2020 Update to the Plum Creek Watershed Protection Plan

DEVELOPED BY

THE PLUM CREEK WATERSHED PARTNERSHIP

Plum Creek Watershed Partnership

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Prepared by the
Plum Creek Watershed Partnership

http://plumcreekwatershed.org

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Overview

The 'Plum Creek Watershed Partnership' (Partnership) began implementation of the Plum Creek 'Watershed Protection Plan' (WPP) in February 2008 to guide the restoration and protection of water quality in Plum Creek and its tributaries. Since that time, significant changes have taken place in the watershed.

Large swaths of the watershed have been transformed by the construction of State Highway 130 and rapid residential and commercial growth along the IH-35 Corridor. The rural landscape has changed as well with a considerable increase in the number of small farms in both Hays and Caldwell County along with the precipitous increase of reported feral hog activity throughout the watershed. These changes have altered land use in many areas, affecting the implementation of several management strategies identified in the WPP. Acknowledging and understanding changes in land use and environmental fluctuations in the Plum Creek watershed is essential for determining the adaptive management strategies that will enable continued progress toward the achievement of WPP goals and objectives.

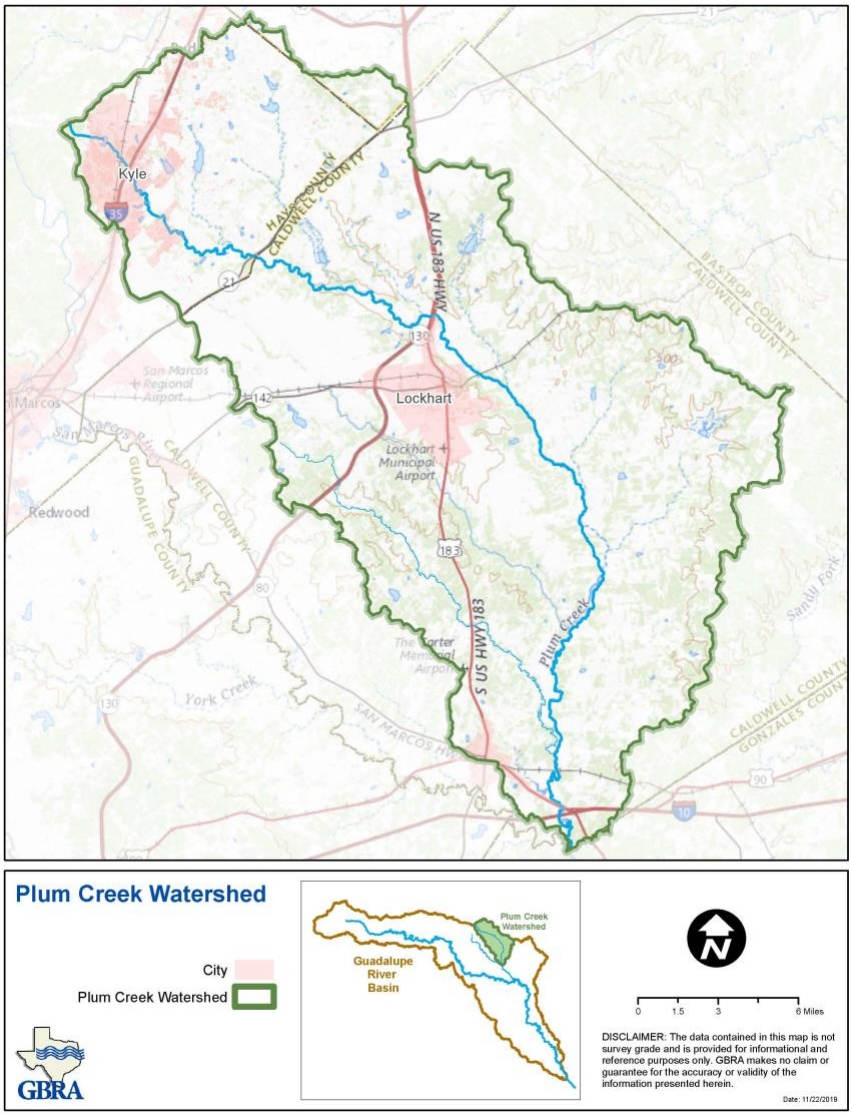

Figure 1. Plum Creek Watershed Map

In 2011, an Interlocal Agreement was signed by 12 project partners and provided matching funds or in-kind services for a CWA §319(h) grant to support a Plum Creek Watershed Coordinator (WC) responsible for continued implementation of the WPP. The presence of a local WC was desired by the Partnership to enhance stakeholder participation in watershed projects, as well as to better understand and respond to the evolving needs and interests of local communities.

The Interlocal Agreement was renewed by all partners in 2018 and a CWA §319(h) grant has secured funding for this position and WPP implementation through 2021.

Effective watershed management is neither a simple, predetermined series of steps or a "quick fix" that guarantees watershed improvement. Rather, it is a long-term commitment to stewardship of the natural resources that characterize a watershed coupled with the adoption of management practices that fit within the socioeconomic dynamics of the local communities. It is the people, not the plan, that will ultimately determine the success or failure of watershed goals. Systematic re-evaluation of prescribed management measures throughout the watershed is imperative. To maintain the greatest likelihood of success, the development, implementation and revision of best practices must consider both historic and newly acquired data along with observed social and ecological trends in the watershed. This document functions as:

- a progress report on efforts to implement the Plum Creek WPP since its initial release with a primary focus on activities and updates from January 2018 through September 2019
- a modification to the goals and strategies identified in the WPP
- an analysis of collected water quality data to ascertain interim progress in achieving water quality restoration goal

Urban Stormwater Management

The Partnership strongly recommends the implementation of low-impact development (LID) projects to mitigate threats to urban stormwater management. LID such as rain gardens, permeable pavement and other "green infrastructure" can significantly reduce stormwater intensity and pollutant loading by limiting the amount of impervious cover for new construction and replacing existing impervious surfaces with strategic retrofits. The Partnership's continued engagement with developers and local municipalities has led to additional funding and broad acceptance for an increase in LID projects throughout the watershed.

Low Impact Development in Plum Creek

As of September 30, 2019, Caldwell County has completed work on its 10,000-gallon rainwater harvesting system for the Justice Center rooftop runoff (Figure 2). Also, a rain garden, with the treatment capacity for 13,000 gallons of runoff, and 2,000 square feet of xeriscaping were installed in front of the parking lot (Figure 3). A new 13,250 square foot permeable parking lot is still in the design stages. The permeable area included in the new parking lot will have the ability to treat and drain an area of 20,000 square feet. The County has offered one workshop and one site tour. Maintenance involving several volunteer groups such as the Caldwell Master Gardeners, Pegasus School, Keep Lockhart Beautiful, and Texas State University takes place monthly during the summer and fall, fostering strong community relationships with the Partnership, while simultaneously providing a forum for community education and outreach. The Caldwell County Justice Center project, which includes highly visible best management practices (BMP) along with enhanced education and outreach efforts, serves as a prime example of one Partnership community's vision and leadership in Plum Creek WPP implementation.

Figure 2. 10,000-gallon rainwater harvesting system at the Caldwell County Justice Center

Following Caldwell County's success, the City of Kyle applied for and was awarded a CWA §319(h) grant to both demonstrate improved water quality in Plum Creek through LID BMPs and encourage adoption of more LID in booming communities along the IH-35 corridor. The LID BMPs are planned for installation at the City of Kyle Wastewater Treatment Facility (WWTF), and the construction of the LID features is pending completion of a design review and revision for the overall WWTF project. The City of Kyle is in the commission and review phase of its WWTF expansion with Texas Commission on Environmental Quality (TCEQ) over its treatment parameters, with final completion of construction projected for December 2022. LID features included this project are as follows: install 2,500 gal. rainwater harvesting system, 15,000 sq. ft. of bioswale, 5,880 sq. ft. porous concrete, 400 sq. ft. of xeriscape, 33,000 sq. ft. of open space with compost amended soil and drought tolerant native trees, shrubs and grasses.

Post-Register Thursday, September 5, 201

New green infrastructure hits Caldwell County

LPR Staff Report

A volunteer group of eight Texas State University students, six representatives from The Pegasus School and several local gardeners, residents, county officials and environmental professionals joined together on Saturday to spend two hours maintaining three green infrastructures located at the Caldwell County Justice Center.

Green infrastructures are stormwater management systems that mimic nature to treat and reduce stormwater runoff from pavement and other urban surfaces. The green infrastructures maintained by the volunteer group included two large xeriscape beds and a rain garden.

The 1,550 square-foot rain garden was installed in 2017 by the Plum Creek Watershed Partnership and is one of the largest demonstration projects for this area. It is currently used as an educational platform on stormwater management to kids, college students and the public.

Planted in the rain garden are native grasses, shrubs, and trees that provide a habitat for butterflies, insects and birds. The rain garden removes sediment, phosphorus and nitrogen from stormwater runoff before it reenters the water system. While maintaining an aesthetically pleasing appearance, this rain garden treats 2.5 acres of stormwater runoff from the concrete parking lot and can treat up to 16,500 gallons of stormwater runoff.

The volunteers accomplished the equivalent of over 40 hours of work by removing weeds, pruning plants, bagging clippings, adding mulch and watering the plants.

Following the work was an educational outreach led by Texas State student leaders. The students emphasized the importance of pollutant removal through green infrastructure and how the rain garden contributes to water quality in Plum Creek.

Top personnel on this project includes Plum Creek Watershed Coordinator Stephen Risinger, Caldwell County Grants Administrator Dennis Engelke, Caldwell County Judge Hoppy Haden, Environmental Engineer Elizabeth Arceneaux, local gardeners Lee Rust and Anna Ybarra. During the volunteer event Dennis Engelke expressed his hopes of these green infrastructures becoming "a demonstration project that can be replicated in other communities within Caldwell County". Towards the end of the event Stephen Risinger, expressed his excitement "for the community's collaboration to better the environment and for the headway for similar projects in the Plum Creek Watershed Partnership".

For more information on how you can get involved in the next Rain Garden cleanup, please contact Stephen Risinger at 830-557-7358 or srisinger@plumcreekwatershed.org

Volunteers from throughout Caldwell County work to install a new xeriscape garden at the Caldwell County Justice Center. **Photo courtesy of the Caldwell County Justice Center**

Figure 3. Image of story run in the Lockhart Post Register discussing the importance of rain gardens in storm water run-off mitigation

Additionally, the City of Lockhart launched a project that has conducted a riparian evaluation of Town Creek, a tributary of Plum Creek located almost entirely in the City of Lockhart. With funding provided by TCEQ, and U.S. Environmental Protection Agency (EPA) through a CWA §319(h) grant, the city will perform riparian restoration measures based on the findings of the evaluation. In addition, it will increase riparian buffer area no-mow zones, establish a schedule for mowing temporary public viewing areas along the creek on a rotating basis, and will install a rain garden at a city park entrance. The WC will work closely with them to conduct education and outreach associated with these measures. The City of Lockhart is currently proceeding with design options regarding the construction of a 2,000 sq. ft. rain garden as a part of the restoration of Town Creek in Lockhart, TX.

Table 1. Watershed-wide Urban Stormwater Updates

Urban Stormwater Updates through September 2019	
City of Buda	• Street sweeping – 5 miles per month • Collected 25,600 bags of waste or 6,400 lbs. • New City Municipal Complex utilizes reuse water for irrigation • Added trash racks in four ponds to reduce floatables • Updated plastic stormwater markers to metal markers for longevity
City of Kyle	• Updated and submitting the Stormwater Management Plan for TCEQ approval • 4,445 feet of reuse lines installed • Created Grow Zones (no mow zones) along Plum Creek in Steeplechase Park in FY18. • Street sweeping - 150 miles per month • 4 Rain gardens in construction as apart of Burleson Rd CIP
City of Lockhart	• Identified a large domestic waterfowl population in City Park as a potential bacteria source. • Street sweeping - 100 miles per month
City of Luling	*Still waiting on data*
Hays County	No data collected, worked with county to create efficient tracking process for septic installations and violations
Caldwell County	*Still waiting on data*

Wastewater Management

Plum Creek receives treated wastewater from 20 outfalls that are associated with 14 different TPDES permits located in the watershed (Figure 4). Plum Creek also receives substantial volumes of untreated or poorly treated wastewater generated in rural areas where septic maintenance is inadequate. These areas are generally low income, unincorporated communities lacking sufficient water and wastewater infrastructure.

Efforts to enhance wastewater management for private septic systems have seen some noteworthy progress since implementation of the Plum Creek WPP began in 2008. While improved management of septic systems continues to be hampered by limited inspection and enforcement capabilities, state agencies and local municipalities in the Plum Creek watershed have taken significant steps to provide much needed funding and incentives for the purpose of reducing the potential for pollutant loading from On-Site Sewage Facilities (OSSF).

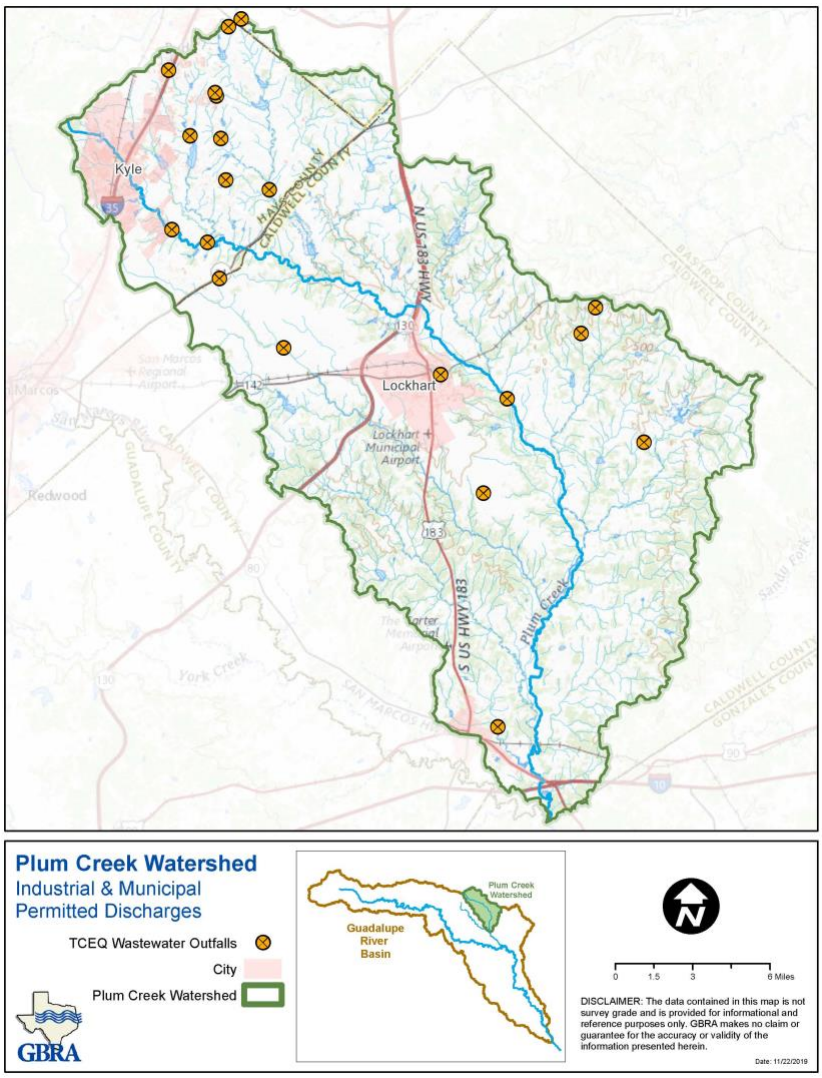

Figure 4. Plum Creek Watershed Permitted Discharge Map

Wastewater Effluent Monitoring

Funding from the EPA, through a grant from the TSSWCB, has been secured for the continued voluntary monitoring of WWTFs, and progress toward treatment improvements for centralized systems in the watershed has seen some progress. The Partnership strongly recommends that WWTFs discharging into Plum Creek and its tributaries strive to achieve 5-5-2-1 treatment levels [5 mg/L $CBOD_5$, 5 mg/L TSS, 2 mg/L NH3-N, 1 mg/L phosphorus]. The Partnership suggests that efforts to achieve WPP goals for wastewater management may require additional financial or other incentives to encourage voluntary adoption of higher treatment levels for WWTFs in the Plum

Creek watershed. While the implementation of WPP recommendations for WWTFs in the watershed is completely voluntary, Texas Pollutant Discharge Elimination System (TPDES) permit limitations and requirements are enforceable under State law.

Sewer Pipe Replacement and New Sewer Service

The cities of Buda, Kyle, Lockhart, and Luling have budgeted city funds to replace aging wastewater conveyance infrastructure. In some areas, sewer lines consist of outdated clay pipes that are easily damaged and typically are beyond their original design life. These cities continue to move forward with replacement of critical areas within city limits. The Cities have made varied progress in replacing sanitary sewer pipes since the WPP was published (Table 2).

Table 2. Sewer line repaired, replaced and/or extended

City	2014 - 2017 New/Repaired/Replaced Sewer Line (linear feet)	2018 - 2019 Sewer Line New/Repaired/ Replaced Sewer Line (linear feet)
Buda	20,954	21,120
Kyle	122,101	43, 177
Lockhart	*None reported in the watershed	27,600
Luling	*None reported in the watershed	*None reported in the watershed
Totals	**143,055**	**91,897**

Signs of new commercial and residential construction are present throughout much of eastern Hays and northern Caldwell County. Expanded wastewater service demands will be extremely high in the Plum Creek watershed over the coming decade. The Partnership will continue to engage developers and local communities to better educate new and current stakeholders on WPP goals including water reuse, Texas Land Application Permits (TLAP), LID and water conservation measures.

Septic Systems in the Watershed

Both Hays and Caldwell Counties adopted new policies and regulations to ensure proper maintenance for new and existing aerobic septic systems. In Caldwell County and the City of Uhland, owners of both new and existing aerobic systems are required to have a quarterly maintenance contract with an approved list of contractors developed by the TCEQ. Hays County does allow homeowners to maintain their own aerobic systems; however, they are required to complete The Homeowner Maintenance of Septic Systems Course offered by the Texas A&M AgriLife Extension Service.

Conventional septic systems in the Plum Creek watershed do not have the same requirements as aerobic systems. The general lack of septic system maintenance and inspection requirements for conventional systems has created a significant obstacle to addressing septic system contributions

to the water quality impairment in Plum Creek. Education and outreach efforts to improve homeowner awareness of the importance of proper septic system use and maintenance have been identified as a critical element for achieving WPP pollutant reduction goals and have been ongoing in the watershed since 2008.

Septic System Tracking

In 2019, WC has worked closely with Hays County Department of Economic Development to develop a dynamic documentation system to track newly installed septic systems, inspections, and septic violations. This system will provide an efficient means for the Partnership to perform analysis of septic related events through-out the Plum Creek watershed.

Hillside Terrace

The Partnership continues to work with Hays County and the City of Buda to find a means to connect a 264-home subdivision (Hillside Terrace) located in Plum Creek sub watershed UH-3 to central sewer service. Hillside Terrace is located in Hays County and is in the Buda Extraterritorial Jurisdiction (ETJ). This subdivision has been identified by local citizens and city and county staff as a site of chronically failing septic systems on small lots and is located in a critical sub watershed identified in the watershed planning process as having a high likelihood of impacting water quality. An unnamed tributary of Andrews Branch passes through and drains much of this neighborhood before it flows into Andrews Branch and Porter Creek that meets with Bunton Branch just before entering Plum Creek upstream of the Uhland water quality monitoring site.

After exploring numerous options over the last several years, Hays County decided to pursue a Brownfields grant Revolving Loan Fund (RLF) to fund the infrastructure needed to provide sewer to the Hillside Terrace neighborhood. Revolving Loan Fund (RLF) Grants provide funding for a grant recipient to capitalize a revolving loan fund and to provide subawards to carry out cleanup activities at brownfield sites. Through these grants, EPA strengthens the marketplace and encourages stakeholders to leverage resources to clean up and redevelop brownfields. When loans are repaid, the loan amount is returned into the fund and re-lent to other borrowers, providing an ongoing source of capital within a community. An RLF Grant applicant may apply for up to $1,000,000 to address brownfield sites contaminated by hazardous substances, pollutants, or contaminants.

Hays County is planning to connect the Hillside Terrace Subdivision to a private company's sewer system upon construction of the proper infrastructure. The Partnership will continue to work with Hays County to achieve funding for this project and procure grant funds for the decommissioning of failing OSSFs and assist Hays County with community outreach efforts to educate the public.

Table 3. TPDES wastewater discharge permits in the Plum Creek watershed.

FACILITY NAME	Type of Disinfection	MAX PERMITTED FLOW (MGD)	PERMIT NUMBER	EFFECTIVE DATE	EXPIRATION DATE	E. *coli* effluent limits	E. *coli* effluent monitoring requirements
KYLE	Chlorine	3/4.5	WQ0011041-002	10/07/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL daily max	once per week
LOCKHART NO. 2 (FM 20 Plant)	UV	1.5	WQ0010210-002	05/13/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL daily max	once per day
BUDA	Chlorine	1.5	WQ0011060-001	03/30/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL daily max	once per week
LOCKHART NO. 1 (Larremore Street Plant)	Chlorine	1.1	WQ0010210-001	02/12/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL daily max	once per week
LULING-NORTH	Chlorine	0.9	WQ0010582-002	08/18/2017	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL daily max	twice per month
RANCH AT CLEAR FORK	Chlorine	0.33/0.7	WQ0014439-001	04/20/2016	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL daily max	once per month
RAILYARDS-VILLAGE HOMES	Chlorine	0.075/0.12375	WQ0014060-001	09/10/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL single grab	once per quarter
GOFORTH	Chlorine	0.0424	WQ0013293-001	04/30/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL single grab	once per week
SUNFIELD	Chlorine	0.25/0.5/0.99	WQ0014377-001	05/04/2017	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL daily max	once per month
SHADOW CREEK (formerly CASTLETOP)	Chlorine	0.162/0.486	WQ0014431-001	05/21/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL single grab	once per month
CROSSWINDS	Chlorine	0.20/0.40	WQ0015011-001	06/24/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL single grab	once per month
WINDY HILL	Chlorine	0.45	WQ0015478-001	10/25/2016	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL single grab	once per quarter
CAMINO REAL	Chlorine	0.42	WQ0015323-001	11/2/2015	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL single grab	Once per month
CALDWELL VALLEY	Chlorine	1.55	WQ0015064-001	05/19/2017	02/01/2020	126 cfu/100mL daily avg[2]; 399 cfu/100mL single grab	Once per month

[1] Language in "Other Requirements" – The permittee is hereby placed on notice that the Executive Director of the TCEQ will be initiating rulemaking and/or changes to procedural documents that may result in bacteria effluent limits and monitoring requirements for this facility.

