Wastewater Management

Compared with work to address other potential sources, efforts to secure funding to enhance wastewater management for both centralized treatment facilities and private septic systems have not been as successful. Permit renewal and the inherent difficulties of making substantial voluntary capital investments during unfavorable economic conditions have combined to prevent significant progress to date toward treatment improvements for centralized systems. Likewise, improved management of septic systems continues to be hampered by limited inspection/ enforcement, as well as by inadequate resources to assist economically limited homeowners. However, some accomplishments as described below have provided water quality benefits and will help guide future progress. In the WPP, the Partnership identified several common goals and strategies for wastewater treatment facilities. Based on the East Hays County Wastewater Compact and in order to reduce nutrient loading to Plum Creek, the Partnership strongly recommended that wastewater treatment facilities strive to achieve 5-5-2-1 treatment levels. The Partnership recommended that existing facilities voluntarily work towards this increased treatment and that new facilities apply for TPDES permits with these requirements. The Steering Committee now clarifies that zero discharge, land application of wastewater effluent would result in greater pollutant loading reductions. The Partnership recommends that new wastewater treatment facilities consider Texas Land Application Permits (TLAP) as an alternative to dispose of treated effluent.

WASTEWATER MANAGEMENT

Regional Water and Wastewater Planning Studies

In addition to the previous Regional Wastewater Facility Planning Study for Eastern Hays County completed prior to WPP development, Hays County and Caldwell County have both conducted a Water and Wastewater planning study with funding from TWDB. The Caldwell County study was sponsored by the county and GBRA in August 2009 and focused on water supply planning for future development and current availability and viability of proposed regional water projects. However, water supply strategies investigated in this study were limited to those already listed in TWDB planning documents. The study also addressed future wastewater management needs for both septic systems and centralized treatment, with recommendations closely aligning with those in the WPP to reduce the potential for pollutant loading. The recommended regional wastewater treatment facilities are based on a regionalization concept that will ultimately provide four regional wastewater facilities in the county (Figure 10). These facilities will be sized and phased to accommodate growth and enable reuse of reclaimed water.

Hays County commissioned a Water-Wastewater Facilities Plan to assess current conditions and water and wastewater service demand and supplies, make alternative forecasts of future growth and associated service needs and define current and future unmet needs. Also included was an assessment of alternative management strategies for addressing unmet needs and identification of preliminary recommendations of water management actions needed in the next 50 years. The study focuses primarily on the area west of the IH-35 corridor cities. The study was sponsored by the Hays County Commissioners Court with funding support from the Texas Water Development Board and ten regional and local government entities and utilities with jurisdiction over portions of the planning area.

