

2018 Update to the Plum Creek Watershed Protection Plan

DEVELOPED BY

THE PLUM CREEK WATERSHED PARTNERSHIP



2018 Update to the Plum Creek Watershed Protection Plan

Prepared by the
Plum Creek Watershed Partnership



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Overview

The ‘Plum Creek Watershed Partnership’ (Partnership) began implementation of the Plum Creek ‘Watershed Protection Plan’ (WPP) in February 2008 in an effort 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.

The region has endured the most severe drought on record, at times resulting in all but those areas immediately below springs or effluent discharges running dry, dramatically impacting the landscape and substantially affecting pollutant loading characteristics. Conversely, the State of Texas experienced its wettest year on record in 2015. Further, 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 a number of 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.

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 as a way 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 2014 and a CWA §319(h) grant has secured funding for this position and WPP implementation through 2018.

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:

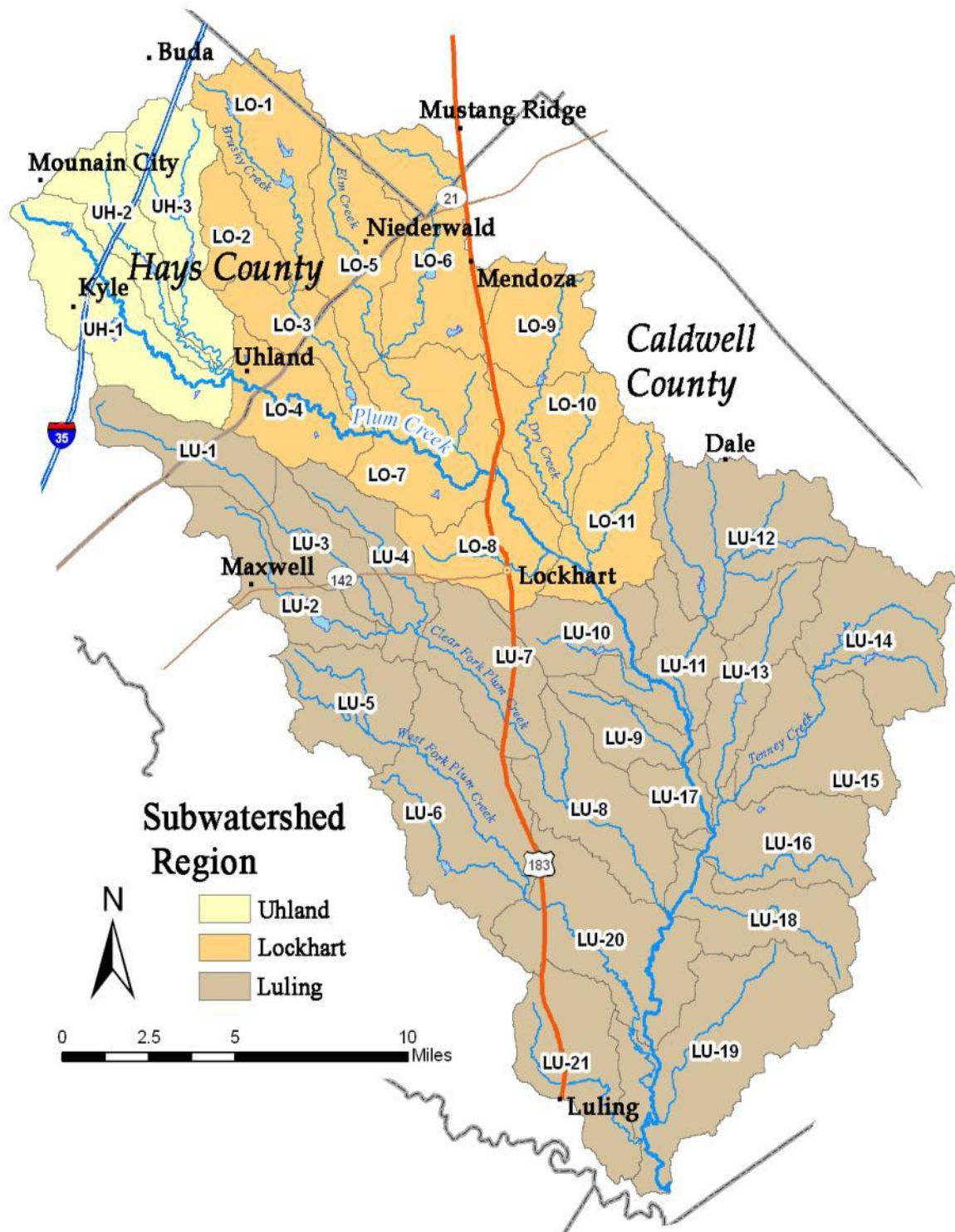
- a progress report on efforts to implement the Plum Creek WPP since its initial release with a primary focus on activities and updates from Jan. 2014 through Dec. 2017

- 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 goals

Table 1. Timeline of funding for implementation grants received and/or managed since January 1, 2014

Caldwell County TCEQ																
GBRA WQ Monitoring																
GBRA Isotope																
GBRA BST																
Caldwell TDA																
WQMP IP																
GBRA IP Coordination																
Caldwell County CAPCOG																
GBRA/Lockhart TCEQ																
Buda TWDB																
Timeline of Dates	Jan-14	Apr-14	Jul-14	Oct-14	Jan-15	Apr-15	Jul-15	Oct-15	Jan-16	Apr-16	Jul-16	Oct-16	Jan-17	Apr-17	Jul-17	Oct-17

Figure 1. Subwatersheds identified for Plum Creek.¹ Two-letter abbreviation corresponds to the stream segment and associated Clean Rivers Program (CRP) monitoring location receiving runoff from each subwatershed. UH = Uhland [17406]; LO = Lockhart [12647]; LU = Luling [12640]. See Table 13 for a detailed list of all monitoring locations in the watershed.



Urban Stormwater Management

Rapid urban development has continued in the Plum Creek watershed throughout the reporting period. Implementation of water quality BMPs in developing areas remains a top priority for WPP and Partnership success. The Partnership has fostered strong relationships with the cities of Kyle, Lockhart, Luling, and Buda serving to inform decisions and investments in WPP implementation strategies that satisfy city needs and advance water quality improvement efforts.

Large swaths of the watershed have been transformed by the construction of State Highway 130, which opened October 24, 2012. Further, rapid residential and commercial growth along the Interstate 35 Corridor between Austin and San Antonio continues to pose substantial challenges for managing urban stormwater and municipal wastewater throughout the uppermost segments of Plum Creek. The City of Kyle, in particular, experienced exponential population growth (427%) from 2000 to 2010 as defined by the U.S. Census Bureau (Tables 2 and 3). As small towns struggle with becoming urbanized centers, the impacts to existing stormwater and wastewater systems can be profound, greatly increasing the risk of significant water quality degradation.

As defined by the 2010 Census, the cities of Buda and Kyle are both included as part of the Urbanized Area of the City of Austin (Figure 2). Each of these cities now falls under Phase II MS4 requirements. The Texas Commission on Environmental Quality (TCEQ) issued the Phase II MS4 General Permit, TPDES Permit No. TXR040000, on December 13, 2013. The City of Kyle received notice in early 2014 that they would be included as a regulated entity under this permit and has implemented efforts throughout the reporting period to comply with the new provisions.

Table 2. Population of incorporated cities completely or partially within the Plum Creek watershed¹.

City	2000 Census Population	2010 Census Population	Percent Change
Buda	2,404	7,295	203%
Kyle	5,314	28,016	427%
Lockhart	11,615	12,698	9%
Luling	5,080	5,411	7%
Martindale	953	1,116	17%
Mountain City	671	648	-3%
Mustang Ridge	785	861	9%
Niederwald	584	565	-3%
Uhland	386	1,014	163%

¹ Source: Texas State Data Center and Office of the State Demographer.

Table 3. Population of counties partially within the Plum Creek Watershed².

County	2000 Census Population	2010 Census Population	Percent Change
Caldwell	32,194	38,066	18%
Hays	97,589	157,107	61%
Travis	812,280	1,024,266	26%

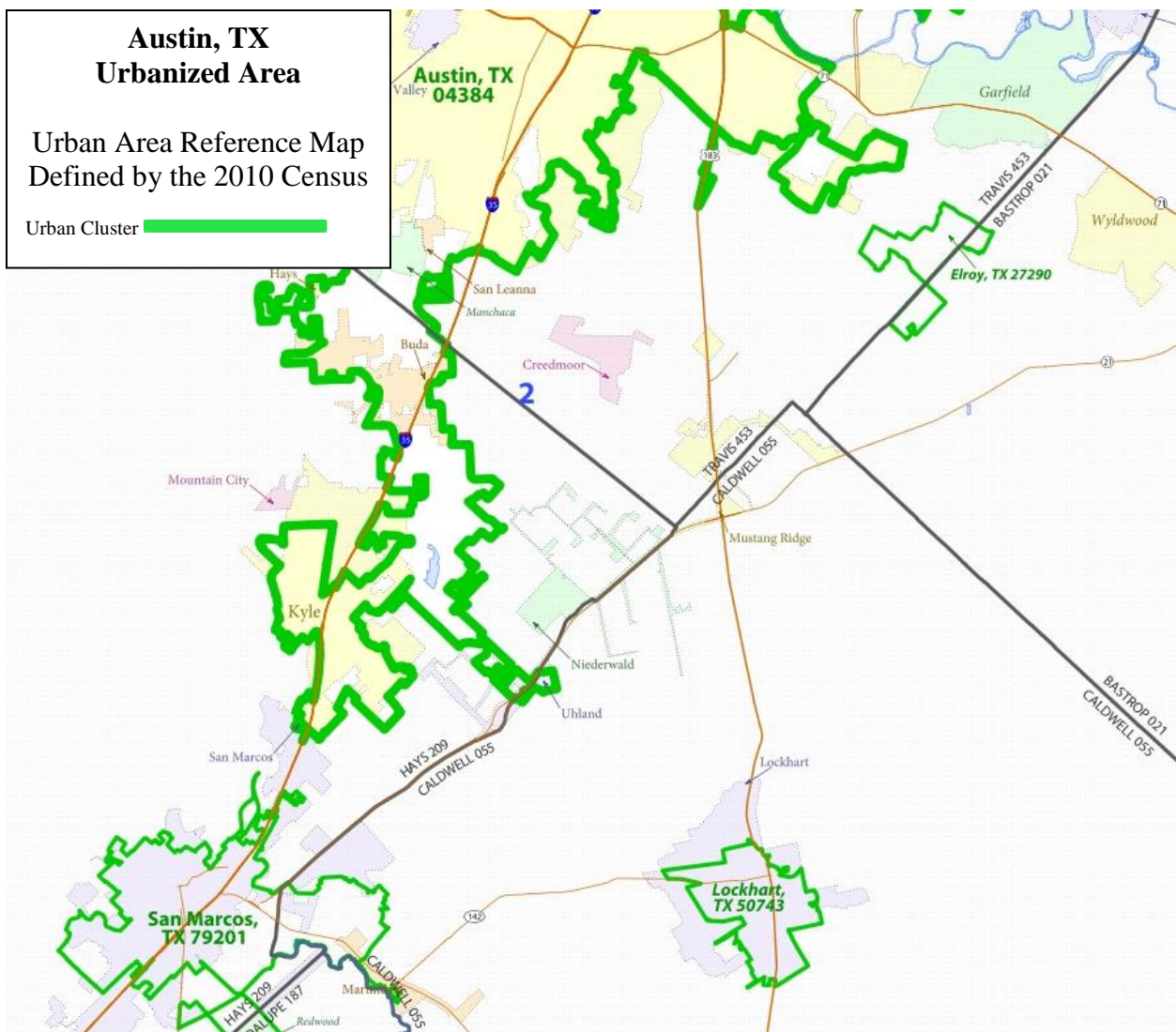


Figure 2. Lower Portion of Austin Urbanized Area Map as Defined by the 2010 Census includes the cities of Buda and Kyle.

Low-Impact Development

In an effort to minimize these risks to the watershed, the Partnership strongly recommends the implementation of low-impact development (LID) projects. 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.

Responding to Caldwell County budget shortfalls for landscaping and additional parking infrastructure to accompany a major building renovation that would become the County’s new Justice Center, the Partnership worked with the County Judge and Commissioners to develop a CWA §319(h) grant proposal through the TCEQ to retrofit the facility with LID components, including raingardens, xeriscape, rainwater harvesting and the construction of a permeable paver parking lot. The \$370,402 project included significant local investment and drew on existing partnerships with Caldwell County AgriLife Extension and Keep Lockhart Beautiful, among others, to provide matching and in-kind funds. The project was selected for funding and executed in November 2015. The Caldwell County Justice Center project, which will include highly visible BMPs 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.

As of December 31, 2017, Caldwell County has completed work on its 10,000 gallon rainwater harvesting system for the Justice Center rooftop runoff (figures 3 and 4), a rain garden across the front of the parking lot with treatment capacity for 13,000 gallons of runoff (figures 5 and 6) and 2,000 square feet of xeriscaping (figure 7) has been completed. A new 13,000 square foot permeable paver parking lot with 36 parking spaces is still in the planning stages. The County has offered one workshop and one site tour.



Figure 3. Construction of rainwater harvesting concrete pad



Figure 4. 10,000 gallon rainwater harvesting system



Figure 5. Construction of rain garden



Figure 6. Completed rain garden



Figure 7. Xeriscaping plants completed by Texas Sage Master Gardeners

Following Caldwell County’s success, the City of Kyle worked with the Partnership throughout 2015 to develop a new CWA §319(h) grant proposal 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 \$220,368 project to construct green stormwater infrastructure at the City’s new administration building for its planned WWTP expansion was selected by TCEQ for EPA review in December 2015 and subsequently funded. TCEQ has approved the design of the LID features for the WWTP. However, since it is a portion of a major construction project at the WWTP, construction of the LID features is pending completion of a design review and revision for the overall WWTP project.

State and federal grant programs such as 319 are vital tools for the introduction and encouragement of nonpoint source management efforts in the urban sector; however, consideration must be given to the fiscal and staff limitations of smaller communities. While the Partnership is committed to ensuring the success of the aforementioned projects proposed by Caldwell County and the City of Kyle, grant projects that require significant matching funds and frequent reporting do present a significant challenge for smaller municipalities that, in many cases, have the greatest need for this type of financial support. To this end, the Partnership has continued to work with partner cities and TCEQ to improve communication and develop new strategies for achieving urban stormwater management milestones identified in the WPP. Several meetings with TCEQ staff and Partnership Steering Committee representatives facilitated by the Plum Creek WC were conducted in 2014. As a result of these meetings and the successful Caldwell County and City of Kyle proposals, the Partnership intends to engage the cities of Uhland, Lockhart and Luling to develop future CWA §319(h) funding proposals for TCEQ consideration.

Urban Riparian Restoration

In September of 2017 the City of Lockhart launched a project that will be conducting 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. EPA through a CWA §319(h) grant, the city will perform riparian restoration measured 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 City will conduct education and outreach associated with these measures. As of 12/31/17, a first-of-its-kind QAPP for the riparian evaluation was in development. It has since been approved. An update of additional urban stormwater management within the watershed can be found in Table 4.

Table 4. Urban stormwater management updates.

Project Description	Project Notes through December 31, 2017
<i>Urban Stormwater Assessments, Mapping and Illicit Discharge Survey</i>	<p>To identify the most effective locations for the installation of structural stormwater controls for the cities of Kyle and Lockhart.</p> <p>City of Kyle - 2,058 storm drain inlets, 291 storm drain outlets, and 825 stormwater manholes (see <i>Appendix A</i>).</p> <p>City of Lockhart - 288 storm drain inlets. GBRA awarded a 2-year grant to complete City of Lockhart illicit discharge survey and final report in 2016. GBRA didn't find any illicit discharges.</p>
<i>Urban Stormwater Markers</i>	Cities of Buda, Kyle and Lockhart have installed "no dumping" markers on the majority of storm drain inlets throughout the city limits.
<i>Street Sweeping Programs</i>	<p>Street sweeping programs continued in cities throughout the Plum Creek watershed.</p> <p>Kyle - 150 miles per month Lockhart - 50-60 miles per month Buda - 192 miles Luling - All city streets are swept monthly</p>
<i>Urban Waterfowl Management</i>	City of Lockhart identified a large domestic waterfowl population in City Park as a potential bacteria source. Fifty percent of the existing duck population was removed in 2014.
<i>Dog Waste Management</i>	<p>Cities of Kyle, Buda, Lockhart and Luling have pet waste ordinances requiring proper disposal in parks and public areas. Fifty pet waste stations are known to be in use throughout the watershed, including: Kyle (16), Buda (18), Lockhart (10), and Luling (6).</p> <p>Enforcement of existing ordinances and education of pet owners remain priorities. Public education campaigns in Kyle, Lockhart, Luling and Buda promote proper pet waste management.</p>
<i>Hays County Development Regulations</i>	In July 2011, Hays County adopted regulations to provide a framework for the orderly and efficient development of rural and suburban areas outside of incorporated cities. According to Hays County Development

	Services, these regulations have served to simplify procedures, avoid delays, save expense, and facilitate the administration and enforcement of laws and regulations by the County. The regulations are consistent with the WPP goals of improving water quality from stormwater, construction sites, and wastewater from new development and are supported by the Partnership.
<i>Caldwell County Development Regulations</i>	<p>In January 2011, Caldwell County adopted an ordinance for the purpose of providing a framework for, “the safe, orderly, and healthful development of the unincorporated areas, these issues being hereby declared to be worthwhile public purposes and in the public interest.”² The regulations are consistent with the WPP goals of improving water quality from stormwater, construction sites, and wastewater from new development and are supported by the Partnership. The ordinance includes:</p> <ul style="list-style-type: none">• On Site Sewage Facility (OSSF) requirements including certification by an engineer or licensed sanitarian and maintenance agreements for new and existing aerobic systems• Drainage design requirements and criteria to manage stormwater conveyance• Erosion and sediment control requirements to manage erosion and requires the development of a permanent erosion control plan• Stream setback requirements protecting riparian vegetation and water quality

² From *Caldwell County Development Ordinance*, adopted January 18, 2011

Wastewater Management

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, particularly older conventional 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 OSSFs.

Funding for the continued voluntary monitoring of WWTFs has been secured, 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 CBOD₅, 5 mg/L TSS, 2 mg/L NH₃-N, 1 mg/L phosphorus]. Currently, six permitted WWTFs in the watershed require 5-5-2-1 treatment of wastewater: Sunfield, Shadow Creek, Crosswinds, Windy Hill, Camino Real and City of Buda. The City of Buda has also installed purple pipe along most of Main Street from Old San Antonio Road through Stagecoach Park to Public Works, and along Cabela's Drive from Main Street to Old San Antonio Road.

