a minimum of 34 °F in January, although below-freezing temperatures have occurred from October through April (Arguez et al., 2010a). The frost-free period in Kerrville generally lasts for about 224 days, with the average last frost occurring March 29 and the average first frost occurring on November 8 (Arguez et al., 2010b).

Climate normals obtained from the National Oceanic and Atmospheric Administration (NOAA) for the Kerrville 3 NNE weather station (USC00414782, shown in Figure 4) indicate a bimodal precipitation pattern (Figure 5). The wettest months are typically May and June (4.0 inches each), followed by September and October (3.7 inches each), while January and August (at 1.6 and 1.7 inches, respectively) are normally the driest months.

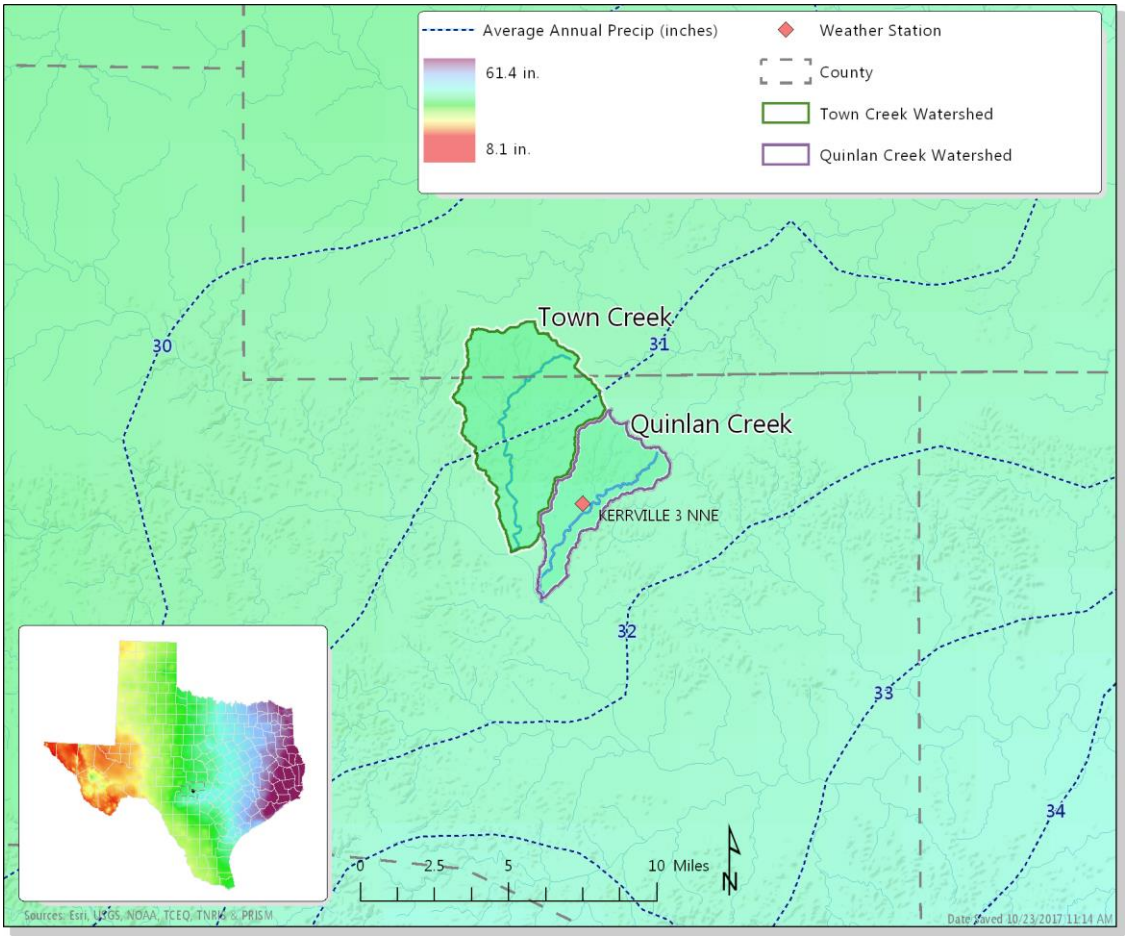

Figure 4. Annual average precipitation map showing isohyets (in inches) for areas in the vicinity of the Quinlan Creek and Town Creek watersheds (1981-2010).

Source: (PRISM, 2012)

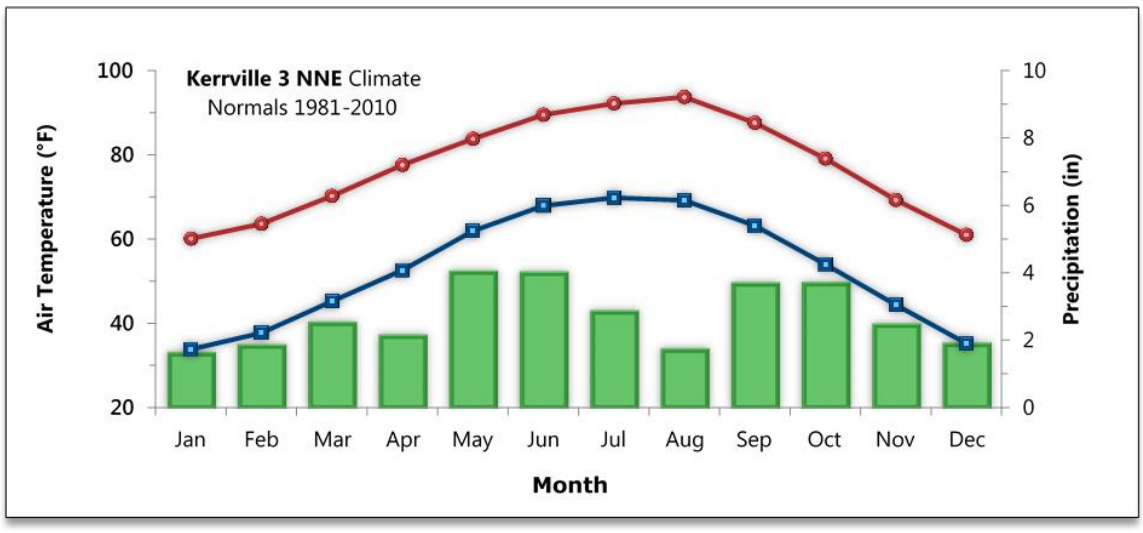

Figure 5. Chart showing the average minimum and maximum air temperature and total precipitation by month from 1981–2010 for the Kerrville 3 NNE weather station.

Source: (Arguez et al., 2010a)

Land Use

The land use/land cover data for the Quinlan Creek and Town Creek watersheds were obtained from the 2011 National Land Cover Database (NLCD; Homer et al., 2015) and are displayed in Figure 6.

As shown in Table 3, the watershed area encompassing Segment 1806D (Quinlan Creek watershed) is approximately 7,463 acres. Dominant land uses in the Quinlan Creek watershed include Evergreen Forest and Shrub/Scrub (both at 31 percent).