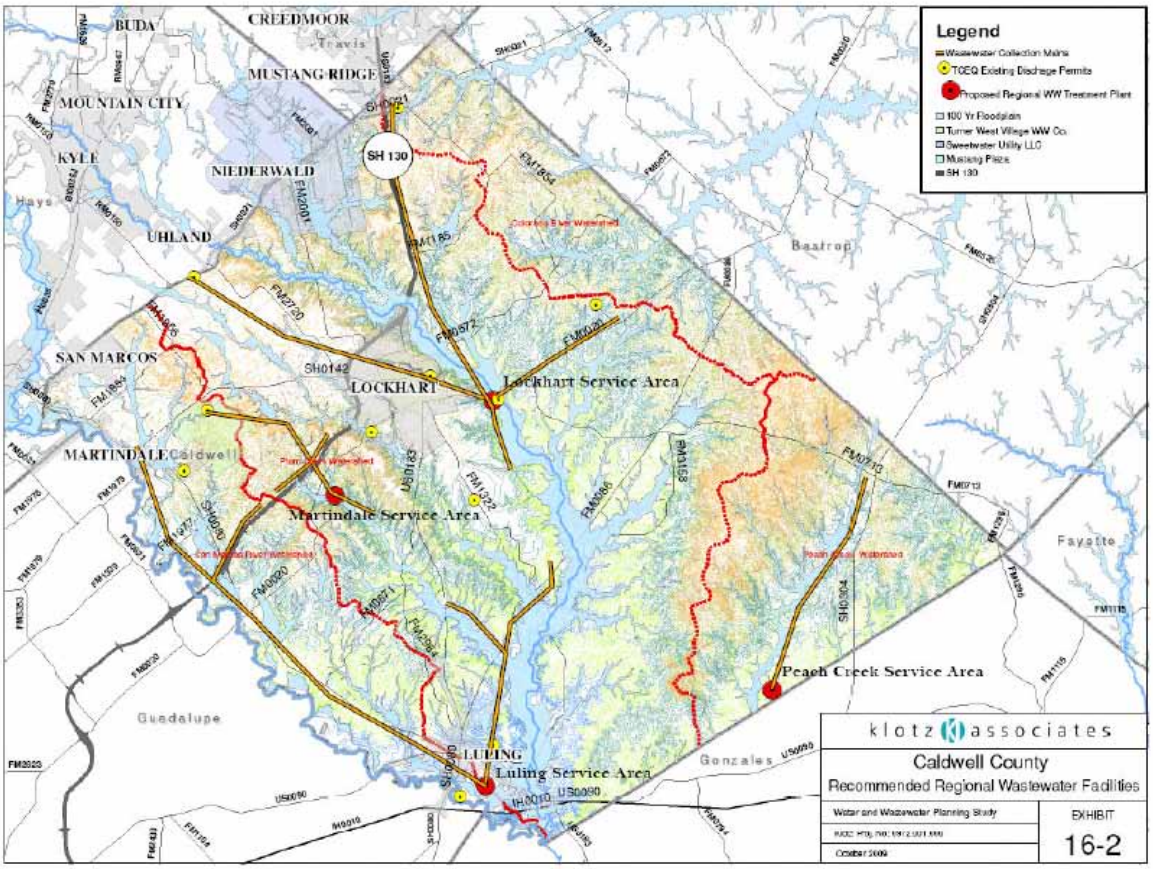

Figure 10. Recommended regional wastewater facilities in Caldwell County.

Kyle Water Reuse Feasibility Study

The City of Kyle is conducting a study of the feasibility of implementing the Region L water supply strategy of using reclaimed water from WWTF effluent by identifying potential users and costs of expanding an existing single user system. The one year study is 100% grant funded through 50% by TWDB and 50% from Bureau of Reclamation. Study objectives include: identifying viable means of implementing the regional objective of conserving the Barton Springs/Edwards Aquifer groundwater resources and Guadalupe River surface water resources through water recycling and reuse; reduce the annual discharge of nutrients to Plum Creek; Provide sustainable water sources for the continued growth of Kyle, Meet the increasing recreation service expectations of a growing community. Plum Creek Watershed Partnership is represented on the Technical Advisory Group and attended the kickoff meeting on September 28, 2011. The project will be completed in November 2012.

Buda Water Reuse Projects

The City of Buda has almost completed its Wastewater Treatment Plant (WWTP) Expansion from 0.95 MGD to 1.5 MGD. As part of this expansion project, the city has installed reuse pipe from the WWTP to the City Park property on the south side of the WWTP. The city is in the process of obtaining a Chapter 210 permit modification from TCEQ to allow the distribution of reuse water to additional locations that were not included in the original permit authorization. A bulk reuse station is being designed for construction immediately south of the Public Works

Department that will allow contractors to utilize reuse water instead of potable water for construction projects. This project will be online later this year.

Several years ago Buda 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. These lines were recently tested and are ready to provide reuse water to customers pending final TCEQ approval of the Chapter 210 permit modification. These lines will provide irrigation to the main street medians, City Park, and the sportsplex. In addition, there is potential for use of this water for irrigation by Cabela's, the new Microtel Hotel, the new Noah's Ark Self Storage, the proposed multi-family development at the southwest corner of the Cabela's tract, Creekside Villas, Texas Lehigh Cement, and by Nighthawk Foods for reuse water to replenish their cooling towers.