While progress is clearly being made with regard to wastewater management efforts in the Plum Creek watershed, a series of illicit discharges and other major permit violations from 2010 through 2017 at the City of Kyle WWTF and Goforth WWTF have made progress toward achieving nonpoint source water quality goals identified in the WPP extremely difficult to ascertain. After extended litigation, the City of Kyle has secured operational capacity at the City of Kyle WWTF and is no longer a co-permittee with Aqua Texas, Inc.. Plans for renovation, maintenance and expansion of the WWTF are underway. Discussions with the City of Kyle continue regarding future plans to adopt reuse strategies, land application and/or 5-5-2-1 treatment levels.

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, TPDES permit limitations and requirements are enforceable under State law. The operation of WWTFs can be lucrative, and in some cases, companies may consider the penalties assessed by regulatory agencies for permit violations minimal compared to making the necessary infrastructure and system improvements to ensure sustained permit compliance. TCEQ and other regulatory agencies could consider stricter regulatory policies, including more substantial fines and additional monitoring requirements, to deter repeated violations from poorly performing facilities, particularly those discharging into threatened and impaired waterways such as Plum Creek. The anticipated adoption of new statewide water quality standards for nutrients for freshwater streams will serve to further protect water quality in the Plum Creek watershed.

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 5).

Table 5. Sewer line repaired, replaced and/or extended by Plum Creek watershed cities since WPP implementation.

City	2008 - 2013	2014 - 2017
	Sewer Line Repaired/ Replaced (linear feet)	Sewer Line Repaired/ Replaced (linear feet)
Buda	10,023	20,954
Kyle	4,660	122,101
Lockhart	5,470	*None reported in the watershed
Luling	*None reported in the watershed	*None reported in the watershed
Totals	20,153	143,055

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. While several developers have reached out to the Partnership for consultation prior to construction, the potential impacts to surface water quality in the Plum Creek watershed from an increase in permitted WWTFs and OSSFs cannot be overstated. The Partnership will continue to engage developers and local communities to better educate new and current stakeholders on WPP goals including water reuse, TLAPs, LID and water conservation measures.

Septic Systems in the Watershed

Both Hays and Caldwell Counties adopted new policies and regulations in 2011 to ensure proper maintenance for new and existing aerobic septic systems. In Caldwell County and the City of Umland, 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 an extensive training course.

Conventional septic systems in the Plum Creek watershed do not have the same requirements as aerobic systems. As a result, maintenance of such systems is frequently neglected, and problematic systems often are reported only when a complaint is filed by a neighbor or other individuals due to standing water and smell. If problems are severe enough to cause surfacing of wastewater, it is very likely that system failure has been occurring underground for an extended period of time. These situations can only be prevented if all systems are required to undergo regular inspection and maintenance. 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. Three workshops were conducted for watershed homeowners in 2014, including one conventional OSSF maintenance workshop in Caldwell County and two aerobic system operation workshops in Hays County. In 2017, one conventional OSSF maintenance workshop was conducted in Luling, and two aerobic system operation workshops were conducted in Kyle and Lockhart.

Table 6. 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 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, 125 conservation plans have been written and implemented (table 7). Additionally, conservation planning assistance has been provided to 150 landowners in the watershed.

Table 7: Conservation planning status as of December 31, 2017

Type of Agricultural Operation	Total Farms	Conservation Plans Needed	Completed Plans
Livestock Operation	702	235	120
Cropland	142	24	5

Texas A&M AgriLife Extension, TSSWCB and the SWCD Technician have promoted interaction between the Steering Committee and the NRCS Work Groups to blend the goals of the Plum Creek WPP with the resource concerns and conservation priorities for the Environmental Quality Incentives Program (EQIP). Recommendations from the Local Work Groups assist NRCS in allocating EQIP county base funds and with resource concerns for other USDA Farm Bill programs.

Small Farms Trending Up

It is interesting to note that despite the rapid population increase in the region, the total land in farms has actually remained steady, with a small, but somewhat surprising, increase in both Hays and Caldwell County from 2007 to 2012¹. While total agricultural acreage has been relatively stable, the number of farms, particularly those under 50 acres, has risen significantly from 2007 to 2012². Table 8 provides selected agricultural data for Caldwell County and Hays County.

Table 8. 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)		Land in Small Farms (<50 acres)	
	2007	2012	2007	2012	2007	2012	2007	2012	2007	2012	2007	2012
Caldwell ¹	1,421	1,623	304,737	310,433	214	191	71,459	55,928	587	693	12,649	14,832
Hays	1,136	1,439	235,568	245,006	207	170	39,265	30,315	532	750	11,089	14,056
Note: 2012 Land in Farms as a percent of Total Land Area – Caldwell County (88.7%), Hays County (56.3%)												

¹ USDA, National Agricultural Statistics Service, 2007 and 2012 Census of Agriculture – County Data

¹ Increase in number of farms under 50 acres from 2007 to 2012: Caldwell County(+18.1%), Hays County (+41.0%)

Recognizing the trend toward smaller farms and noting the changing demographics of rural land ownership in Caldwell County away from legacy landowners and toward those with limited experience and/or knowledge of sustainable agricultural management practices, in 2012 the Caldwell County AgriLife Extension, Leadership Advisory Board, identified small acreage farms as a primary area of concern. AgriLife Extension in Hays County has also taken steps to address the increasing number of smaller farms with a “Small Acreage Landowner, Land Management Series” that offered five separate workshops in July and August of 2013. Additionally, these efforts have continued in the watershed with an additional Small Acreage Stewardship Workshop held on May 31, 2017, by Texas A&M AgriLife Extension, USDA-NRCS, and the Caldwell-Travis SWCD.

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 particular demographic could yield significant improvements in water quality throughout the Plum Creek watershed. At a meeting facilitated by a Partnership Steering Committee member in January 2013, the WC presented information on the Plum Creek WPP to a group of Caldwell County realtors. A key result of this meeting was an agreement that packets containing information on the Plum Creek WPP would be distributed to new and prospective homeowners and landowners in Caldwell County and surrounding areas.

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. Effects of their activities on water resources include increased sediment, bacteria and nutrient loading, algae blooms, oxygen depletion, and bank erosion. In areas where high numbers of feral hogs are present or where animals spend a significant portion of their time in and near streams, they can be a major contributor of bacteria and nutrients. These animals have caused such concern at the national level that they have received specific attention from the Office of the President. Executive Order 13112 was issued in 1999 to all federal agencies. This Presidential Document calls upon agencies “whose actions may affect the status of invasive species” to detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner” through “eradicating, suppressing, reducing, or managing invasive species populations, preventing spread of invasive species from areas where they are present.”

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 and 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.

Following the early success of Hog Out programs in Hays and Caldwell County in 2012 that saw the initiation of bounty programs in each county, the establishment of the Caldwell County Feral Hog Task Force (CCFHTF) and adoption of the *Caldwell County – Hays County Feral Hog Action Plan (Action Plan)* by the CCFHTF in July 2013, the Partnership and WC became central figures in an expanded feral hog control effort throughout 2014, 2015 and 2016.

In August 2013, Caldwell County and Hays County officials were notified that they had received the first Texas Department of Agriculture (TDA) County Hog Abatement Matching Program (CHAMP) grant awarded in the State of Texas. The grant was managed by the CCFHTF and supported the implementation of year-1 of the *Action Plan* with a combined \$30,000 in TDA funds and \$55,163 in local cash and in-kind contributions.

The CCFHTF has used multiple metrics, including “Feral Hog Population Growth, Density and Harvest in Texas” and conference calls with industry experts to provide a basis for determining project goals, objectives and results analyses. Key management components of the project included a \$5/hog bounty program, aerial control, three wireless corral traps, a 40’ drop net, and a professional trapping company that also operates a certified feral hog holding facility working

to coordinate food bank donations through USDA inspected processors. Based on extremely limited population data due to the size of the project area and lack of effective tools for determining local feral hog populations, a total harvest goal of 5,835 feral hogs to be removed in year one through the CHAMP grant project was expected to significantly reduce current feral swine numbers and set the stage for the potential to achieve zero to negative long-term population growth of the Caldwell and Hays County feral hog population. To facilitate this goal, the WC worked with the CCFHTF to develop the “Landowner Cooperative Sharing Program.”

Implementation of the *Action Plan* began September 1, 2013. Initial results showed 90% of the total harvest was taking place in Caldwell County. To boost involvement and better track the feral hog harvest in Hays County, a “Log Your Hogs” campaign was implemented in April 2014 along with a “Hog Hunters Brunch, Awards and Raffle” event held in Kyle along with an AgriLife feral hog workshop hosted by the Hays County Extension Office. Despite these efforts, the reported harvest in Hays County remained low compared to Caldwell County and future efforts in Hays County became more focused on outreach and education. Varying land use and landowner demographics were determined to be the prevailing reasons for different results in the two counties. Figure 8 shows the one-year harvest totals for CHAMP.

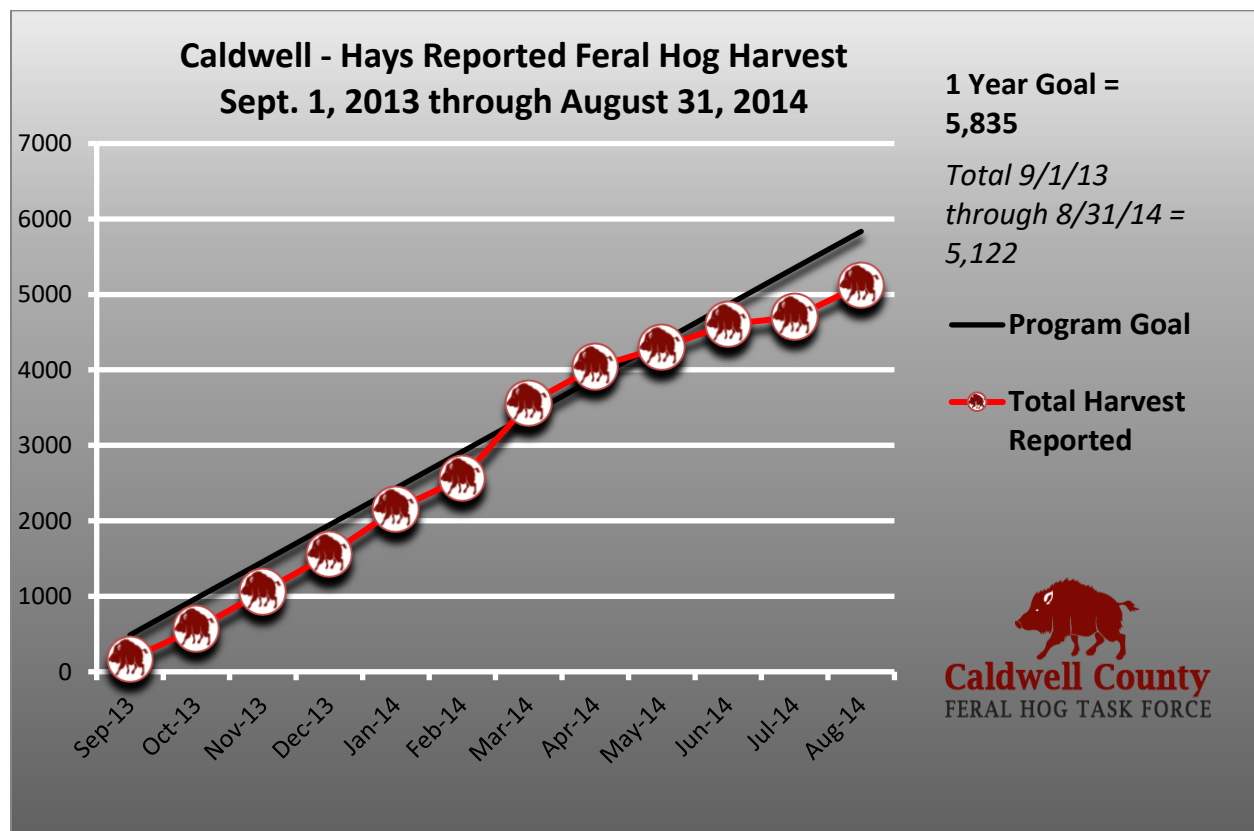


Figure 8. Caldwell – Hays County Feral Hog Action Plan progress September 2013 to August 2014.

The follow up to the CHAMP program was called the County Hog Out Management Program (CHOMP) and focused specifically on programs and reductions in Caldwell County. Funds from this program totaling \$25,000 supported the development of a CCFHTF website (www.feralhogtaskforce.com), landowner cost sharing to support the addition of 20 corral traps and other technologies such as mobile-ready game cameras. Ongoing maintenance of the County's wireless trap cooperative and bounty program were also funded through this program. Based on harvest data and hog population analytics, it was estimated that the harvest rate sustained in Caldwell County over a 15-month period from September 2013 through November 2014 reached 78% of the estimated feral hog population in Caldwell County through the documented removal of 8,283 hogs in the county. In 2015 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 733 hogs. By the end of the reporting period for this WPP update, the documented harvest of feral hogs in Caldwell County had exceeded 10,000.

So far the CCFHTF created *Action Plan*, has far exceeded any previous attempts to quantify feral hog damage and harvest rates in the Plum Creek watershed and, on a larger scale, Caldwell and Hays County. The Partnership encourages stakeholders to continue feral hog management practices that will serve to improve water quality in the watershed. Further, the Partnership and WC will continue to work with the CCFHTF to develop a sustainable, long-term funding mechanism to continue their efforts in the Plum Creek watershed. To find out more information on CCFHTF programs, visit www.feralhogtaskforce.com.

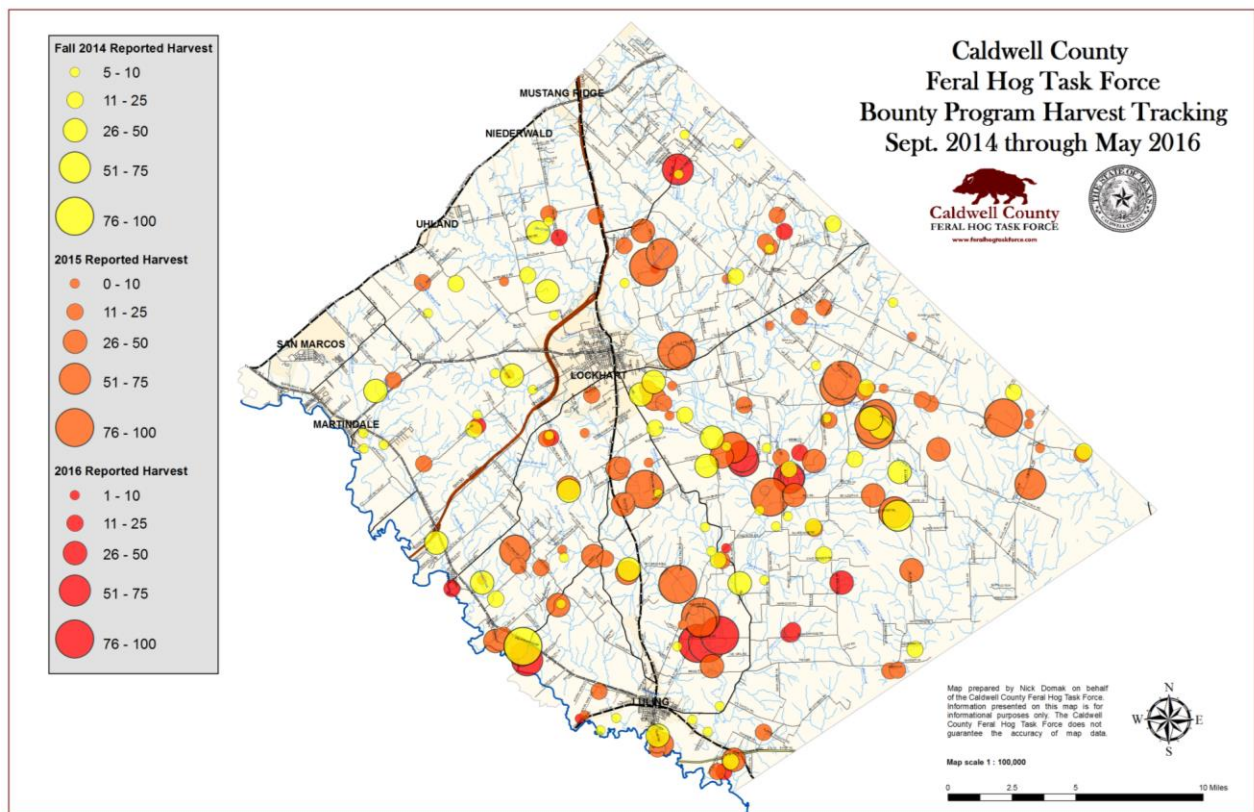


Figure 9. Caldwell County feral hog harvest map from Sept. 2014 through May 2016.

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. Outreach and education will continue to be a key focus of the Partnership's efforts throughout implementation. With the addition of a local WC in 2012, watershed stakeholders have been given a "go to person" for information ranging from stocking rates and range management to dealing with fish kills and oil spills. The Plum Creek 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 group 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.

A major success for the Partnership was the acquisition of TCEQ CWA §106 funds to support the *Taking Charge of Water Quality in the Plum Creek Watershed* project to conduct a significant portion of the educational activities outlined in the WPP. Many of the resources developed through this project have been adapted and utilized in other watersheds across the state, and the effort has received multiple awards for its creativity and effectiveness. In coordination with this project and other Partnership efforts, AgriLife Extension, GBRA, and TSSWCB have produced numerous publications, press releases, and newsletters directed toward watershed stakeholders. Additionally, multiple websites and educational modules have been developed as information and education resources for the public in Plum Creek and across the state.

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>. Over 750 copies have been printed and distributed throughout the watershed at Partnership Meetings, city council and county commissioner court meetings, field days, workshops, and other events. One hundred fifty (150) flash drives preloaded with the 2014 Plum Creek WPP Update along with the 2012 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.

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 from 2012 through 2017. 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

A database organizing Plum Creek contacts into unique categories of interest is managed by the WC. As of December 2017, the Partnership's stakeholder contact list has grown to well over 1,000 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 through the use of 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. In an effort to harness local energy, enhance stakeholder participation and address community concerns, unique themes focusing on current events in the watershed have been incorporated into press releases and meeting agendas. 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*; the Keep Lockhart Beautiful, *Plum Creek/Town Branch/Lockhart Springs Clean-Up and Environmental Fair*; the Luling Foundation Field Day; Chisholm Trail Roundup, *Natural Resources Fair*; and the Annual Bastrop-Caldwell County Wildlife Management Association Wildlife Extravaganza and others. Since 2006, approximately 8,150 individuals have been reached with information on Partnership efforts in the watershed through these events. Table 9 provides a detailed list of workshops and events coordinated by the WC and Partnership throughout the 2014-17 reporting period.