The watershed area encompassing Segment 1806E (Town Creek watershed) is about 15,028 acres and is also dominated by Evergreen Forest (41 percent) and Shrub/Scrub (32 percent).

Both watersheds are mostly rural, with only about 23 percent of the combined area classified as Developed. The Quinlan Creek watershed is more developed (33 percent) than the Town Creek watershed (18 percent).

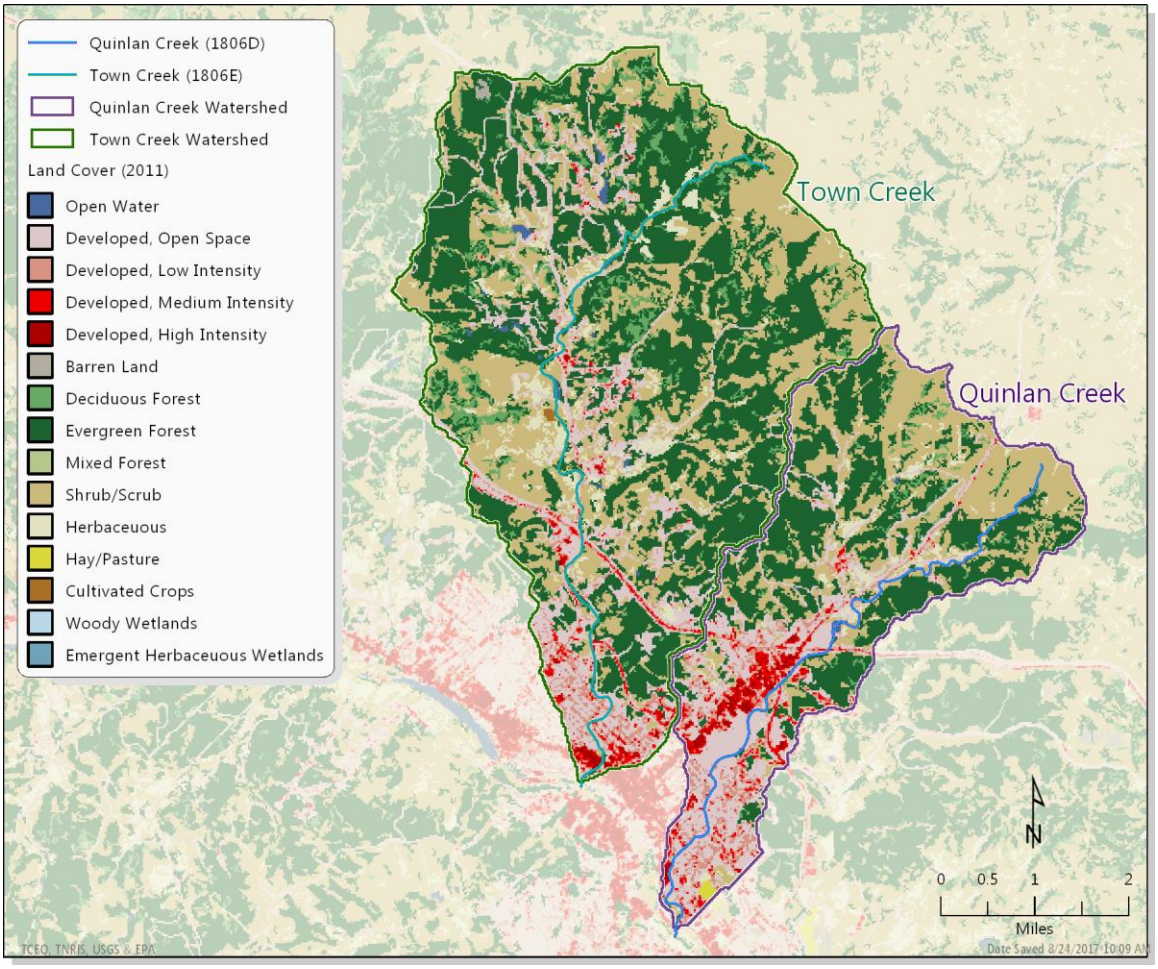

Figure 6. Land use/land cover map showing categories within the Quinlan Creek and Town Creek watersheds.

Source: (Homer et al., 2015)

Table 3. Land use/land cover within the Quinlan Creek and Town Creek watersheds.

Source: (Homer et al., 2015)

2011 NLCD Classification	Quinlan Creek Watershed		Town Creek Watershed	
	Acres	Percent of Total	Acres	Percent of Total
Open Water	8.5	0.1%	65.4	0.4%
Developed, Open Space	1,491.4	20.0%	1,930.4	12.8%
Developed, Low Intensity	539.1	7.2%	494.6	3.3%
Developed, Medium Intensity	289.8	3.9%	190.1	1.3%
Developed High Intensity	112.8	1.5%	50.3	0.3%
Barren Land (Rock/Sand/Clay)	-	-	15.8	0.1%
Deciduous Forest	154.6	2.1%	740.6	4.9%
Evergreen Forest	2,332.9	31.3%	6,169.0	41.1%
Shrub/Scrub	2,320.5	31.1%	4,770.8	31.7%
Herbaceous	193.5	2.6%	589.3	3.9%
Hay/Pasture	19.8	0.3%	-	-
Cultivated Crops	-	-	8.7	0.1%
Woody Wetlands	-	-	2.9	0.0%
Total	**7,462.9**	**100%**	**15,027.9**	**100%**

Watershed Population and Population Projections

According to the 2010 Census (USCB and TNRIS, 2017), there are an estimated 5,901 people in the Quinlan Creek watershed, indicating a population density of 506 people/square mile. The majority of the population (5,333 people, or 90 percent) lives within the Kerrville city limits (Figure 7). Approximately 34 percent of the area in the watershed is included within the Kerrville city boundary.

Also according to the 2010 Census, there are an estimated 5,314 people in the Town Creek watershed, indicating a population density of 226 people/square mile. The majority of the population (3,903 people, or 73 percent) lives within the Kerrville city limits (Figure 7). Approximately 11 percent of the area in the watershed is included within the Kerrville city boundary.

Geospatial analysis based on water user groups (WUGs), which allows a refinement of county and city-level projections developed by the Office of the State Demographer and the Texas Water Development Board (TWDB, 2016), reveals that populations are predicted to increase 14.0 percent in the Quinlan Creek watershed and 15.8 percent in the Town Creek watershed between 2010 and 2050 (Table 4).