[2] Language in "Definitions" defines *daily avg* as the arithmetic average of all effluent samples as required by the permit within a period of one calendar month consisting of at least four separate measurements.

Agricultural Nonpoint Source Management

The Caldwell-Travis Soil and Water Conservation District (SWCD), in cooperation with the Hays County SWCD, received a TSSWCB CWA §319(h) nonpoint source grant in October 2008 to provide technical assistance for development of TSSWCB-certified Water Quality Management Plans (WQMPs). The grant has continued to be renewed, providing technical assistance and financial incentives to implement certain BMPs prescribed in the WQMPs throughout the reporting period of this WPP Update. The Caldwell-Travis SWCD hired a technician in May 2009 to provide the technical assistance and implement the program in the Plum Creek watershed within Caldwell and Hays Counties. The Caldwell-Travis SWCD technician works closely with TSSWCB and USDA-Natural Resources Conservation Service (NRCS) to provide technical assistance to landowners. Since implementation of the WPP began, over 150 conservation plans have been written and implemented.

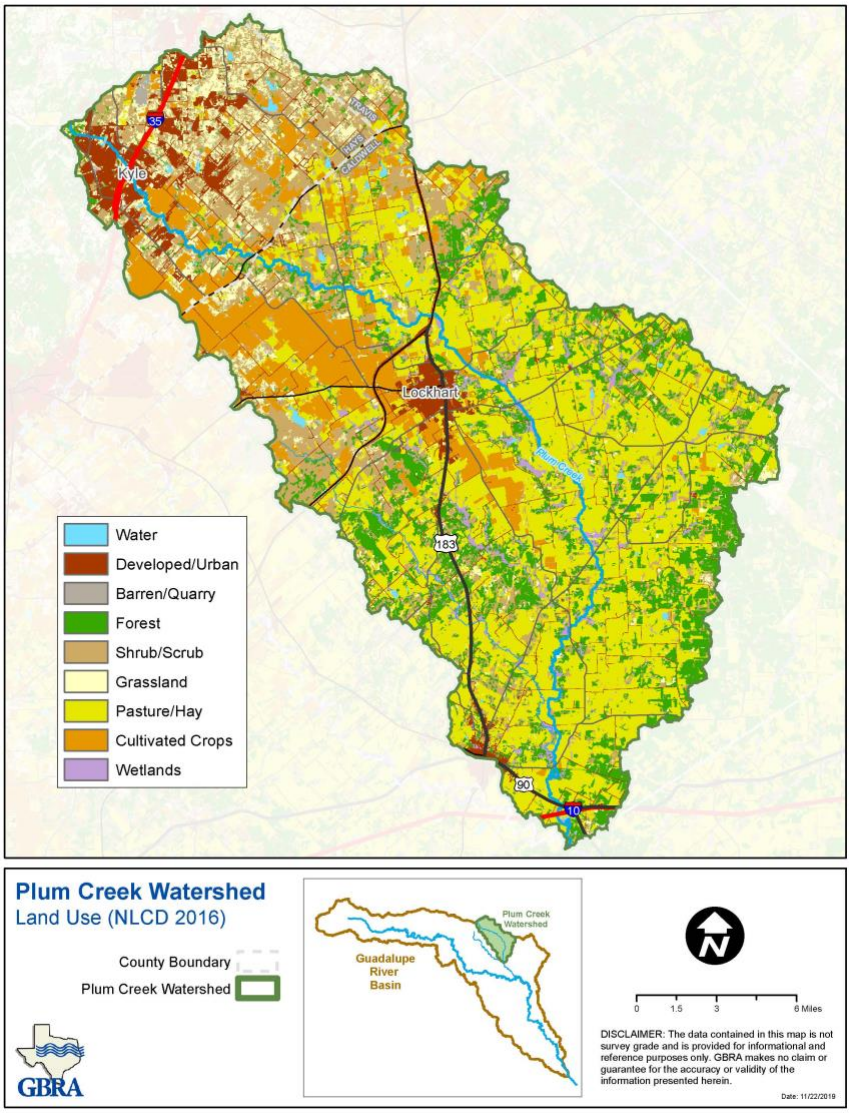

Figure 5. Plum Creek Watershed Land Use Map

2017 Census of Agricultural

The Census of Agriculture is conducted every five years by USDA's National Agricultural Statistics Service (NASS) with information directly from farmers and ranchers. NASS found the average size of Caldwell County farms in 2017 was 188 acres, down 2% from 191 acres in 2012. Furthermore, the total number of land in farms in 2017 (285,170 acres) has seen an 8% decrease since 2012.

The number of farms with cropland decreased by 5% from 2012 to 2017, however the number of acres of cropland has increased by 21% from 55,928 acres in 2012, to 67,906 acres in 2017. Among livestock operations, NASS counted an 11% decline in the number of cattle ranches in Caldwell County, with a total of 1114 farms in 2017. Contrasting with the decline in cattle ranches, beef cattle numbers increased by 10% in 2017.

Small Farms Trending Up

Despite rapid development and population increase, the total acreage committed to agricultural use has seen a noticeable increase with an additional 11,987 acres in Caldwell County and 22,688 acres in Hays County. Small farms, particularly those under 50 acres, have risen significantly in Caldwell County from 2012 to 2017[1]. This could be in part, due to the migration of residents from surrounding metropolitan areas into more rural communities. Table 4 provides selected agricultural data for Caldwell County and Hays County.

Table 4. Selected data from USDA Census of Agriculture for Caldwell County and Hays County.

County	Number of Farms		Land in Farms (Acres)		Average Size of Farm (Acres)		Total Cropland (Acres)		Number of Small Farms (<50 acres)	
	2012	2017	2012	2017	2012	2017	2012	2017	2012	2017
Caldwell	1,623	1,517	310,433	285,170	191	188	55,928	67,906	693	726
Hays	1,439	1,128	245,006	263,239	170	233	30,315	52,995	750	608
Note: 2017 Land in Farms as a percent of Total Land Area – Caldwell County (88%), Hays County (56%)										

[1] USDA, National Agricultural Statistics Service, 2012 and 2017 Census of Agriculture – County Data

In 2012 the Caldwell County AgriLife Extension Leadership Advisory Board identified small acreage farms as a primary area of concern, recognizing the trend toward smaller farms and noting the changing demographics of rural land ownership in Caldwell County away from legacy landowners toward those with limited experience and/or knowledge of sustainable agricultural management practices. AgriLife Extension has taken steps to address the increasing number of smaller farms with a "Small Acreage Landowner, Land Management Series" that offered yearly workshops held on September 20, 2018, and July 25, 2019, drawing approximately 40 attendees each.

The Partnership feels it is critical that new landowners are educated on proper livestock stocking rates, nutrient management and riparian ecosystem function. Additional agricultural and water quality outreach to this demographic could yield significant improvements in water quality throughout the Plum Creek watershed.

Wildlife and Non-Domestic Animal Management

In the State of Texas, feral hogs cause a variety of problems including agricultural damage, predation of livestock, pets, and wildlife, transmission of disease and parasites, and extensive environmental damage.

Feral Hog Control in the Watershed

Plum Creek watershed stakeholders have taken on the challenge of controlling feral hog populations directly. As the statewide Texas feral hog population continues to increase, landowners in Caldwell and Hays County, with guidance and support from the Partnership, have come together with local government officials, professional trappers, recreational hunters, agricultural organizations, environmental groups, wildlife management associations, outdoor enthusiasts, multiple state agencies, a private helicopter company, a toll road operator, and river authority to implement an innovative program that seeks to take this part of Central Texas back from the feral hogs.

A Texas A&M AgriLife Extension County Feral Hog Abatement Grant was applied for and subsequently awarded to Caldwell County. Due to the limited timeframe for fund expenditure, primary abatement efforts took place over just a two-month period, July and August 2018. Total documented feral hog abatement through county implemented bounty programs over this period included the removal of over 1,000 feral hogs in the Plum Creek Watershed. Additionally, over a 7-month period from March 2019 through August 2019, over 2,600 feral hogs were removed from the Plum Creek watershed through hunting/trapping methods by individual landowners. Due to the resounding success and high participation rates of the Caldwell County Bounty Program, additional funding was needed to extend the program until its official close in August of 2019. In response, the Caldwell County Commissioner's Court convened on March 8, 2019, and approved an additional $3,000 to ensure funding lasted until the official close of the program.

Central Texas
FERAL HOG TASK FORCE

Figure 6. Feral Hog Task Force Logo

To support AgriLife Extension efforts, and to increase local participation of landowners in Caldwell County, the WC worked with the Central Texas Feral Hog Task Force to implement the ongoing maintenance of the County's wireless trap cooperative and bounty program. In 2018 a grant was secured from the Texas Department of Agriculture (TDA) to conduct aerial control of feral hogs, which resulted in the removal of an additional 100 hogs. The Partnership and WC will continue to work with Caldwell County to develop a sustainable, long-term funding mechanism to continue their efforts in the Plum Creek watershed.

Bacterial Source Tracking

The Partnership collaborated with TSSWCB, GBRA and Texas Water Resources Institute (TWRI) to initiate a Bacterial Source Tracking (BST) project to help address the impacts of land use changes in the Plum Creek watershed over the last 10 years. Bacterial source tracking is a valuable tool for identifying human and animal sources of fecal pollution. Water samples were collected at five sites in the watershed over a 12-month period.

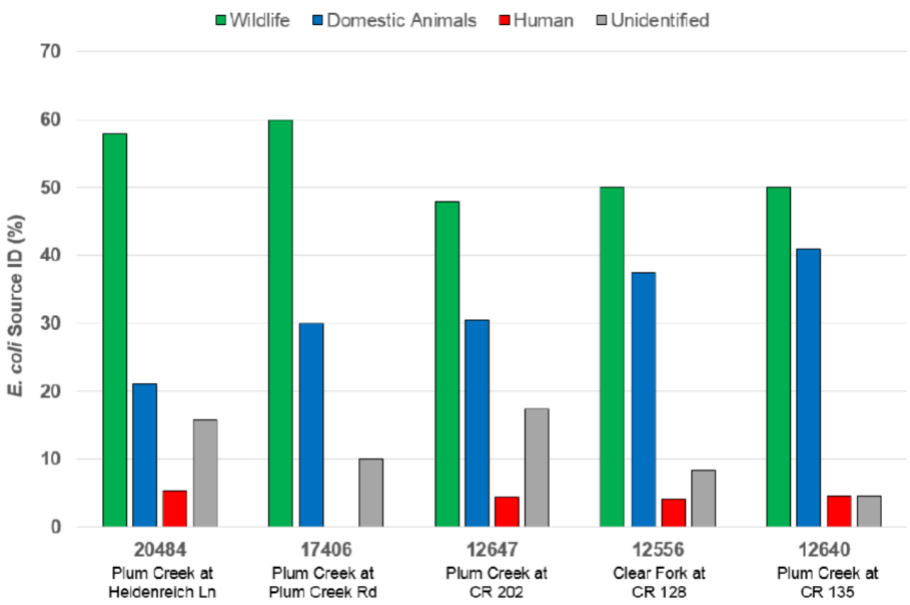

Figure 7. Plum Creek Watershed BST Results Graphic

E. coli from wildlife (avian and non-avian) dominated all sources (53%), followed by domestic animals (32%) and human sources (4%). When sources were compared across the five sampling sites, there was generally a decrease in wildlife contributions and an increase in livestock and domesticated animal contributions from the upper to lower portions of the watershed. In all cases, human *E. coli* represented a small proportion of identified isolates and were primarily found in samples collected below WWTF outfalls.

At a Partnership meeting held Thursday February 12th, 2019, The Partnership designated the following sub-watersheds as focus areas for agricultural and stormwater BMP implementation as a direct result of the BST findings; UH-1, LO-1, LO-8, LU-12, LU-6, LU-19, LU-20, LU-21.

Outreach and Education Strategy

PUBLIC OUTREACH

Education of citizens in the watershed to increase awareness and facilitate involvement in the Plum Creek WPP process continues to be of tremendous significance in the push to reduce nonpoint source pollution. The WC coordinates quarterly stakeholder meetings and regularly makes site visits to assist or consult watershed landowners and municipal officials with project planning. At times, the WC has also served as a liaison between landowners and regulatory agencies when questions or concerns arise about possible violations and impacts to water quality. Informal one-on-one or small groups meetings facilitated by the WC have also provided many opportunities for new partnerships, enhanced cooperatives and innovative solutions for water quality concerns in the watershed.

Plum Creek Watershed Protection Plan

The Plum Creek WPP is a 176-page document that can be found electronically at the Plum Creek Website at http://www.gbra.org/plumcreek/watershed-protection-plan.aspx. Copies have been distributed throughout the watershed at Partnership Meetings, city council and county commissioner court meetings, field days, workshops, and other events as of the reporting period. The 2018 WPP Update and original WPP have been distributed at local and statewide meetings, workshops and events. PDFs of these documents may also be downloaded from the website at gbra.org/plumcreek.

Plum Creek Contact List and Targeted Outreach

The Partnership has made great strides to engage stakeholders through enhanced electronic communication protocols defined by a targeted outreach approach focusing on the delivery of user-specific content. Sign-up sheets have been made available at numerous state and local events attended by the WC through September 2019. In addition to general contact information, individuals are asked to identify any related professional or volunteer organizations with which they are affiliated, as well as to prioritize specific Plum Creek WPP components for which they would like to receive additional information including:

- Feral hog programs
- Water Quality Management Plans
- Volunteer opportunities

As of September 2019, the Partnership's stakeholder contact list has grown to well over 1,300 individuals and groups. Further, the delivery of project-specific materials, meeting announcements, RSVPs and updates can now be directed toward designated audiences and critical stakeholders using a Constant Contacts account managed by the WC. The targeted approach to outreach has been applied to selected Partnership meetings and other watershed programs. One key objective for the WC was to ascertain and strive to understand local concerns and attitudes toward issues with the potential to impact the watershed. The Partnership website and Facebook page provide additional outreach tools and are maintained and updated regularly by the WC. As a result of these efforts, quarterly Partnership Steering Committee meetings, community events and technical workshops have been consistently well attended by new and repeat stakeholders.

Outreach at Local Meetings, Workshops and Events

The Partnership coordinates workshops and participates actively in several local annual events that have a strong environmental stewardship component. These include the City of Kyle, *Plum Creek Watershed Clean-Up*; Keep Lockhart Beautiful, *Plum Creek/Town Branch/Lockhart Springs Clean-Up*; Luling Foundation Field Day; and Chisholm Trail Roundup. Since 2006, approximately 10,000 individuals have been reached with information on Partnership efforts in the watershed through these events. Table 5 provides a detailed list of workshops and events coordinated by the WC and Partnership throughout the 2018-2019 reporting period.

Table 5. Plum Creek Watershed Partnership Workshops and Events 2018-19

Date	Workshop/Event	Location
Feb. 2018	Plum Creek Partnership Steering Committee Meeting	Kyle, TX
Nov. 2018	Plum Creek Agricultural Farm Tour	Caldwell County, TX
Nov. 2018	Keep Lockhart Beautiful Town Branch Cleanup	Lockhart, TX
Dec. 2018	Plum Creek Partnership Public Meeting	Kyle, TX
Feb. 2019	34th Annual Texas River Cleanup along Plum Creek	Kyle, TX
Feb. 2019	Plum Creek Partnership Steering Committee Meeting	Uhland, TX
Mar. 2019	Caldwell County Feral Hog Bounty Collection	Lockhart, TX
Apr. 2019	Healthy Lawns Healthy Waters Homeowner Workshop	Lockhart, TX
Apr. 2019	Earth Day Watershed Model Demonstrations	Kyle, TX
Apr. 2019	Caldwell County Feral Hog Bounty Collection	Lockhart, TX
May. 2019	Keep Texas Waterways Clean Plum Creek Pickup	Lockhart, TX
May. 2019	Caldwell County Feral Hog Bounty Collection	Lockhart, TX
May. 2019	Public PCWP Meeting/Soil Health & Turf Management Workshop	Luling, TX
May. 2019	Caldwell County Justice Center Rain Garden Maintenance	Lockhart, TX
Jun. 2019	Healthy Lawns Healthy Waters Homeowner Workshop	Lockhart, TX
Jun. 2019	Caldwell County Feral Hog Bounty Collection	Lockhart, TX
Jun. 2019	Caldwell County Justice Center Rain Garden Maintenance	Lockhart, TX
Jun. 2019	Chisholm Trail Roundup Post-Event Cleanup	Lockhart, TX
Jul. 2019	Caldwell County Justice Center Rain Garden Maintenance	Lockhart, TX
Aug. 2019	Healthy Lawns Healthy Waters Homeowner Workshop	Kyle, TX
Aug. 2019	Homeowner OSSF Workshop	Uhland, TX
Aug. 2019	Caldwell County Feral Hog Bounty Collection	Lockhart, TX
Sept. 2019	Riparian & Stream Ecosystem Training	Lockhart, TX
Sept. 2019	Plum Creek Partnership Steering Committee Meeting	Lockhart, TX

In addition to presentations and annual project updates given to Partnership businesses, organizations and municipalities, the WC regularly engages the public at quarterly meetings of the Partnership Steering Committee. As public interest in Partnership activities has grown, the WC has been invited to serve as the keynote speaker or featured presenter for several local and regional organizations representing a diverse array of watershed stakeholders including:

- Lost Pines and Caldwell Master Gardeners
- City of Lockhart Beautification Committee
- Clear Fork Wildlife Management Association
- Caldwell County American Legion
- Texas Parks and Wildlife Department
- Plum Creek Elementary School
- City of Kyle Public Library Earth Day Event
- Central Texas Feral Hog Task Force

GBRA Youth Education and Plum Creek School Water Quality Project

To promote youth education and involvement in the Partnership, a water quality monitoring program was initiated in the 2006-2007 school year and is being conducted annually. Over 8,000 students and teachers from Hays ISD, Lockhart ISD, and Luling ISD schools have participated in classroom instruction and hands-on investigation of water quality in Plum Creek since 2006. GBRA's effort has continued with a total of 4,975 fourth and fifth grade students and over 30 teachers conducting a round of water quality testing in the classrooms. The GBRA Ag Fair held each year at the Big Red Barn near Seguin, TX, has provided hands-on educational opportunities for thousands of area elementary students throughout the Guadalupe-Blanco River Watershed, including Plum Creek Elementary Schools. Each year, the Plum Creek WC demonstrates runoff potential and erosion effects for a variety of land uses and land cover types using a rainfall simulator. Table 6 highlights the impact of GBRA's youth education programs from 2018 - 2019.

Table 6. Highlights of the GBRA youth education program, Jan. 2018 through Sept. 2019

Spring 2018	Lockhart State Park Spring presentations to Lockhart fifth graders (300 students Hays and Lockhart ISDs water quality testing program fourth graders (360) Composition Challenge (6 Plum Creek schools, 480 fourth grade students)
Fall 2018	Lockhart State Park Fall presentations to Lockhart fifth graders (300 students)
Spring 2019	Lockhart State Park Spring presentations to Lockhart fifth graders (390 students) Hays and Lockhart water quality testing program fourth graders (500) Composition Challenge (5 Plum Creek schools, 340 fourth grade students)
Fall 2019	Lockhart State Park Fall presentations to Lockhart fifth graders (300 students)

Volunteer Monitoring

Texas Stream Team (TST) is an environmental education and monitoring program administered by Texas State University-San Marcos funded through a Clean Water Act §319 grant from TCEQ. TST is a network of trained volunteers collecting water quality data on lakes, rivers, streams, wetlands, and estuaries across the state. In addition to their trainings regularly held in San Marcos, TST has provided numerous educational opportunities for watershed stakeholders. As of this update, efforts are being pursued to have a dedicated Stream Team Citizen Scientist Trainer in the Plum Creek Watershed. Additionally, the Lockhart Chapter of the Lyon's Club approved to fund the procurement of a Texas Stream Team Core Water Monitoring Kit in a unanimous vote at the Lyon's Club monthly meeting in September 2019. The Dr. Eugene Clark Public Library in Lockhart, TX has verbally agreed to house a Texas Stream Team Water Quality Monitoring kit, allowing constant access to trained monitors when sampling in the Plum Creek Watershed.