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 a number of local and regional organizations representing a diverse array of watershed stakeholders including:

- Caldwell County Farm Bureau Annual Convention
- Hays County, Lost Pines and Guadalupe Master Naturalist Chapters

- Houston-Galveston Area Council of Governments
- Texas Water Utility Association
- Clear Fork Wildlife Management Association
- Independent Cattlemen's Association of Texas, Mid-Tex & Guada-Coma Chapters
- Texas River Protection Association
- Tri-Community Wildlife Management Association
- Meeting of Caldwell County realtors
- Lockhart Kiwanis
- Lockhart and Luling Lion's Club
- Texas Invasive Species Coordinating Committee
- Plum Creek Elementary School
- Texas Legislature – Ag and Natural Resources Committee (invited presentation)
- Caldwell County 4-H Camp
- Capital Area Master Naturalist
- St. Stephen's Episcopal School Earth Day Booth
- Thousands more have been reached through educational programming and meetings

Table 9. Plum Creek Watershed Partnership Workshops and Events 2014-17

<u>Date</u>	<u>Workshops and/or Events</u>	<u>Location</u>
Feb. 2014	Lone Star Healthy Streams – Feral Hog Workshop	Luling, TX
Apr. 2014	Caldwell/Hays Hog Hunters Appreciation Brunch and Awards	Kyle, TX
Jun. 2014	Smart Growth Workshop	Lockhart, TX
Sep. 2014	Homeowner OSSF Workshop	Lockhart, TX
Sep. 2014	Hot Dogs Day of Service	Luling, TX
Sep. 2014	Homeowner OSSF Workshop	Kyle, TX
Oct. 2014	Keep Lytton Springs Beautiful Cleanup	Lytton Springs, TX
Oct. 2014	Homeowner OSSF Workshop	San Marcos, TX
Oct. 2014	Keep Lockhart Beautiful Cleanup and Environmental Fair	Lockhart, TX
Nov. 2014	Veterans Day Salute (service oriented feral hog program)	Lockhart, TX
Feb. 2015	Lone Star Healthy Streams – Feral Hog Workshop	Luling, TX
Oct. 2015	Keep Lockhart Beautiful Cleanup and Environmental Fair	Lockhart, TX
Dec. 2015	Texas Watershed Steward Workshop	Lockhart, TX
Aug. 2016	Urban Riparian Workshop	Lockhart, TX
May 2017	Small Acreage Stewardship Workshop	Lockhart, TX
June 2017	LID workshop on Green Infrastructure	Lockhart, Tx
July 2017	Homeowner OSSF Workshop	Kyle & Luling, TX
Aug. 2017	Homeowner OSSF Workshop	Lockhart, TX
Sept. 2017	Riparian & Stream Ecosystem	Lockhart, TX
Nov. 2017	Green Stormwater Infrastructure Workshop	Lockhart, TX
Nov. 2017	Urban Riparian & Stream Ecosystem Workshop	Kyle, TX

Local, State and National Media

The Plum Creek watershed has been a focus of much media attention throughout the region, state, nation and beyond. Based on stakeholder participation rates and media coverage, the Plum Creek feral hog component and CCFHTF program have been the most popular media stories of 2014-2017. Local and regional media outlets, which provide more stakeholder-specific information, have also shown a spotlight on Plum Creek watershed workshops, trainings and other projects, including Keep Lockhart Beautiful activities. Other stories of public interest and/or concern affecting the Plum Creek watershed have also been featured in local, state and national media outlets. Those with the greatest potential to impact WPP implementation have included the opening of the 85 mph SH130 Tollway, illicit discharges from the Kyle WWTF, the Ranch at Clear Fork WWTF and associated housing and commercial development to be located near Uhland, TX, and the proposed SH130 Environmental Park, a landfill and transfer station to be located north of Lockhart.

Notable media coverage since the 2014 WPP update has included:

- Multiple radio interviews with KLBJ News in Austin and the Texas Farm Bureau Report
- *Here a Pig, There a Pig*, featured in the April 2014 issue of Texas Co-op Power magazine
- *Counties stepping up feral hog eradication efforts*, Lone Star Outdoor News
- Feature length articles discussing the Partnership and/or Plum Creek activities published in San Francisco Chronicle, Austin-American Statesman, Hays Free Press, San Marcos Daily Record, Luling Newsboy, Lockhart Free Press, the GBRA River Run and others
- A feature story on Fusion TV, filmed on location in the Plum Creek watershed in April 2014
- *War against feral hogs rages on*, front page of Austin-American Statesman in Dec. 2015
- *Feral swine have Texas county at epicenter of hog wild battle*, Fox New Dec. 2015
- *Bounty program in Caldwell County for Feral Hogs may be model for state*, Fox 7 News Jan. 2016

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 10 highlights the impact of GBRA's youth education programs 2014 - 2017.

Table 10. Highlights of the GBRA youth education program, Jan. 2014 through Dec. 2017.

2014	Water Quality Presentations (1,000 students, 26 teachers, 10 campuses in Hays, Lockhart & Luling districts) Composition Challenge (495 students, 29 teachers, 7 campuses in Hays & Lockhart districts)
2015	Water Quality Presentations (1,035 students, 34 teachers, 10 campuses in Hays, Lockhart & Luling districts) Composition Challenge (410 students, 22 teachers, 6 campuses in Hays & Lockhart districts)
2016	Water Quality Presentations (1,580 students, 63 teachers, 10 campuses in Hays, Lockhart & Luling districts) Composition Challenge and Water Treatment Plant tour (500 students, 26 teachers, 5 campuses in Hays, Luling and & Lockhart districts)
2017	Water Quality Presentations (1,360 students, 34 teachers, 10 campuses in Hays, Lockhart & Luling districts) Composition Challenge (620 students, 26 teachers, 6 campuses in Hays & Lockhart districts)

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. TST has a strong presence in the Plum Creek watershed with volunteers monitoring 18 locations in the watershed (Figure 10). In addition to their trainings regularly held in San Marcos, TST has provided numerous educational opportunities for watershed stakeholders.

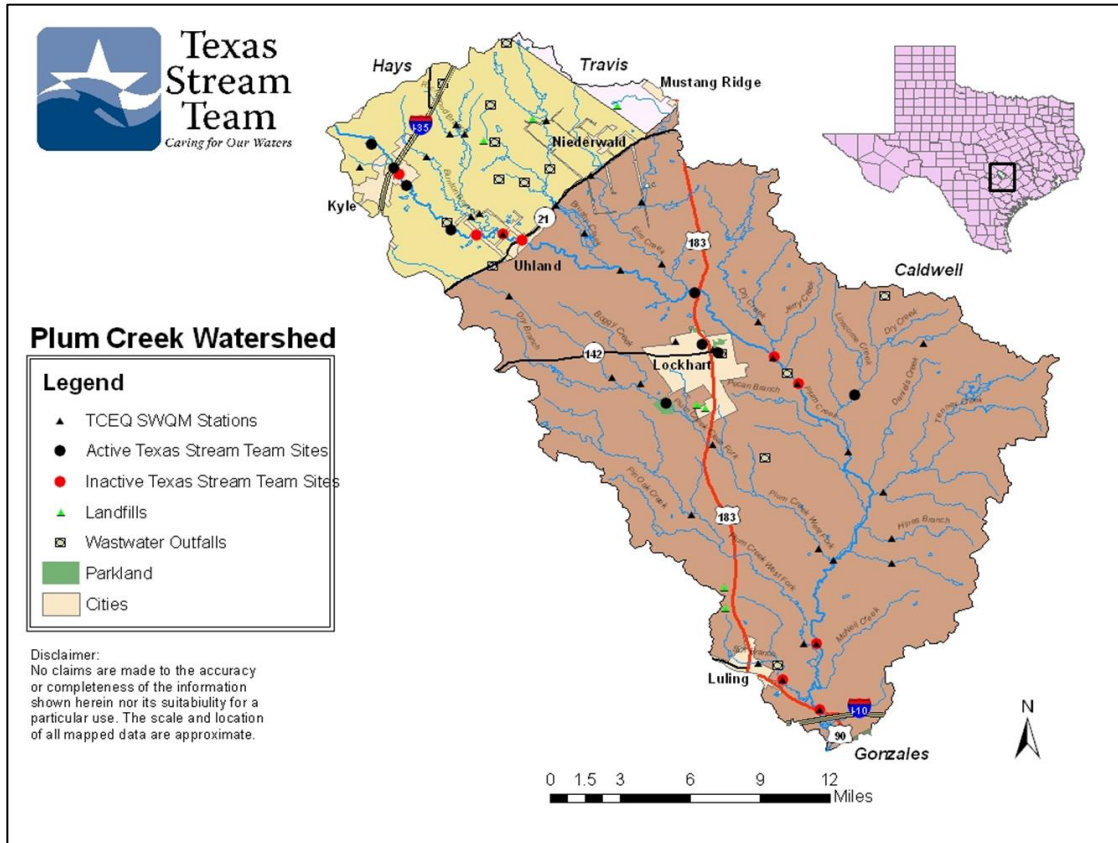


Figure 10. Map of volunteer monitoring locations in the Plum Creek watershed.

TARGETED POLLUTANT SOURCE OUTREACH EFFORTS

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, school teachers, and residents in the Plum Creek watershed, this module has been promoted across the state and has been utilized in several other watershed efforts.

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.

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 (<http://www.gbra.org/fog.swf>) and has been used by 6,734 unique visitors since its release 2009.

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 HHW management and recycling. A TCEQ CWA §319(h) grant awarded to the City included provisions for hosting annual hazardous and electronic waste collection days in 2010 and 2011. The City has utilized additional funds including a Capital Area Council of Governments (CAPCOG) FY 2014 and FY 2016 Solid Waste Grants, see Table 11 for collection results.

Table 11. City of Lockhart household hazardous waste collection event results, 2010 thru 2017.

Year	Total # Households	HHW collected in lbs	Hazardous Paint in lbs	Lead Acid Batteries in lbs	Cost of Hazardous Materials contractor Services
2010	250	5,661	13,287	225	\$13,428
2011	288	3,651	11,561	20	\$11,366
2012 ¹	175	4,173	6,172	0	\$15,267
2013	107	3,053	4,380	0	\$8,681
2014	176	2,059	6,230	0	\$15,621
2015	-	-	-	-	-
2016	174	19,604	17,946	60	\$22,555
2017	-	-	-	-	-
Total	1,170	38,201	59,576	305	\$86,918

Lockhart's TCEQ CWA §319(h) grant project also provided for expansion of services at the city recycling center to include disposal of kitchen fats, oils, and grease (FOG) in addition to existing oil, oil filter, and antifreeze disposal services. A collection tank for grease and cooking oils was placed at the Lockhart Recycling Center, so the material can be removed and recycled into products such as animal feeds and ingredients used in consumer and industrial products like soaps, cosmetics, rubber and plastics. An additional CAPCOG Solid Waste Grant awarded to the City for FY 2013 provided \$18,000 toward the purchase of a forklift for the Lockhart Recycling Center. To support these projects, the City has handed out 1,505 FOG jugs at numerous local events, distributed multiple informative flyers to 5,300 Lockhart utility customers and produced "What can I do?" biodegradable litter bags and reusable tote bags. The tote bags and 1-gallon FOG jugs included stickers and other items to encourage youth participation.

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

As mentioned earlier in the update, rapid urban development continues through the Plum Creek watershed increasing the priority of stormwater management. Through a CWA §319(h) grant with TCEQ two workshops were hosted in Lockhart addressing the wide variety of practices, design, installation and benefits of green infrastructure or low impact development.

Two workshops in Lockhart were hosted in June and November of 2017. The workshop in November was unique in that a hands-on/tour of the installation of the rainwater harvesting collection system at the Caldwell County Justice Center was part of the agenda. (figure 11).



Figure 11: Green Stormwater Infrastructure Workshop, Caldwell County Justice Center – Lockhart, TX

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 2014 through 2017 a number of programs have emphasized nutrient, crop, and livestock grazing management and practices. From January 2014 to December 2017 the following programs have been conducted:

- April 28, 2014 – Feral Hog Workshop (52 attendees)
- May 5, 2015 – Wildlife Management Workshop (25 attendees)
- Wednesday May 31, 2017- Small Acreage Stewardship Workshop (40 attendees)



Figure 12: Small Acreage Stewardship Workshop on May 31, 2017

The Lone Star Healthy Streams Program



The Lone Star Healthy Streams (LSHS) Program provides rural landowners with education on reducing the amount of bacteria entering Texas water bodies. The program is providing a coordinated and comprehensive education program designed to increase awareness of the bacteria issues associated with grazing and dairy cattle, poultry, horses and feral hogs; and encourages voluntary implementation of BMPs to reduce bacteria runoff, which will ultimately lead to improved water quality. Development of this program was initiated in 2007 by the Texas AgriLife Extension Service and TWRI with funding through CWA §319(h) grants from TSSWCB and EPA. More information on the Lone Star Healthy Streams Program is available at <http://lshs.tamu.edu/>.

To date, the following LSHS programs have been delivered in the watershed:

- October 2010 – Luling Foundation Water Field Day – 162 individuals
- March 2011 – Caldwell County – 31 individuals
- August 2011 – Caldwell County Expo presentation – 85 individuals
- February 2012 – Luling Feral Hog Workshop – 310 individuals
- February 2013 – Luling Feral Hog Workshop – 125 individuals
- February 2014 – Luling Feral Hog Workshop – 103 individuals
- February 2015 – Luling Feral Hog Workshop – 112 individuals

Soil and Water Testing Campaigns

During the reporting period, annual soil testing campaigns have been conducted by the Caldwell-Travis Soil and Water Conservation District. TSSWCB and EPA provided grant funding through a CWA Section 319(h) grant to pay for almost 70 soil samples in the watershed from 2014-2017. This management practice has not only provided environmental benefits by reducing nutrient loading to the soil and potentially to water resources, but also created the opportunity for an economic impact.

Stream and Riparian Workshops

Riparian workshops held in the watershed have targeted owners 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. Riparian areas, not only serve to retain soil moisture and provide critical wildlife habitat, they are often nature's last defense for reducing pollutant loading in streams. While it is no easy task to determine where nonpoint source pollution originates, it is clear as to what it must go through to reach a stream. Through outreach and education, along with dedicated land managers, many riparian areas throughout the Plum Creek watershed are improving; however, drought, feral hog activity, overgrazing and continued development along the creek are just a few of the major risk factors to riparian health in the watershed. 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 "remove the hindrances" to riparian ecosystem health and allow natural restoration of these sensitive but resilient areas to take place. To augment stakeholder knowledge and facilitate the adoption of management practices most effective for protecting riparian areas, a significant investment of time and resources has been paid to riparian outreach and education.

The Partnership has coordinated with the TPWD, USDA Natural Resources Conservation Service - State Riparian Service Team, and the Nueces River Authority to conduct riparian workshops. The program, funded through a TSSWCB and EPA CWA §319(h) grant, provides no-cost education on how streams function and the role of vegetation in stream systems. The workshop included indoor classroom presentations by representatives from AgriLife Extension, TPWD, Texas A&M Forest Service, USDA Natural Resources Conservation Service and Guadalupe-Blanco River Land Trust coupled with an afternoon field visit to stream sites to see Plum Creek in action.

Recognizing the risk to riparian areas and water quality as a function of the rapid increase in small farm ownership in both Caldwell and Hays County, in 2013 the Partnership attempted to utilize the knowledge, influence and networking power of trained local landowners to communicate the importance of proper riparian ecosystem stewardship to neighbors and friends in the Plum Creek watershed. The Partnership organized 3 riparian workshops as part of overall Plum Creek WPP implementation in 2016 and 2017. Both Urban Riparian workshops included classroom education and field evaluation of an urban stream, Town Branch in the City of Lockhart and Steeplechase Park in the City of Kyle.



Figure 13: Urban Riparian Workshop in the City of Lockhart

ILLEGAL DUMPING/LITTER PREVENTION CAMPAIGN

In 2012 and 2014, the WC worked with Caldwell County to apply for CAPCOG Regional Solid Waste grant funds to hold CCEs in each of the four Caldwell County Precincts. Despite significant budget cuts for this grant program each year, the Caldwell County CCE's were awarded a grants in the amount of \$18,349 and \$8,460, respectively, to conduct the events. Local match has exceeded \$20,000 in cash and in-kind contributions each year. Two key aspects of these proposals were the inclusion of tire disposal to be provided at no cost to local citizens, and the involvement of Pegasus School volunteers, based in Caldwell County, to provide assistance with the removal and hauling of nonhazardous solid waste from handicapped and elderly individuals (Figure 20). Due to the anticipated expense and unknown public interest in the tire collection program, tires were capped at 200 per event; however, after seeing truckloads of tires turned away one hour into the first event, the WC worked with the County to identify less expensive disposal options that included tire recycling. In response to a Partnership proposal, in December 2012, the Caldwell County Commissioner's Court voted to supplement the tire program with \$3,000 in additional funds. The new approach received much support from watershed stakeholders and excellent participation rates by county citizens. Thirteen events funded locally and through CAPCOG grants were held in Caldwell County from 2012 through 2017 including:

- 155 tons of solid waste collected (includes tires @ 20 pounds each)
- 3,459 tires removed/recycled
- 605 participants
- 112 volunteer hours donated

Caldwell County received an additional \$8,760 grant from CAPCOG to fund four additional CCEs with tire collection during the FY2016-17 cycle. CAPCOG has become an active partner in implementation and outreach for the Plum Creek WPP and is represented regularly at public meetings, collection events and educational programs throughout the watershed.



Figure 14. Pegasus school student volunteers participate in a Caldwell County Community Collection Event.

To help promote proper disposal of waste and to deter future illegal dumping in the watershed, two community collection events occurred in 2017; one in Caldwell County and one in Hays County. These were jointly funded by a CWA §319(h) grant from the TSSWCB and EPA, the Green Group, and Hays County. These events provided free non-hazardous solid waste disposal, tire recycling, and E-waste recycling in Hays County. Combined, these two events collected over 23 tons, or 46,160 pounds, of solid waste.



Figure 15: Hays County Illicit Dumping Cleanup – July 2017



Figure 16. Twenty-eight volunteers from Texas Lutheran University clean up illegal dumping location during *HOT Dogs Day of Service*, September 6, 2014. An estimated 3,000 lbs. of refuse were removed.

KEEP LOCKHART BEAUTIFUL

With the City of Lockhart's renewed 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 merger serving 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.

From 2014 to 2017 the Partnership worked with KLB, GBRA and the City of Lockhart to continue the annual *KLB Cleanup and Environmental Fair* (Figure 17). More than forty local business, organizations and individual sponsors contributed over \$5,000 to the effort in each year, more than double the fundraising effort prior to 2012. As the Partnership has assumed primary coordination of the Lockhart event since 2013, we have been fortunate to retain a core group of cleanup leaders and volunteers that return year after year. These dedicated and enthusiastic individuals provide knowledge, experience and consistency to the event. In addition to these wonderful sponsors and volunteers, the Partnership would also like to thank the GBRA staff that participates every year in a coordinated cleanup both upstream and downstream of the Lockhart WWTFs. Volunteer rates continue to remain high, with well over 200 volunteers attending the cleanup and participating in the environmental fair each year.