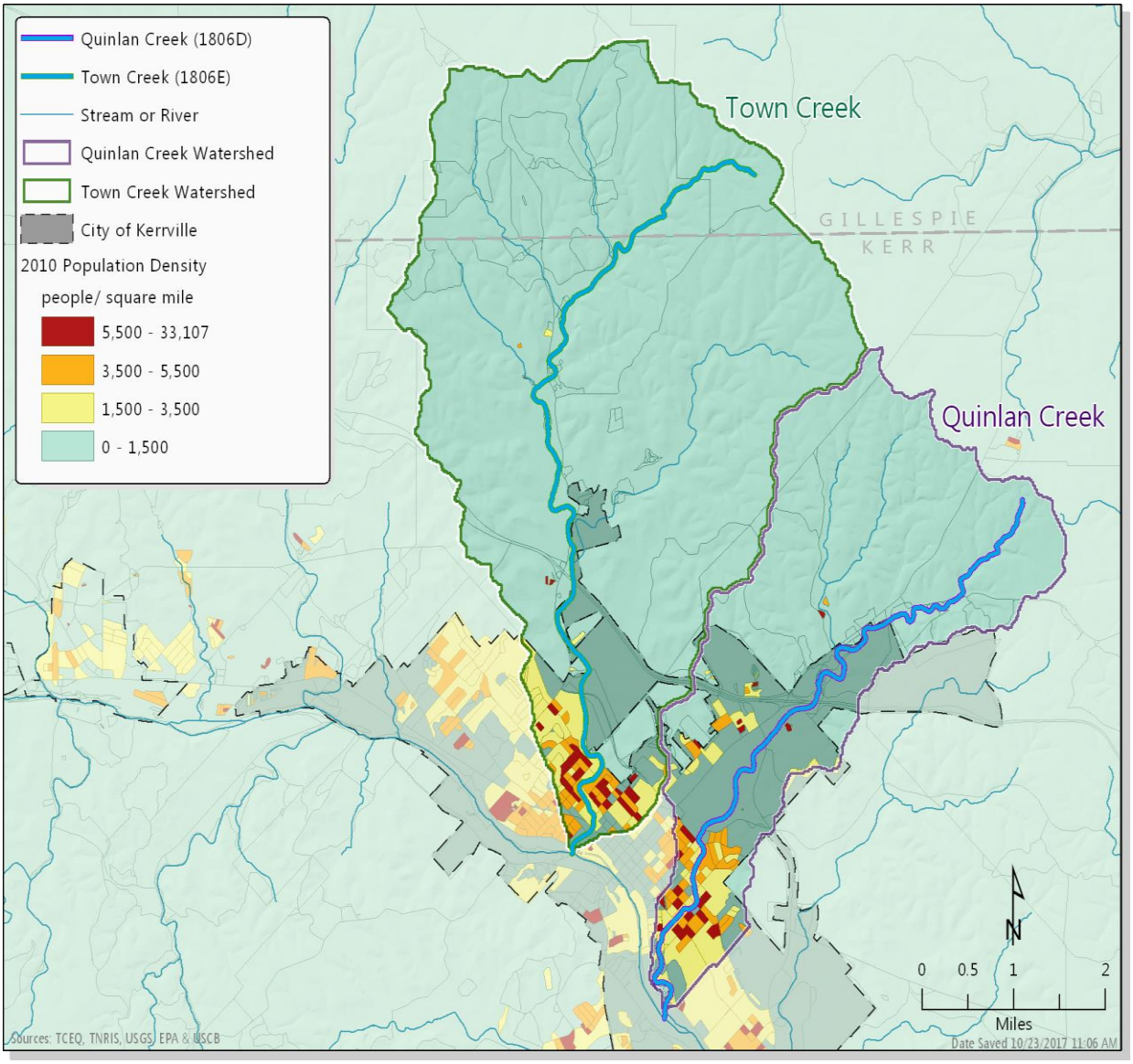

Figure 7. Population density map showing 2010 population by census block, along with the City of Kerrville boundary.

Source: (USCB and TNRIS, 2017)

Table 4. 2010 Population and 2020–2050 Population Projections for the Quinlan Creek and Town Creek watersheds.

Sources: (USCB and TNRIS, 2017; TWDB, 2016)

Watershed	Area (WUG)	2010 U.S. Census	Population Projections				Popu-lation Change (2010-2050)	Percent Increase (2010-2050)
			2020	2030	2040	2050		
Quinlan Creek	Kerrville	5,333	5,569	5,782	5,907	6,032	+699	13.11%
	Kerr County, outside Kerrville	568	609	649	673	696	+128	22.54%
	Total	**5,901**	**6,178**	**6,431**	**6,580**	**6,728**	**+827**	**14.01%**
Town Creek	Kerrville	3,903	4,076	4,231	4,323	4,415	+512	13.11%
	Kerr County, outside Kerrville	1,103	1,184	1,261	1,306	1,351	+248	22.48%
	Gillespie County, outside Fredericks-burg	308	317	343	363	388	+80	25.97%
	Total	**5,314**	**5,577**	**5,835**	**5,992**	**6,154**	**+840**	**15.81%**

Endpoint Identification

The endpoint for the TMDL is to maintain the concentration of *E. coli* below the geometric mean criterion of 126 MPN/100mL. This endpoint was applied to both AUs addressed by this TMDL. This endpoint is identical to the geometric mean criterion for primary contact recreation in the 2010 TSWQS (TCEQ, 2010b).

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. WWTF outfalls and stormwater discharges from industries and construction sites represent the regulated sources in the project watershed.

Domestic and Industrial Wastewater Treatment Facilities

Currently, no WWTFs exist within the Quinlan Creek watershed, and a single facility (Hill Country Camp; TPDES permit number 14832-002) within the Town Creek watershed treats domestic wastewater (Figure 2). The facility's current permit was issued in April 2016. The available discharge monitoring report (DMR) data indicate that there has been no discharge from May 2016 through February 2017. Table 5 summarizes the information for this permit.

Table 5. Permitted WWTF in the the Quinlan Creek and Town Creek watersheds.

Source: Individual TPDES Permit

TPDES Permit Number	NPDES Permit Number	Facility	AU	TMDL Receiving Waters	Final Permitted Discharge (MGD[1])	Average Discharge (MGD)
14832-002	TX0136298	Hill Country Camp	1806E_01	Unnamed Tributary; thence to Town Creek	0.025	No Discharge[2]

[1] MGD = million gallons per day

[2] From EPA Enforcement and Compliance History Online (ECHO), May 2016–February 2017. Additionally, indicated to be operating and using effluent for irrigation, with no discharge (T. Bushnoe, personal communications, April 5, 2017).

Sanitary Sewer Overflows

Sanitary sewer overflows (SSOs) are unauthorized discharges that must be addressed by the responsible party. The TCEQ Region 13 Office maintains a database of SSO data reported by municipalities. These SSO data typically contain estimates of the total gallons spilled, responsible entity, and a general location of the spill. A summary of the reports of SSO events that were determined to have occurred within the Quinlan Creek and Town Creek watersheds between January 2012 and December 2016 are shown in Table 6.

Table 6. Summary of SSO incidences reported in the Quinlan Creek and Town Creek watersheds from 2012–2016.