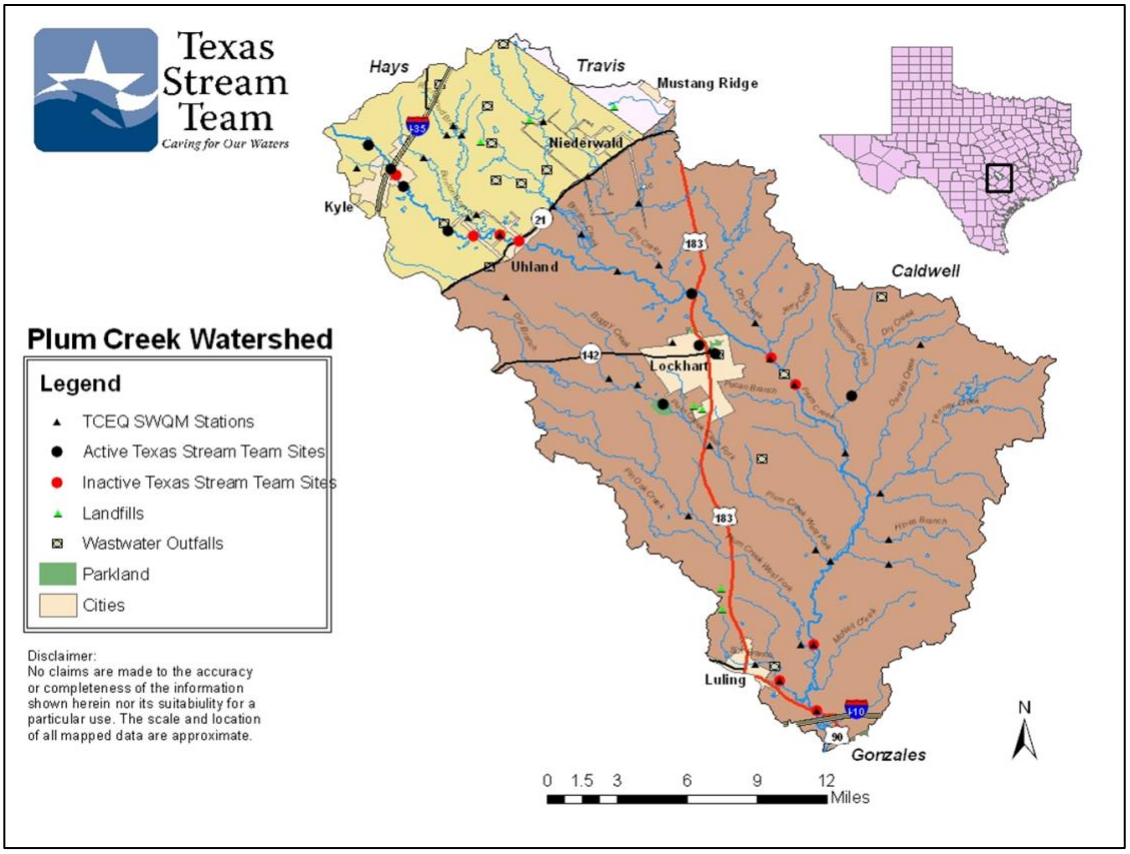

Figure 8. Map of volunteer monitoring locations in the Plum Creek watershed.

TARGETED POLLUTANT SOURCE OUTREACH EFFORTS

Household Hazardous Waste and Recycling Programs

The City of Lockhart has taken an aggressive approach to attaining grant funding and budgeting local funds to enhance Household Hazardous Waste (HHW) management and recycling. A TCEQ CWA §319(h) grant awarded to the City of Lockhart included provisions for hosting annual hazardous and electronic waste collection days in April 18, 2018 and March 2, 2019. During 2019, The City has utilized additional funds including a Capital Area Council of Governments (CAPCOG) FY 2018 Solid Waste Grants, see Table 7 for collection results.

Table 7. City of Lockhart household hazardous waste collection event results, 2018 thru 2019.

Year	Total # Households	HHW collected in lbs.	Hazardous Paint in lbs.
2018	121	11,495	208
2019	222	21,090	4,175
Total	343	32,585	4,383

The cities of Kyle, Buda and Lockhart each provide information on their websites regarding HHW and recycling. Hays County residents, including the cities of Buda and Kyle now have access to free HHW disposal twice per week thanks to an agreement between Hays County and the City of San Marcos. A private company provides hazardous waste disposal for Luling businesses but does not service residential customers.

Low Impact Development Workshops

Rapid urban development continues through the Plum Creek watershed increasing the priority of stormwater management. A volunteer group of Texas State University students, The Pegasus School, and several representatives from Keep Lockhart Beautiful joined together on the final Saturday during the summer and fall months to spend two hours maintaining three green infrastructure components at the Caldwell County Justice Center. The volunteers accomplished the equivalent of over 40 hours of work by maintaining these structures. The WC held an educational workshop that explained the importance of green infrastructure to the water quality in the Plum Creek watershed after each workday. Working with several volunteer groups such as the ones mentioned above help the Partnership to develop strong community relationships, while simultaneously providing a forum for community education and outreach.

Figure 9. Group of volunteers tending to the Caldwell County Justice Center's rain garden as a part of monthly maintenance efforts by several community groups

Nutrient, Crop, and Livestock Grazing Management Education

Agricultural and Natural Resource education programs have been provided frequently for Caldwell County and Hays County residents and producers. During 2018 and 2019 several programs have emphasized nutrient, crop, and livestock grazing management and practices. From January 2018 to September 2019 the following programs have been conducted:

- September 20, 2018- Small Acreage Stewardship Workshop (40 attendees)
- November 2, 2018- Plum Creek Watershed Conservation Farm Tour
- May 30, 2019- Public PCWP Meeting (42 attendees)
- July 25, 2019- Small Acreage Stewardship Workshop (39 attendees)
- September 5, 2019- Wildlife Management Workshop (41 attendees)

Plum Creek Watershed Conservation Farm Tour

The Caldwell-Travis SWCD hosted a Plum Creek Watershed Farm Tour on November 7th, 2018, to highlight local conservation efforts within the Plum Creek Watershed.

Figure 10. Gathering of attendees at the Plum Creek Watershed Farm Tour held on November 7th, 2018

The SWCD Technician in Caldwell County, presented at the first stop on a property with an active Water Quality Management Plan to discuss the various BMPs that had been implemented. A water quality management plan (WQMP) is a site-specific plan developed through and approved by soil and water conservation districts for agricultural or silvicultural lands. The plan includes appropriate land treatment practices, production practices, management measures, technologies or combinations thereof. The purpose of WQMPs is to achieve a level of pollution prevention or abatement determined by the TSSWCB, in consultation with local soil and water conservation districts, to be consistent with state water quality standards.

The tour also included a stop at a local agricultural producer's property that demonstrated crop rotations, irrigation water management, soil health, water quality, pest management, and nutrient management.

Soil Testing Campaign

During the reporting period, annual soil testing campaigns have been conducted by the Caldwell-Travis SWCD. TSSWCB and EPA provided grant funding through a CWA Section 319(h) grant to pay for over 20 soil samples in the watershed from 2018-2019. A soil test is an important tool that provides valuable information to help landowners make informed nutrient management decisions.

Figure 11. Public Plum Creek Partnership meeting /Soil Health and Turf Management Workshop on May 30, 2019

Stream and Riparian Workshops

Riparian workshops have been held in the watershed to educate landowners and managers of property adjacent to Plum Creek and its tributaries with a focus on management practices to restore and maintain riparian health in these critical areas. The Partnership has placed a high value on protecting and restoring riparian areas within the watershed. If properly implemented, most of the best practices identified in the WPP will serve to help improve riparian ecosystem health and allow natural restoration of these sensitive but resilient areas to take place.

Online Education

Stormwater Management Module - CWA §106 funds from TCEQ and EPA enabled GBRA to develop an online educational module for municipal operations employees outlining the processes and best practices for urban stormwater management. The module has been promoted among watershed cities and is available on the Partnership and GBRA websites at http://www.gbra.org/stormwater/default.aspx. Since it was developed in September 2009, a total of 2,068 unique visitors have utilized the module.

Online Septic System Module - CWA §106 funding from TCEQ and EPA also supported GBRA and AgriLife Extension efforts to develop an online module to address the proper function and maintenance of septic systems. Illustrating both conventional and aerobic systems, the module was developed for OSSF owners, professional installers, maintenance providers, and inspectors. The module is available in both English (http://www.gbra.org/septic.swf) and Spanish (http://www.gbra.org/septic-spanish.swf) and can be found on the GBRA website. Since its launch in 2009, the module has been utilized by 107,396 unique visitors. While initial efforts focused on local municipal officials, schoolteachers, and residents in the Plum Creek watershed, this module has been promoted across the state and has been utilized in several other watershed efforts.

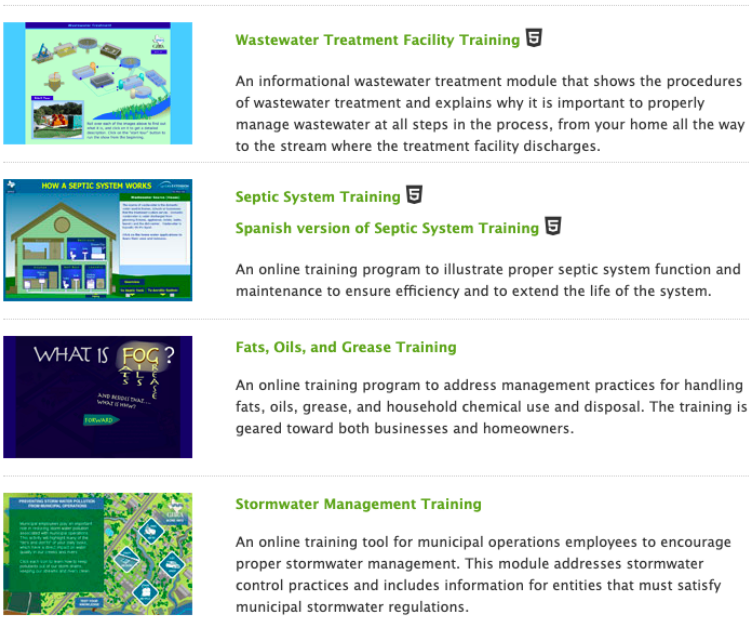

Figure 12. Screenshot of Online Fats Oils, and Grease Module

Online Fats, Oils, and Grease Module –CWA §106 funds from TCEQ and EPA supported the development of an online training module to outline management practices for handling FOG. The module also addresses proper use and disposal of household hazardous chemicals and is geared toward both businesses and homeowners. The module is available on the GBRA and Partnership websites

Online Wastewater Treatment Facility Module - CWA §106 funds from TCEQ and EPA were used by GBRA to develop an online informational wastewater treatment module that addresses treatment methods and processes and explains the importance of proper wastewater management to protect the quality of receiving waters. In addition to being distributed to public officials and watershed residents by email and over 760 post cards, this module was sent to wastewater facility operators for use in educating the public. The module is available on both the Partnership and GBRA (http://www.gbra.org/wastewater-treatment.swf) websites and has received 214,392 unique visitors since its launch in 2009.

Partnership Website and Facebook Page

The Partnership website (http://gbra.org/plumcreek) is maintained by and hosted by the GBRA. The site includes information about the Plum Creek watershed, background on the WPP and the Partnership, links to updated water quality data, information on feral hog control and other management programs, descriptions of outreach efforts, a list of upcoming events, a library of resources developed for the Partnership, and links to project partners and related sites. The number of page views and rate of new visitors to these websites are valuable metrics for determining the popularity of new projects and sustained interest in existing watershed programs. During the reporting period, the Plum Creek Watershed Partnership webpage was visited over 3,000 times, averaging approximately 150 individual visits per month. Maintaining public interest and expanding the reach of WPP programs to new audiences are critical to Partnership sustainability and WPP success.

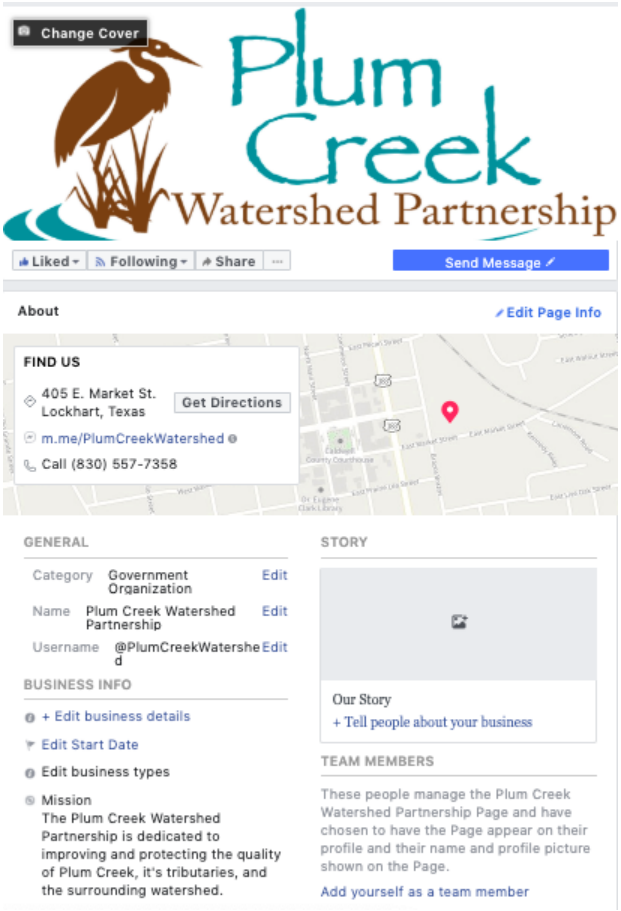

Figure 13. View of the Plum Creek Watershed Partnership Facebook Page

Social media platforms, such as the Partnership's Facebook page, have been created to engage local stakeholders with photos and commentary on Partnership events, announce watershed activities, highlight media coverage and provide links to additional resources. The WC regularly posts educational material that pertains to WPP implementation of the Partnership Facebook page that regularly reaches over 100 users per month. The WC also regularly consults with stakeholders through means of the Partnership Facebook page and the use of @PlumCreekWatershed, scheduling site visits and to circulate information regarding the WPP. The Partnership Facebook page has earned a "Fast Responder" badge with prompt feedback within 2 hours or less. Outlets such as the Partnership Facebook page streamline the stakeholder outreach process and expanding the reach of the Partnership.

ILLEGAL DUMPING/LITTER PREVENTION CAMPAIGN

The Great Texas River Cleanup

About 120 people participated in the city of Kyle's inaugural event in conjunction with the 33rd annual Great Texas River Cleanup. The initiative, held March 3, 2019, focused on cleaning litter and debris from creeks and tributaries that flow into the San Marcos and Blanco rivers. The first location for the city's inaugural effort was held at Waterleaf Park, near the headwaters of Plum Creek. 58 volunteers and community leaders worked tirelessly to remove 2000 lbs. of trash, 550 lbs. of metal recycling, 40 lbs. of non-metal recyclables, and 4 tires from the Plum Creek Watershed.

Figure 14. Great Texas River Cleanup Billboard along I-35 in Kyle, TX

"We worked with them (The Great Texas River Cleanup) because we wanted to bring forward storm water awareness and make people aware that what gets thrown in ditches and what gets thrown in parking lots can go into the creek," said Kathy Roecker, Stormwater Management Plan Administrator for the City of Kyle and Plum Creek Watershed Partnership Board Member.

Keep Texas Waterways Clean: Plum Creek Pickup

In an effort to spread awareness of active implementation activities described in the original WPP, the WC coordinated with The Guadalupe-Blanco River Trust, and The Keep Texas Waterways Clean program to organize a waterway cleanup at 2 sites along Town Branch and Plum Creek proper, which runs through the Plum Creek Wetlands Preserve that was procured by The Guadalupe-Blanco River Trust in 2015. The property contains a diverse mix of habitat types, including over a mile of riparian woodlands along Plum Creek, emergent and forested wetlands, and deep-water wetlands. This is a unique opportunity as wetland habitats of this size are rare in central Texas.

Originally slated for May 4, 2019, the Keep Texas Waterways Clean: Plum Creek Pickup had secured over $1,000 in donations and in-kind services. The Plum Creek Pickup also received commitments from over 40 volunteers representing several community groups such as Lockhart National Honors Society, Caldwell 4-H, and Keep Lockhart Beautiful.

Figure 15. Keep Texas Waterways Clean Event Poster

Unfortunately, the event was postponed twice due to inclement weather and was ultimately cancelled. The WC intends to establish this spring clean-up event as a yearly occurrence. Events like these are great for the community while simultaneously providing an opportunity to educate local stakeholders about the positive effects that trash cleanups, and areas such as the Plum Creek Wetlands Preserve have on watershed health.

KEEP LOCKHART BEAUTIFUL

With the City of Lockhart's commitment to becoming an official Keep Texas Beautiful Affiliate, the decision was made by the City and the Partnership in 2013 that developing a Keep Lockhart Beautiful (KLB) Cleanup Subcommittee under the auspices of the City's "Keep Lockhart Beautiful" program would be a mutually beneficial collaboration, serving to bolster the City's new program and provide oversight and accounting for Cleanup Event funds and services. The WC currently sits on the Keep Lockhart Beautiful Board of Directors and serves as the chair of the KLB Cleanup Subcommittee.

Figure 16. 11th Annual, Keep Lockhart Beautiful Cleanup, November 2018

From 2018-2019 the Partnership worked with KLB, GBRA and the City of Lockhart to continue the annual *KLB Cleanup* (Figure 15). More than forty local businesses, organizations and individual sponsors contributed over $3,000 to the effort each year. Volunteer rates continue to remain high, with well over 200 volunteers attending the cleanup and participating in the cleanup each year. The WC consistently looks for more cleanup opportunities in the watershed. One such event was the Chisholm Trail Roundup, where a group of 12 volunteers from Pegasus School (Figure 16) removed trash and debris from the parade route and distribute over 200 trash bags to parade attendees.

Figure 17. 2019 Chisholm Trail Roundup volunteer group from Pegasus School

Measures of Success

The Texas State Soil and Water Conservation Board (TSSWCB) provided Clean Water Act (CWA) §319(h) funding for the Guadalupe-Blanco River Authority (GBRA) to conduct intensive implementation monitoring to supplement data collected by the Clean Rivers Program (CRP) for Texas Commission on Environmental Quality (TCEQ) assessments. The current GBRA contract 17-09 monitoring regime includes routine, wet and dry weather targeted, wastewater treatment facility (WWTF) discharges, and spring monitoring. GBRA samples the eight routine stations and seven WWTFs on a monthly basis. GBRA collects thirty-seven targeted stations at a frequency of eight times per year during both dry and wet weather conditions. In order to track groundwater contributions, GBRA monitors three spring stations, four times per year, on a seasonal basis. The most recent TCEQ 2018 draft biennial assessment of Plum Creek identified impairments of the contact recreation standard for *E. coli* and concerns for nutrient concentrations greater than the screening limit. The regulatory threshold for *E. coli* is 126 MPN/100mL. The screening limits for nutrients are 0.69 mg/L for total phosphorus, 1.95 mg/L for nitrate nitrogen and 0.33 mg/L for ammonia nitrogen. GBRA performed descriptive statistics at each of the monitoring stations for the four parameters discussed in the Plum Creek WPP. The following tables and figures summarize the geometric means for *E. coli* and the average concentrations for nitrate nitrogen, total phosphorus and ammonia nitrogen. The geometric mean is an average of data that has been transformed to control for extreme differences in observed concentrations. These tables utilize all data collected from the implementation of the Plum Creek WPP in 2008 to the end of the current TSSWCB 17-09 monitoring project in September 30, 2019.

PLUM CREEK MAINSTEM STATION MONITORING

GBRA collects routine and wet and dry weather targeted water quality monitoring at twelve stations on the main stem of Plum Creek. Routine sampling occurred at three stations representative of the upper (Plum Creek at Plum Creek Road), middle (Plum Creek at CR 202) and lower (Plum Creek at CR 135) portions of the watershed. GBRA collected weather targeted samples at nine additional main stem stations. The TSSWCB chose each of these stations in order to quantify longitudinal changes in pollutant loading from point source discharges and contributing tributaries (nonpoint sources) throughout the watershed. Table 8 provides a summary of the *E. coli* and total phosphorus concentrations and Table 9 summarizes the nitrate nitrogen and ammonia nitrogen at these stations. These tables include geometric means of *E. coli* and average concentrations of nutrients for all data collected during WPP implementation. These tables also separate results into samples collected during wet weather conditions with runoff influence, and samples collected during dry weather conditions. Target concentrations for these tables are less than the regulatory screening criteria of 126 MPN/100 mL for *E. coli*, 1.95 mg/L for nitrate nitrogen, 0.69 mg/L for total phosphorus and 0.33 mg/L for ammonia nitrogen. The headwaters of Plum Creek, downstream of NRCS reservoir #1, is the only main stem monitoring station with an *E. coli* geometric mean concentration less than the regulatory standard. Average total phosphorus and nitrate nitrogen concentrations are greater than the screening criteria at all Plum Creek main stem stations downstream of the Lehman road station. Average ammonia nitrogen concentrations that are greater than the screening criteria are localized to the Heidenreich Road and Plum Creek Road monitoring stations upstream of State Highway 21 and the city of Uhland.