Figure 17. 8th Annual, Keep Lockhart Beautiful Cleanup and Environmental Fair, October 2015.

2015 Governor's Community Achievement Award

After receiving 2nd Place in the statewide competition for their efforts in 2013, KLB buckled down in 2014 to win the KTB Governor's Community Achievement Award for the City of Lockhart. The award is given annually to cities that demonstrate superior leadership in beautification and environmental stewardship. Highlights of the 2014 programs included a new KLB Business Partner program and outreach and education efforts of the Partnership. The prestigious award was received by KLB members at the 2015 KTB Annual Conference. Along with the award, the City of Lockhart received a \$160,000 grant from TxDOT to construct a landscaping project in the City. Congratulations KLB volunteers and thanks so much to the Lockhart community!



Figure 18 (left). KLB Partner Program promoted at 2014 KLB Cleanup and Environmental Fair Oct. 11, 2014. Figure 19 (right). Waste in Place program at Carver Kindergarten, Dec. 17, 2014.

Measures of Success

ROUTINE WATER QUALITY MONITORING DATA

The 2014 Update to the Plum Creek WPP reported impairments and concerns for the three Plum Creek segments monitored through the CRP and evaluated in the 2012 Texas Integrated Report. With the release of the 2014 Texas Integrated Report, concerns have been updated for segments of Plum Creek. The TCEQ used data collected during the seven-year reporting period from December 1, 2005 through November 30, 2012 in their assessment which resulted in total phosphorus added to the lower segment (1810_01) with orthophosphorus being removed as a concern for the middle segment (1810_02) and depressed dissolved oxygen being removed from the upper segment (1810_03). Table 12 identifies the current impairments and concerns in Plum Creek as described in the 2014 Texas Integrated Report.

Table 12. Impairments and concerns for Plum Creek, 2014 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	<i>E. coli</i> geometric mean	Nonsupport (4b)
	Depressed dissolved oxygen	Concern
	Nitrate screening level	Concern
	Total phosphorus	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	<i>E. coli</i> geometric mean	Nonsupport (4b)
	Impaired Habitat	Concern
	Nitrate screening level	Concern
	Total Phosphorus screening level	Concern
1810_03: From approximately 0.5 miles upstream of SH 21 to upper end of segment	<i>E. coli</i> geometric mean	Nonsupport (4b)
	Nitrate screening level	Concern
	Total Phosphorus screening level	Concern

In 2008, a CWA §319(h) grant was awarded to GBRA to collect water quality data under routine and targeted hydrologic conditions. The monitoring program increased the number of routine (monthly) monitoring sites from the original three CRP monitored sites to eight. It also includes targeted sites that are monitored once under dry weather conditions and once under wet weather conditions each season, collecting field, conventional, flow and bacteria parameter groups. The current monitoring program includes the 8 routine sites, 40 targeted sites spread throughout the

watershed, 7 WWTP sites, 3 spring sites and a stormwater site. These data will be utilized to target “hot spots” in the watershed.

The following map (Figure 20) and table (Table 13) identify monitoring station locations and type. Only parameters discussed in the WPP are included here.

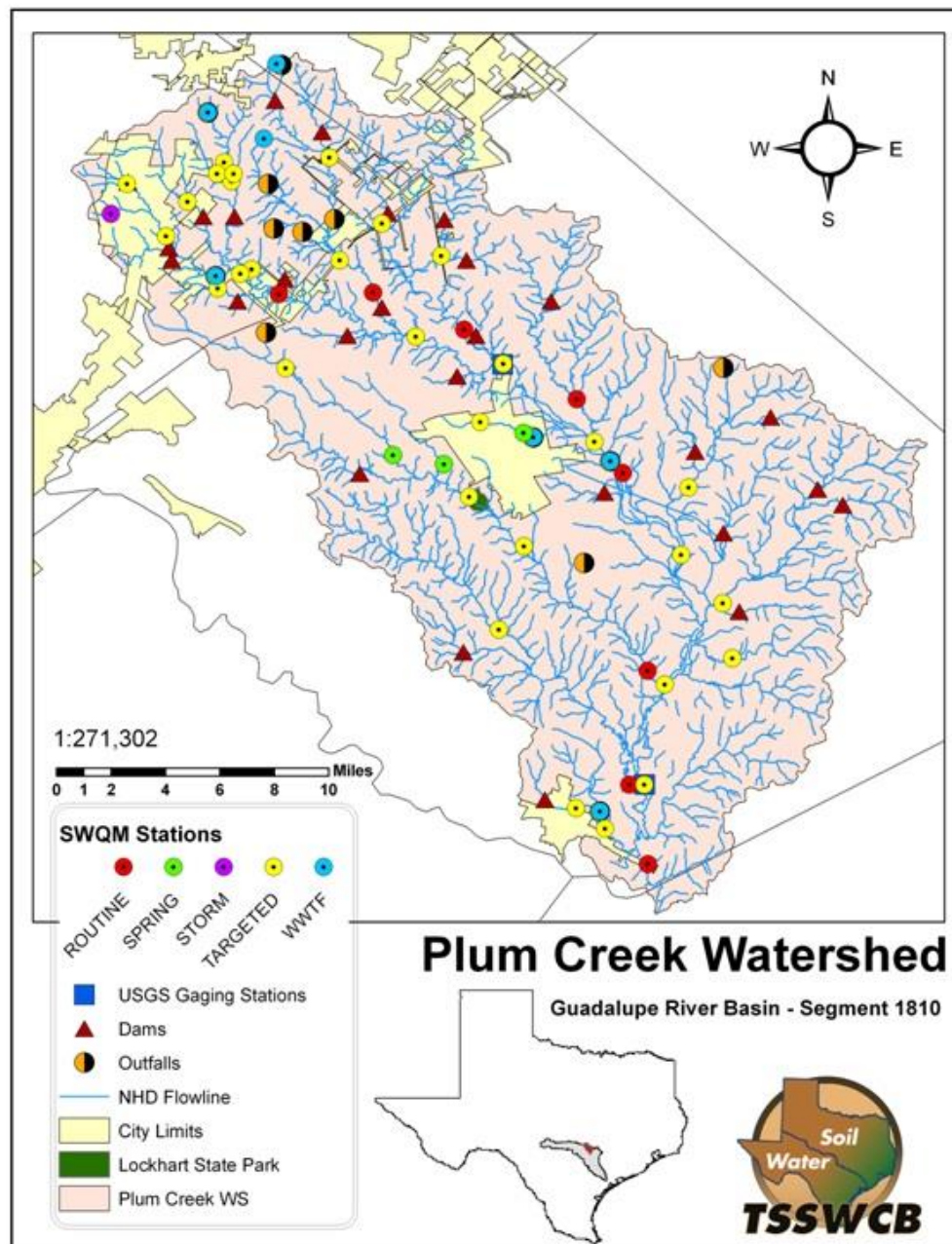


Figure 20. Water quality monitoring locations in the Plum Creek watershed.

Table 13. Plum Creek monitoring locations and sampling type. Continued on next page

Site No.	Site Name	Latitude	Longitude	Sample Type
12538	Andrews Branch at CR 131	30.03	97.827	Targeted
12555	Salt Branch at FM 1322	29.676	97.625	Targeted/Stormwater
12556	Clear Fork Plum Creek at Salt Flat Rd. (CR 128)	29.76	97.602	Routine/Targeted/Diurnal
12557	Town Branch at E. Market St. (upstream of Lockhart WWTP #1)	29.885	97.665	Targeted
12558	Elm Creek at CR 233	29.96	97.798	Routine/Targeted/Diurnal
12559	Porter Creek at Dairy Road	29.974	97.812	Targeted
12640	Plum Creek at CR 135	29.657	97.602	Routine/Targeted/Diurnal
12642	Plum Creek at Biggs Road (CR131)	29.7	97.604	Targeted
12643	Plum Creek at FM 1322	29.753	97.593	Targeted
12645	Plum Creek at Youngs Lane (CR 197)	29.822	97.584	Targeted
12647	Plum Creek at Old McMahan Rd (CR202)	29.865	97.615	Routine/Targeted/Diurnal/ Stormwater
12648	Plum Creek at Old Kelly Road (CR 186)	29.882	97.63	Targeted
12649	Plum Creek at CR 233	29.938	97.725	Targeted
14945	Clear Fork Plum Creek at Old Luling Rd (CR 213)	29.826	97.668	Targeted
16709	Town Branch west of Lockhart	29.826	97.668	Targeted
17406	Plum Creek at Plum Creek Road	29.96	97.798	Routine/Targeted/Diurnal
18343	Plum Creek upstream of US 183	29.923	97.679	Targeted
20479	Unnamed Tributary FM 150 near Hawthorn Dr.	30.003	97.887	Targeted
20480	Plum Creek downstream of NRCS 1 spillway	30.019	97.879	Targeted
20481	Bunton Branch at Heidenreich Lane	29.971	97.819	Targeted
20482	Brushy Creek at FM 2001 (dwnstrm of NRCS 12)	30.033	97.771	Targeted
20483	Elm Creek at SH 21 (downstream of NRCS 16)	29.998	97.743	Targeted
20484	Plum Creek at Heidenreich Lane (downstream of Kyle WWTP)	29.963	97.831	Targeted/Stormwater
20486	11041-002 City of Kyle and Aquasource WWTP	29.97	97.832	WW Effluent
20487	Brushy Creek at SH 21	29.978	97.766	Targeted
20488	Brushy Creek at Rocky Road (Upstream NRCS 14)	29.961	97.748	Routine/Targeted/Diurnal
20489	Cowpen Creek at Schuelke Road	29.981	97.712	Targeted
20490	Clear Fork Plum Creek at Farmers Road	29.921	97.794	Targeted
20491	Dry Creek at FM 672	29.904	97.64	Routine/Targeted/Diurnal
20492	10210-001 City of Lockhart WWTP #1	29.884	97.663	WW Effluent
20493	Clear Fork Plum Creek at PR 10 (State Park)	29.853	97.697	Targeted
20494	10210-002 City of Lockhart WWTP #2	29.872	97.622	WW Effluent
20495	Dry Creek at FM 713	29.858	97.58	Targeted
20496	Tenney Creek at Tenney Creek Road	29.796	97.562	Targeted
20497	West Fork Plum Creek at FM 671	29.782	97.681	Targeted

Site No.	Site Name	Latitude	Longitude	Sample Type
20498	Copperas Creek at Tenney Creek Road (downstream of Cal-Maine)	29.751	97.557	Targeted
20499	10582-002 City of Luling WWTP	29.685	97.627	WW Effluent
20500	West Fork Plum Creek at Biggs Road (CR131)	29.7	97.612	Routine/Targeted/Diurnal
20501	Salt Branch at Salt Flat Road (Upstream of Luling WWTP)	29.687	97.64	Targeted
20502	Bunton Branch at Dacy Lane (upstream of NRCS 5)	30.009	97.847	Targeted
20503	Plum Creek at Lehman Road	29.991	97.858	Targeted
20504	Porter Creek at Quail Cove Road	30.024	97.822	Targeted
20505	Richmond Branch at Dacy Lane	30.024	97.831	Targeted
20507	Clear Fork Springs at Borchert Loop (CR 108)	29.869	97.731	Spring
20508	Boggy Creek Springs at Boggy Creek Road (CR 218)	29.865	97.713	Spring
20509	Lockhart Springs	29.887	97.668	Spring
20510	Hines Branch at Tenney Creek (CR 141, downstream of Cal-Maine)	29.767	97.557	Targeted
99923	11060-001 City of Buda and GBRA WWTP	30.057	97.836	WW Effluent
99936	14431-001 GBRA Shadow Creek WWTP	30.043	97.811	WW Effluent
99937	14377-001 GBRA Sunfield WWTP	30.083	97.799	WW Effluent

GBRA ROUTINE MONITORING RESULTS

The water quality data collected at eight routine sites on Plum Creek, including five tributaries, is compiled in the following tables. The data was collected as part of the CWA §319 grants, a TSSWCB state grant and the Clean Rivers Program. Grant funding ended in October of 2017 and new funding for sampling didn't begin until February of 2018. Only parameters discussed in the WPP are listed. The data has been separated based on the hydrologic conditions of each sampling event. Rainfall data, additional parameters for these locations and results from monitoring can be found on the GBRA website at <http://www.gbra.org/plumcreek/data.aspx>.

The region has experienced moderate to exceptional drought conditions throughout much of time period since implementation of the Plum Creek WPP; however, drought conditions have lessened and been replaced with some exceptionally wet weather in the watershed over the reporting period for this update, January 2014 through October 2017 including the Memorial Day flooding in 2015 and Hurricane Harvey in August of 2017. As such, variable weather patterns have continued to impact hydrologic function and sampling opportunities.

Water quality data collected at 8 routine monitoring stations in the Plum Creek watershed are presented in Tables 14 through 17. The objective of the routine monitoring was to provide water quality data to assess the effectiveness of implementing the Plum Creek WPP by enhancing current routine ambient monitoring regimes.

Plum Creek was first listed on the 303(d) list in 2004 due to high *E. coli* concentrations. All segments of the creek were removed from the 303(d) list with the issuance of the 2010 Texas Integrated Report which reclassified the entirety of Plum Creek as a *Category 4b* stream. While Plum Creek continues to exceed the water quality contact recreation standard of 126 organisms per 100 mL throughout its upper, middle and lower reaches, a TMDL is not currently being considered for implementation by the TCEQ as “other control requirements are reasonably expected to result in the attainment of all standards.”

Table 14. Water quality monitoring results for *E. coli* at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather).

Monitoring Station	<i>E. coli</i> Geomean 2008 - 2017*	Median Flow (cfs) 2008 - 2017	<i>E. coli</i> Geomean - Wet	No. of Samples (Wet)	Range - Wet	Media n Flow (cfs) Wet	<i>E. coli</i> Geomean - Dry	No. of Samples (Dry)	Range - Dry	Media n Flow (cfs) - Dry	% Change Between Dry and Wet**
Plum Creek at Plum Creek Road	498	3.6	724	49	64 - >24,000	22	402	86	36 - >4,840	2.2	44.48%
Plum Creek at CR 202	317	9	585	52	36 - 35,000	47	214	81	16 - 3,200	5.6	58.81%
Plum Creek at CR 135	225	17	527	50	20 - 13,000	62	136	85	9 - 6,000	8.8	74.19%
Brushy Creek at Rocky Road	225	0.01	771	42	19 - >24,000	0.04	86	54	3 - 1,900	0	88.84%
Elm Creek at CR 233	181	0	562	41	5 - 40,000	0.4	65	46	<1 - 7,300	0	88.43%
Dry Creek at FM 672	576	0.4	1031	26	140 - 18,000	1.1	144	15	17 - 1,400	0	86.03%
Clear Fork at CR 128	241	2.4	630	46	41 - 22,000	6.3	129	73	3 - 3,400	1.2	79.52%
West Fork at Biggs Road	134	0.01	350	40	<10 - >11,000	0.02	62	50	<1 - 3,800	0.01	82.28%

*Entire data set under all flow conditions through October of 2017.

**Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow geometric mean greater than the water quality standard of 126 organisms/100 mL under dry conditions.

Total phosphorus concentrations are assessed for concerns using a screening concentration of 0.69 mg/L. The data collected under dry conditions at the main stem sites (Plum Creek at Plum Creek Road, Plum Creek at CR 202 and Plum Creek at CR135) exceed this screening concentration consistently. The total phosphorus results of the monitoring at the routine stations are in Table 15. Comparing the phosphorus concentrations measure under dry conditions to the concentrations measure under wet conditions, the main stem sites show a reduction in the phosphorus load as a result of dilution from runoff. All five routine tributary stations fell below the screening concentration during both wet and dry weather conditions.

Table 15. Water quality monitoring results for phosphorus at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather).

Monitoring Station	Total P Mean 2008 - 2017*	Median Flow (cfs) 2008 - 2017	Total P Mean - Wet	No. of Samples (Wet)	Range - Wet	Median Flow (cfs) - Wet	Total P Mean - Dry	No. of Samples (Dry)	Range - Dry	Median Flow (cfs) - Dry	% Change Between Dry and Wet**
Plum Creek at Plum Creek Road	2.04	3.6	1.02	48	0.14 - 4.56	22	2.61	85	0.04 - 5.26	2.2	-155.88%
Plum Creek at CR 202	1.04	9	0.78	52	0.14 - 2.26	47	1.2	81	0.21 - 2.69	5.6	-53.54%
Plum Creek at CR 135	0.73	17	0.66	50	0.19 - 2.12	62	0.77	85	0.22 - 2.69	8.8	-16.67%
Brushy Creek at Rocky Road	0.12	0.01	0.14	42	0.03 - 0.37	0.04	0.1	54	0.03 - 0.3	0	28.58%
Elm Creek at CR 233	0.16	0	0.19	41	0.06 - 0.8	0.4	0.14	46	0.05 - 0.94	0	26.32%
Dry Creek at FM 672	0.3	0.4	0.31	26	0.11 - 0.69	1.1	0.27	15	0.08 - 0.47	0	12.90%
Clear Fork at CR 128	0.11	2.4	0.16	46	<0.02 - 0.9	6.3	0.08	73	<0.02 - 0.5	1.2	50.00%
West Fork at Biggs Road	0.4	0.01	0.36	40	0.07 - 0.85	0.02	0.44	50	0.06 - 2.14	0.01	-22.22%

*Entire data set under all flow conditions through October of 2017.

**Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow Total P mean greater than the water quality screening criteria of 0.69 mg/L under dry conditions.

Total nitrate nitrogen concentrations are assessed for concerns using a screening concentration of 1.95 mg/L. The data collected under dry conditions at the main stem sites (Plum Creek at Plum Creek Road, Plum Creek at CR 202 and Plum Creek at CR135) exceed this screening concentration consistently. The nitrate nitrogen results of the monitoring at the routine stations are in Table 16. The mean concentrations at these stations was also higher than the screening criteria when all weather conditions were included. All five routine tributary stations fell below the screening concentration during both wet and dry weather conditions.

Table 16. Water quality monitoring results for nitrate nitrogen at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather).

Monitoring Station	NO3-N Mean 2008 - 2017*	Median Flow (cfs) 2008 - 2017	NO3-N Mean - Wet	No. of Samples (Wet)	Range - Wet	Median Flow (cfs) - Wet	NO3-N Mean - Dry	No. of Samples (Dry)	Range - Dry	Median Flow (cfs) - Dry	% Change Between Dry and Wet**
Plum Creek at Plum Creek Road	10.29	3.6	5.23	43	0.37 - 29.3	22	13.14	80	0.6 - 34.8	2.2	-151.24%
Plum Creek at CR 202	5.2	9	3.38	52	0.22 - 11.6	47	6.37	81	0.58 - 16.3	5.6	-88.46%
Plum Creek at CR 135	2.12	17	2.23	50	0.07 - 9.48	62	2.06	85	<0.05 - 7.32	8.8	7.62%
Brushy Creek at Rocky Road	0.27	0.01	0.47	42	<0.05 - 5.47	0.04	0.13	54	<0.05 - 0.69	0	72.34%
Elm Creek at CR 233	0.25	0	0.4	41	<0.05 - 4.02	0.4	0.11	46	<0.05 - 0.48	0	72.50%
Dry Creek at FM 672	0.43	0.4	0.54	25	<0.05 - 3.78	1.1	0.19	9	<0.05 - 0.80	0	64.81%
Clear Fork at CR 128	1.18	2.4	1.42	46	<0.05 - 7.54	6.3	1.03	73	<0.05 - 6.83	1.2	27.46%
West Fork at Biggs Road	0.27	0.01	0.28	40	<0.05 - 1.36	0.02	0.26	49	<0.05 - 1.06	0.01	7.14%

*Entire data set under all flow conditions through October of 2017.

**Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow Nitrate concentration greater than the water quality screening criteria of 1.95 mg/L under dry conditions.

Total ammonia nitrogen concentrations are assessed for concerns using a screening concentration of 0.33 mg/L. The ammonia nitrogen results of the monitoring at the routine stations are in Table 17. The only station that has an average concentration above the screening criteria is Plum Creek at Plum Creek Road. The average concentration at this station is above the screening criteria during both wet and dry weather conditions. This station is most impacted by wastewater influences because it is downstream of the discharges of two municipalities and receives very little influence from spring flow. All seven other routine monitoring stations have average concentrations below the screening criteria during both wet and dry weather conditions.

Table 17. Water quality monitoring results for ammonia-nitrogen at routine stations in Plum Creek categorized by meteorological conditions during sampling (dry weather or wet weather).

Monitoring Station	NH3-N Mean 2008 - 2017*	Median Flow (cfs) 2008 - 2017	NH3-N Mean - Wet	No. of Samples (Wet)	Range - Wet	Median Flow (cfs) - Wet	NH3-N Mean - Dry	No. of Samples (Dry)	Range - Dry	Median Flow (cfs) - Dry	% Change Between Dry and Wet**
Plum Creek at Plum Creek Road	0.79	3.6	0.77	49	<0.1 - 21.2	22	0.81	84	<0.1 - 9.68	2.2	-5.19%
Plum Creek at CR 202	0.19	9	0.16	52	<0.1 - 0.71	47	0.2	79	<0.1 - 1.43	5.6	-25.00%
Plum Creek at CR 135	0.18	17	0.18	50	<0.1 - 0.66	62	0.18	83	<0.1 - 0.74	8.8	0.00%
Brushy Creek at Rocky Road	0.19	0.01	0.16	41	<0.1 - 0.37	0.04	0.22	54	<0.1 - 1.08	0	-37.50%
Elm Creek at CR 233	0.21	0	0.19	40	<0.1 - 1.04	0.4	0.23	46	<0.1 - 1.24	0	-21.05%
Dry Creek at FM 672	0.23	0.4	0.22	25	<0.1 - 0.76	1.1	0.27	14	<0.1 - 0.76	0	-22.72%
Clear Fork at CR 128	0.18	2.4	0.16	46	<0.1 - 0.36	6.3	0.19	73	<0.1 - 0.65	1.2	-18.75%
West Fork at Biggs Road	0.19	0.01	0.19	40	<0.1 - 1.91	0.02	0.2	50	<0.1 - 0.98	0.01	-5.26%

*Entire data set under all flow conditions through October of 2017.

**Positive change indicates an increase in pollutant load with rainfall. Negative change indicates that rainfall is diluting the base flow pollutant concentration.

Stations highlighted have a base flow ammonia-nitrogen mean of greater than the water quality screening criteria of 0.33 mg/L under dry conditions.

Data collected at the wastewater treatment facilities are tabulated in Table 18. This table identifies the common wastewater parameters that were analyzed and compares them to the Plum Creek WPP permit recommendations. The objective of the task that covered effluent monitoring was to provide water quality data to assess the effectiveness of implementing the Plum Creek WPP through effluent monitoring. 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 just upstream of the Plum Creek at Heidenreich Lane (20484) targeted monitoring station. The Sunfield and Shadow Creek facilities discharge into the Brushy Creek Tributary of Plum Creek, which merges with Plum Creek just upstream of the Plum Creek at CR 233 targeted monitoring station (12649). The Lockhart #1 facility discharges into the Town Branch tributary of Plum Creek, which merges with Plum Creek upstream of the Plum Creek at CR 186 (12648) targeted monitoring station. The Lockhart #2 facility 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 Tributary of Plum Creek before it merges with Plum Creek upstream of the Plum Creek at CR 135 (12640) CRP monitoring station. A large outlier event documented during this project at the Kyle WWTF on 08/15/17, ammonia nitrogen levels were recorded at 39.3 mg/L, TKN was recorded at 49.4 mg/L and *E.coli* was recorded at >48,000 MPN/100 mL in the effluent grab sample.

Table 18. Wastewater treatment plant water quality monitoring results in the Plum Creek Watershed 2008-2017

Monitoring Station	Median Flow (CFS)	Geomean <i>E. coli</i> (MPN/100 mL)	Mean pH (S.U.)	Mean D. O. (mg/L)	Mean TSS (mg/L)	Mean Total P (mg/L)	Mean BOD (mg/L)	Mean CBOD (mg/L)	Mean COD (mg/L)	Mean NH3-N (mg/L)
PC WPP Recommended Permit Limits	2.3	126	6.5 to 9	5	5	1.0	5	5		2.0
Buda WWTF	1.4	2.4	7.5	8.2	1	0.41	1.6	1.2	16.5	0.40
Kyle WWTF	2.7	81.6	7.4	7.9	10	3.70	3.9	3.3	33.1	2.03
Sunfield WWTF	0.1	1.3	7.6	8.6	1	0.52	1.4	1.4	15.3	0.21
Shadow Creek WWTF	0.2	3.6	7.6	7.7	1	0.53	1.6	1.5	18.1	0.98
Lockhart #2 WWTF	1.5	11.4	7.6	8.4	5	2.56	1.5	1.5	21.3	0.45
Lockhart #1 WWTF	0.7	2.4	7.1	8.3	3	2.98	2.0	2.3	21.6	0.71
Luling North WWTF	0.3	2.6	7.1	8.2	10	4.26	2.0	2.5	28.7	0.49

Stations highlighted have concentrations greater than the Plum Creek WPP recommended permit limits.

Data collected from Boggy Springs, Lockhart Springs, and Clear Fork Springs can be found in Table 19. The samples were collected quarterly but the hydrologic conditions were noted. These results could be impacted by the difficulty of collecting a representative sample of the springs, one that would not be impacted by either low flow conditions or after a rainfall event that contributes pollutant loads via surface runoff to the channel at the outlet of the springs.

Table 19. Water quality monitoring results for three springs sites in the Plum Creek Watershed 2008-2017 .

Monitoring Station	Median Flow CFS	Geomean E. coli MPN/100 mL	Mean TSS mg/L	Mean D. O. mg/L	Mean SC μ S/cm	Mean Total P mg/L	Mean NO3-N mg/L	Mean Chloride mg/L	Mean Sulfate mg/L	Mean NH3-N mg/L	Mean TKN mg/L
Stream Screening Criteria	2.3	126		5	1723	0.69	1.95	350	150	0.33	
Boggy Creek Springs at Boggy Creek Road	0.2	190	8.0	7.6	716	0.06	6.29	14	48	0.26	0.37
Clear Fork Springs at Borchert Loop	0.9	289	10.4	8.8	760	0.04	6.18	25	83	0.15	0.40
Lockhart Springs	0.8	297	2.9	9.2	781	0.05	10.56	29	63	0.16	0.25

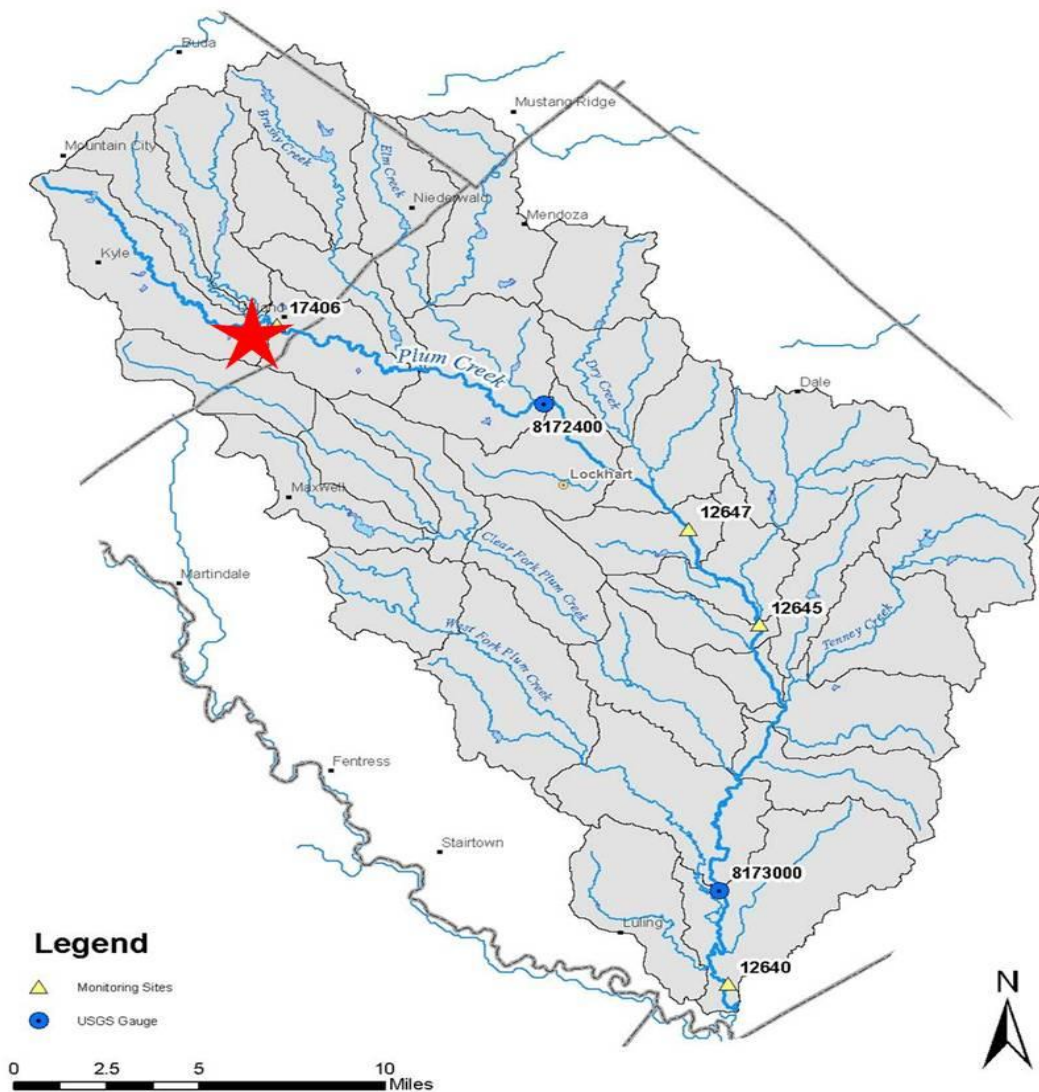
Highlighted values exceed the TCEQ stream standard or screening criteria for Plum Creek

ANALYSIS OF WATER QUALITY TRENDS AT CRP STATIONS

A trend analysis was calculated at the three CRP stations that are monitored monthly and located in Umland (Figure 21-24), Lockhart (Figure 25-28) and Luling (Figure 29-32). The yellow line on the graphs indicates the water quality standard for *E. coli* (126 mpn/100mL) and the state's screening criteria level for nitrate nitrogen (1.95mg/L) and total phosphorus (mg/L). The black line of the graphs is the trend line.

Figure 21. Umland CRP routine monitoring station

Umland CRP Routine Station 17406



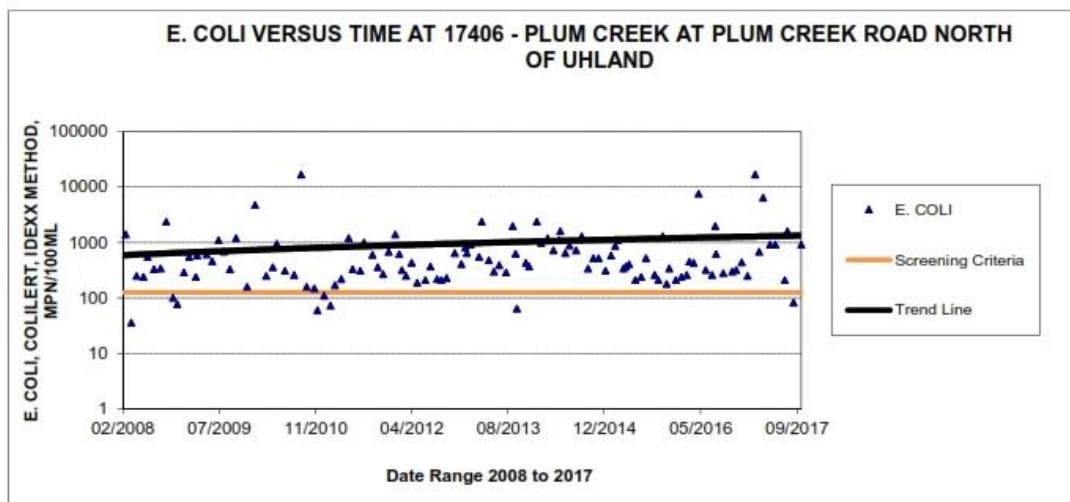


Figure 22: E. coli over time- Plum Creek at Plum Creek Road

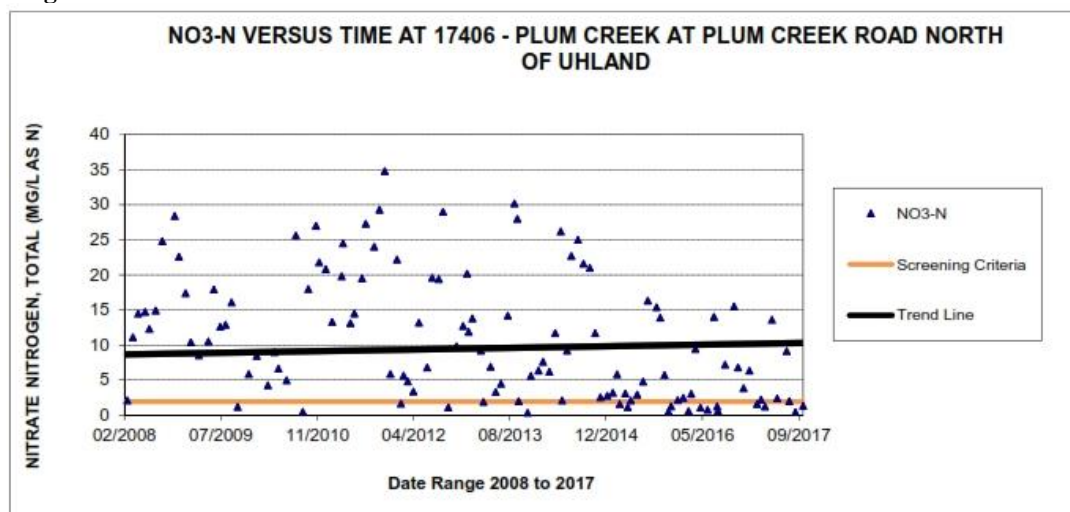


Figure 23: NO3-N over time at 17406-Plum Creek at Plum Creek Road

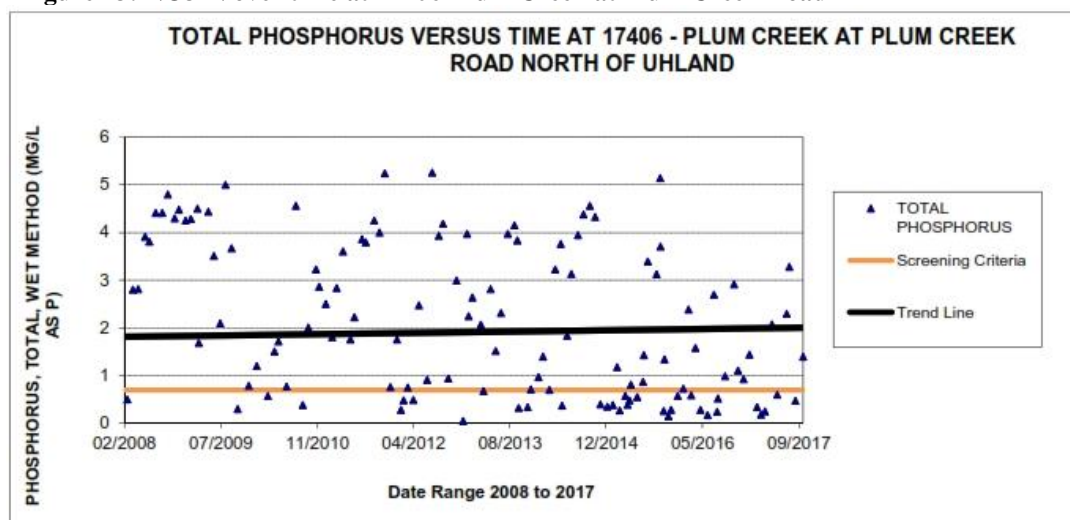
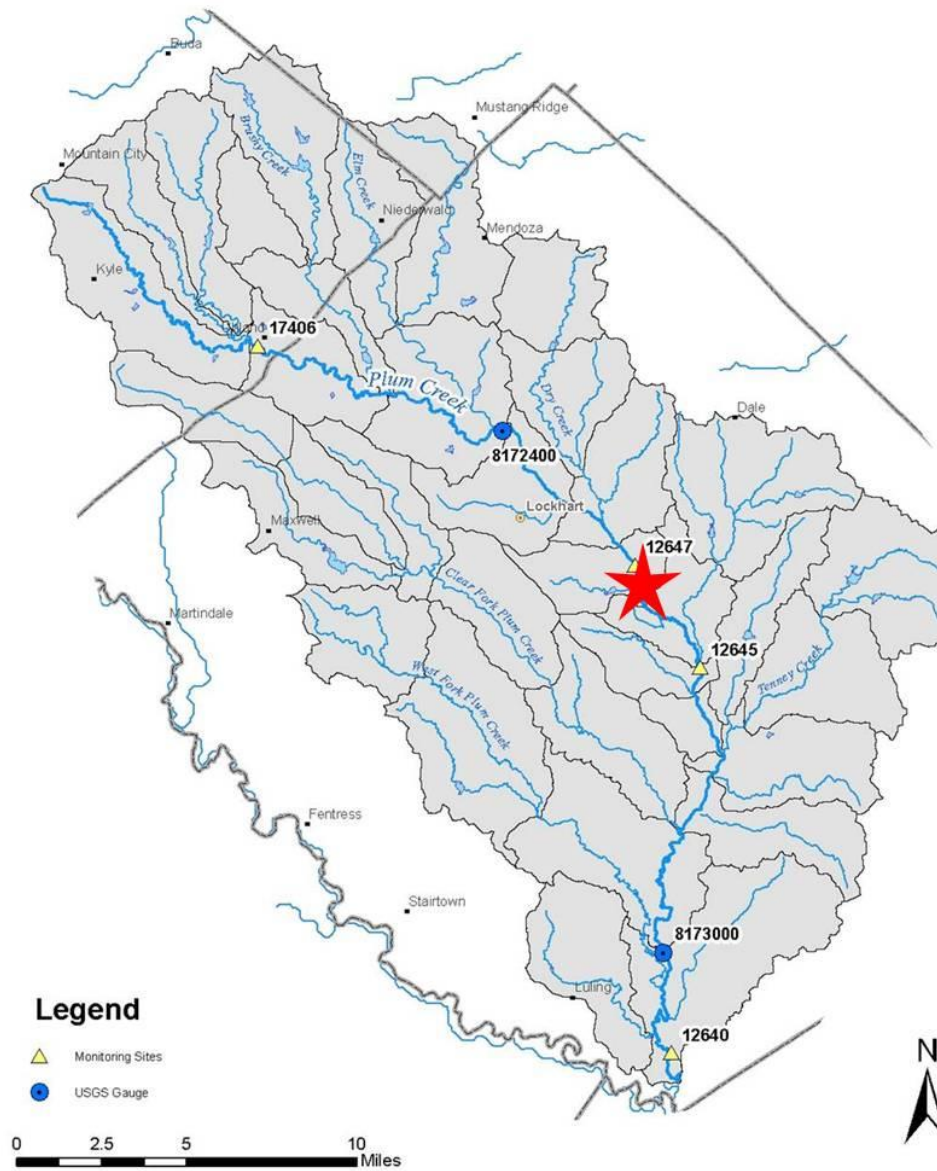


Figure 24: Total Phosphorus over time at 17406-Plum Creek at Plum Creek Road

Figure 25. Lockhart CRP routine monitoring station and water quality trend analysis for *E. coli*, nitrate nitrogen, and total phosphorus.