Source: TCEQ Region 13

AU	Number of Incidents	Total Volume (gallons)	Average Volume (gallons)	Minimum Volume (gallons)	Maximum Volume (gallons)
1806D_01	9	4,555	506	15	2,940
1806E_01	13	3,990	307	10	1,200

TPDES-Regulated Stormwater

TPDES general permits cover stormwater discharges from Phase II urbanized areas, industrial facilities (General Permit number TXR050000), concrete production facilities (General Permit number TXG110000), and construction sites over one acre (General Permit number TXR150000). A review of active stormwater general permits coverage (TCEQ, 2017) in the Quinlan Creek watershed as of June 8, 2017, found one active industrial facility and one active concrete production facility. A concurrent review of active stormwater general permits coverage in the Town Creek watershed found one active industrial facility and two active construction sites. There are currently no Phase II municipal separate storm sewer systems (MS4s) in either watershed. Table 7 summarizes the area in each watershed covered by general stormwater permits.

Table 7. Summary of land area (acres / % of watershed) covered by general stormwater permits in the Quinlan Creek and Town Creek watersheds as of June 8, 2017.

Source: TCEQ Water Quality General Permits & Registration Search (TCEQ, 2017)

AU	MS4	Industrial	Construction	Concrete Production	Total Area of General Permits
1806D_01	0 / 0.000%	14 / 0.188%	45 / 0.603%	4 / 0.054%	63 / 0.844%
1806E_01	0 / 0.000%	27 / 0.180%	53 / 0.353%	0 / 0.000%	80 / 0.532%

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 onsite 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 wildlife such as mammals and birds. In developing bacteria TMDLs, it is important to identify the potential for bacteria contributions from wildlife. Riparian corridors of streams and rivers naturally attract wildlife. With direct access to the stream channel, direct deposition of wildlife waste can be a concentrated source of bacteria loading to a water body. Wildlife also deposit fecal bacteria onto land surfaces, where rainfall runoff may wash bacteria into nearby streams.

For feral hogs, the Texas A&M Institute of Renewable Natural Resources (IRNR), recently renamed as the Texas A&M Natural Resources Institute, reported a range of feral hog densities within Texas of 1.33 to 2.45 hogs/square mile (IRNR, 2013). The average hog density (1.89 hogs/square mile) was multiplied by the hog-habitat area in the Quinlan Creek and Town Creek watersheds (7.85 and 19.19 square miles, respectively). Habitat deemed suitable for hogs followed as closely as possible to the land use selections of the IRNR study and include from the 2011 NLCD: Pasture/Hay, Cultivated Crops, Shrub/Scrub, Grassland/Herbaceous, Deciduous Forest, Evergreen Forest, and Woody Wetlands. Table 8 identifies the estimated feral hog population for each AU watershed.

For deer, the Texas Parks and Wildlife Department (TPWD) publishes data showing deer population-density estimates by deer management unit (DMU) across the state (TPWD, 2017). Spatial analysis using DMU and white-tailed deer range layers provided by TPWD reveals that for the Quinlan Creek watershed, 3,009 acres are within DMU 5, and 1,373 acres are within DMU 7 North. For the Town Creek watershed, 13,023 acres are within DMU 5. The 2017 population densities for those DMUs are 9.58 acres/deer (DMU 5) and 6.45 acres/deer (DMU 7 North). Table 8 identifies the estimated deer population for each AU watershed.

Table 8. Estimated feral hog and deer populations in the Quinlan Creek and Town Creek watersheds.

Sources: (INRI, 2013; TPWD, 2017)

AU	Deer	Feral Hogs
1806D_01	15	527
1806E_01	36	1,359

Domesticated Animals

Livestock are a potential source of bacteria in the project watershed. The numbers of livestock that are found within the Quinlan Creek and Town Creek watersheds were estimated from county level data obtained from the 2012 Census of Agriculture (USDA NASS, 2014; Table 9). The county-level data were refined to better reflect actual numbers within the impaired AU watersheds. Using the 2011 NLCD, the refinement was performed by determining the total area of the suitable livestock land cover categories of Grassland/Herbaceous and Pasture/Hay within the Quinlan Creek watershed and Kerr County. A ratio was then computed by dividing the livestock total land use area of the watershed by the livestock total land use area of the county. The county-level agricultural census data were then multiplied by the ratio to determine the estimated Quinlan Creek watershed domestic animal populations. For Town Creek, the same approach was used, but Gillespie County information was also included in the calculations. These numbers, however, are not used to develop an allocation of allowable bacteria loading to livestock.

Table 9. Estimated total livestock inventory, by commodity, for Quinlan Creek and Town Creek watersheds in 2012.

Source: (USDA NASS, 2014)

AU	Cattle and Calves	Deer and Elk (Domestic)	Goats and Sheep	Horses, Ponies, Mules, Burros, and Donkeys	Poultry
1806D_01	66	44	125	11	17
1806E_01	201	99	356	27	45

Fecal matter 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 10 summarizes the estimated number of dogs and cats for the TMDL watershed. Pet population estimates were calculated as the estimated number of dogs (0.584) and cats (0.638) per household (AVMA, 2012). The actual contribution and significance of bacteria loads from pets reaching the water bodies of the impaired AU watersheds is unknown.

Table 10. Estimated households and pet populations for the Quinlan Creek and Town Creek watersheds.

Source: (AVMA, 2012)

AU	Estimated Number of Households	Estimated Dog Population	Estimated Cat Population
1806D_01	2,583	1,508	1,648
1806E_01	2,472	1,444	1,577

Onsite Sewage Facilities

Estimates of the number of OSSFs in the Quinlan Creek and Town Creek watersheds were based on 9-1-1 building locations received from the Kerr Emergency 9-1-1 Network (T. Bushnoe, personal communication, April 6, 2017). For the areas of the Quinlan Creek and Town Creek watersheds, OSSFs were estimated to be households that were outside of either a Certificate of Convenience and Necessity (CCN) sewer area (PUC, 2016) or a city boundary (TNRIS, 2016). The estimated number of OSSFs by watershed using the 9-1-1 addresses is provided in Table 11, and potential OSSF locations are presented in Figure 8.

Table 11. OSSF estimate for the Quinlan Creek and Town Creek watersheds.