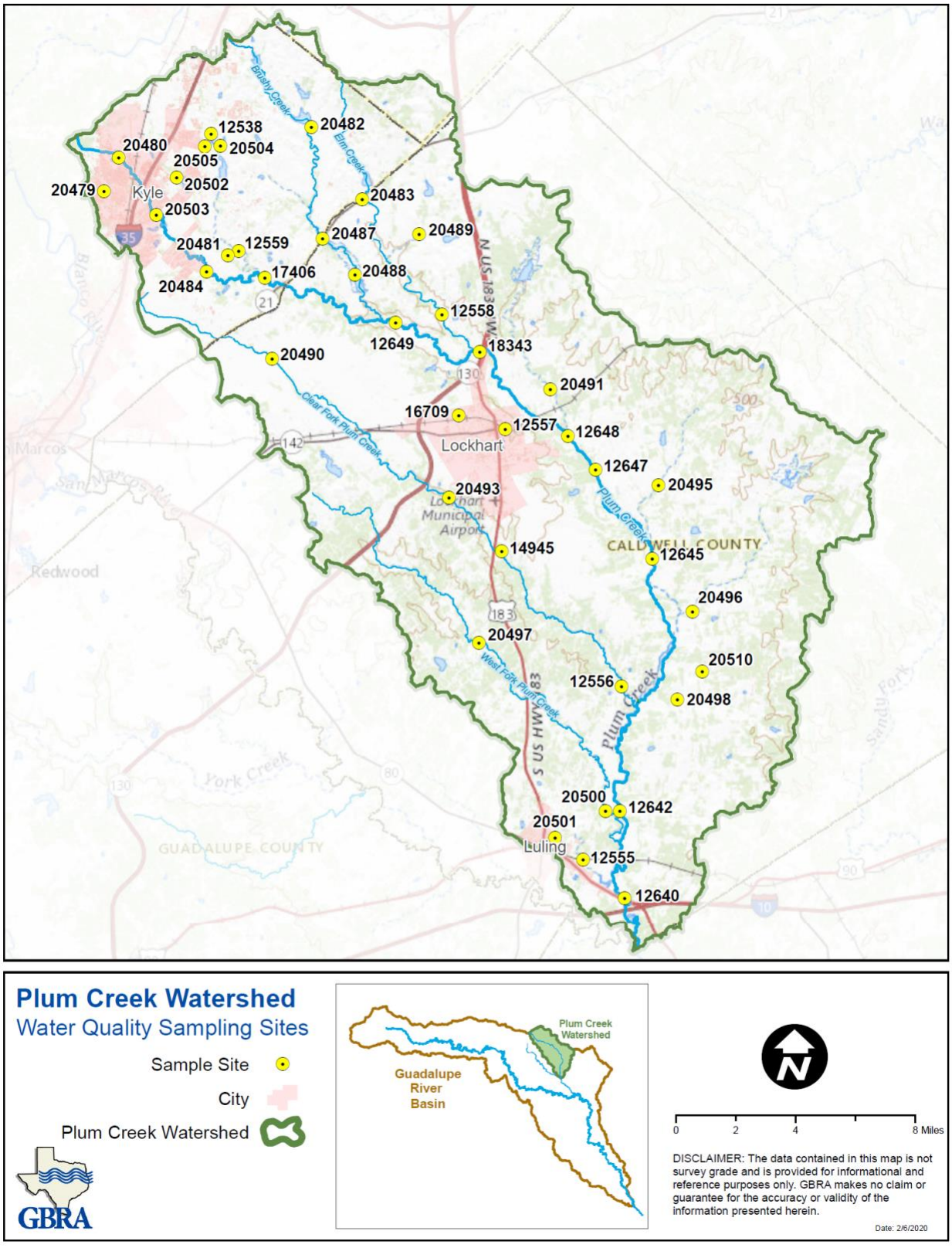

Figure 18. Plum Creek Water Quality Sampling Stations

Table 8. Water quality monitoring results for *E. coli* and total phosphorus in Plum Creek main stem from 2008 - 2019.

Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	*E. coli* (MPN/100 mL) Geomean	*E. coli* (MPN/100 mL) Geomean Wet	*E. coli* (MPN/100 mL) Geomean Dry	Total P (mg/L) Mean	Total P (mg/L) Mean Wet	Total P (mg/L) Mean Dry
Plum Creek at NRCS #1 (20480)	0.0	0.6	0.0	41	77	17	0.22	0.20	0.25
Plum Creek at Lehman (20503)	0.6	3.7	0.10	255	474	131	0.05	0.07	0.03
Plum Creek at Heidenreich (20484)	4.1	10.0	2.7	1324	1652	1092	2.47	1.69	3.25
Plum Creek at PC Rd (17406)	4.7	23.5	2.2	484	761	379	1.95	0.98	2.47
Plum Creek at CR 233 (12649)	7.4	34.0	2.7	288	643	129	1.47	0.90	2.04
Plum Creek at HWY 183 (18343)	8.0	90.0	3.2	240	643	84	1.18	0.80	1.59
Plum Creek at CR 186 (12648)	7.3	49.0	3.8	389	690	207	0.88	0.72	1.06
Plum Creek at CR 202 (12647)	10.0	54.0	6.3	324	654	210	1.01	0.74	1.18
Plum Creek at CR 197 (12645)	9.5	44.0	5.4	439	819	196	0.93	0.76	1.14
Plum Creek at FM 1322 (12555)	12.5	60.0	6.4	449	1134	168	0.83	0.74	0.93
Plum Creek at CR 131 (12642)	19.0	91.5	7.4	475	1047	205	0.76	0.76	0.76
Plum Creek at CR 135 (12640)	19.0	69.0	10.0	245	616	138	0.71	0.64	0.75

Highlighted stations have an *E. coli* geometric mean concentration greater than the regulatory standard of 126 MPN/100 ml during base flows.

Table 9. Water quality monitoring results for nitrate nitrogen and ammonia nitrogen at Plum creek main stem monitoring stations from 2008 - 2019.

Monitoring Station	Median Flow (cfs)	Median Flow Wet	Median Flow Dry	NO3-N (mg/L) Mean	NO3-N Mean Wet	NO3-N Mean Dry	NH3-N (mg/L) Mean	NH3-N Mean Wet	NH3-N Mean Dry
Plum Creek at NRCS #1 (20480)	0.0	0.6	0.0	0.51	0.39	0.69	0.25	0.15	0.39
Plum Creek at Lehman (20503)	0.6	3.7	0.10	0.64	0.75	0.52	0.15	0.15	0.14
Plum Creek at Heidenreich (20484)	4.1	10.0	2.7	11.05	9.17	12.93	1.97	1.09	2.82
Plum Creek at PC Rd (17406)	4.7	23.5	2.2	9.70	4.87	12.31	0.92	0.72	1.02
Plum Creek at CR 233 (12649)	7.4	34.0	2.7	5.98	3.39	8.56	0.23	0.24	0.21
Plum Creek at HWY 183 (18343)	8.0	90.0	3.2	3.54	2.12	5.05	0.32	0.44	0.19
Plum Creek at CR 186 (12648)	7.3	49.0	3.8	5.07	2.68	7.69	0.16	0.16	0.16
Plum Creek at CR 202 (12647)	10.0	54.0	6.3	5.31	3.43	6.48	0.18	0.15	0.19
Plum Creek at CR 197 (12645)	9.5	44.0	5.4	3.75	2.86	4.87	0.17	0.15	0.21
Plum Creek at FM 1322 (12555)	12.5	60.0	6.4	3.16	2.27	4.13	0.16	0.16	0.15
Plum Creek at CR 131 (12642)	19.0	91.5	7.4	2.46	2.20	2.74	0.18	0.19	0.18
Plum Creek at CR 135 (12640)	19.0	69.0	10.0	2.34	2.31	2.35	0.17	0.17	0.18

PLUM CREEK MAINSTEM STATION SPATIAL ANALYSIS

Figure 1 illustrates the spatial distribution of *E. coli* data at each Plum Creek main stem station. Stations are displayed on the chart from left to right in order from upstream to downstream. The box and whiskers plot shows the median *E. coli* concentration at each station surrounded by a box containing the upper and lower quartiles of data and lines that extend out to the highest and lowest reasonably observed values. The dots on the graph represent data outliers that were recorded outside of the bounds of normal statistical reasonability. A red horizontal line in the graph indicates the geometric mean regulatory standard of 126 MPN/100 mL. Bacteria concentrations are lowest at the headwaters of the watershed with a geometric mean of 41 MPN/100 mL. Geometric mean concentrations rise to 255 MPN/100 mL at the Lehman road station and reach the highest levels of 1324 MPN/100 mL in the entire watershed at the Heidenreich Road monitoring station. Concentrations decrease to 484 MPN/100 mL at the Plum Creek Road station downstream and then remain relatively stable to the confluence with the San Marcos River.

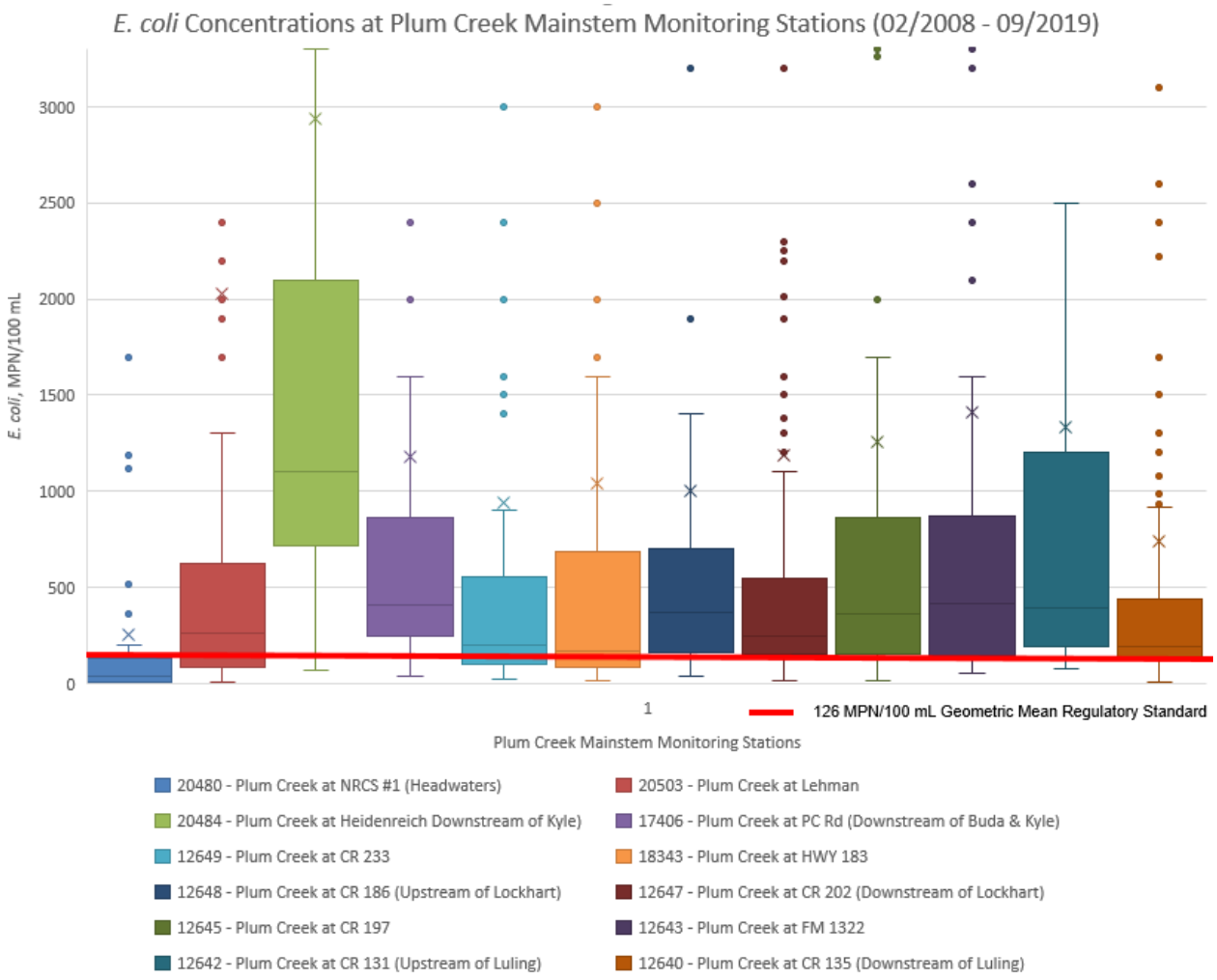

Figure 19: Distribution of *E. coli* concentrations at Plum Creek main stem monitoring stations arranged from upstream to downstream.

PLUM CREEK TRIBUTARY STATION MONITORING

GBRA performed monitoring of 26 stations on 18 tributaries and sub-watersheds of Plum Creek. Several of the larger tributaries had multiple sampling locations. Technicians collected routine monthly samples at five stations located on Brushy Creek at Rocky Road, Elm Creek at CR 233, Dry Creek at FM 672, Clear Fork at Salt Flat Road, and West Fork at Biggs Road. The TSSWCB chose these stations to represent the major contributing tributaries of Plum Creek. GBRA collected the other monitoring stations for wet or dry weather conditions at a frequency of twice per quarter. Table 3 provides a summary of the *E. coli* and total phosphorus concentrations and Table 4 summarizes the nitrate nitrogen and ammonia nitrogen at these stations. These tables include geometric means of *E. coli* and average concentrations of nutrients for all data collected during

WPP implementation. Tables 10 and 11 also separate results into samples collected during wet weather conditions with runoff influence, and samples collected during dry weather. GBRA categorized and summarized the data in each table based on the hydrologic conditions present during each sampling event. The regulatory screening criteria for all tributary monitoring stations is less than 126 MPN/100 mL for *E. coli* geometric mean, 1.95 mg/L for nitrate nitrogen, 0.69 mg/L for total phosphorus and 0.33 mg/L for ammonia nitrogen. The geometric mean for *E. coli* is greater than the regulatory limit in all tributaries except the upper portions of Brushy Creek and Clear Fork, but the concentrations in most tributaries drop below the limit when rainfall runoff influence is controlled. Nitrate nitrogen are greater than the screening criteria in the Andrew's Branch, Clear Fork, Town Branch and Salt Branch tributaries. The only perennial tributary stations with average ammonia nitrogen and total phosphorus concentrations greater than the screening criteria are on the Salt Branch near the City of Luling.

Table 10. Water quality monitoring results for *E. coli* and total phosphorus in Plum Creek tributaries from 2008 - 2019.

Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	*E. coli* (MPN/100mL) Geomean	*E. coli* Geomean Wet	*E. coli* Geomean Dry	Total P (mg/L) Mean	Total P Mean Wet	Total P Mean Dry
Unnamed at FM 150 (20479)	0.30	0.60	0.25	316	338	267	0.05	0.05	0.05
Andrew's at CR 131 (12538)	1.30	1.90	1.05	324	511	202	0.23	0.18	0.28
Richmond at Dacy (20505)	0.10	0.40	0.01	380	645	220	0.08	0.07	0.09
Unnamed at Quail Cove (20504)	0.03	0.06	0.01	552	858	39	0.12	0.13	0.03
Porter at Dairy Lane (12559)	1.70	5.00	1.10	454	816	211	0.11	0.14	0.08
Cowpen at Schuelke (20489)	2.40	2.60	0.00	1151	1268	820	0.25	0.25	0.25
Bunton at Dacy (20502)	0.35	2.40	0.04	144	386	52	0.08	0.10	0.07
Bunton at Heidenreich (20481)	1.05	6.40	0.40	321	486	165	0.07	0.08	0.04
Brushy at FM 2001 (20482)	0.08	0.08	0.05	98	234	15	0.12	0.12	0.11
Brushy at SH21 (20487)	0.80	6.80	0.01	244	766	57	0.11	0.13	0.07
Brushy Creek at Rocky Rd (20488)	0.01	0.10	0.00	210	785	83	0.12	0.14	0.11
Elm Creek at SH 21 (20483)	0.02	0.10	0.01	194	377	40	0.11	0.11	0.09
Elm Creek at CR 233 (12558)	0.00	0.50	0.00	158	645	51	0.17	0.19	0.15
Clear Fork at Farmers Rd (20490)	0.02	0.02	0.04	59	88	35	0.10	0.11	0.08
Clear Fork at PR10 (20493)	1.80	3.55	1.20	167	368	74	0.09	0.13	0.04
Clear Fork at Old Luling Rd (14945)	1.60	4.70	0.90	157	304	79	0.10	0.15	0.05
Clear Fork at Salt Flat Rd (12556)	2.90	6.65	1.30	253	629	142	0.11	0.16	0.08
Town Branch at Stueve Ln (16709)	0.00	0.00	0.00	498	445	2400	0.67	0.70	0.30
Town Branch at E. Market St (12557)	1.40	1.55	0.84	566	960	312	0.09	0.14	0.04
Dry Creek at FM 672 (20491)	0.20	0.85	0.00	551	1059	160	0.29	0.31	0.26
Dry Creek at FM 713 (20495)	0.50	1.10	0.00	963	1554	354	0.23	0.25	0.18
Tenney Creek at Tenney Crk Rd (20496)	4.00	4.70	0.15	845	1044	112	0.34	0.35	0.24
Hines Branch at Tenney Crk Rd (20510)	0.00	0.00	0.00	350	487	68	0.27	0.29	0.18
Copperas at Tenney Crk Rd (20498)	0.06	0.20	0.01	730	1011	366	0.78	1.01	0.30
West Fork at FM 671 (20497)	0.05	0.15	0.01	448	616	135	0.15	0.17	0.07
West Fork at Biggs Rd (20500)	0.01	0.02	0.01	134	418	58	0.41	0.37	0.44
Salt Branch at Salt Flat Rd (20501)	0.01	0.06	0.00	847	1140	566	0.33	0.26	0.44
Salt Branch at FM 1322 (12555)	0.30	0.70	0.20	343	602	185	2.61	1.49	3.85

Highlighted stations have an *E. coli* geometric mean concentration greater than the regulatory standard of 126 MPN/100 ml during base flows.

Table 11. Water quality monitoring results for nitrate nitrogen and ammonia nitrogen in Plum Creek tributaries from 2008 - 2019.

Monitoring Station	Median Flow (cfs)	Median Flow (cfs) Wet	Median Flow (cfs) Dry	NO3-N Mean	NO3-N Mean Wet	NO3-N Mean Dry	NH3-N Mean	NH3-N Mean Wet	NH3-N Mean Dry
Unnamed at FM 150 (20479)	0.30	0.60	0.25	1.36	1.57	0.85	0.17	0.18	0.16
Andrew's at CR 131 (12538)	1.30	1.90	1.05	10.57	7.28	13.96	0.19	0.19	0.20
Richmond at Dacy (20505)	0.10	0.40	0.01	0.63	0.93	0.30	0.30	0.16	0.45
Unnamed at Quail Cove (20504)	0.03	0.06	0.01	0.35	0.40	0.06	0.16	0.17	0.10
Porter at Dairy Lane (12559)	1.70	5.00	1.10	0.83	0.70	1.02	0.20	0.18	0.22
Cowpen at Schuelke (20489)	2.40	2.60	0.00	0.51	0.60	0.17	0.25	0.28	0.12
Bunton at Dacy (20502)	0.35	2.40	0.04	0.36	0.50	0.21	0.17	0.16	0.17
Bunton at Heidenreich (20481)	1.05	6.40	0.40	3.51	0.60	8.17	0.16	0.16	0.17
Brushy at FM 2001 (20482)	0.08	0.08	0.05	0.31	0.39	0.11	0.15	0.17	0.13
Brushy at SH21 (20487)	0.80	6.80	0.01	0.43	0.56	0.21	0.18	0.14	0.22
Brushy Creek at Rocky Rd (20488)	0.01	0.10	0.00	0.29	0.44	0.19	0.19	0.16	0.21
Elm Creek at SH 21 (20483)	0.02	0.10	0.01	0.28	0.34	0.15	0.14	0.16	0.10
Elm Creek at CR 233 (12558)	0.00	0.50	0.00	0.23	0.38	0.11	0.19	0.18	0.20
Clear Fork at Farmers Rd (20490)	0.02	0.02	0.04	5.64	4.51	7.16	0.14	0.16	0.12
Clear Fork at PR10 (20493)	1.80	3.55	1.20	3.74	2.86	4.64	0.18	0.16	0.21
Clear Fork at Old Luling Rd (14945)	1.60	4.70	0.90	2.58	1.98	3.20	0.17	0.18	0.17
Clear Fork at Salt Flat Rd (12556)	2.90	6.65	1.30	1.47	1.57	1.41	0.17	0.15	0.18
Town Branch at Stueve Ln (16709)	0.00	0.00	0.00	1.67	1.22	8.03	0.29	0.29	0.26
Town Branch at E. Market St (12557)	1.40	1.55	0.84	11.07	10.19	12.06	0.18	0.17	0.19
Dry Creek at FM 672 (20491)	0.20	0.85	0.00	0.37	0.49	0.16	0.21	0.20	0.24
Dry Creek at FM 713 (20495)	0.50	1.10	0.00	0.31	0.31	0.32	0.19	0.18	0.19
Tenney Creek at Tenney Crk Rd (20496)	4.00	4.70	0.15	0.31	0.33	0.17	0.14	0.14	0.16
Hines Branch at Tenney Crk Rd (20510)	0.00	0.00	0.00	0.51	0.60	0.05	0.23	0.23	0.24
Copperas at Tenney Crk Rd (20498)	0.06	0.20	0.01	0.26	0.34	0.09	0.90	1.12	0.32
West Fork at FM 671 (20497)	0.05	0.15	0.01	0.28	0.34	0.05	0.16	0.14	0.22
West Fork at Biggs Rd (20500)	0.01	0.02	0.01	0.27	0.26	0.28	0.18	0.18	0.19
Salt Branch at Salt Flat Rd (20501)	0.01	0.06	0.00	0.24	0.19	0.31	0.71	0.21	1.38
Salt Branch at FM 1322 (12555)	0.30	0.70	0.20	10.68	5.14	16.75	0.37	0.33	0.41

PLUM CREEK WASTEWATER STATION MONITORING

Table 12 summarizes water quality monitoring data collected from seven active WWTFs in the Plum Creek watershed. GBRA collected these samples monthly throughout the implementation period in order to better quantify point source contributions and compare effluent values to stream screening criteria. Sample collections did not have bias towards weather conditions and some samples occurred during high flow conditions. Each of these facilities contributes discharges to different portions of the watershed. The Buda WWTF discharges into the Andrew's Branch of Porter Creek, which merges with Plum Creek just upstream of the Plum Creek at Plum Creek Road (17406) CRP monitoring station. The Kyle WWTF discharges into Plum Creek upstream of the Plum Creek at Heidenreich Road (20484) targeted monitoring station. Sunfield WWTF and Shadowcreek WWTF discharge into Brushy Creek, which merges with Plum Creek upstream of the Plum Creek at CR 233 (12649) targeted monitoring station. Lockhart #1 WWTF discharges into Town