Lockhart CRP Routine Station 12647



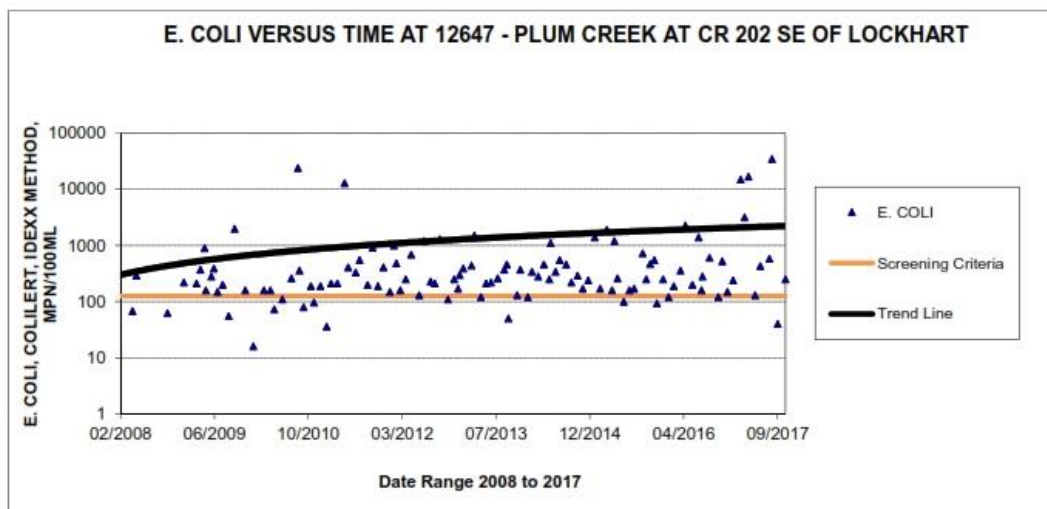


Figure 26: E. coli over time at 12647- Plum Creek at CR 202 SE of Lockhart

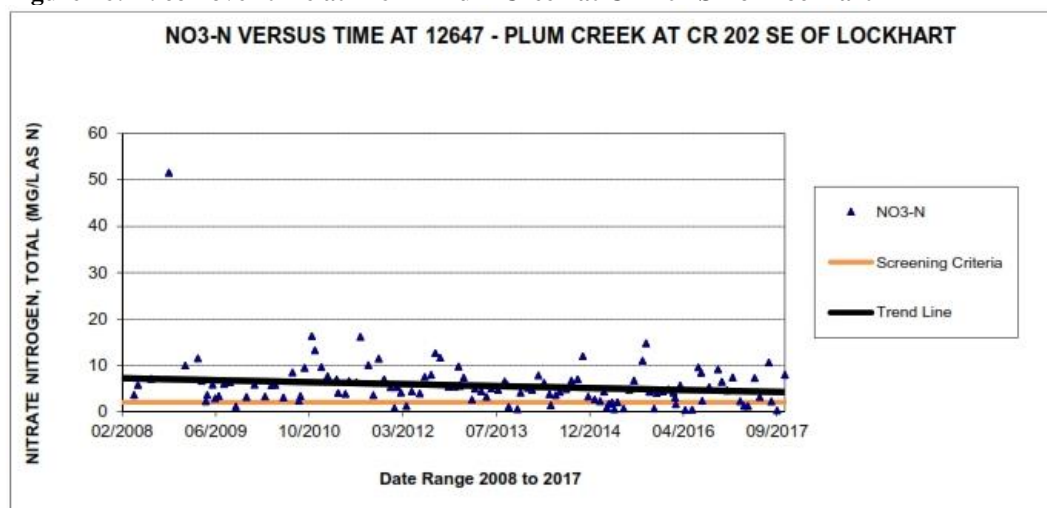


Figure 27: NO3-N over time at 12647- Plum Creek at CR 202 SE of Lockhart

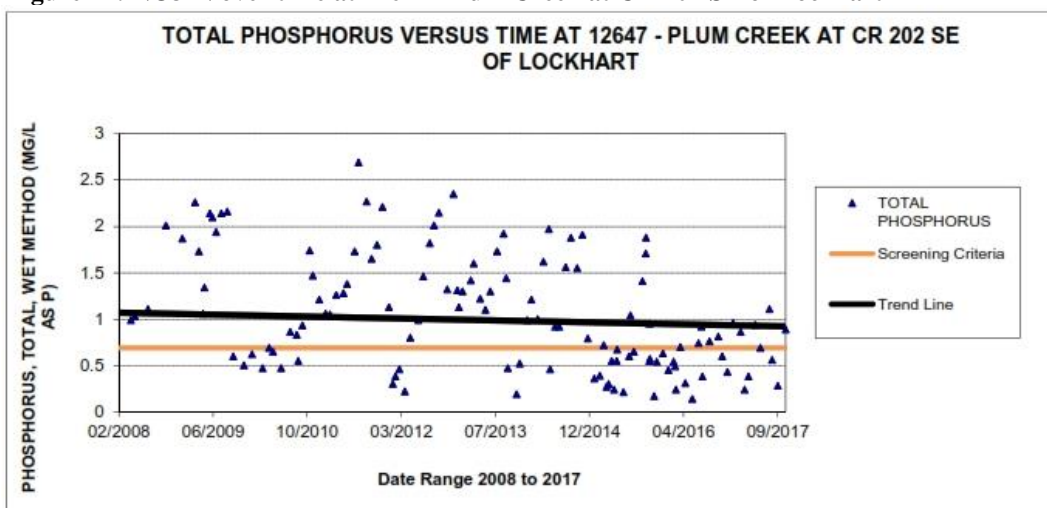
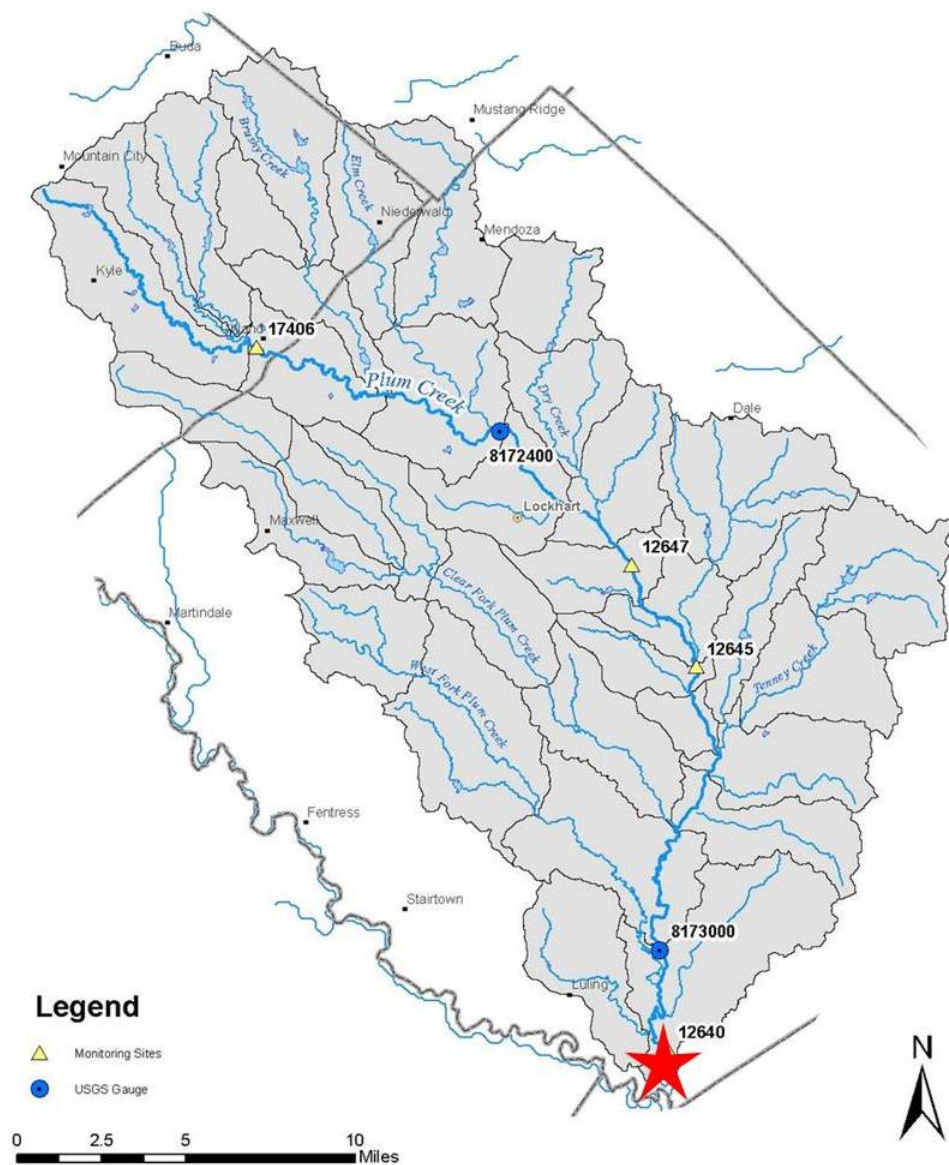


Figure 28: Total Phosphorus over time at 12647- Plum Creek at CR 202 SE of Lockhart

Figure 29. Luling CRP routine monitoring station and water quality trend analysis for *E. coli*, nitrate nitrogen, and total phosphorus.

Luling CRP Routine Station 12640



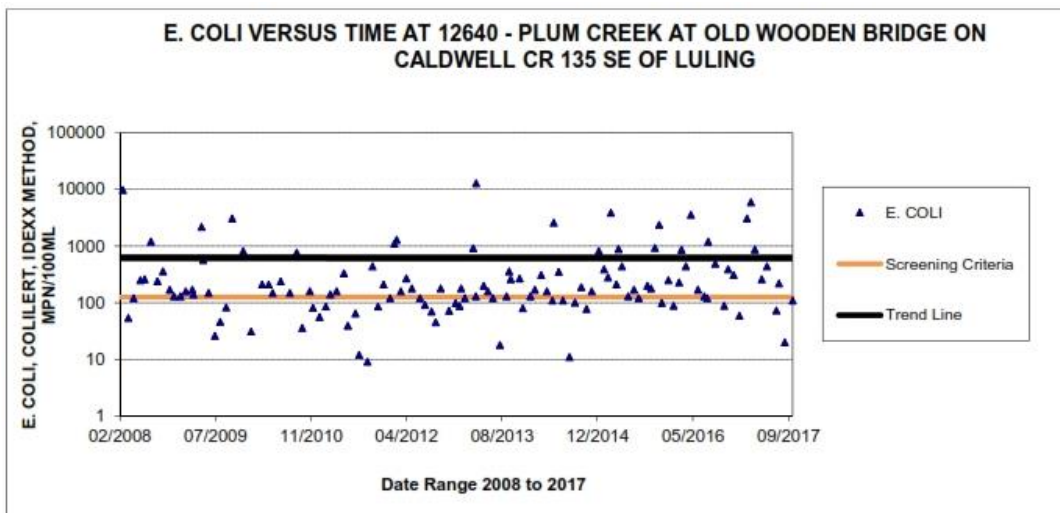


Figure 30: E. coli over time at monitoring site 12640

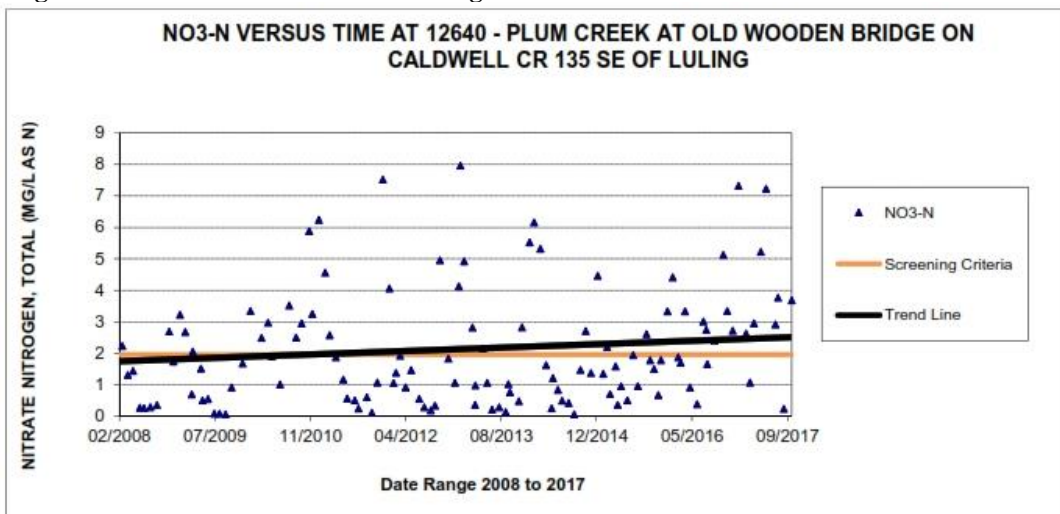


Figure 31: NO3-N over time at monitoring site 12640

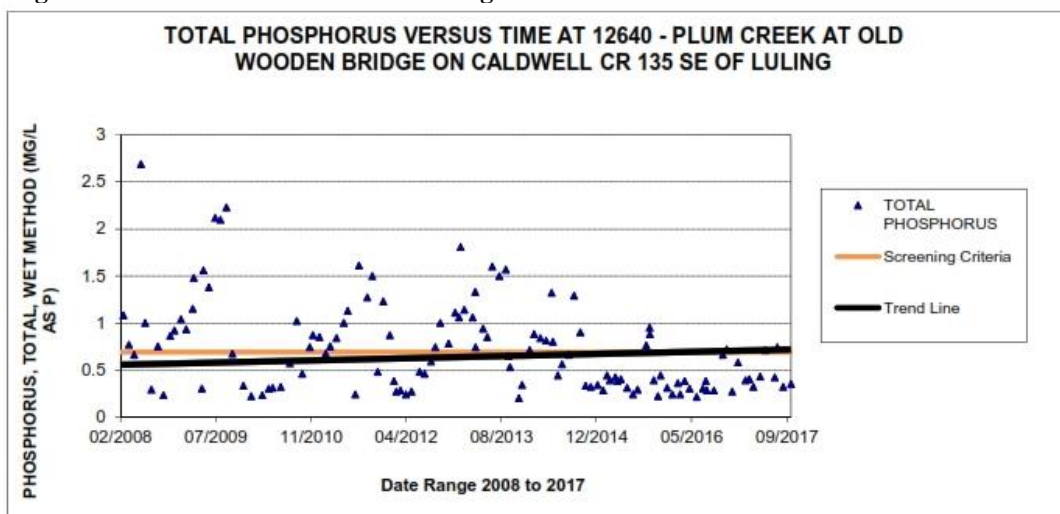


Figure 32: Total Phosphorus over time at monitoring site 12640

GBRA TARGETED MONITORING RESULTS

TSSWCB provided CWA §319(h) funding for the GBRA to conduct an intensive targeted monitoring project to supplement data collected for TCEQ assessment purposes. In addition to expanding the number of routine monthly monitoring stations from three to eight sites monthly (as discussed in the previous section), 40 sites are now sampled twice per season during both dry and wet weather conditions; six WWTFs are sampled once per season, three springs are sampled seasonally; and automated stormflow sampling of selected rainfall events was conducted at an urban site in the City of Kyle. After the initial period of funding (May 2007 through March 2010), TSSWCB utilized state general revenue to continue the mainstem and tributary portions of this monitoring regime through December 2010. GBRA continued this comprehensive monitoring regime through 2017 with additional CWA §319(h) grant funds from the TSSWCB. This increased monitoring strategy provides a higher level of understanding of the spatial and temporal trends of pollutant loading, serves to refine the focus of management efforts, and helps track the performance of ongoing implementation activities. Because this is a critical part of adaptive management in the Plum Creek watershed, the targeted monitoring will play a key role in future watershed efforts and should continue. Table 20 and 21 summarizes data collected thus far. There is a considerable variation between and within sites, depending on the water quality parameter.

Table 20. Water quality monitoring results for *E. coli* and total phosphorus at targeted monitoring stations in the Plum Creek Watershed categorized by meteorological conditions during sampling (dry weather or wet weather). Continued on next page.