Sources: (Kerr Emergency 9-1-1 Network; PUC, 2016; and TNRIS, 2016)

AU	Estimated OSSFs
1806D_01	298
1806E_01	933

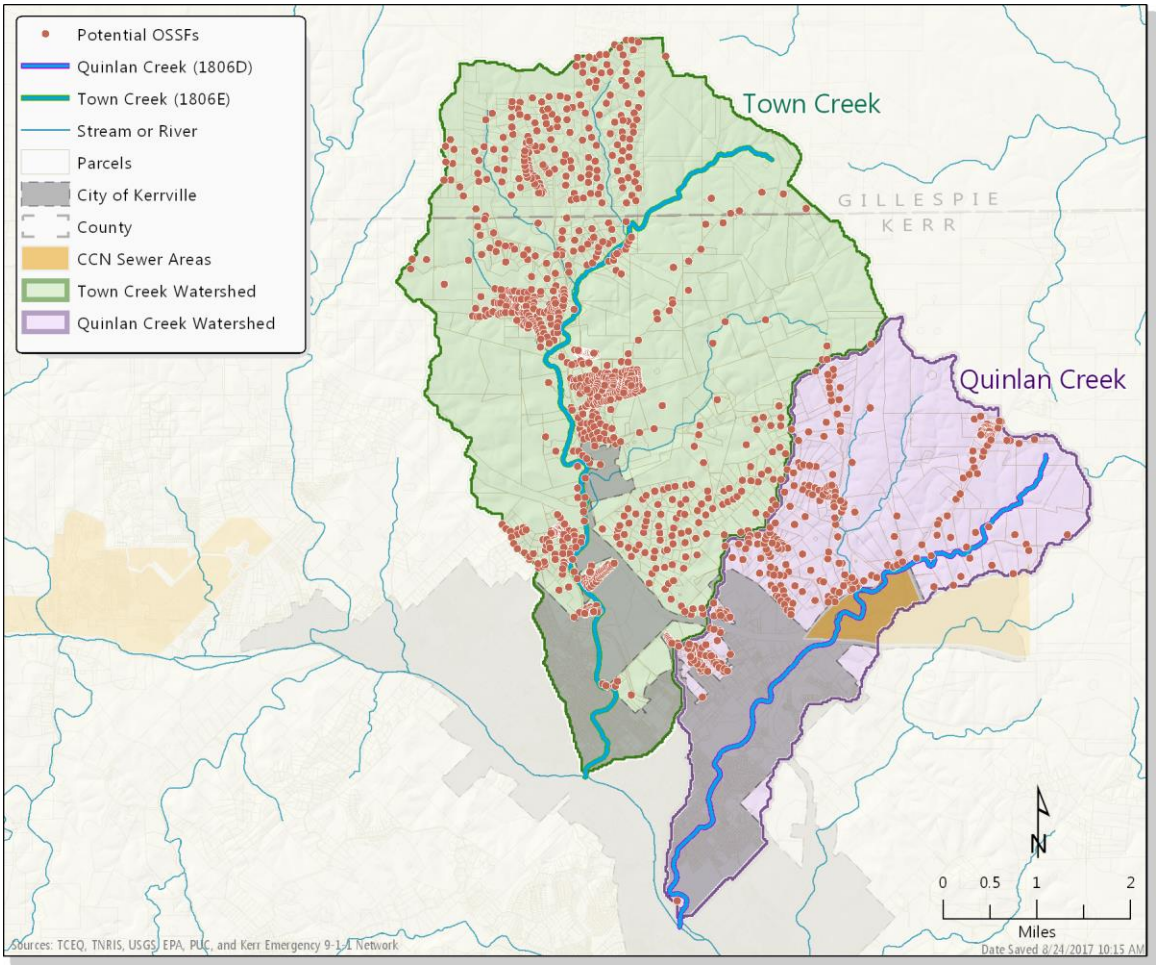

Figure 8. OSSF locations within the Quinlan Creek and Town Creek watersheds.

Sources: (Kerr Emergency 9-1-1 Network; PUC, 2016; and TNRIS, 2016)

Linkage Analysis

Load duration curves (LDCs) were 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 existing and 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 (Brady and Hauck, 2017) provides details about the analyses, tools, and their applications.

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 TMDLs covered by this report incorporate an explicit MOS by setting a target for indicator bacteria loads that is 5 percent lower than the geometric mean criterion.

Pollutant Load Allocation

The TMDL component for the two impaired AUs covered in this report are derived using the median flow within the High Flows regime (or 5 percent flow) of the LDC developed for the sampling station located near the outlet of each AU watershed.

Based on the LDCs to be used in the pollutant load allocation process with historical *E. coli* data added to the graphs (Figures 9 and 10), the following broad linkage statements can be made. For both the Quinlan Creek and Town Creek watersheds, the historical *E. coli* data indicate that elevated bacteria loadings occur under all flow conditions, but become most elevated under the highest flows and are often below the single sample criterion under the lowest flows. Regulated stormwater comprises a small portion of the watershed (0.84 percent for the Quinlan Creek watershed and 0.53 percent for the Town Creek watershed) and must be considered only a minor contributor.

Most likely, unregulated stormwater comprises the majority of high flow related loadings. The elevated *E. coli* loadings under the lower flow conditions cannot be reasonably attributed to WWTFs since the DMR records for the single WWTF in the Town Creek watershed indicate “no discharge” and the Quinlan Creek watershed contains no permitted WWTFs. Therefore, other sources of bacteria loadings under lower flows and in the absence of overland flow contributions (i.e., without stormwater contribution) are most likely contributing bacteria directly to the water as could occur through direct deposition of fecal material from wildlife, feral hogs, and livestock. The actual contribution of bacteria loadings attributable to these direct sources of fecal material deposition cannot be determined using LDCs.

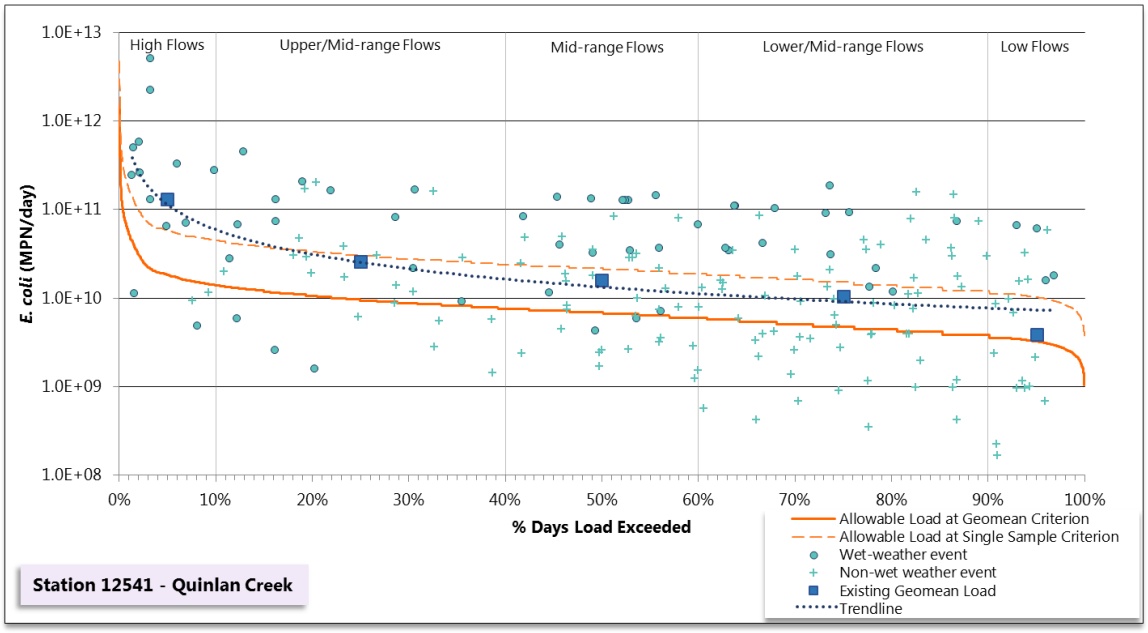

Figure 9. LDC for Quinlan Creek (Station 12541).