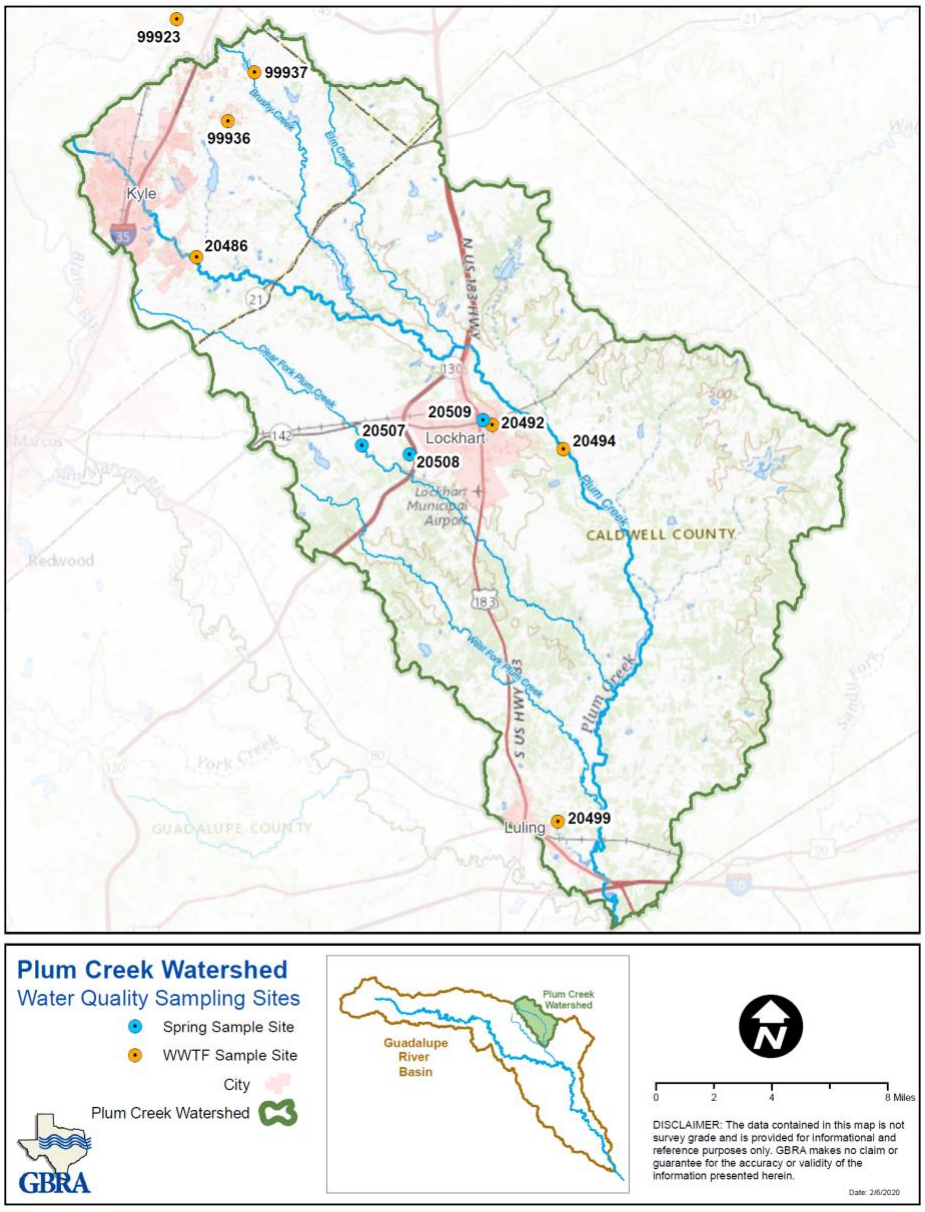

Figure 20. Plum Creek Wastewater and Spring Sampling Stations

Branch upstream of the Lockhart #2 WWTF. Lockhart #2 WWTF discharges into Plum Creek upstream of the Plum Creek at CR 202 (12647) CRP monitoring station. The Luling North WWTF discharges into the Salt Branch, which merges with Plum Creek upstream of the Plum Creek at CR 135 (12640) CRP monitoring station. WWTF results for the current project remained consistent with previously recorded values. Although average nutrient concentrations from Plum

Creek WWTF effluents frequently exceed screening standards, TCEQ assesses effluent compliance against permitted pollutant criteria, which are specific to each facility.

Table 12. Wastewater treatment facility monitoring results in the Plum Creek Watershed 2008-2019.

Station	Median Flow (CFS)	Geometric Mean *E. coli* (MPN/100 mL)	Mean TSS (mg/L)	Mean Dissolved Oxygen (mg/L)	Mean Total Phosphorus (mg/L)	Mean Nitrate Nitrogen (mg/L)	Mean Ammonia Nitrogen (mg/L)	Mean BOD (mg/L)	Mean CBOD (mg/L)
Stream Screening Criteria	NA	126	NA	5	0.69	1.95	0.33	5	5
Buda WWTF (99923)	1.6	2.3	1	8.2	0.39	15.50	0.38	1.6	1.3
Kyle WWTF (20486)	3	69.2	11	7.9	3.63	19.67	1.94	4.1	4.1
Sunfield WWTF (99937)	0.1	1.4	1	8.6	0.54	39.49	0.21	1.5	1.5
Shadow Creek WWTF (99936)	0.2	2.9	1	7.8	0.52	14.71	0.85	1.5	1.4
Lockhart #2 WWTF (20494)	1.5	12.8	5	8.4	2.59	6.67	0.49	1.6	1.8
Lockhart #1 WWTF (20492)	0.7	2.3	3	8.2	2.97	17.22	0.62	2.0	2.2
Luling North WWTF (20499)	0.3	2.6	11	8.1	4.33	29.86	0.46	2.1	2.5

PLUM CREEK SPRING STATION MONITORING

Table 13 summarizes water quality monitoring data collected from Boggy Springs, Lockhart Springs, and Clear Fork Springs. GBRA collected these samples once per quarter in order to identify pollutant contributions from freshwater springs. Sample collection did not have bias towards weather conditions, but the collector noted hydrologic conditions and some samples occurred during rainfall runoff events. Influences from ambient weather conditions at these stations may be particularly impactful due to the limited number of samples collected.

Table 13. Water quality monitoring results for Plum Creek Springs from 2008 – 2019.

Station	Median Flow (CFS)	Geometric Mean *E. coli* (MPN/100 mL)	Mean TSS (mg/L)	Mean Dissolved Oxygen (mg/L)	Mean Total Phosphorus (mg/L)	Mean Nitrate Nitrogen (mg/L)	Mean Ammonia Nitrogen (mg/L)
Stream Screening Criteria	NA	126	NA	5	0.69	1.95	0.33
Boggy Creek Springs at Boggy Creek Road (20508)	0.3	208	8.1	7.6	0.05	6.90	0.23
Clear Fork Springs at Borchert Loop (20507)	1.0	281	9.5	8.7	0.04	7.13	0.14
Lockhart Springs	0.9	272	2.6	9.1	0.05	11.59	0.15

Highlighted stations have an *E. coli* geometric mean concentration greater than the regulatory standard of 126 MPN/100 ml.

ANALYSIS OF WATER QUALITY TRENDS AT ROUTINE MONITORING STATIONS

GBRA performed a trend analysis at the eight monthly TSSWCB routine monitoring stations for *E. coli*, nitrate nitrogen, total phosphorus and ammonia nitrogen from February of 2008 to September of 2019. The three locations monitored on the main stem of Plum Creek are station 17406 (Plum Creek at Plum Creek Road) in Uhland (Figures 21-24), station 12647 (Plum Creek at CR 202) in Lockhart (Figures 25-28) and station 12640 (Plum Creek at CR 135) in Luling (Figures 29-32). GBRA also routinely monitors five tributaries of Plum Creek. Routine tributary monitoring stations 20500 on the West Fork (Figures 33-36) and 12556 on the Clear Fork (Figures 37-40) discharge into Plum Creek between the cities of Luling and Lockhart. The three remaining stations 20491 on Dry Creek (Figures 41-44), 12558 on Elm Creek (Figures 45-48) and 20488 on Brushy Creek (Figures 49-52) discharge into Plum Creek downstream of Uhland. The solid red line on the graphs indicates the water quality standard for E. *coli* (126 MPN/100mL) and the dotted red line indicates the TCEQ screening criteria level for nitrate nitrogen (1.95 mg/L), total phosphorus (0.69 mg/L) and ammonia nitrogen (0.33 mg/L). The black line of the graphs shows the trend of monitoring parameter concentrations over time. Trend graphs were included for all the monitoring parameters discussed in the Plum Creek WPP, but only a portion of these trends were statistically significant (p value ≤ 0.10). *E. coli* concentrations were significantly increasing at the Lockhart (12647), Luling (12640), West Fork (20500) and Clear Fork (12556) stations. Nitrate nitrogen trends were statistically significant at all the Plum Creek main stem stations (17406, 12647 and 12640) and at the West Fork (20500), Clear Fork (12556) and Elm Creek (20488) stations. Total phosphorus trends were statistically significant at the Lockhart (12647), Luling (12640), and Clear Fork (12556) stations. Ammonia nitrogen trends were statistically significant at the Uhland (17406), West Fork (20500), Clear Fork (12556), Dry Creek (20491), and Elm Creek (12558) stations. Stream flow throughout the watershed has increased significantly since the implementation of the WPP in 2008 and this is likely driving many of the observed trends.

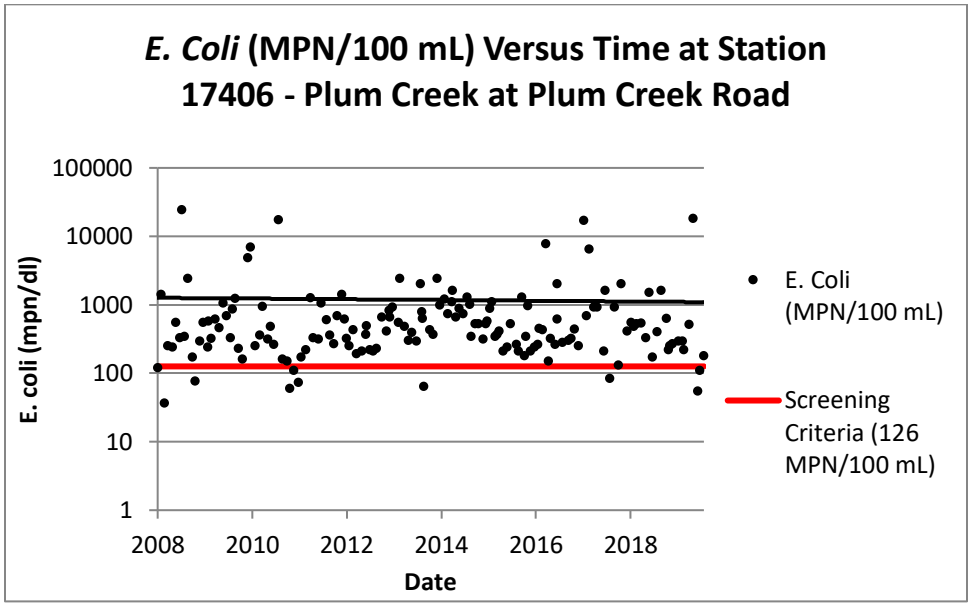

Figure 21: *E. coli* over time at 17406 - Plum Creek at Plum Creek Road near Uhland from 2008 – 2019.

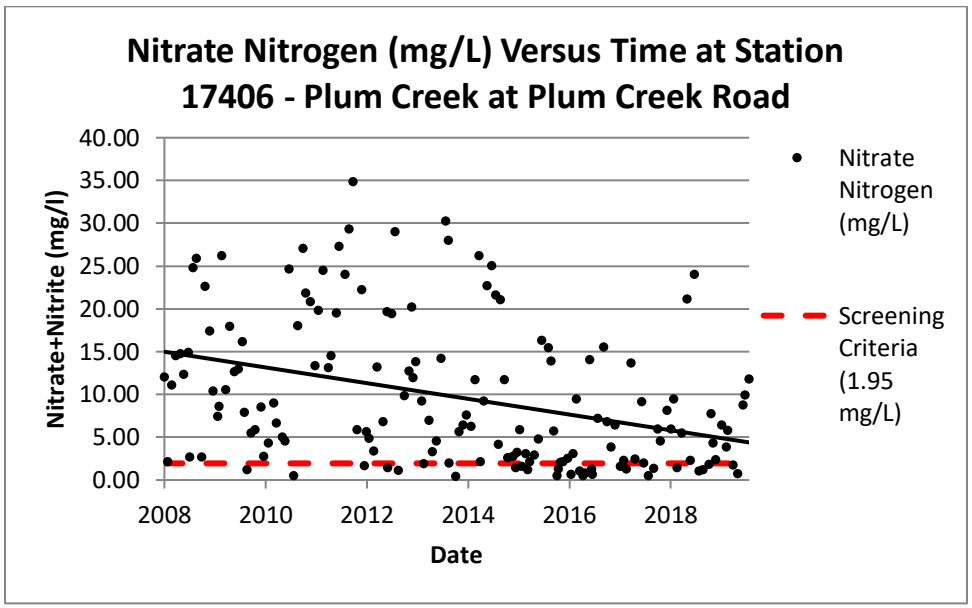

Figure 22: NO3-N over time at 17406 - Plum Creek at Plum Creek Road near Uhland from 2008 – 2019.

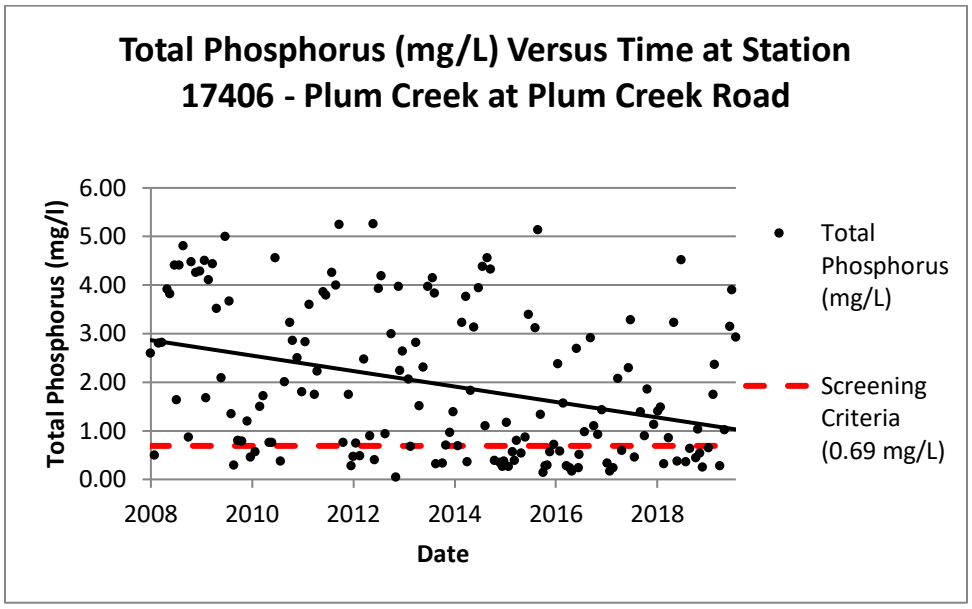

Figure 23: Total Phosphorus over time at 17406 - Plum Creek at Plum Creek Road near Uhland from 2008 – 2019.

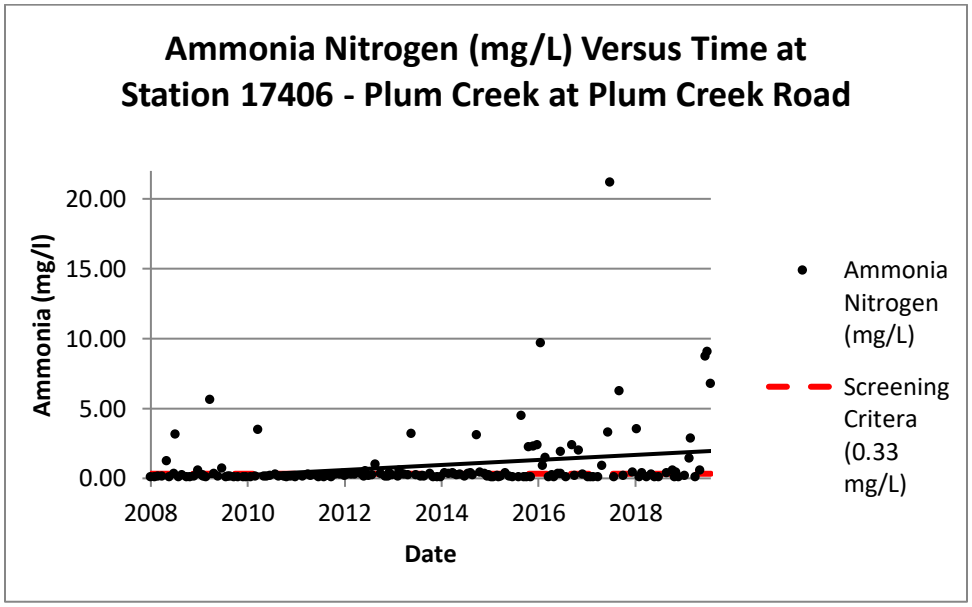

Figure 24: Ammonia Nitrogen over time at 17406 - Plum Creek at Plum Creek Road near Uhland from 2008 – 2019.

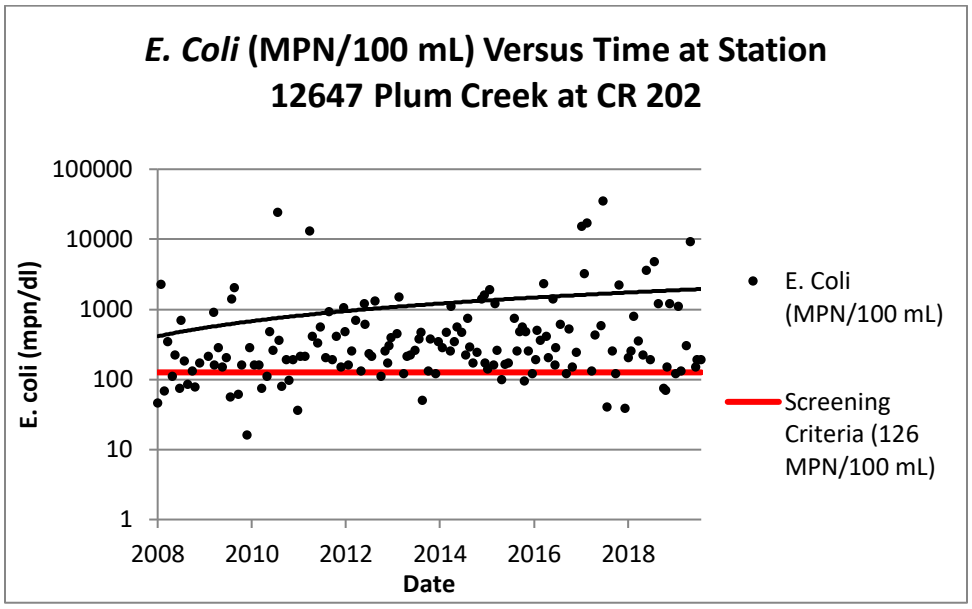

Figure 25: *E. coli* over time at 12647 - Plum Creek at CR 202 SE of Lockhart from 2008 – 2019.

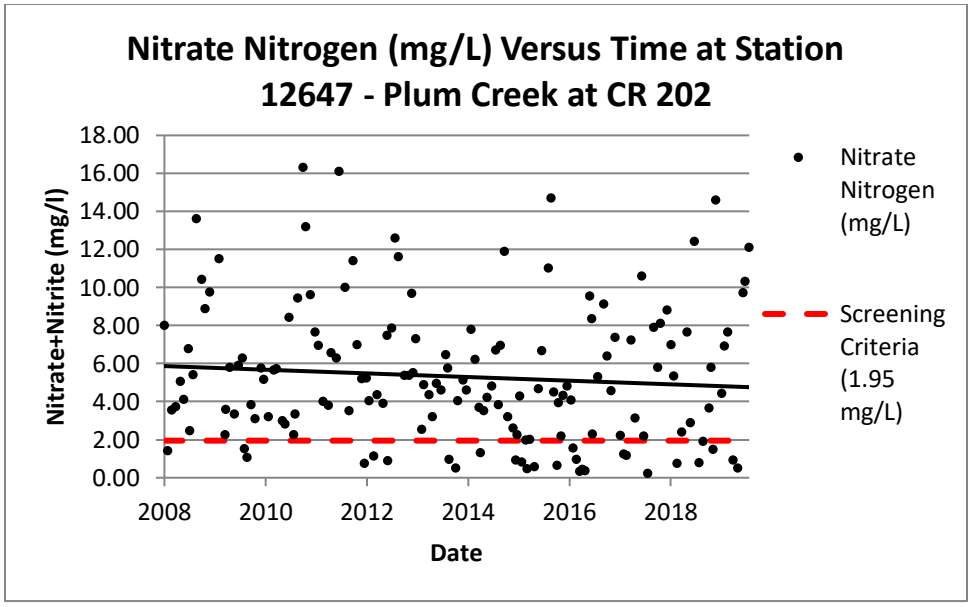

Figure 26: NO3-N over time at 12647 - Plum Creek at CR 202 SE of Lockhart from 2008 – 2019.