Monitoring Station	Median Flow (cfs) 2008 – 2017	Median Flow (cfs) - Wet	Median Flow (cfs) - Dry	<i>E. coli</i> Geomean 2008 - 2017	<i>E. coli</i> Geomean - Wet	<i>E. coli</i> Geomean - Dry	Total P Mean 2008 - 2017	Total P Mean Wet	Total P Mean Dry
Plum Creek at NRCS #1	0.0	1.0	0.0	43	72	18	0.24	0.21	0.31
Plum Creek at Lehman	0.5	4.2	0.04	243	490	93	0.05	0.06	0.03
Plum Creek at Heidenreich	3.2	9.1	2.2	1397	1776	1099	2.44	1.63	3.41
Plum Creek at PC Rd	3.6	22.0	2.2	497	724	402	2.04	1.02	2.61
Plum Creek at CR 233	5.8	34.0	1.9	304	699	116	1.53	0.98	2.16
Plum Creek at HWY 183	7.2	37.0	1.9	248	644	79	1.23	0.86	1.67
Plum Creek at CR 186	6.3	27.5	3.6	405	688	209	0.91	0.76	1.10
Plum Creek at CR 202	9.0	47.0	5.6	317	585	214	1.04	0.78	1.20
Plum Creek at CR 197	9.5	44.0	5.4	439	819	196	0.93	0.76	1.14
Plum Creek at FM 1322	11.0	47.0	5.2	466	1104	166	0.84	0.75	0.96
Plum Creek at CR 131	13.0	74.0	6.4	471	1049	190	0.82	0.83	0.81
Plum Creek at CR 135	17.0	62.0	8.9	225	527	136	0.73	0.66	0.77
Unnamed at FM 150	0.20	0.60	0.10	242	298	173	0.04	0.02	0.07
Andrew's at CR 131	1.30	1.90	0.90	344	556	188	0.25	0.19	0.32
Richmond at Dacy	0.09	0.40	0.01	391	655	212	0.09	0.07	0.11
Unnamed at Quail Cove	0.03	0.06	0.01	552	858	39	0.12	0.13	0.03
Porter at Dairy Lane	1.40	5.15	0.60	467	818	176	0.10	0.13	0.06
Cowpen at Schuelke	2.40	2.60	0.00	948	1308	45	0.24	0.24	0.17
Bunton at Dacy	0.40	2.60	0.02	171	451	51	0.06	0.06	0.06
Bunton at Heidenreich	0.90	6.60	0.35	334	517	133	0.07	0.08	0.05
Brushy at FM 2001	0.02	0.06	0.00	112	279	3	0.09	0.11	0.04
Brushy at SH21	0.30	6.80	0.01	239	838	35	0.11	0.13	0.07
Brushy Creek at Rocky Rd	0.01	0.04	0.00	225	771	86	0.12	0.14	0.10

Elm Creek at SH 21	0.10	0.85	0.00	324	440	63	0.09	0.10	0.03
Elm Creek at CR 233	0.00	0.45	0.00	181	562	65	0.16	0.19	0.14
Clear Fork at Farmers Rd	0.01	0.01	0.00	65	85	35	0.11	0.12	0.07
Clear Fork at PR10	1.40	2.90	0.90	164	350	64	0.08	0.12	0.03
Clear Fork at Old Luling Rd	1.20	4.10	0.80	156	305	68	0.10	0.15	0.05
Clear Fork at Salt Flat Rd	2.45	6.30	1.20	241	630	129	0.11	0.16	0.08
Town Branch at Stueve Ln	0.00	0.00	0.00	498	445	2400	0.67	0.70	0.30
Town Branch at E. Market St	1.20	1.55	0.84	541	888	288	0.90	0.12	0.05
Dry Creek at FM 672	0.35	1.10	0.00	576	1031	144	0.30	0.31	0.27
Dry Creek at FM 713	0.70	1.05	0.00	1138	1898	264	0.22	0.26	0.13
Tenney Creek at Tenney Crk Rd	4.35	4.35	N/A	955	955	N/A	0.35	0.35	N/A
Hines Branch at Tenney Crk Rd	0.00	0.00	0.00	350	487	68	0.27	0.29	0.18
Copperas at Tenney Crk Rd	0.10	0.20	0.01	935	1115	506	0.76	0.93	0.13
West Fork at FM 671	0.02	0.08	0.00	472	654	20	0.17	0.16	0.08
West Fork at Biggs Rd	0.01	0.02	0.01	134	350	62	0.40	0.36	0.44
Salt Branch at Salt Flat Rd	0.01	0.06	0.00	870	1165	561	0.35	0.26	0.48
Salt Branch at FM 1322	0.30	0.70	0.20	360	594	193	2.48	1.55	3.64

*Entire data set under all flow conditions through October of 2017.

Stations highlighted have a base flow geometric mean greater than the water quality standard of 126 organisms/100 mL under dry conditions.

Table 21. Water quality monitoring results for nitrate nitrogen and ammonia nitrogen at targeted monitoring stations in the Plum Creek Watershed categorized by meteorological conditions during sampling (dry weather or wet weather). Continued on next page.

Monitoring Station	Median Flow (cfs) 2008 - 2017	Median Flow (cfs) - Wet	Median Flow (cfs) - Dry	NO3-N Mean 2008 – 2017*	NO3-N Mean Wet	NO3-N Mean Dry	NH3-N Mean 2008 – 2017*	NH3-N Mean Wet	NH3-N Mean Dry
Plum Creek at NRCS #1	0.0	1.0	0.0	0.58	0.42	0.86	0.28	0.16	0.48
Plum Creek at Lehman	0.5	4.2	0.04	0.69	0.78	0.56	0.16	0.16	0.16
Plum Creek at Heidenreich	3.2	9.1	2.2	11.43	9.54	13.69	1.53	0.88	2.29
Plum Creek at PC Rd	3.6	22.0	2.2	10.29	5.23	13.14	0.79	0.77	0.81
Plum Creek at CR 233	5.8	34.0	1.9	6.19	3.75	9.03	0.22	0.26	0.17
Plum Creek at HWY 183	7.2	37.0	1.9	3.45	2.32	4.81	0.34	0.48	0.16
Plum Creek at CR 186	6.3	27.5	3.6	5.01	2.92	7.60	0.16	0.16	0.15
Plum Creek at CR 202	9.0	47.0	5.6	5.20	3.38	6.37	0.19	0.16	0.20
Plum Creek at CR 197	9.5	44.0	5.4	3.75	2.86	4.87	0.17	0.15	0.21
Plum Creek at FM 1322	11.0	47.0	5.2	2.85	2.09	3.79	0.17	0.17	0.17
Plum Creek at CR 131	13.0	74.0	6.4	2.20	2.30	2.08	0.21	0.22	0.20
Plum Creek at CR 135	17.0	62.0	8.9	2.12	2.23	2.06	0.18	0.18	0.18
Unnamed at FM 150	0.20	0.60	0.10	1.52	1.99	0.74	0.18	0.19	0.18
Andrew's at CR 131	1.30	1.90	0.90	11.16	7.57	15.68	0.21	0.20	0.23
Richmond at Dacy	0.09	0.40	0.01	0.64	0.96	0.23	0.34	0.17	0.54
Unnamed at Quail Cove	0.03	0.06	0.01	0.35	0.40	0.06	0.16	0.17	0.10
Porter at Dairy Lane	1.40	5.15	0.60	0.85	0.76	1.04	0.22	0.19	0.27
Cowpen at Schuelke	2.40	2.60	0.00	0.60	0.66	0.05	0.28	0.30	0.10
Bunton at Dacy	0.40	2.60	0.02	0.40	0.53	0.24	0.17	0.16	0.18
Bunton at Heidenreich	0.90	6.60	0.35	0.74	0.57	1.09	0.18	0.17	0.21
Brushy at FM 2001	0.02	0.06	0.00	0.40	0.47	0.06	0.18	0.18	0.16
Brushy at SH21	0.30	6.80	0.01	0.43	0.59	0.13	0.19	0.15	0.26
Brushy Creek at Rocky Rd	0.01	0.04	0.00	0.27	0.47	0.13	0.19	0.16	0.22
Elm Creek at SH 21	0.10	0.85	0.00	0.33	0.38	0.08	0.16	0.17	0.10
Elm Creek at CR 233	0.00	0.45	0.00	0.25	0.40	0.11	0.21	0.19	0.23

Clear Fork at Farmers Rd	0.01	0.01	0.00	3.81	3.31	5.03	0.13	0.13	0.13
Clear Fork at PR10	1.40	2.90	0.90	3.07	2.80	3.41	0.20	0.16	0.25
Clear Fork at Old Luling Rd	1.20	4.10	0.80	2.05	1.93	2.19	0.19	0.18	0.19
Clear Fork at Salt Flat Rd	2.45	6.30	1.20	1.18	1.42	1.03	0.18	0.16	0.19
Town Branch at Stueve Ln	0.00	0.00	0.00	1.67	1.22	8.03	0.29	0.29	0.26
Town Branch at E. Market St	1.20	1.55	0.84	10.29	9.75	11.00	0.19	0.17	0.21
Dry Creek at FM 672	0.35	1.10	0.00	0.43	0.54	0.19	0.23	0.22	0.27
Dry Creek at FM 713	0.70	1.05	0.00	0.36	0.33	0.46	0.20	0.19	0.22
Tenney Creek at Tenney Crk Rd	4.35	4.35	N/A	0.33	0.33	N/A	0.14	0.14	N/A
Hines Branch at Tenney Crk Rd	0.00	0.00	0.00	0.51	0.60	0.05	0.23	0.23	0.24
Copperas at Tenney Crk Rd	0.10	0.20	0.01	0.33	0.40	0.09	1.13	1.33	0.42
West Fork at FM 671	0.02	0.08	0.00	0.33	0.36	0.05	0.18	0.15	0.47
West Fork at Biggs Rd	0.01	0.02	0.01	0.27	0.28	0.26	0.19	0.19	0.20
Salt Branch at Salt Flat Rd	0.01	0.06	0.00	0.26	0.21	0.34	0.81	0.23	1.69
Salt Branch at FM 1322	0.30	0.70	0.20	9.78	5.55	15.01	0.33	0.32	0.35

*Entire data set under all flow conditions through October of 2017.

Stations highlighted have a base flow Nitrate concentration greater than the water quality screening criteria of 1.95 mg/L under dry conditions.

STREAM BIOLOGICAL ASSESSMENTS

In addition to water quality analyses, GBRA conducts annual biological and habitat assessments at two sites in the Plum Creek watershed under the Clean Rivers Program: Plum Creek at CR 202 near Lockhart (12647) and Plum Creek at Plum Creek Road near Uhland (17406). Surveys of the fish and macroinvertebrate communities in the stream as well as the plant communities and physical characteristics of the environment adjacent to the stream serve as indicators of positive or negative responses to changes in stream conditions. The type and the number of fish and macroinvertebrate species collected are used to calculate the Index of Biotic Integrity (IBI). Table 22 presents the IBI scores and the classifications based on those scores for each site evaluated since 2006. Bioassessments were not performed at either site in 2007 and at the Plum Creek at Plum Creek Road site in 2009 due to high flow events that scoured the stream.

Table 22. Stream biological screening assessments at TCEQ Stations 17406 & 12647 in Plum Creek.

Stream Biological Assessment - IBI Score (Classification)												
Location	2006		2008		2009		2010		2011		2012	
	Nekton	Benthic	Nekton	Benthic	Nekton	Benthic	Nekton	Benthic	Nekton	Benthic	Nekton	Benthic
Plum Creek at Plum Creek Road near Uhland	34 (Interm)	20 (Limited)	42 (High)	29 (High)	Flooding	Flooding	41 (High)	24 (Interm)	Removed from Monitoring Schedule			
Plum Creek at CR 202 downstream of Lockhart	24 (Limited)	17 (Limited)	42 (High)	22 (Interm)	40 (Interm)	25 (Interm)	35 (Interm)	24 (Interm)	43 (High)	26 (Interm)	34 (Limited)	33 (High)

During the March 2009 Guadalupe River Basin coordinated monitoring meeting, the CRP stakeholders agreed to remove the biological monitoring event at station 17406 after fiscal year 2010 in order to re-distribute the funding into new monitoring projects elsewhere in the basin. The decision to discontinue the biological assessment at this station was largely due to the results from the last available assessment event in September of 2008 using the newly published SWQM Procedures Manual: Volume 2 aquatic life monitoring (ALM) protocols. This screening event showed that all three calculated biological monitoring criteria were meeting the designated “High” aquatic life use for the stream segment. The removal of biological monitoring at station 17406 was also possible because aquatic life use monitoring had been added to another station (12647) on Plum Creek at Old McMahan Road, downstream of the City of Lockhart, which represented a larger portion of the Plum Creek watershed.

The IBI classification system for nekton species developed by the TPWD is specific to each ecoregion. The IBI classification system for the benthic community developed by the TCEQ is applied to all ecoregions across the state. The following are the stream classifications assigned based on IBI scores (Table 23).

Table 23. Stream classifications assigned based on IBI scores for the site.

Classification	Nekton	Benthic
Exceptional	≥49	>36
High	41-48	29-36
Intermediate	35-40	22-28
Limited	<35	<22

GBRA has observed that the majority of macroinvertebrate species collected at both locations are *tolerant species*. Additionally, there are very few nekton species collected per unit effort and those fish species caught included very few benthic invertivores (fish that feed on invertebrates). The lower species diversity and number of individuals collected have negatively impacted the IBI scores at the Plum Creek sites. There are more tolerant species found at these sites than intolerant species.

The TCEQ assesses the biological integrity of streams by comparing the classification given a site based on the IBI score to the water quality standard for flowing streams. The presumed use for flowing streams is High Aquatic Life Use. Aquatic Life Monitoring (ALM) protocol used by TCEQ requires that two assessments be conducted each year for two years, with one of the annual assessments done in the critical period (July-September) and one done outside the critical period (March-October). The biological assessments conducted by GBRA on the Plum Creek sites were performed only in the critical period of each year. ALM performed by GBRA on the Plum Creek sites was intended to provide baseline-screening data on environmental conditions.

In 2014 and 2015, a full Aquatic Life Monitoring Event was collected on the Plum Creek at CR 135 (TCEQ Station 12640). In contrast to previous biological screening events, this Aquatic Life Monitoring (ALM) event consisted of two separate samples that were collected within the same calendar year and could be used to assess a designated aquatic life use. Both sample events were collected during the biological index period between March 15th and October 15th. Additionally, one of the events was targeted for the biological critical period between July 1st and September 30th. The critical period was targeted to ensure that the stream can be characterized during the period of lowest flows, lowest dissolved oxygen levels and highest temperatures, when organisms are under the greatest stress. Monitoring was conducted at this location because it is the closest station to the confluence of the Guadalupe River and is located downstream of all permitted point source discharges in the watershed. The location of this station made it more suitable than the previously monitored locations upstream for assessing the biological health of the watershed.

Table 24. Aquatic Life Monitoring Events at TCEQ Station 12640 on Plum Creek.

Stream Biological Assessment - IBI Score (Classification)				
Location	2014		2015	
	Nekton	Benthic	Nekton	Benthic
Plum Creek at CR 135 Event 1	31 (Limited)	32 (High)	37 (Interm)	36 (High)
Plum Creek at CR 135 Event 2	36 (Interm)	37 (Except)	40 (Interm)	38 (Except)

The results of the 2014 and 2015 aquatic life monitoring events at station 12640 indicated that the benthic macroinvertebrate populations at this location were consistently meeting or exceeding the designated “High” aquatic life assigned to this stream segment. The fish collected at this location consistently scored lower than the designated aquatic life use (Table 24). Several factors may have contributed to the assessed scores at this station. A major drought affected the entire region from 2011 to 2014 and long-term changes in fish diversity and abundance may have occurred during this time. Scouring floods of 3,000 cfs and 16,000 cfs occurred in May of 2014 and May of 2015, respectively. These flood events both occurred over a month before the closest sampling events, but fish species in the watershed may have relocated into the larger San Marcos River drainage as a result. The benthic macroinvertebrate populations may have had adequate time to recover from these flood events and repopulated more quickly than the fish populations. Overall, the nekton score did not meet the designated use criteria, with an assessed mean of 36 and a coefficient of variation of 10.39%, but the exceptional macroinvertebrate scores may indicate the influence of other mitigating factors.

In 2017, GBRA completed an Aquatic Life Monitoring Event on the spring fed Town Branch of Plum Creek in Lockhart City Park. The Clean Rivers Program coordinated monitoring partners identified a concern for dissolved oxygen at this location in the 2014 TCEQ Texas Integrated Report for Surface Water Quality. The GBRA performed an Aquatic Life Monitoring Event in 2017 to assess the potential effects of this assessed concern on the biological populations in this waterbody. During the first monitoring event, the GBRA observed a line of trail horses walking through the middle of the stream for the entire reach of the assessment. This activity visibly clouded the water and disturbed much available biological habitat that the GBRA evaluated. The resulting Nekton and Benthic Macroinvertebrate scores were both below the designated high aquatic life use for this event. The Plum Creek Watershed Coordinator contacted the trail riding company that was responsible and notified them of the impact to the water quality of the stream. During the subsequent monitoring event, the GBRA found no signs of potential impacts from horses in the stream and the index of biotic integrity scores for the fish population increased to high, while the macroinvertebrate score increased to exceptional (Table 25).

Table 25. Aquatic Life Monitoring Events at TCEQ Station 20509 on Town Branch Tributary of Plum Creek.

Stream Biological Assessment - IBI Score (Classification)		
Location	2017	
	Nekton	Benthic
Town Branch at Lockhart City Park Event 1	40 (Interm)	27 (Interm)
Town Branch at Lockhart City Park Event 2	42 (High)	38 (Except)

BACTERIAL SOURCE TRACKING

Bacterial source tracking (BST) is a valuable tool for identifying human and animal sources of fecal pollution. The Partnership, has continued to evaluate opportunities to employ BST strategies throughout the reporting period for this Update. Further, investments by the state in building BST analytical laboratory infrastructure and the use of the Texas *E. coli* BST library now provide substantial cost and time savings for the identification of nonpoint source pollution in watersheds across the state. A renewed interest in BST has led to some very encouraging results. Discussions among the TSSWCB, GBRA, the City of Kyle and additional members of the Partnership have led to the development a state-funded BST monitoring project for Plum Creek. Sampling began in the spring of 2016 and lasted for one year. With dramatic land use changes in the watershed since the development of the Plum Creek WPP, the Partnership is encouraged that the results of this study will shine new light on the current sources and conditions contributing to significant *E. coli* loading in several key subwatersheds. The findings will be available in 2018 and will enable the Partnership to identify critical sources and locations for pinpoint implementation of BMPs for mitigating nonpoint source pollution and other adaptive management measures.

NITRATE NITROGEN ISOTOPE STUDY

Since monitoring of Plum Creek and Geronimo Creek began in the late 1990's, these creeks have shown elevated concentrations of nitrate-nitrogen. Currently, because the state stream water quality standards are not numeric for nutrients, exceedences of a screening concentration of 1.95 mg/L nitrate-nitrogen have been used to designate a stream as having a concern for nitrate-nitrogen. The possible sources of the nutrient concern are numerous. Plum Creek is effluent-dominated and is also fed by springs that come from the Leona Aquifer, known to have elevated concentrations of nitrate-nitrogen. Geronimo Creek is also fed by springs from that same aquifer. Stakeholders in both watersheds have long suspected fertilizer use as the source of the nitrates in the Leona, but oddly enough, elevated concentrations of nitrates had been seen in well testing long before commercial inorganic fertilizers came into use. Septic systems, organic fertilizers, nitrifying plants and atmospheric deposition round out the list of possible sources.