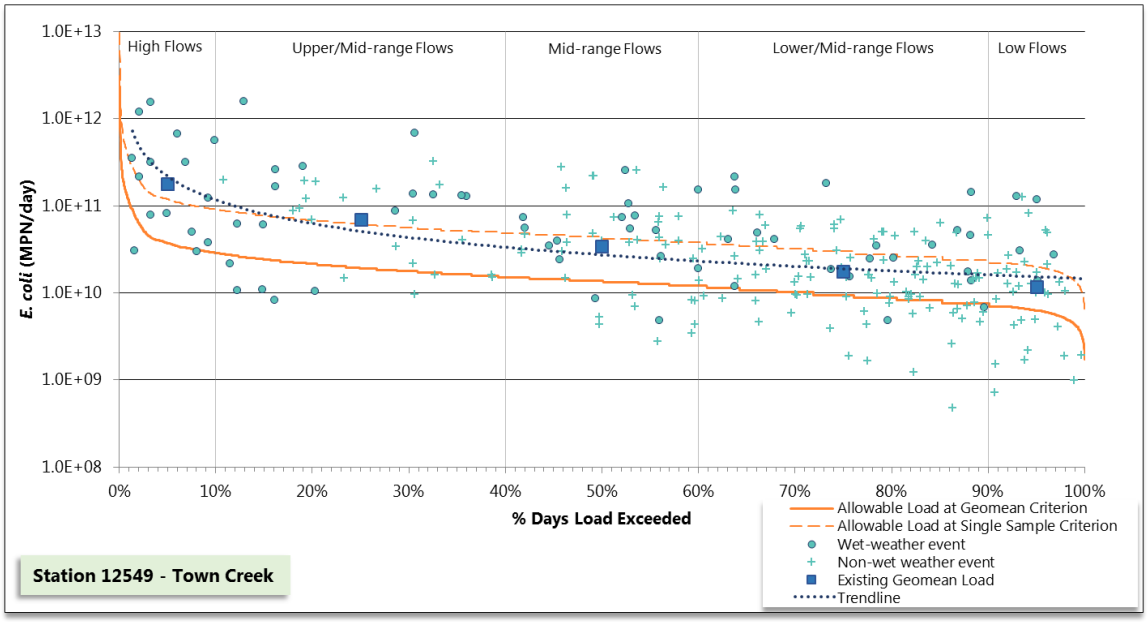

Figure 10. LDC for Town Creek (Station 12549).

Wasteload Allocation

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

WWTFs

TPDES-permitted WWTFs are allocated a daily wasteload (WLA_{WWTF}) calculated as their full permitted discharge flow rate multiplied by the instream geometric mean criterion. The *E. coli* primary contact

recreation geometric mean criterion of 126 MPN/100mL is used as the WWTF target. Table 12 presents the WLA for the WWTF located in the project watershed.

Table 12. Summary of WLAs for WWTFs in the the Quinlan Creek and Town Creek watersheds.

TPDES / NPDES Permit	Facility	Final Permitted Discharge (MGD)	*E. coli* Permit Limit (MPN/100 mL)	*E. coli* WLA_{WWTF} (Billion MPN/day)
not applicable	-	-	-	-
1806D_01 Total WLA_{WWTF}				0.000
14832-002 / TX0136298	Hill Country Camp	0.025	126	0.119
1806E_01 Total WLA_{WWTF}				0.119

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}). 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 land area included in each watershed that is under the jurisdiction of stormwater permits is used to estimate the amount of overall runoff load that should be allocated as the permitted stormwater contribution in the WLA_{SW} component of the TMDL. For the construction activities general permits, the authorization contains an "Area Disturbed" field. Due to the variable and temporary nature of construction projects, it was preferable to average the acreages (on a monthly basis) associated with active permits over the most recent 10 years of the available period of record. The results of this temporal averaging were used as representative of the average area under construction activities stormwater permits. The percentage of land under the jurisdiction of stormwater permits in each watershed was less than 1 percent (0.84 percent for Quinlan Creek and 0.53 percent for Town Creek).

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 contact recreation standard.

For this TMDL, the conventional FG calculation is affected by the scarcity of WWTFs. In this case, the single WWTF (located within the Town Creek watershed) is associated with a camp (Table 12), rather than a community or municipality. By using TCEQ design guidance for domestic WWTFs, and assuming the potential for a residential development of a density sufficient to require centralized sewer collection, an alternative method was implemented.

According to Rule § 217.32 of the Texas Administrative Code (TAC), new WWTFs are to be designed for a daily wastewater flow of 75–100 gallons per capita per day (TAC, 2008). Conservatively taking the higher daily wastewater flow capacity (100 gallons) and multiplying it by a potential population change would result in a permitted flow for FG. Based on the information in Table 4, the projected population change for unincorporated areas of the subject watersheds for the 2010–2050 time period is 128 in the Quinlan Creek watershed and 328 in the Town Creek watershed. Conservatively assuming a larger population consistent with a potential residential development—1,000 people—and multiplying that by the higher daily wastewater flow capacity yields a value of 0.10 MGD. This value would be considered the full permitted discharge of a potential future WWTF.

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 TMDLs in this document will result in protection of existing designated uses and conform to Texas's antidegradation policy.

TMDL Calculations

Table 13 summarizes the TMDL calculations for the Quinlan Creek and Town Creek watersheds. Each of the TMDLs was calculated based on median flow in the 0–10 percentile range (5 percent exceedance, High Flows regime) for flow exceedance from the LDC developed for the downstream SWQM station in each watershed (12541 and 12549, respectively). Allocations are based on the current geometric mean criterion for *E. coli* of 126 MPN/100mL for each component of the TMDL.

The final TMDL allocations (Table 14) needed to comply with the requirements of 40 Code of Federal Regulations (CFR) § 103.7 include the FG component within the WLA_{WWTF}.

In the event that the criterion changes due to a change in the designated recreational use, Appendix A provides guidance for recalculating the allocations in Table 14.

Table 13. TMDL allocation summary for the Quinlan Creek and Town Creek watersheds.

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

AU	TMDL	WLA_{WWTF}	WLA_{SW}	LA	MOS	FG
1806D_01	18.291	0	0.143	16.756	0.915	0.477
1806E_01	37.428	0.119	0.186	34.775	1.871	0.477

Table 14. Final TMDL allocations for the Quinlan Creek and Town Creek watersheds.