Regional Wastewater Compact

Both Regional Water and Wastewater Planning Studies resulted in the development of draft compacts between local municipalities and counties. Neither compact has been signed by all parties. The Eastern Hays County Wastewater Compact was a goal of the Partnership, but there were no further agreements beyond the initial signatories of the City of Niederwald, Hays County, and GBRA. The Caldwell County Wastewater Compact was drafted following the same recommendations. Through the WPP process the ideas in the compact were discussed again with the current city councils and commissioner courts and included in the WPP as wastewater measures. The recommendations of the compact were included and approved as recommendations in the WPP that was signed by the Steering Committee including members representing all of the cities and counties, covering the entire watershed. Most wastewater treatment facilities renewed their permits during 2008-2010 (see Table 4), so new permit requirements will not be considered until 2013-2015. More Stringent limits to improve effluent remains a high priority in the watershed, despite facing significant financial hurdles associated with improved treatment process costs.

Sewer Pipe Replacement and New Sewer Service

The cities of 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. The City of Lockhart has replaced approximately 4,000 linear feet of existing sewer pipes. The City of Kyle has replaced approximately 4,660 linear feet of sewer main and extended new service lines to approximately 50 homes at a cost of about $432,000. The City of Luling extended first-time sewer service to about 50 homes and businesses located within the San Marcos Watershed with 16,672 linear feet of sewer main and service lines for a cost of $1,746,620. The City of Buda installed 2,652 linear feet of new wastewater pipe which replaced 1,500 linear feet of degraded sewer lines for a cost of about $216,000; the City of Buda is in the process of replacing 8,523 linear feet of pipe over the next three years (2012-2014) at a projected cost of $1,467,000.

Table 4. Revised Table 7.3 in WPP. TPDES wastewater discharge permits in Plum Creek Watershed.

FACILITY NAME	Type of Disinfection	MAX PERMITTED FLOW (MGD)	PERMIT NUMBER	EFFECTIVE DATE	EXPIRATION DATE	*E. coli* effluent limit in permit?	*E. coli* effluent monitoring in permit?
KYLE	Chlorine	3/4.5	WQ0011041-002	02/04/2010	02/01/2015	no limit in either phase[1]	no monitoring requirement in either phase[1]
LOCKHART NO. 2 (FM 20 Plant)	UV	1.5	WQ0010210-002	02/04/2010	02/01/2015	126 cfu/100mL daily avg[2]; 394 cfu/100mL daily max	once per day
BUDA	Chlorine	0.6/0.95/1.5	WQ0011060-001	02/16/2010	02/01/2015	no limit in either phase[1]	no monitoring requirement in either phase[1]
LOCKHART NO. 1 (Larremore Street Plant)	Chlorine	1.1	WQ0010210-001	03/04/2010	02/01/2015	126 cfu/100mL daily avg[2]; 394 cfu/100mL daily max	once per week
LULING-NORTH	Chlorine	0.9	WQ0010582-002	05/28/2009	02/01/2014	no limit[1]	no monitoring requirement[1]
RANCH AT CLEAR FORK	Chlorine	0.33/0.7	WQ0014439-001	04/28/2008	02/01/2013	no limit in either phase[1]	no monitoring requirement in either phase[1]
NIEDERWALD (SWEETWATER)	Chlorine	0.075/0.122/0.25	WQ0014672-001	09/21/2010	03/01/2015	126 cfu/100mL daily avg[2]; 394 cfu/100mL daily max	once per quarter
RAILYARDS-PARKLAND	UV	0.35	WQ0014165-001	07/28/2005	02/01/2010	n/a – permit expired	n/a – permit expired
RAILYARDS-VILLAGE HOMES	Chlorine	0.075/0.12375	WQ0014060-001	05/11/2010	02/01/2015	126 cfu/100mL daily avg[2]; 394 cfu/100mL daily max	once per quarter
GOFORTH	Chlorine	0.0424	WQ0013293-001	04/13/2010	02/01/2015	126 cfu/100mL daily avg[2]; 394 cfu/100mL daily max	once per week
SUNFIELD	Chlorine	0.25/0.5/0.99	WQ0014377-001	08/06/2009	02/01/2014	no limit in either phase[1]	no monitoring requirement in either phase[1]
SHADOW CREEK (formerly CASTLETOP)	Chlorine	0.162/0.486	WQ0014431-001	02/22/2010	02/01/2015	no limit in either phase[1]	no monitoring requirement in either phase[1]

[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.