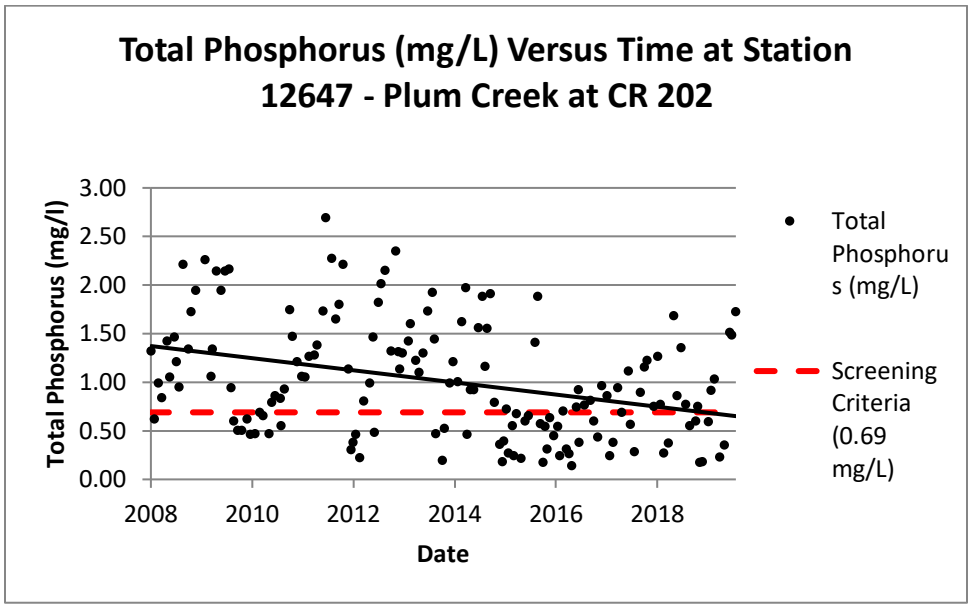

Figure 27: Total Phosphorus over time at 12647 - Plum Creek at CR 202 SE of Lockhart from 2008 – 2019.

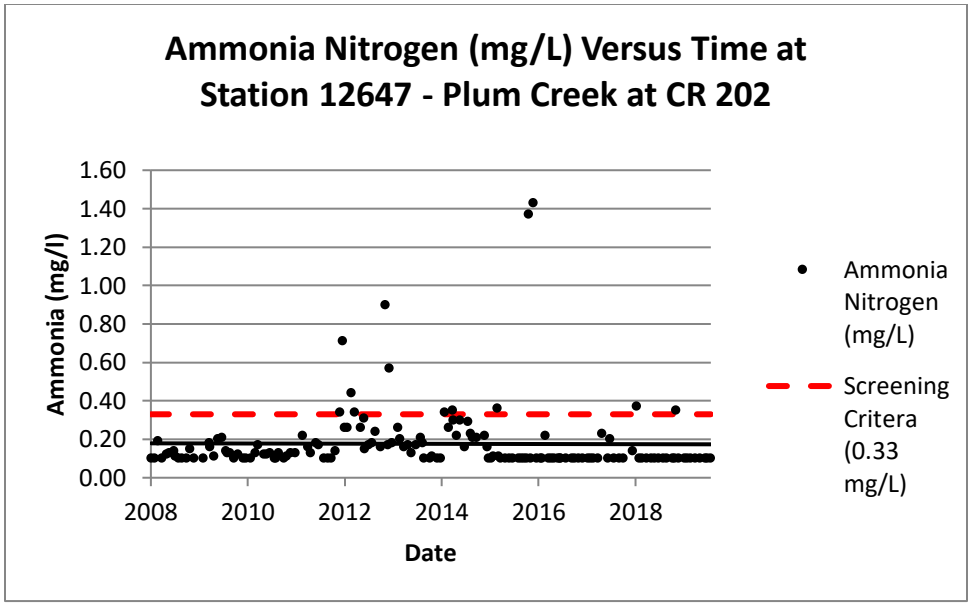

Figure 28: Ammonia Nitrogen over time at 12647 - Plum Creek at CR 202 SE of Lockhart from 2008 – 2019.

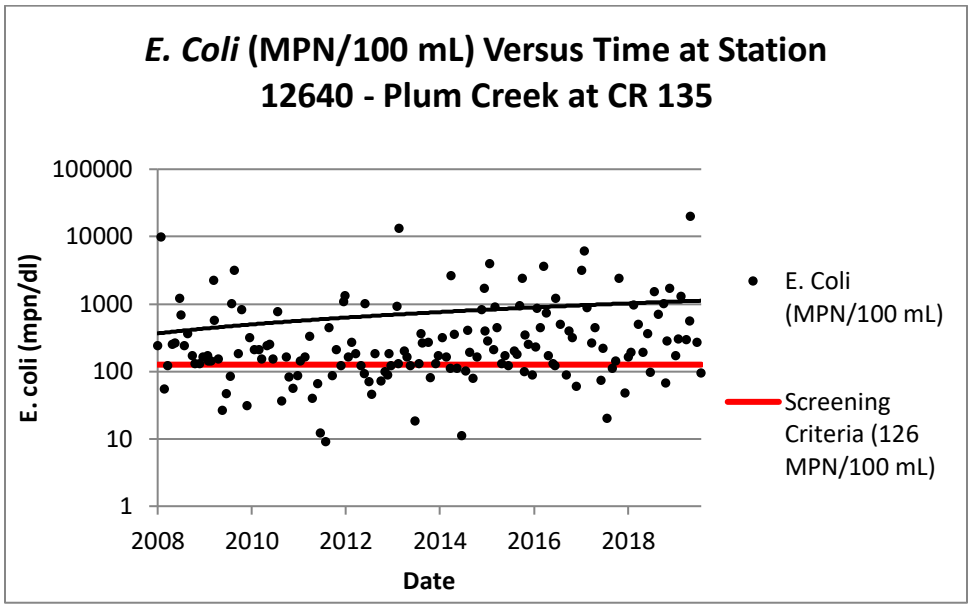

Figure 29: *E. coli* over time at monitoring site 12640 – Plum Creek at CR 135 SE of Luling from 2008 - 2019.

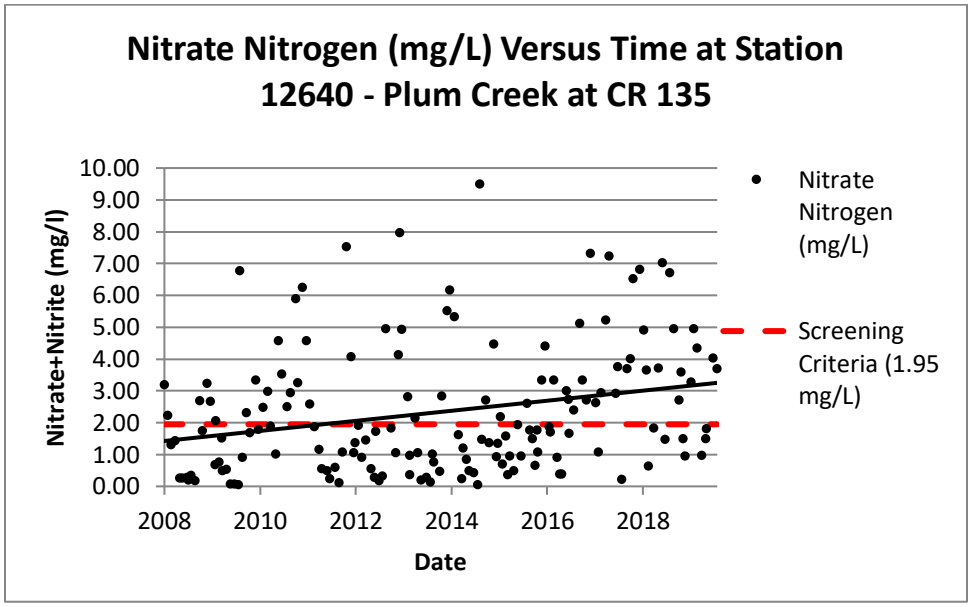

Figure 30: NO3-N over time at monitoring site 12640 – Plum Creek at CR 135 SE of Luling from 2008 - 2019.

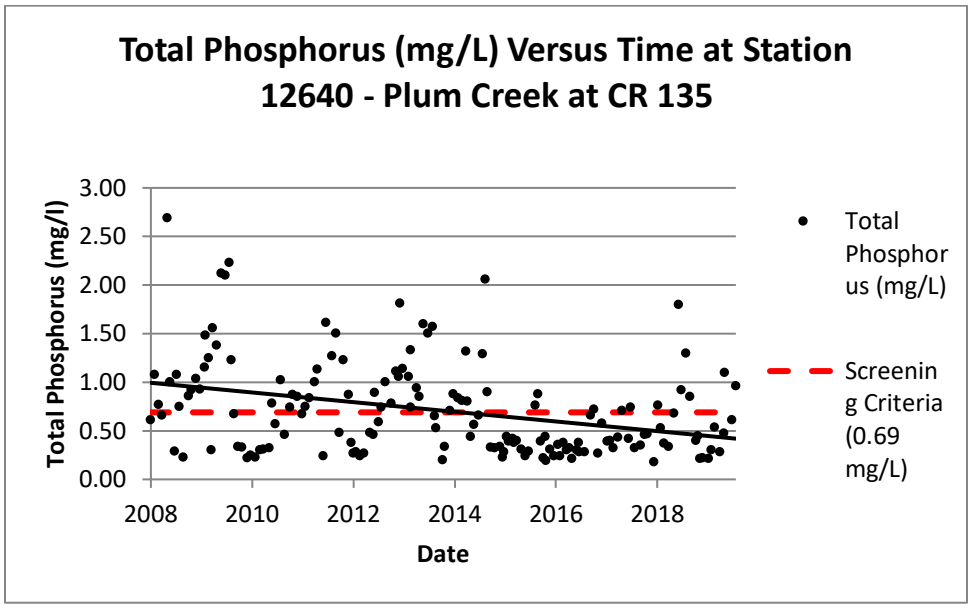

Figure 31: Total Phosphorus over time at monitoring site 12640 – Plum Creek at CR 135 SE of Luling from 2008 - 2019.

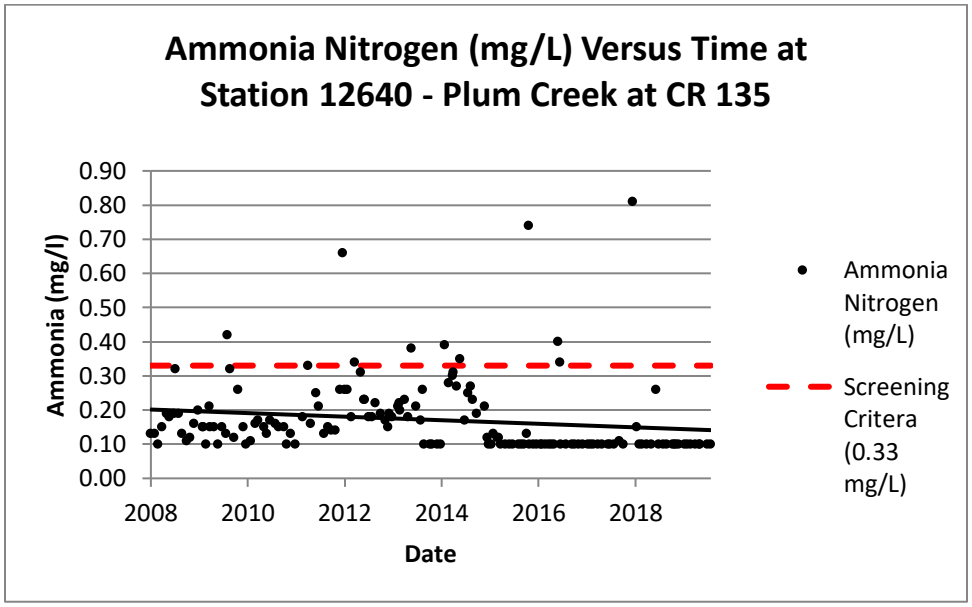

Figure 32: Ammonia Nitrogen over time at monitoring site 12640 – Plum Creek at CR 135 SE of Luling from 2008 - 2019.

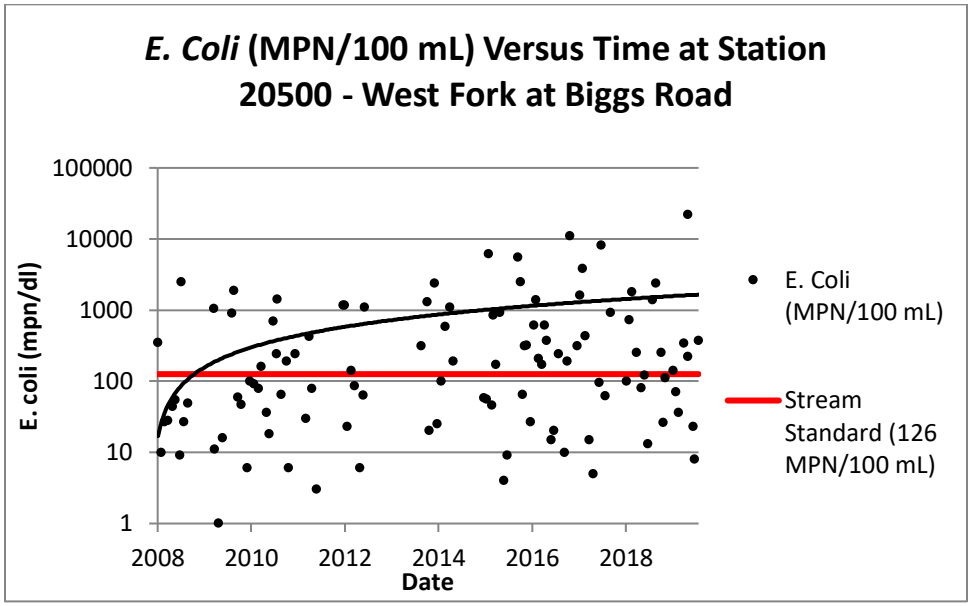

Figure 33: *E. coli* over time at monitoring site 20500 – West Fork at CR 131 NE of Luling from 2008 - 2019.

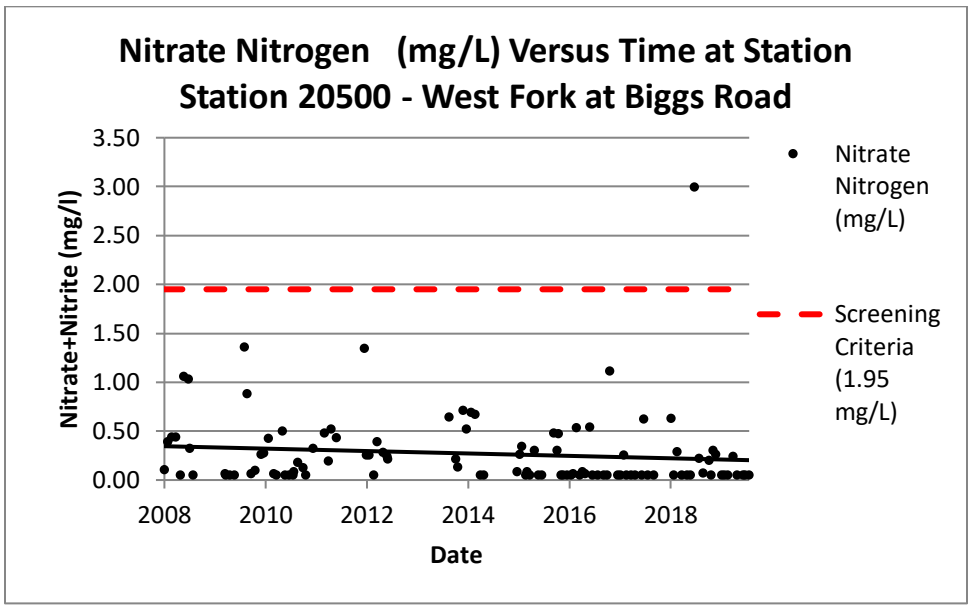

Figure 34: NO3-N over time at monitoring site 20500 – West Fork at CR 131 NE of Luling from 2008 - 2019.

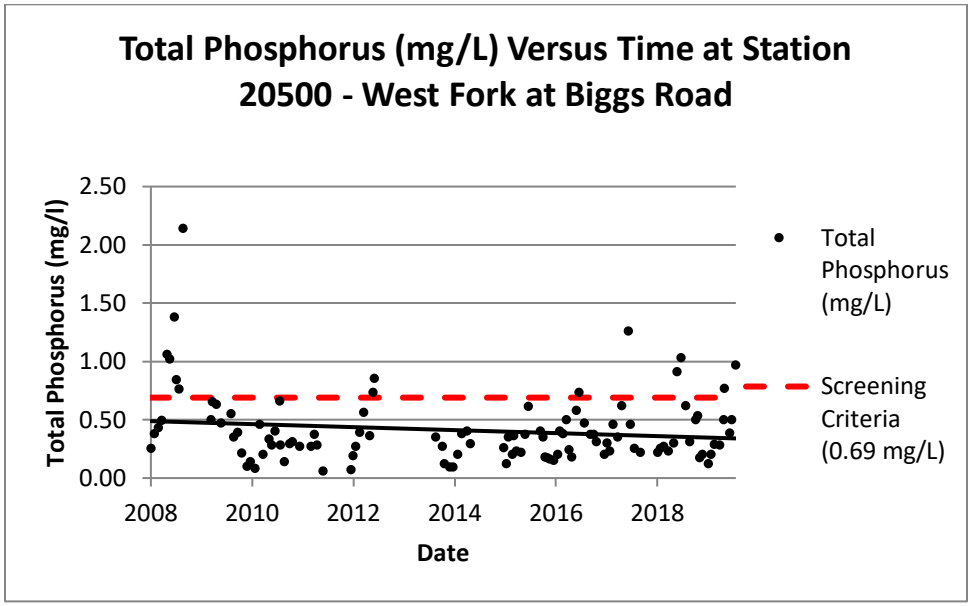

Figure 35: Total Phosphorus over time at monitoring site 20500 – West Fork at CR 131 NE of Luling from 2008 - 2019.

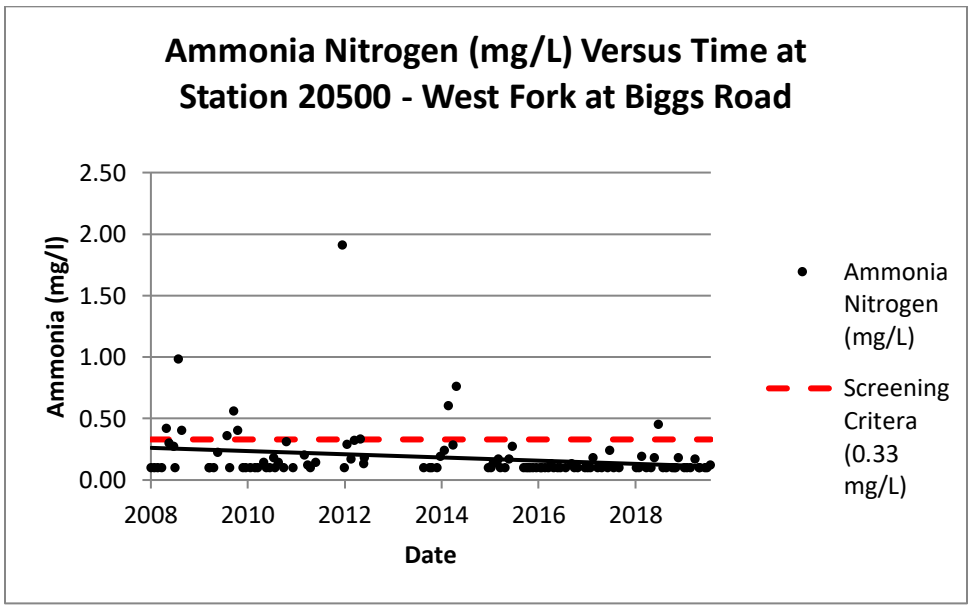

Figure 36: Ammonia Nitrogen over time at monitoring site 20500 – West Fork at CR 131 NE of Luling from 2008 - 2019.

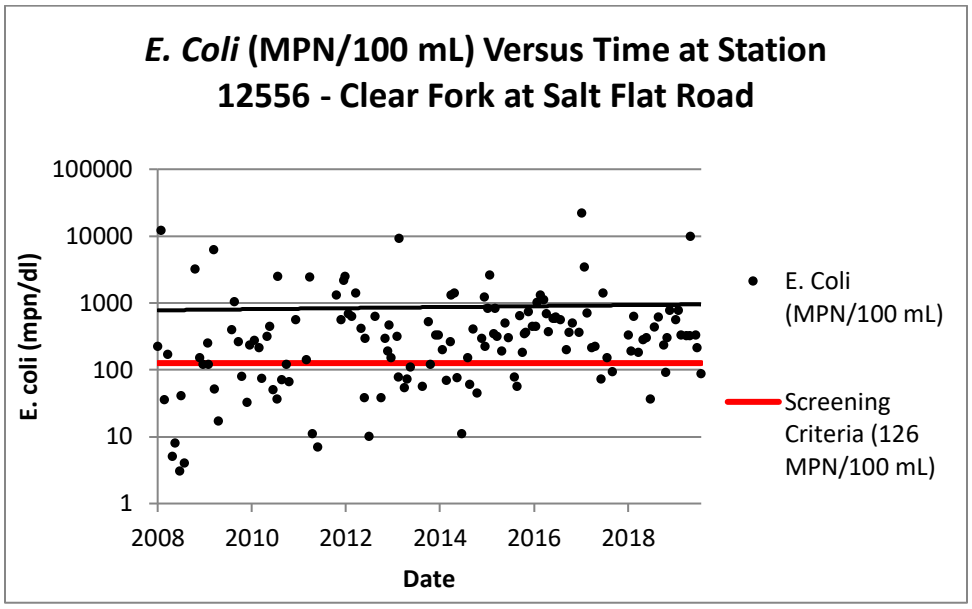

Figure 37: *E. coli* over time at monitoring site 12556 – Clear Fork at CR 128 SE of Lockhart from 2008 - 2019.