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

AU	TMDL	WLA_{WWTF}[1]	WLA_{SW}	LA	MOS
1806D_01	18.291	0.477	0.143	16.756	0.915
1806E_01	37.428	0.596	0.186	34.775	1.871

[1] WLA_{WWTF} includes the future potential allocation to WWTFs

For the previous TMDL on the Guadalupe River Above Canyon Lake (TCEQ, 2007), pollutant load allocations were determined from the median flow of each of the five flow regimes comprising the LDCs: 5 percent exceedance for High Flows (0–10 percent), 25 percent exceedance for Moist Conditions (10–40 percent), 50 percent exceedance for Mid-range Flow (40–60 percent), 75 percent exceedance for Dry

Conditions (60–90 percent), and 95 percent exceedance for Low Flows (90–100 percent). For more recent bacteria TMDLs across Texas, the TCEQ has considered only the median value of the highest designated flow regime in the pollutant load allocations. For consistency with the original Guadalupe River Above Canyon Lake TMDL, the pollutant load allocations for each of the five flow regimes are provided in Appendix B.

Seasonal Variation

Federal regulations in 40 CFR § 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 12 years (2005–2016) of routine monitoring collected in the warmer months (May–September) against those collected during the cooler months (October–April). 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 in indicator bacteria between cool and warm weather seasons for both Quinlan Creek (two-sample t (n = 188) = 3.58, p = 0.436E-04) and Town Creek (two-sample t (n = 230) = 4.24, p = 3.21E-05), with the warm season having the higher concentrations.

Public Participation

The TCEQ maintains an inclusive public participation process. From the inception of the TMDL study, the TCEQ 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 these TMDL additions (Brady and Hauck, 2017) was posted on the TMDL project page at: <www.tceq.texas.gov/assets/public/waterquality/tmdl/65guadalupe/65-quinlantown-tsd-final.pdf> on September 8, 2017. Stakeholders were consulted on the addendum to these TMDLs through a public meeting held in Kerrville on December 14, 2017, where the results of the study were presented by the TCEQ project manager. 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 online news page at <www.tceq.texas.gov/waterquality/tmdl/tmdlnews.html>, and the document will be posted at <www.tceq.texas.gov/permitting/wqmp/WQmanagement_updates.html>. The public will have an opportunity to comment on this addendum during a 30-day WQMP update public comment period (February 9–March 12, 2018).

TCEQ accepted public comments on the original TMDL during the period March 23–April 23, 2007. Three comments were submitted, and none of them referred directly to the AUs in this TMDL addendum. TCEQ accepted public comments on the corresponding Implementation Plan (I-Plan) during the period April 23–May 23, 2011. Three comments were submitted, and none of them referred directly to the AUs in this TMDL addendum.

Implementation and Reasonable Assurance

The two segments and AUs covered by this addendum are within the existing bacteria TMDL watersheds of the Mission and Aransas Rivers, which drain to Copano Bay. These watersheds are within the area covered by the I-Plan developed with the assistance of local stakeholders. The I-Plan (TCEQ, 2016b) was approved by the TCEQ on May 25, 2016. 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.

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Appendix A

Equations for Calculating TMDL Allocations for Contact Recreation Standard Changes

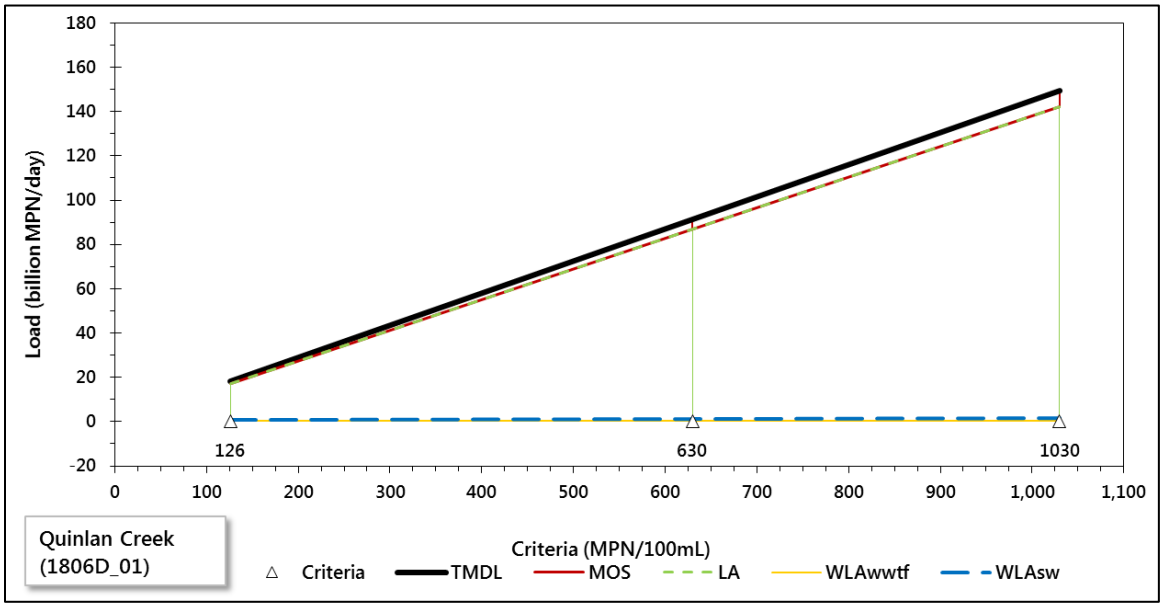

Figure A-1. *E. coli* allocation loads for Quinlan Creek (1806D_01) as a function of water quality criteria.

Equations for calculating new TMDL and allocations (in billion MPN/day *E. coli*) for Quinlan Creek (1806D_01):

TMDL = 0.14516487 * Std
MOS = 0.00725824 * Std
LA = 0.13674242 * Std - 0.47297317
WLA_{WWTF} = 0.47700000
WLA_{SW} = 0.00116421 * Std - 0.00402683

Where:

Std = Revised Water Quality Standard
MOS = Margin of Safety
LA = Total load allocation (non-permitted source contributions)
WLA_{WWTF} = Wasteload allocation (permitted WWTF + FG) [Note: WWTF load held at existing primary contact (126 MPN/100mL) criteria]
WLA_{SW} = Wasteload allocation (permitted stormwater)

Table A-1. Summary of allocation loads for Quinlan Creek (1806D_01) at selected revised water quality standards.