New Discharge Permit in the Plum Creek Watershed

EB Windy Hill, L.P. has applied to the TCEQ for a new permit to authorize the discharge of treated domestic wastewater at a daily average flow not to exceed 0.20 million gallons per day in the interim phase and a daily average flow not to exceed 0.40 million gallons per day in the final phase. The plant will be located south of the end of Mockingbird Lane and approximately 2 miles east of the intersection of Interstate Highway 35 and County Road 122 (Bebee Road) in Hays County. The treated effluent will be discharged to Porter Creek which flows into Soil Conservation Service (SCS) Site 6 Reservoir, to Porter Creek, to Bunton Branch and finally into Plum Creek. The unclassified receiving water has a high aquatic life designated use for the Porter Creek and SCS Site 6 Reservoir portions. The SCS Site 6 Reservoir is designated as a high hazard dam, meaning dam failure may cause loss of life or serious damage to infrastructure; design work for rehabilitation of the Site 6 dam has been approved, but there is currently no funding for construction (see *Other Developments* section for further discussion of high hazard flood control dams). The effluent limitations in the interim and final phases of the draft permit, based on a 30-day average, are 5 mg/l $CBOD_5$, 5 mg/l TSS, 2 mg/l NH3-N, 1 mg/l phosphorus, 126 CFU or MPN of E. coli per 100 ml and 5.0 mg/l minimum dissolved oxygen (DO). The effluent must contain a chlorine residual of at least 1.0 mg/l and must not exceed a chlorine residual of 4.0 mg/l after a detention time of at least 20 minutes based on peak flow.

Voluntary Effluent Monitoring by WWTF

The Buda, Lockhart, Shadow Creek, and Sunfield wastewater treatment facilities in the Plum Creek watershed have voluntarily initiated monthly *E. coli* and even some phosphorus monitoring with their own financial resources. If these parameters are not included in their permit limits, then they are conducting voluntary monitoring and the resulting data are not required to be sent to TCEQ. This monitoring is conducted by each WWTF and is separate from the TSSWCB CWA §319(h) grant for targeted sampling in the Plum Creek watershed that includes monitoring of WWTF effluent.

The Lockhart facilities voluntarily have collected phosphorus data on a periodic basis using their own financial resources. Results of the targeted water quality monitoring program indicate this should be a priority at all facilities to improve understanding of the role of point sources in nutrient enrichment, which appears to be significant. Removing phosphorus remains a high priority in the watershed, despite facing significant financial hurdles associated with improved effluent treatment.

The Partnership also participated in numerous discussions with TCEQ in pursuit of unannounced inspections to provide additional information on loading from point sources. However, no unannounced inspection program has been implemented by TCEQ in the watershed.

New E. coli Effluent Limits and Monitoring Requirements for Permitted WWTFs

As of December 31, 2009, TCEQ, through the Texas Pollutant Discharge Elimination System (TPDES), requires bacteria effluent limits and monitoring requirements in all WWTF permits. These new requirements will be a part of permit language for all TPDES permits for which a Notice of Application and Preliminary Decision is published on or after January 1, 2010. These new requirements will call for periodic *E. coli* monitoring of all facilities, which will provide additional information on the long-term loading potential of point sources in the watershed. Most

facilities in the watershed renewed their permits during 2008-2010, but six of the twelve permits were renewed without the *E. coli* limits and one permit expired. TCEQ responded that these permits may have been in the approval process prior to the rule change to include *E. coli* limits. The new monitoring requirements for *E. coli* limits for the remaining 7 WWTFs will not be considered until 2013-2015 when the next round of permit renewals are scheduled. Table 4 identifies WWTFs in the watershed, their bacteria discharge limits, and those to which TCEQ has applied the new bacteria effluent limits and monitoring requirements.