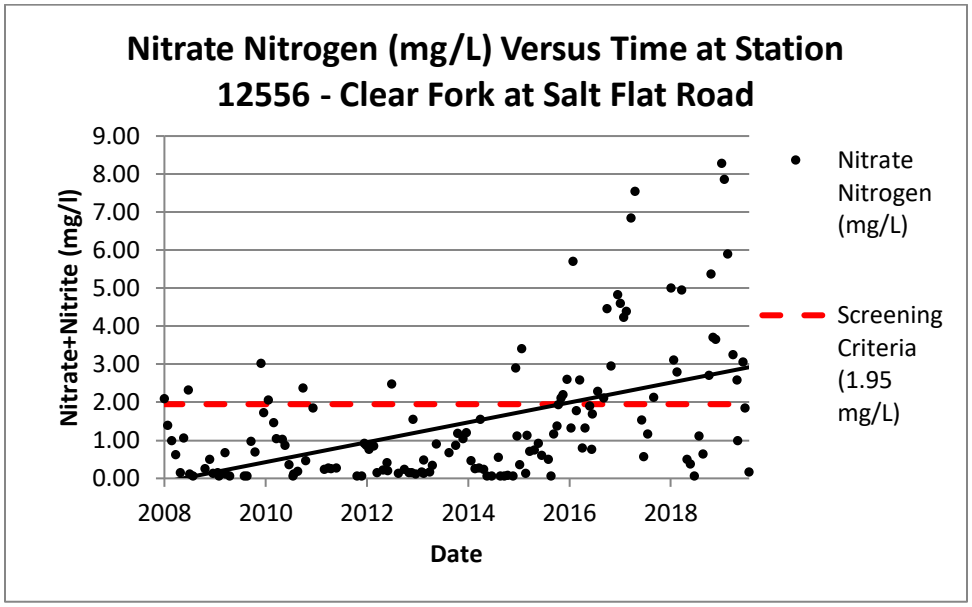

Figure 38: NO3-N over time at monitoring site 12556 – Clear Fork at CR 128 SE of Lockhart from 2008 - 2019.

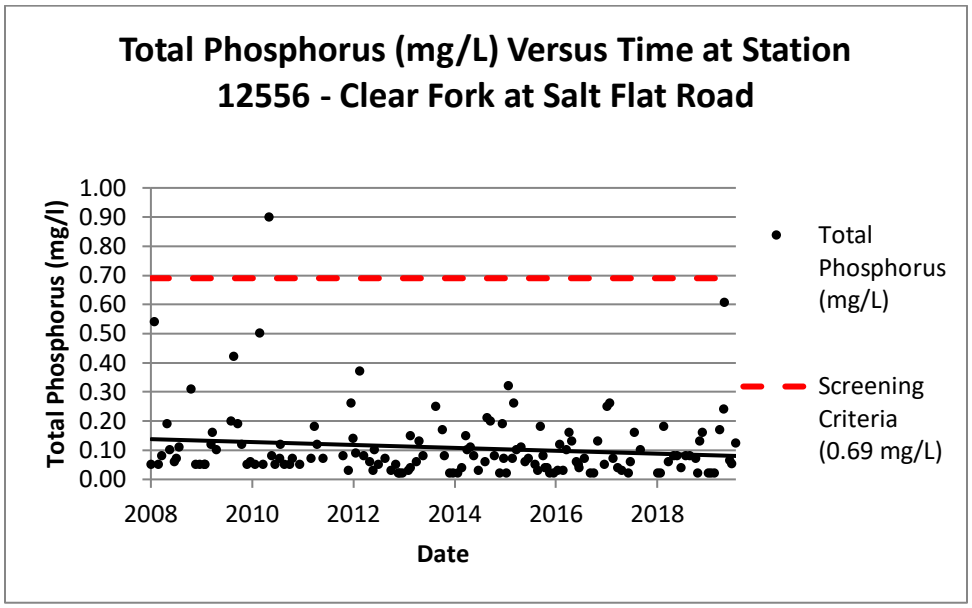

Figure 39: Total Phosphorus over time at monitoring site 12556 – Clear Fork at CR 128 SE of Lockhart from 2008 - 2019.

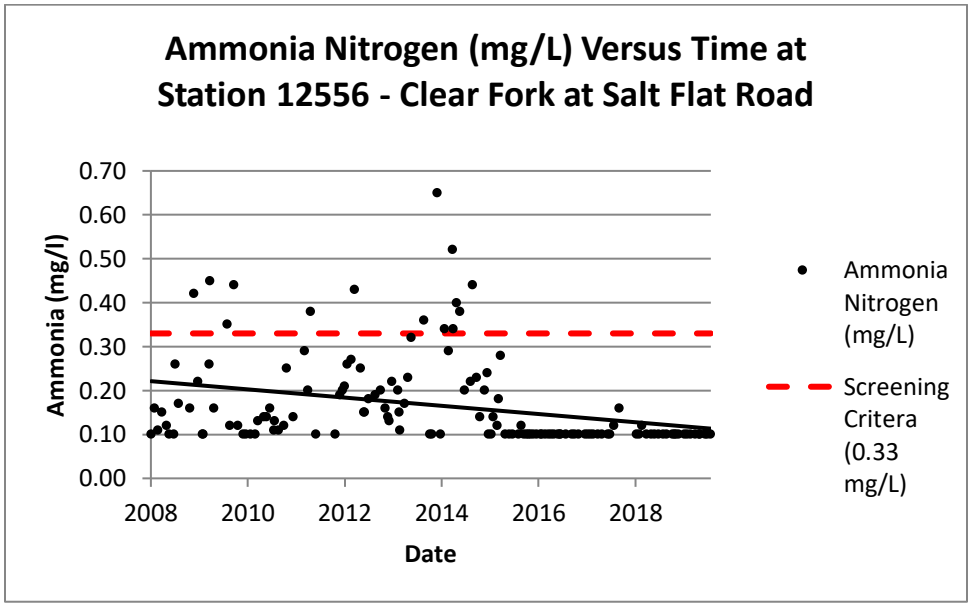

Figure 40: Ammonia Nitrogen over time at monitoring site 12556 – Clear Fork at CR 128 SE of Lockhart from 2008 - 2019.

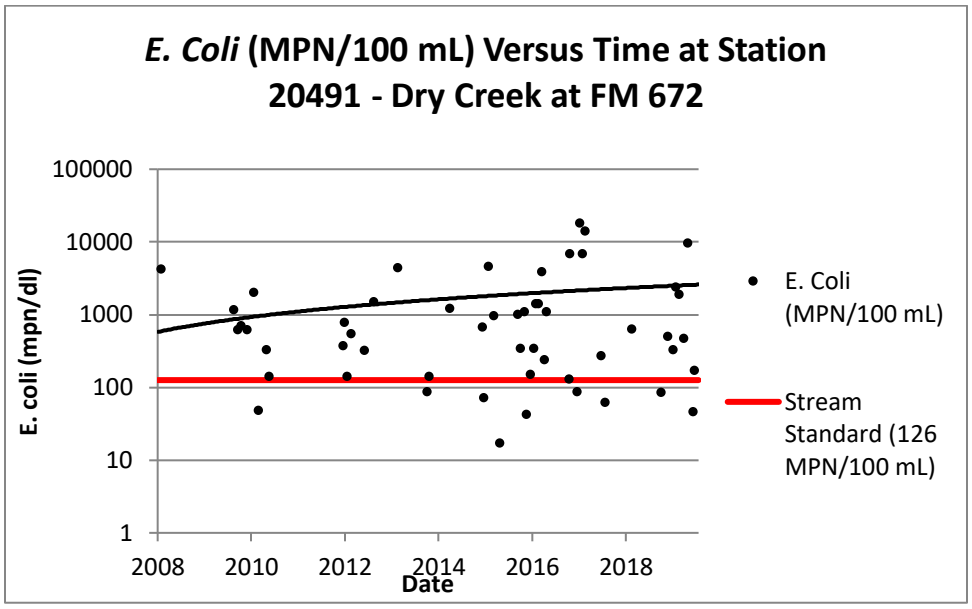

Figure 41: *E. coli* over time at monitoring site 20491 – Dry Creek at FM 672 near Lockhart from 2008 - 2019.

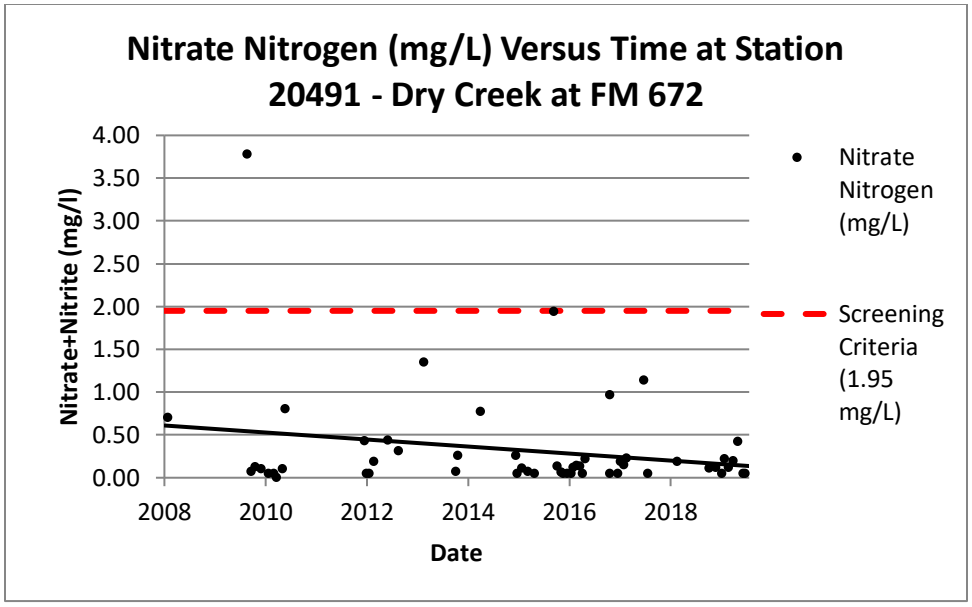

Figure 42: NO3-N over time at monitoring site 20491 – Dry Creek at FM 672 near Lockhart from 2008 - 2019.

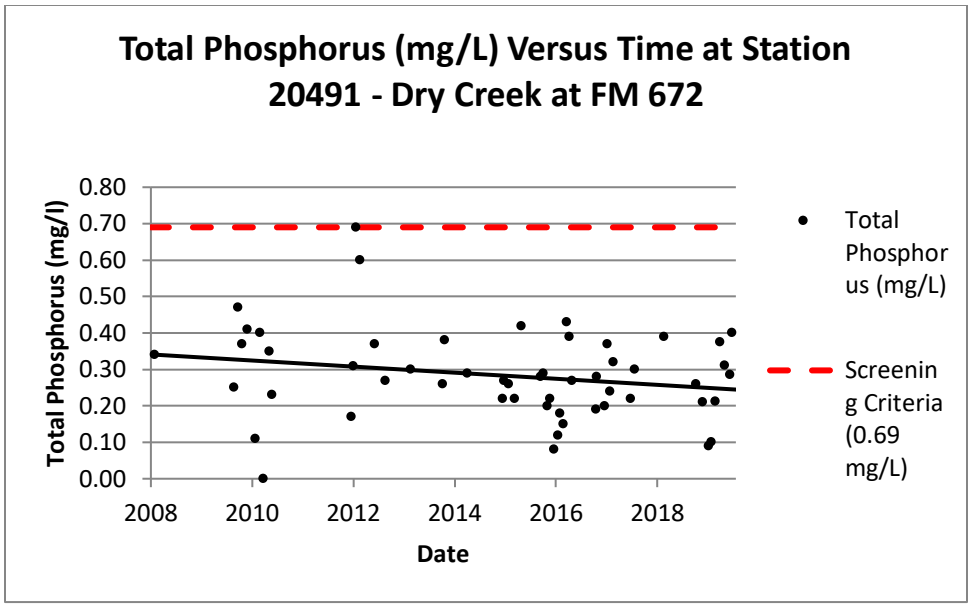

Figure 43: Total Phosphorus over time at monitoring site 20491 – Dry Creek at FM 672 near Lockhart from 2008 - 2019.

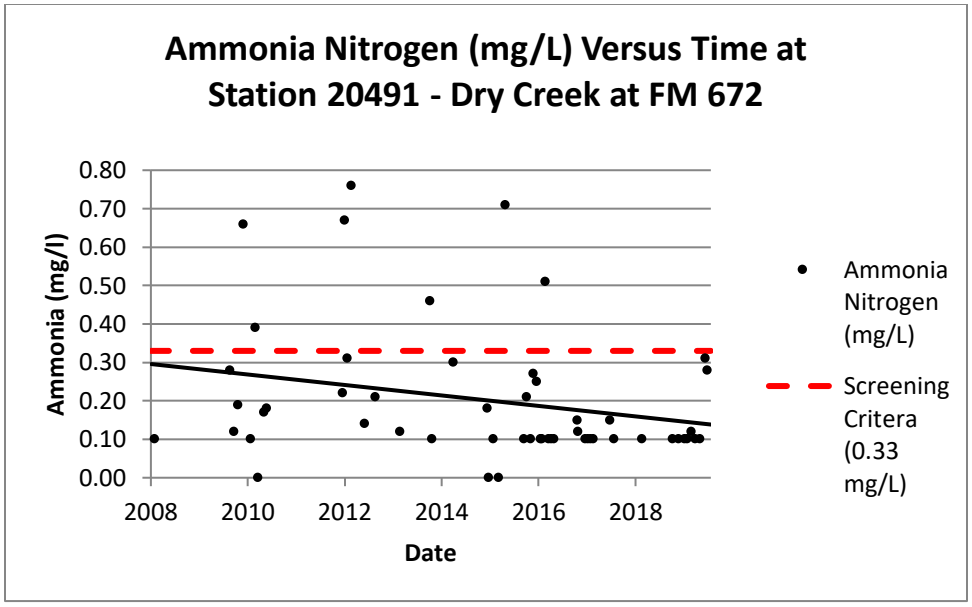

Figure 44: Ammonia Nitrogen over time at monitoring site 20491 – Dry Creek at FM 672 near Lockhart from 2008 - 2019.

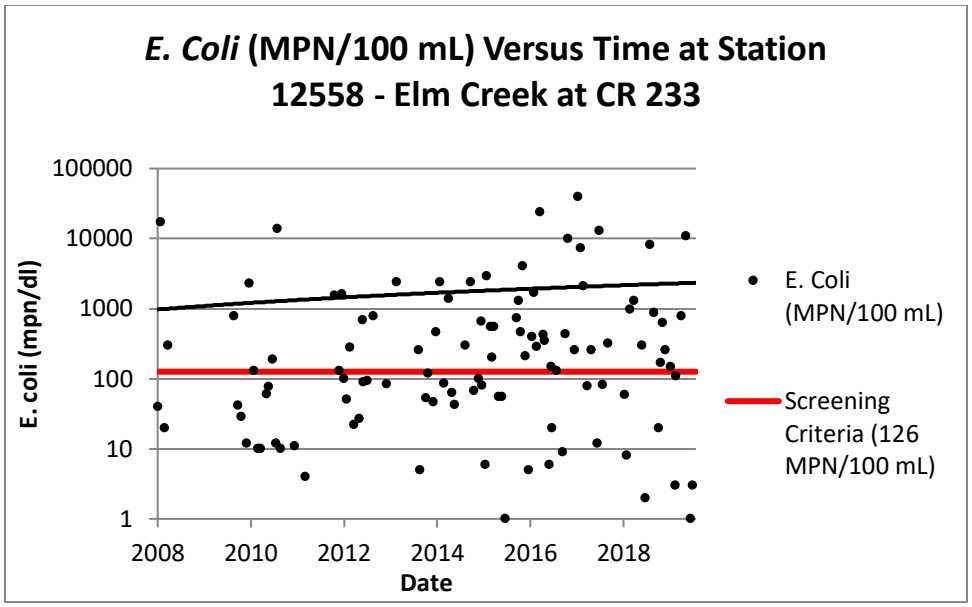

Figure 45: *E. coli* over time at monitoring site 12558 – Elm Creek at CR 233 NW of Lockhart from 2008 - 2019.

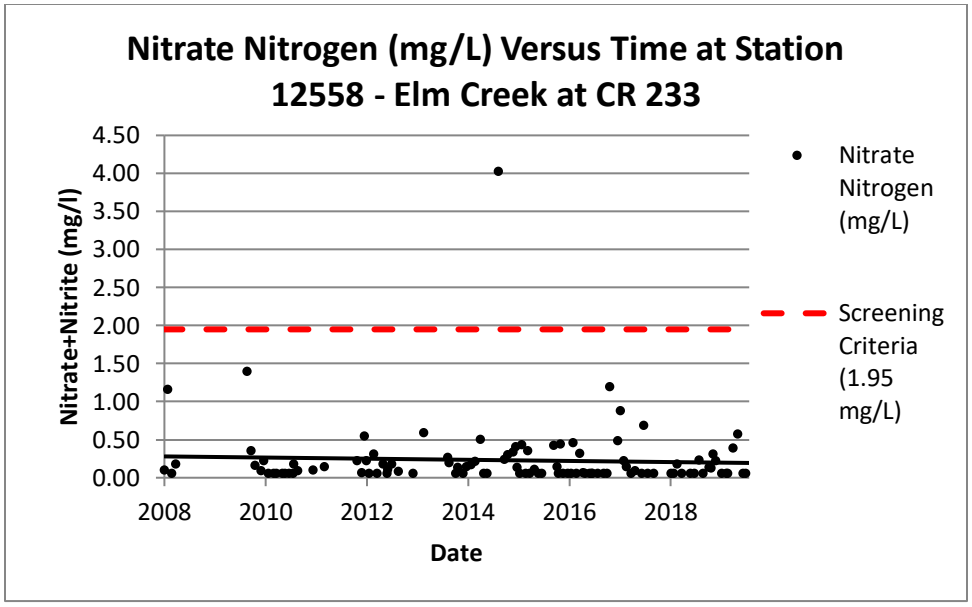

Figure 46: NO3-N over time at monitoring site 12558 – Elm Creek at CR 233 NW of Lockhart from 2008 - 2019.

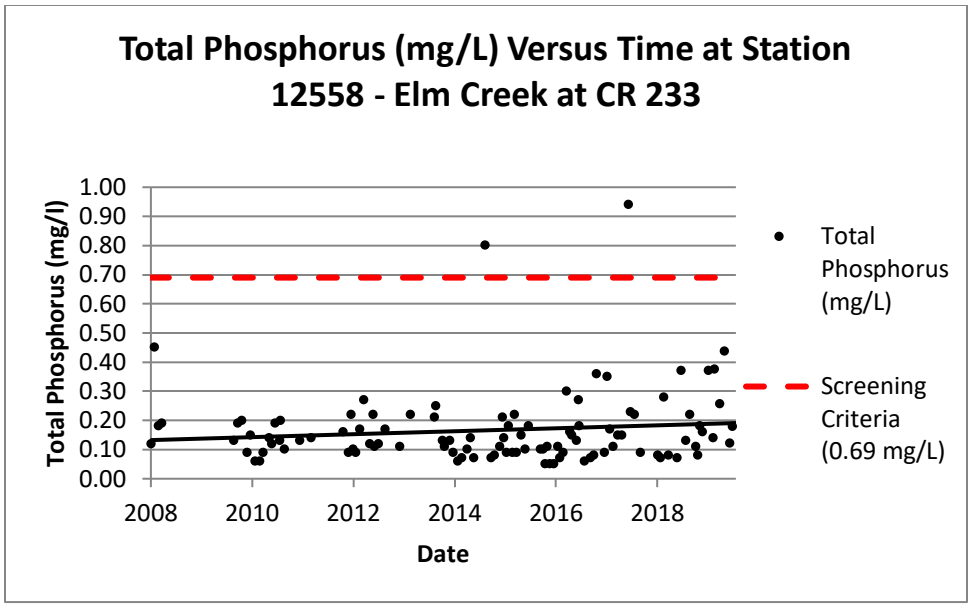

Figure 47: Total Phosphorus over time at monitoring site 12558 – Elm Creek at CR 233 NW of Lockhart from 2008 - 2019.

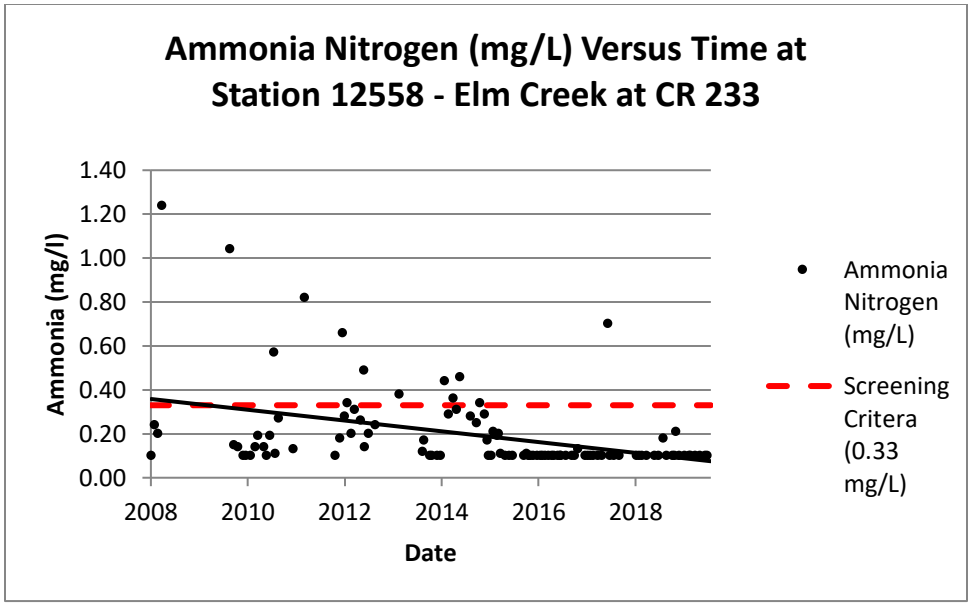

Figure 48: Ammonia Nitrogen over time at monitoring site 12558 – Elm Creek at CR 233 NW of Lockhart from 2008 - 2019.