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

Std (MPN/100mL)	TMDL	MOS	LA	WLA_{WWTF}[1]	WLA_{SW}
126	18.291	0.915	16.756	0.477	0.143
630	91.454	4.573	85.675	0.477	0.729
1030	149.520	7.476	140.372	0.477	1.195

[1] WLA_{WWTF} includes the future potential allocation to WWTFs and is held at the primary contact (126 MPN/100mL) criteria

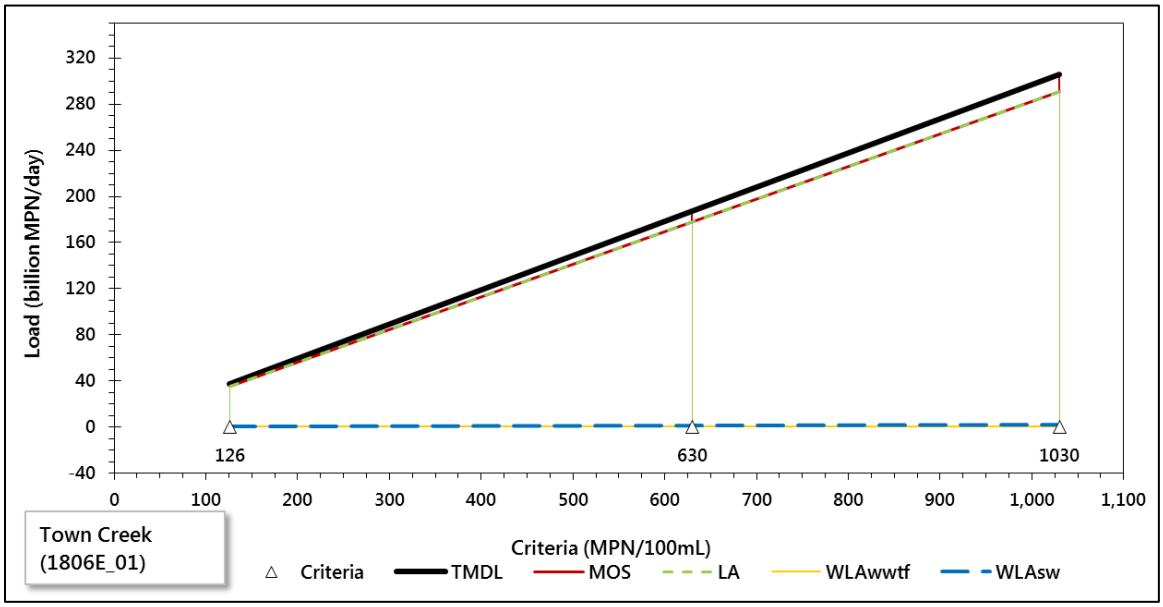

Figure A-2. *E. coli* allocation loads for Town Creek (1806E_01) as a function of water quality criteria.

Equations for calculating new TMDL and allocations (in billion MPN/day *E. coli*) for Town Creek (1806E_01):

TMDL = 0.29704802 * Std
MOS = 0.01485240 * Std
LA = 0.28069349 * Std - 0.5928749
WLA_{WWTF} = 0.59600000
WLA_{SW} = 0.00150213 * Std - 0.00317251

Where:

Std = Revised Water Quality Standard
MOS = Margin of Safety
LA = Total load allocation (non-permitted source contributions)
WLA_{WWTF} = Wasteload allocation (permitted WWTF + FG) [Note: WWTF load held at existing primary contact (126 MPN/100mL) criteria]
WLA_{SW} = Wasteload allocation (permitted stormwater)

Table A-2. Summary of allocation loads for Town Creek (1806E_01) at selected revised water quality standards.

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

Std (MPN/100mL)	**TMDL**	**MOS**	**LA**	**WLA_{WWTF}[1]**	**WLA_{SW}**
126	37.428	1.871	34.775	0.596	0.186
630	187.140	9.357	176.244	0.596	0.943
1030	305.959	15.298	288.521	0.596	1.544

Appendix B

Pollutant Load Allocations by Flow Regime for Quinlan Creek and Town Creek

For the previous TMDL on the Guadalupe River (TCEQ, 2007), pollutant load allocations were determined from the median flow of each of the five flow regimes comprising the LDCs:

1. 5 percent exceedance for High Flows (0–10 percent),
2. 25 percent exceedance for Upper/Mid-range Conditions (10–40 percent),
3. 50 percent exceedance for Mid-range Flow (40–60 percent),
4. 75 percent exceedance for Lower/Mid-range Conditions (60–90 percent), and
5. 95 percent exceedance for Low Flows (90–100 percent).

For more recent bacteria TMDLs across Texas, the TCEQ has considered only the median value of the highest designated flow regime in the pollutant load allocations. Within this appendix is provided the pollutant load allocation information for each of the five flow regimes of Quinlan and Town Creeks. Tables B-1 and B-2 contain the TMDL allocation summaries comparable to what is provided in Tables 13 and 14 of this addendum (which only presented the High Flows regime), expanded to include the values for each of the five flow regimes.

Table B-1. TMDL allocation summary by flow regime for the Quinlan Creek and Town Creek watersheds.

AU	Stream Name	Indicator	Flow Regime	TMDL	WLA_{WWTF}	WLA_{SW}	LA	MOS	Future Growth
1806D_01	Quinlan Creek	*E. coli*	High Flows	18.291	0	0.143	16.756	0.915	0.477
			Upper/Mid-range Flows	9.384	0	0.071	8.367	0.469	0.477
			Mid-range Flows	6.927	0	0.052	6.052	0.346	0.477
			Lower/Mid-range Flows	4.777	0	0.034	4.027	0.239	0.477
			Low Flows	3.241	0	0.022	2.580	0.162	0.477
1806E_01	Town Creek	*E. coli*	High Flows	37.428	0.119	0.186	34.775	1.871	0.477
			High/Mid-range Flows	19.012	0.119	0.093	17.372	0.951	0.477
			Mid-range Flows	13.932	0.119	0.067	12.572	0.697	0.477
			Low/Mid-range Flows	9.487	0.119	0.045	8.372	0.474	0.477
			Low Flows	6.311	0.119	0.029	5.370	0.316	0.477

Table B-2. Final TMDL allocation summary by flow regime for the Quinlan Creek and Town Creek watersheds.

AU	Stream Name	Indicator	Flow Regime	TMDL	WLA_{WWTF}	WLA_{SW}	LA	MOS
1806D_01	Quinlan Creek	*E. coli*	High Flows	18.291	0.477	0.143	16.756	0.915
			Upper/Mid-range Flows	9.384	0.477	0.071	8.367	0.469
			Mid-range Flows	6.927	0.477	0.052	6.052	0.346
			Lower/Mid-range Flows	4.777	0.477	0.034	4.027	0.239
			Low Flows	3.241	0.477	0.022	2.580	0.162
1806E_01	Town Creek	*E. coli*	High Flows	37.428	0.596	0.186	34.775	1.871
			Upper/Mid-range Flows	19.012	0.596	0.093	17.372	0.951
			Mid-range Flows	13.932	0.596	0.067	12.572	0.697
			Lower/Mid-range Flows	9.487	0.596	0.045	8.372	0.474
			Low Flows	6.311	0.596	0.029	5.370	0.316

[a]WLA_{WWTF} includes the FG component.