The TCEQ has begun to develop numeric water quality standards for nitrate-nitrogen. At the end of that process, the standards established by TCEQ and the EPA could move Plum Creek and Geronimo Creek from a designation of “concern for nutrients” to the 303(d) List of impaired waterbodies. The Plum Creek and Geronimo Creek Watershed Partnerships have not waited for “impaired waterbody” status to start working on best management practices that could reduce sources of nitrates. In order to help direct efforts and funding toward the most likely or most influential source(s) of nitrate, this project will look to isotopic signatures of nitrogen and oxygen in the nitrates. The ratios of the isotopes of nitrogen and oxygen in nitrate often are useful for determining sources of nitrates in groundwater and surface water. Isotopic ratios are expressed as the ratio of the heavier isotope to the lighter isotope relative to a standard in parts per thousand (USGS, 2011). Figure 33 describes graphically the relationship of nitrogen and oxygen isotopes, and the nitrogen cycle.

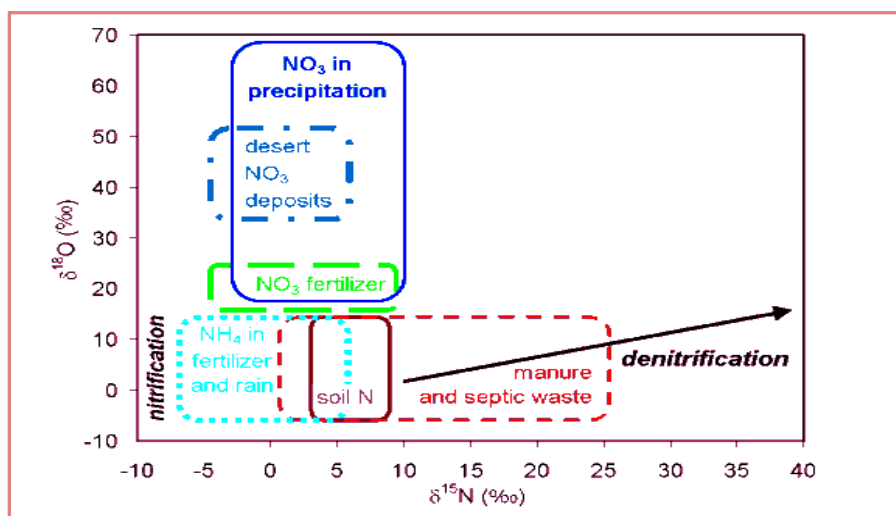


Figure 33. Relationships of nitrogen and oxygen isotopes and the nitrogen cycle.

TSSWCB provided CWA §319(h) grant funding for GBRA & USGS to conduct a scientific investigation of the sources of nitrate in the Geronimo and Plum Creek watersheds. A combination of different types of sites in these watersheds were sampled for selected major ions, trace elements, nutrient species and stable isotopes of nitrate during the project period. GBRA and USGS conducted the following monitoring in the Plum and Geronimo Creeks; (1) targeted surface water quality monitoring over a range in hydrologic conditions (wet and dry conditions), collecting field, flow and conventional parameter groups, (2) targeted groundwater quality monitoring, collecting field and conventional parameter groups, and (3) targeted spring quality monitoring, collecting field, flow and conventional parameter groups. Field parameters and flow were collected at the same time as the water-quality samples.

The USGS Scientific Investigations Report: *Water Quality, Sources of Nitrate, and Chemical Loadings in the Geronimo Creek and Plum Creek Watersheds, South-Central Texas, April 2015 – March 2016* was released in 2017. The results from the Plum Creek watershed indicate that (1) water quantity and quality are surface-water dominated; (2) nitrate concentrations vary widely, with concentrations highest in WWTP samples, groundwater samples, and stream samples collected at sites downstream from WWTPs and lowest in stream samples collected from the

tributaries; (3) under low-flow conditions the predominant source of flow and nitrate is WWTPs, and nitrate loads are relatively low; and (4) during higher flow storm events the source of nitrate is no longer dominated by the WWTP contribution (Lambert, Opsahl, Musgrove 2017).

This publication can be found at <https://pubs.er.usgs.gov/publication/sir20175121>.

BACTERIA REDUCTIONS

Tables 26 and 27 evaluate *E. coli* load characteristics and anticipated reductions upon full implementation of the Plum Creek WPP.

Table 26. Annual load characteristics and *E. coli* reductions for each station (in billions of cfu).

Monitoring Station	Average Annual <i>E. coli</i> Load (cfu/year)	Lower 95% CI	Upper 95% CI	Load Reduction (cfu/year)	Target Load (cfu/year)
Uhland (17406)	1.12E+05	8.74E+04	1.36E+05	7.28E+04	3.92E+04
Lockhart (12647)	4.26E+05	2.46E+05	6.06E+05	6.39E+04	3.62E+05
Luling (12640)	3.02E+07	1.04E+07	5.01E+07	1.24E+07	1.78E+07

Table 27. Estimated regional pollutant load reductions expected upon full implementation of the Plum Creek WPP.

Management Measure	Expected Load Reduction								
	Uhland			Lockhart			Luling		
	Ec ¹	N ²	P ³	Ec	N	P	Ec	N	P
Urban Stormwater Management Measures									
Pet Waste Collection Stations	7.2E+12	70.6	8.2	7.3E+12	158.5	17.9	6.0E+14	1.4	N/A
Comprehensive Urban Stormwater Assessment	4.3E+13	531.7	19.1	1.9E+13	929.6	32.5	1.8E+15	7.8	N/A
Retrofit Stormwater Detention Basins									
Initiate Street Sweeping Program									
Manage Urban Waterfowl Populations									
Rehabilitate Stormwater Retention Pond									

Wastewater Management Measures									
Wastewater Upgrade (TSS Reduction)	3.5E+10	N/A	N/A	2.1E+10	N/A	N/A	3.2E+12	N/A	N/A
Wastewater Upgrade (Phosphorus Removal)									
Voluntary Monthly E. coli Monitoring									
Voluntary Monthly Phosphorus Monitoring									
Sanitary Sewer Pipe Replacement									
Lift Station SCADA Installation									
Initiate Sanitary Sewer Inspection Program									
Septic System Inspection/Enforcement (New Position)	6.1E+12	22.7	13.3	5.0E+12	42.2	24.2	3.8E+14	0.4	N/A
Septic System Repair									
Septic System Replacement									
Septic System Connection to Sewer									
Agricultural Management Measures									
WQMP Technician (New Position)	9.6E+12	5,472	827	2.1E+13	30,427	4,772	5.6E+15	542	N/A
Livestock Water Quality Management Plans									
Cropland Water Quality Management Plans									
Non-Domestic Animal and Wildlife Management Measures									
Feral Hog Control (New Position)	7.3E+12	1,615	327	1.2E+13	5,902	1,163	4.0E+15	105	N/A
Feral Hog Control (Equipment)									

¹ Ec: *E. coli* reduction indicated in cfu/year.

² N: Nitrogen reduction in kg/year.

³ P: Phosphorus reduction in kg/year.

ADAPTIVE MANAGEMENT

Adaptive management is a type of natural resource management in which decisions are made as part of an ongoing science-based process. Adaptive management involves testing, monitoring, and evaluating applied strategies, and incorporating new knowledge into management approaches that are based on scientific findings and the needs of society. Results are used to modify management policy, strategies, and practices [65 Fed. Reg. 62566-62572 (October 18, 2000)].

The Partnership is committed to adaptive management of the Plum Creek WPP. The Plum Creek watershed is extremely diverse in terms of land use, land cover and socioeconomic characteristics with rapid development in the headwaters and a predominantly rural setting for the lower reaches of the watershed. Over the course of project implementation, instream monitoring data provided by GBRA will be compared with interim milestones and water quality criteria to determine progress in achieving water quality standards. If water quality improvement is not being demonstrated within the proposed timeframes, efforts will be made to increase adoption of BMPs and/or adjust strategies or focus areas if and when necessary.

Since the publication of the 2012 Update to the Plum Creek WPP, the Partnership has worked diligently to continue to engage new stakeholders and to communicate with existing partners in an effort to build greater support for management measures identified in the Plum Creek WPP. The early success of the CCFHTF is just one example of adaptive management as a direct result of efforts on behalf of the Partnership and its project partners to cooperate in new and innovative ways to improve water quality while also reducing the extreme economic and ecological damage wrought by feral hog activity in the watershed. The involvement of so many people throughout the watershed in feral hog programs during the reporting period for this Update has led to much local, state and national media attention on the risks posed to water quality by expanding feral hog populations. This is an important point that is clearly taking hold in the watershed as Partnership meeting attendance and new visitors to the Plum Creek website continue to increase.

Further, it has become unmistakably apparent that the Partnership must develop new strategies to better and more actively inform the public and policy makers of the significant impact rapid urban development is having on water quality in the Plum Creek watershed. To address swiftly degrading water quality in the upper reaches of the creek, the Partnership recommends investment in LID, improved management of stormwater runoff and other urban nonpoint source pollution mitigation practices, such as septic-to-sewer projects. When coupled with effective outreach, these projects can provide quick returns on investment in terms of water conservation and improved water quality. Further, these projects will lead to a greater probability of achieving long-term sustainability for a healthy, functioning Plum Creek watershed. The Partnership will actively pursue funding for stormwater management projects for partner cities in the watershed and continue educational efforts for developers, landowners and communities throughout the watershed to raise awareness and encourage participation in the Plum Creek WPP's voluntary programs.

The Partnership will continue to work with regulatory agencies such as the TCEQ and Railroad Commission to communicate the need for adequate oversight of energy development and wastewater management in the watershed. Huge inflows of inadequately treated WWTF effluent in the upper segments of Plum Creek during the reporting period have very likely led to major spikes in *E. coli* concentrations and nutrient levels measured at downstream CRP monitoring sites. While WWTFs provide a necessary service and can contribute beneficial flows to downstream stakeholders, poorly operated facilities have the potential to singlehandedly negate the steady progress that has been made as a result of significant time and resources invested in nonpoint source pollution prevention efforts. The Partnership will continue to encourage water reuse options and voluntary adoption of 5-5-2-1 effluent treatment levels by WWTF operators in the watershed and will continue to provide critical information to our stakeholders and state

agencies as they work together to adopt the policies needed to support responsible growth and the restoration of Plum Creek.

The Plum Creek WPP Update report is a document that will be developed and approved to be published approximately every two years. This report will contain updates on tracking the progress of implementation, outreach activities, and water quality monitoring in the watershed. The report will document and provide updates and any issues or adaptive management decisions on all of the measures within the WPP and any modifications to the goals and strategies identified in the WPP. In addition it will include an analysis of up to date water quality data to determine progress in achieving water quality restoration.

IMPLEMENTATION SCHEDULE AND MILESTONES

The WPP was developed based on a 10-year implementation schedule with implementation proceeding through the end of calendar year 2018. Tables 28 and 29 serve as a progress update to the implementation schedule outlined in the Plum Creek WPP. The tables indicate work completed through December 2017 and can be compared with water quality trends to determine the need for adaptive management. While implementation of some measures began almost immediately, work toward others has required significant additional effort to secure participation and funding. For certain strategies, major work is not expected until later stages of the overall effort. It is anticipated that changes in water quality will experience a lag period following the implementation of management measures, and substantive changes may require several years to be discernible.

Table 28. Progress toward implementation of management measures identified in Table 10.1 of the Plum Creek WPP.

Management Measure	Responsible Party	Year			
		1-3	4-6	Status thru Dec. 2017	7-10
Urban Stormwater Management Measures					
Pet Waste Collection Stations	City of Kyle	13	4	16	4
Pet Waste Collection Stations	City of Lockhart	10	4	10	4
Pet Waste Collection Stations	City of Luling	6	2	6	2
Pet Waste Collection Stations	City of Buda	10	4	18	4
Comprehensive Urban Stormwater Assessment	City of Kyle	1	---	Completed	---
Retrofit Stormwater Detention Basins	City of Kyle	2	---	Completed	---
Initiate Street Sweeping Program	City of Kyle	---	---	Initiated and continuing	---
Comprehensive Urban Stormwater Assessment and Illicit Discharge Survey	City of Lockhart	1	---	Completed	---
Manage Urban Waterfowl Populations	City of Lockhart	---	---	Ongoing	---
Comprehensive Urban Stormwater Assessment	City of Luling	1	---	0	---
Rehabilitate Stormwater Retention Pond	City of Luling	1	---	0	---
Initiate Street Sweeping Program	City of Buda	1	---	Initiated and continuing	---

Management Measure	Responsible Party	Year			
		1-3	4-6	Status thru Dec. 2017	7-10
Wastewater Management Measure					
Wastewater Upgrade (TSS Reduction)	WWTF Operators	---	3	3	7
Wastewater Upgrade (Phosphorus Removal)	WWTF Operators	---	3	3	7
Voluntary Monthly E. coli Monitoring	WWTF Operators	---	---	Ongoing	---
Voluntary Monthly Phosphorus Monitoring	WWTF Operators	---	---	Ongoing	---
Sanitary Sewer Pipe Replacement	City of Kyle	2,400 ft	2,400 ft	4,660 ft	3,200 ft
Lift Station SCADA Installation	City of Kyle	3	4	1	---
Sanitary Sewer Pipe Replacement	City of Lockhart	1,800 ft	1,800 ft	5,470 ft	2,400 ft
Initiate Sanitary Sewer Inspection Program	City of Luling	1	---	1	---
Sanitary Sewer Pipe Replacement	City of Luling	2,400 ft	2,400 ft	0	3,200 ft
Lift Station SCADA Installation	City of Luling	4	1	0	
Sanitary Sewer Pipe Replacement	City of Buda	--	8,523 ft	14,754 ft	--
Septic System Inspection/Enforcement (New Position)	Caldwell County	2		0	
Septic System Repair/Replacement	Hays County	300	300	359---	400
Septic System Repair/Replacement	Caldwell County.	150	150	34**	200
Septic System Connection to Sewer	City of Uhland	100	100	0	150

**No change since November 2011. Caldwell County did not provide additional information requested for this Update.

Management Measure	Responsible Party	Year			
		1-3	4-6	Status thru Dec. 2017	7-10
Agricultural Management Measures					
WQMP Technician (New Position)	SWCD	---	---	Funded through FY 2019	---
Livestock Water Quality Management Plans	SWCD	65	70	120	102
Cropland Water Quality Management Plans	SWCD	6	9	5	9
Non-Domestic Animal and Wildlife Management Measures					
Feral Hog Education (New Position)	AgriLife Extension	---	---	Funded through FY 2019	---
Feral Hog (Demonstration Equipment)	AgriLife Extension	---	---	\$10,000 of Equip.	---
Monitoring Component					
Targeted Water Quality Monitoring	GBRA	---	---	Funded through FY 2019	---
Comprehensive Stream Assessment	GBRA	12	12	13	16
Bacterial Source Tracking	TAMU	1	---	Completed	---

Table 29. Progress toward implementation of management measures identified in Table 10.2 of the Plum Creek WPP.

Outreach Activity	Responsible Party	Year			
		1-3	4-6	Status thru Dec. 2017	7-10
Broad-Based Programs					
Texas Watershed Steward Training Sessions	AgriLife Extension	3	2	3	1
Elementary School Water Quality Project	GBRA	---	---	over 1,000 kids/yr funded through 2017	---
Plum Creek Watershed Protection Brochure	GBRA/ AgriLife Extension	---	---	7,200 distributed of 12,000	---
Tributary and Watershed Roadway Signage	AgriLife Extension	60	---	TxDOT denied	---
Displays at Local Events	AgriLife Extension/TSSWCB	9	9	60	9
Watershed Billboards	AgriLife Extension	Partnership decided against moving forward with this option			
Urban Programs					
Pet Waste Programs	Cities/TCEQ/ AgriLife Extension	2	---	4	---
NEMO Workshops	GBRA/TCEQ/ AgriLife Extension	2	---	4	---
Fats, Oils, and Grease Workshop		2	---	0	---
Municipal Site Assessment Visits		4	---	9	---
Urban Sector Nutrient Education	AgriLife Extension	3	3	4	3
Sports and Athletic Field Education (SAFE)	AgriLife Extension	3	3	1	3

Outreach Activity	Responsible Party	Year			
		1-3	4-6	Status thru Dec. 2017	7-10
Wastewater Programs					
Develop Online Training Modules	GBRA	4	---	4	---
Septic System Workshops and Assistance	AgriLife Extension/GBRA	4	3	12	3
Agricultural Programs					
Soil and Water Testing Campaigns	AgriLife Extension	3	3	10	3
Agriculture Nutrient Management Education	AgriLife Extension	3	3	10	3
Crop Management Seminars	AgriLife Extension	3	3	3	3
Agricultural Waste Pesticide Collection Days	TCEQ	1	No longer funded by TCEQ	1	No longer funded by TCEQ
Lone Star Healthy Streams – Grazing Cattle Education	AgriLife Extension	3	3	3	3
Non-Domestic Animal and Wildlife Programs					
Lone Star Healthy Streams - Feral Hog Management Workshop	AgriLife Extension	2	1	12	2
Additional Programs					
Stream and Riparian Workshops	AgriLife Extension	2	1	6	2
Illegal Dumping Site Targeted Cleanup	GBRA, AgriLife Extension, Keep Texas Beautiful, Cities, Counties	3	3	13	3
Community Stream Cleanup Events		2	3	20	3
Rainwater Harvesting Education/ Demonstration	AgriLife Extension	2	1	5	2

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 (2014) 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, Umland, 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 level, 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 City of 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 Guadalupe Blanco River Authority 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 September of 2019. Caldwell-Travis Soil and Water Conservation District has committed to continue implementing agricultural components of the WPP by providing technical assistance to farmers and ranchers. The project, funded through a CWA Section 319(h) grant from TSSWCB and EPA will also continue to provide financial assistance to implement agricultural BMPs through October of 2019.

The Partnership is hopeful to see wastewater management improvements in the watershed with the renovation, maintenance and expansion of the City of Kyle WWTF. The Partnership will continue to encourage voluntary adoption of higher treatment levels for WWTFs in the watershed, as well as reuse strategies, and land application.

Importantly, a CWA Section 319(h) grant from TSSWCB and EPA, awarded to GBRA, will continue funding a local Watershed Coordinator through November of 2018. In 2017, the Partnership and GBRA submitted a proposal to continue funding the watershed coordinator position through September of 2021; the proposal was subsequently selected for funding by TSSWCB, pending approval by the EPA. 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. Those entities include Caldwell and Hays Counties, the cities of Lockhart, Luling, Kyle, Uhland, and Buda, GBRA, Plum Creek Conservation District, Polonia Water Supply Corporation, Caldwell-Travis Soil and Water Conservation District, and the Hays County Soil and Water Conservation District.

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.

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