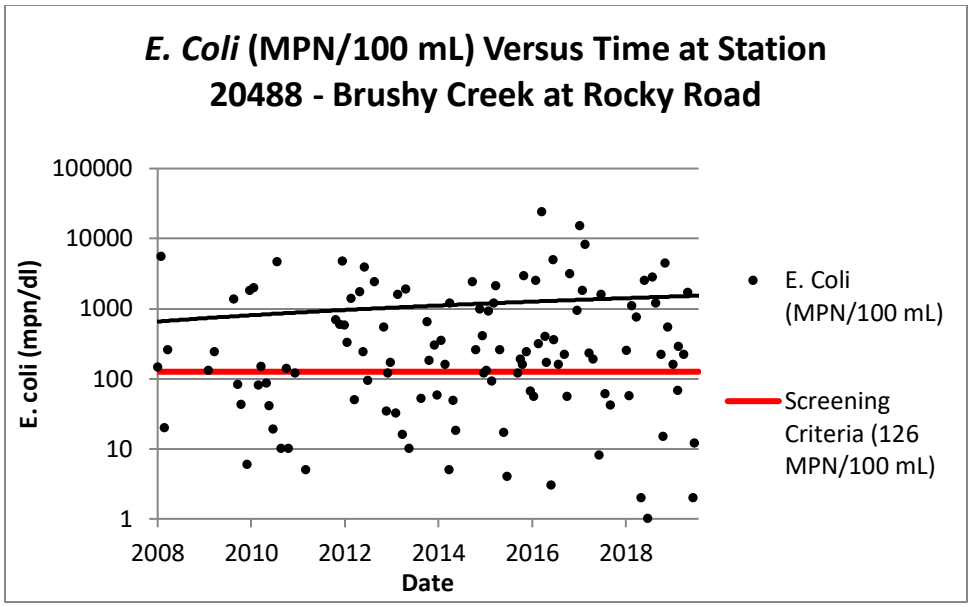

Figure 49: *E. coli* over time at monitoring site 20488 – Brushy Creek at Rocky Road E of Uhland from 2008 - 2019.

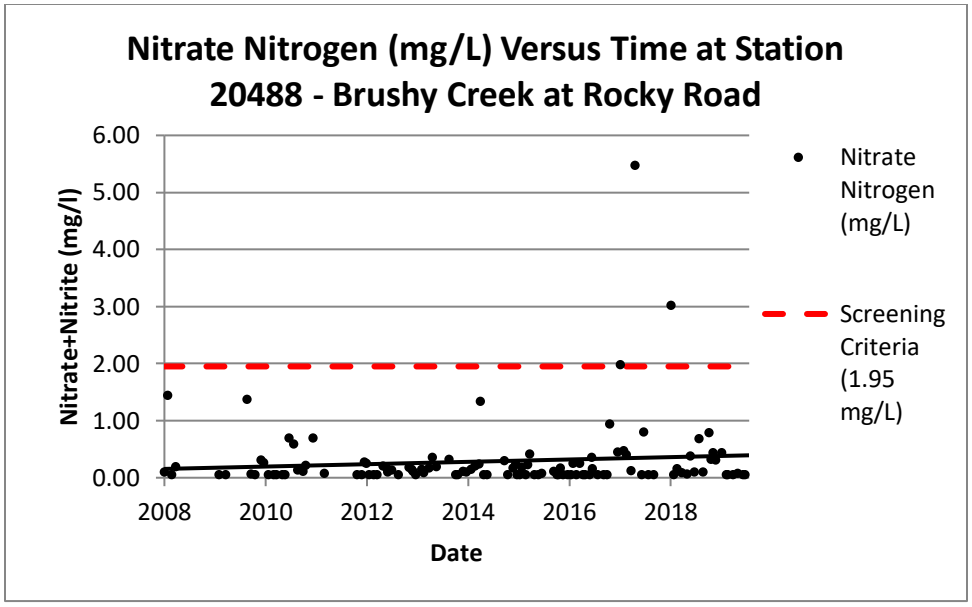

Figure 50: NO3-N over time at monitoring site 20488 – Brushy Creek at Rocky Road E of Uhland from 2008 - 2019.

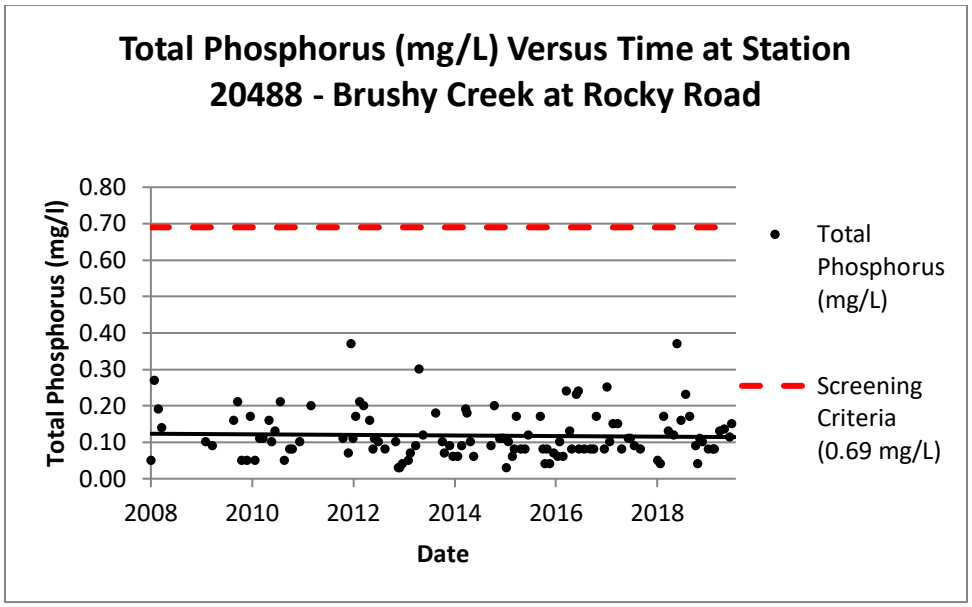

Figure 51: Total Phosphorus over time at monitoring site 20488 – Brushy Creek at Rocky Road E of Uhland from 2008 - 2019.

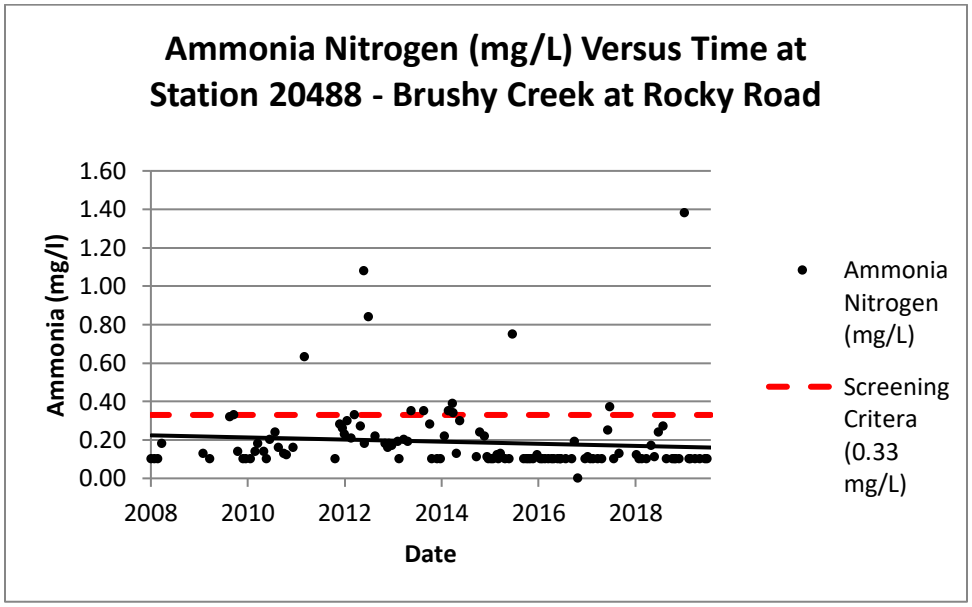

Figure 52: Ammonia Nitrogen over time at monitoring site 20488 – Brushy Creek at Rocky Road E of Uhland from 2008 - 2019.

ASSESSMENT OF CURRENT WATER QUALITY CONDITIONS

TCEQ compiles the Texas Integrated Report of Water Quality (IR) on a biennial basis to identify impaired water bodies and summarize water quality conditions throughout the state. In 2004, TCEQ identified Plum Creek on the 303(d) list of impaired waterbodies due to high E. *coli* concentrations. The issuance of the 2010 Texas Integrated Report reclassified the entirety of Plum Creek as a *Category 4b* stream and removed all segments from the 303(d) list. While Plum Creek continues to exceed the *E.coli* contact recreation standard of 126 organisms per 100 mL throughout its upper, middle and lower reaches, the TCEQ is not currently considering a total maximum daily load study (TMDL) for implementation as "other control requirements are reasonably expected to result in the attainment of all standards." In 2019, the TCEQ issued a Draft 2018 IR, which included a reassessment of data collected in Plum Creek. The FY2018 IR reported evaluations of impairments and concerns for the three Plum Creek segments monitored through the Clean Rivers Program (CRP). This regulatory assessment divides Plum Creek into three distinct stream segments based upon hydrological features and availability of monitoring data. Each of the three stream segments is associated with a historical TCEQ CRP Monitoring station. TCEQ used data collected during the seven-year reporting period from December 1, 2009 through November 30, 2016 to compile their assessment. With the release of the 2018 Draft Report, assessed concerns changed for several segments of Plum Creek. Table 7 identifies the current impairments and concerns in Plum Creek as described in the 2018 Draft Texas Integrated Report.

Upper Assessment Unit (Uhland & Kyle Stations)

The most upstream regulatory assessment unit (AU) of Plum Creek represents the portion of the stream from the headwaters to 0.5 miles upstream of State Highway 21 in the city of Uhland. This portion of the watershed is located in the Edwards Plateau ecoregion and is located in the rapidly developing IH 35 corridor. TCEQ CRP monitoring station 17406 is located 0.4 miles downstream of the confluence with the Bunton Branch tributary of Plum Creek that receives influences from the City of Buda and the Plum Creek main stem that conveys discharges associated with the City of Kyle. A large portion of the stream flow in this segment comes from point source discharges and the nonpoint source influences in this segment are more closely associated with urban land uses than in downstream segments. This portion of Plum Creek is currently impaired for *E. coli* geometric mean (MPN/100 mL) above the regulatory standard. The upper AU also has water quality concerns for nitrate nitrogen, total phosphorus, and impaired microbenthic community. The trend analysis for this AU shows that while *E. coli* concentrations in this portion of the watershed remain relatively stable, they are also consistently higher than the lower portions of the watershed. Ammonia nitrogen concentrations are also significantly increasing. Nitrate nitrogen concentrations are significantly decreasing, which is likely due to dilution from additional rainfall following the drought conditions that persisted from 2010 to 2015.

Middle Assessment Unit (Lockhart)

The middle Plum Creek AU is located in the Blackland Prairie Ecoregion of Caldwell County and the fertile agricultural lands from 0.5 miles upstream of SH21 and 2.5 miles upstream of the confluence with the Clear Fork tributary of Plum Creek. This portion of Plum Creek receives point and non-point source influences from the City of Lockhart and the City of Uhland. Significant tributaries in this portion of the watershed include the intermittent Elm Creek, Brushy Creek and Dry Creek tributaries and the perennially spring fed Town Branch in the City of Lockhart. TCEQ

CRP monitoring station 12647 is located 1.0 miles downstream of Farm to Market Road 20 in Lockhart. The middle AU is impaired for *E. coli* geometric mean (MPN/100 mL) above the regulatory standard. The middle AU also has water quality concerns for nitrate nitrogen and total phosphorus above the screening criteria. TCEQ also identified the Town Branch (1810A) tributary with concerns for *E. coli* geometric mean and nitrate nitrogen and depressed dissolved oxygen below the grab screening level in 2018. The trend analysis of the middle AU showed that *E. coli* is significantly increasing, while nitrate nitrogen and total phosphorus are significantly decreasing. These changes are likely due to increased rainfall in the watershed from 2015 to 2019. Runoff water washes bacterial pollutants into the watershed and dilutes the nutrients concentrations.

Lower Assessment Unit (Luling)

The downstream AU in Plum Creek transitions from the fertile agricultural soils of the Blackland Prairie Ecoregion at a point 2.5 miles upstream of the confluence with the Clear Fork tributary to the sandy soils of the Post Oak Savanah Ecoregion near the confluence with the San Marcos River. This portion of Plum Creek receives point and non-point source influences from the City of Luling and receives the significant drainages of the Clear Fork, West Fork, and Salt Branch tributaries. The TCEQ CRP monitoring station 12640 is located 1.0 miles downstream of the confluence with the Salt Branch Tributary that conveys influences from the City of Luling and 3.0 miles upstream of the confluence with the San Marcos River. This portion of Plum Creek is currently impaired for *E. coli* geometric mean (MPN/100 mL) above the regulatory standard. The lower AU also has water quality concerns for nitrate nitrogen, total phosphorus, impaired fish community, impaired aquatic habitat and depressed dissolved oxygen 24-hour average in 2018. The lower AU of Plum Creek is also experiencing significant increases in *E. coli*, with decreases in total phosphorus, which are likely due to changes in rainfall runoff over time. The unique attribute of the lower AU is that nitrate nitrogen concentrations are significantly increasing over time. This nitrate nitrogen increase reverses the pattern of the two upstream AUs and the reason is currently unknown, although the Clear Fork tributary upstream is also experiencing an increase in this pollutant. This may be an indication that nitrate nitrogen is associated with a nonpoint source pollutant that is unique to the lower portion of the watershed.

Table 14. Current impairments and concerns in Plum Creek as described in the 2018 Draft Texas Integrated Report

Assessment Unit	Parameter	Status
1810_01: Confluence with San Marcos River to approximately 2.5 miles upstream of the confluence with Clear Fork Plum Creek.	E. *coli* geometric mean	Nonsupport (4b)
	Nitrate Nitrogen	Concern
	Total Phosphorus	Concern
	Impaired Fish Community	Concern
	Impaired Aquatic Habitat	Concern
	Dissolved Oxygen 24 Hr. Average	Concern
1810_02: From approximately 2.5 miles upstream of confluence with Clear Fork Plum Creek to approximately 0.5 miles upstream of SH 21.	E. *coli* geometric mean	Nonsupport (4b)
	Nitrate Nitrogen	Concern
	Total Phosphorus	Concern
1810_03: From approximately 0.5 miles upstream of SH 21 to upper end of segment.	E. *coli* geometric mean	Nonsupport (4b)
	Nitrate Nitrogen	Concern
	Total Phosphorus	Concern
	Ammonia Nitrogen	Concern
	Impaired Macrobenthic Community	Concern
1810A_01: Perennial stream from the confluence of Plum Creek upstream to US 183 in the City of Lockhart.	E. *coli* geometric mean	Concern
	Nitrate Nitrogen	Concern
	Depressed Dissolved Oxygen Grab	Concern

WATER QUALITY MONITORING SUMMARY

The 2018 – 2019 Plum Creek 17-09 implementation monitoring project was unusual in that it was not severely impacted by the extreme weather patterns that dominated past monitoring projects in the region. Much of the historical implementation data on Plum Creek was collected during the 2010 - 2015 drought of record. The drought ended in 2015, but extreme floods during Memorial Day in 2015 and during Hurricane Harvey in 2017 changed the hydrology of the watershed in the following years. Extreme hydrological conditions seem to be normal over the past decade in Plum Creek and this has undeniably had an influence on the effective implementation of best management practices (BMPs) and resulting data collected during this period. During drought periods, much of the water in Plum Creek stems from municipal effluent, which may lead to increased nutrient concentrations in the stream. During periods of high rainfall, nonpoint source pollution such as bacteria washes into the stream. The weather patterns of the past decade in the Plum Creek watershed seem to be contributing to increases in nonpoint source pollutants such as bacteria and decreases in pollutants commonly associated with point sources such as nitrate nitrogen and total phosphorus.

The water quality implementation monitoring on Plum Creek has proven to be an essential component in the Plum Creek Watershed Protection process. The data collected during the current TSSWCB 17-09 monitoring project along with historical collections has allowed stakeholders to track changes in pollutant concentrations throughout the implementation period. Implementation efforts to reduce bacteria and nutrient loading in the watershed have not reduced instream bacteria levels to below regulatory thresholds to date. The monitoring data collected throughout this process has provided a greater insight into the amount of bacteria and nutrient loading that is occurring in the watershed. This data has been invaluable in showing that efforts to meet previously projected loading reductions are still needed in order bring the stream into regulatory compliance. Stakeholders can use the monitoring data collected to date to prioritize future BMPs for portions of the watershed where they will have the most impact. Only monitoring project parameters discussed in the WPP have been included this update. The monitoring regime conducted by GBRA for Plum Creek and its tributaries contains a great deal of subsidiary analysis of parameters that were not included in this report. Additional water quality parameter monitoring results are available on the GBRA website at http://www.gbra.org/plumcreek/data.aspx.

Program Coordination and Partnership Sustainability

The Partnership recognized early in the process that the fundamental issues associated with long-term project sustainability are extremely complex. These include concerns about how and by whom the implementation strategy will be facilitated, and how funding will be obtained and managed to support active project management and achieve project goals. To address these critical questions, the Partnership created a sustainability subcommittee to research strategies and provide information and options. Experience, input, and recommendations regarding potential approaches were obtained from numerous agencies, entities, groups, and existing watershed efforts both in Texas and across the nation.

AgriLife Extension effectively facilitated partnership development and initial implementation efforts utilizing personnel located in College Station (i.e., the WC) through the first 5 years of this project. However, it became apparent to the Partnership that there was a need to establish a full-time, locally housed WC to actively facilitate implementation efforts. It was determined that GBRA would be the managing entity of the TSSWCB CWA §319(h) grant for a local WC to take over when the grant managed by AgriLife Extension ended. AgriLife Extension in collaboration with the GBRA and steering committee members engaged personnel and officials with each of the municipalities and counties within the watershed to build strong cooperative partnerships. This effort led to the development, signing (July 2011) and renewal (2018) of an interlocal agreement with local partner entities that provided the 40% match required for a new TSSWCB CWA §319(h) implementation grant to be administered by GBRA. Numerous meetings and presentations were conducted with City Councils, County Commissioner's Courts, and organization boards to provide project updates and information on the interlocal agreement and match structure for the new project. The 12 participating entities included Caldwell and Hays Counties, the cities of Lockhart, Luling, Kyle, Uhland, and Buda, GBRA, Plum Creek Conservation District, Polonia Water Supply Corporation, Hays County Soil and Water Conservation District and the Caldwell Travis Soil and Water Conservation District. The project has established a local WC position managed by GBRA and housed by Caldwell County in Lockhart.

The WC has actively promoted Plum Creek WPP implementation, coordinated the Partnership, continued to build and strengthen local partnerships, and has sought external grants to facilitate implementation activities and provide the balance of funds needed to sustain the position. At meetings held during the summer of 2013, the 12 original participating entities in the Interlocal Agreement, decided to again provide the 40% local match required for a TSSWCB CWA §319(h) implementation grant that currently support local facilitation of the Partnership and the Plum Creek WPP. These efforts have been guided by the understanding that watershed management programs should strive to transition dependency on federal support to local sponsorship. Plum Creek is the first watershed in Texas to solidify, through an interlocal agreement, local governmental entities' commitment to jointly fund a WC for the mutual benefit of all the entities involved.

Continuing Efforts

The Plum Creek Watershed Partnership began implementation of the Plum Creek Watershed Protection Plan in February 2008, and despite major changes within the watershed, with rapid development, years of drought, and employee turnover at the city and county levels, the Partnership continues to be actively engaged in implementation activities. Enthusiasm for continued implementation is evident with the increasing number of new projects within the watershed including LID implementation in Caldwell County and the cities of Lockhart and Kyle, as well as the riparian restoration project in Lockhart.

In addition to new projects, continued commitment from the Partnership will ensure that critical components of the WPP will continue to be implemented. The GBRA will continue water quality monitoring in the watershed through a CWA Section 319(h) grant from the TSSWCB and EPA that provides funding for monitoring through October of 2022. Caldwell-Travis SWCD has committed to continue implementing agricultural components of the WPP by providing technical assistance to farmers and ranchers through the implementation of a CWA Section 319(h) grant from TSSWCB and EPA that will continue to provide financial assistance to write Water Quality Management Plans and implement agricultural BMPs through October of 2022. A CWA Section 319(h) grant from TSSWCB and EPA, awarded to GBRA, will continue funding a local Watershed Coordinator through August of 2021. It is important to note that coordination of this project would not be possible without the continued commitment of the 12 local entities that have signed an interlocal agreement to provide 40% local match, which is required to receive CWA Section 319(h) funds.

The watershed coordinator will continue to actively promote Plum Creek WPP implementation, coordinate the Partnership, continue to build and strengthen local partnerships, and work with partners to develop proposals for external grants to facilitate WPP implementation. Many projects are ongoing such as the *Caldwell County Justice Center Low Impact Development Project* completion of 36 space permeable parking lot, assessment of water quality data collected through the Clean Rivers Program and monitoring projects coordinated by the Guadalupe-Blanco River Authority, *Caldwell County CAPCOG Solid Waste Grants* to fund illicit dumpsite cleanups, Feral Hog removal and eradication through Texas A&M AgriLife Extension- Wildlife Services Grants, and an active project for agricultural BMP implementation through the Caldwell-Travis SWCD. There are also projects that are in their preliminary stages being the *Town Branch Urban Trail Low Impact Development Project* that will further support the implementation of the WPP by restoring and improving Town Branch while providing an educational component to the general public. Understanding the best way to achieve load reductions despite a booming population increase, and its need for additional infrastructure to keep pace are paramount moving forward. With Plum Creek's strong base of dedicated stakeholder groups such as the Plum Creek Watershed Partnership, and the collaborative attitude of municipalities within the watershed, the Partnership is equipped to deal with concerns associated with the rapid changes in land use.