Phosphorus Removal

Many facilities currently do not have phosphorus limits. As a result, phosphorus concentrations in effluent frequently are significantly greater than the screening criteria, particularly in the effluent and downstream of those facilities without phosphorus limits. The Partnership believes it is imperative that point sources be worked with more closely by the regulatory authorities to reduce these substantial and clearly defined nutrient contributions by changes in the TPDES permit or other innovative methods. Load Duration Curves (LDCs) for nutrients using the State's screening criteria's as the target water quality load were developed at each of the three routine stations. Load reductions for total phosphorus based on the LDCs in the WPP resulted in a need for a 27% reduction at the Uhland Station 17406, 5.4% reduction at the Lockhart Station 12647, and no reduction at the Luling Station 12640.

In a proactive effort, the City of Lockhart agreed to support an effort by GBRA to investigate flow-triggered phosphorus removal from the city's wastewater treatment facility, which is operated by GBRA. This approach was proposed to TCEQ in anticipation of a new phosphorus limit in the facility's TPDES permit. However, TCEQ is still working on new statewide water quality standards for nutrients for freshwater streams and thus did not accommodate the change in monitoring protocol. Consequently, the study was not funded, and the Partnership believes that a valuable opportunity to pilot this method to reduce phosphorus loading to Plum Creek during the most critical flows and to obtain data on this innovate strategy was missed. To the greatest extent possible, agency personnel should strive to support proactive and innovative efforts on the part of watershed stakeholders.

Recommended Facility Upgrades and SCADA

To assist in determining upgrades and expansion efforts necessary to achieve the goals outlined in the East Hays County Wastewater Compact, wastewater engineer Martin Rumbaugh volunteered time to visit wastewater treatment facilities in Kyle, Lockhart, and Luling. Following informal inspections of infrastructure, general recommendations and cost estimates for increased levels of treatment were provided to operators of each facility. While these improvements have been encouraged, they largely have not been undertaken due to the need for increased financial investment.

A recommendation for all of the systems was to obtain funding to put lift stations and WWTFs on SCADA systems. After the recent wastewater spill in Kyle of over a million gallons into the Plum Creek and subsequent fish kill, Kyle and AquaSource, Inc. installed a SCADA system at the Kyle plant in November 2011. The City can receive data that indicate effluent depth at the wastewater lift station, helps monitor the WWTF for a possible overflow, and allows the City to contact the operators of the plant if there are any concerns.

AgriLife Extension worked with the City of Luling to develop an application for the 2009 TWDB Clean Water State Revolving Fund (CWSRF) assistance program, which received additional American Recovery and Reinvestment Act funds, to upgrade components of the wastewater collection system and install critical components at the wastewater treatment facility. However, this project was not prioritized high enough to be included in the 2009 Intended Use Plan for CWSRF funding. The City of Luling and other watershed municipalities are hesitant to take on debt to implement treatment upgrades that are not part of current TPDES permit requirements, particularly given current economic conditions. This is a critical issue voiced frequently by facility operators and managers. Unfortunately, funding opportunities other than loans are severely limited.

Serious knowledge gaps remain with regard to regrowth of *E. coli in the environment relative to the completeness of disinfection*. In most cases, effluent sampling conducted by GBRA indicates very low levels, often < 10 cfu/100mL. However, downstream concentrations are often much higher, with no known inflows or significant concentrations of potential sources nearby. Understanding the dynamics of regrowth and reactivation of bacteria after the disinfection process of WWTFs is of vital importance to wastewater management and to watershed stewardship as a whole.

Plum Creek Community Installs Wet Well with Bar Screens to Reduce Suspended Solids in Effluent for Reuse

Construction of a new wet well with bar screens began in November 2011 to reduce suspended solids in effluent from the Kyle wastewater treatment plant to be used for irrigation at the Plum Creek Community Golf Course. The bar screens will collect suspended solids, algae, and plastics that have caused pump clogging in the past so they can be sent to a grinder and then pumped back to the front of the WWTP System for retreating.

Septic System Connection to Sewer

The Partnership continues to work with Hays County and the City of Buda on a potential project to connect a 264-home subdivision (Hillside Terrace) located in Plum Creek subwatershed UH-3 to central sewer service. This project is located in Hays County and is in the Buda ETJ. This subdivision has been identified by local citizens and city and county staff as a site of chronically failing septic systems on small lots and is located in a critical subwatershed identified in the watershed planning process as having a high likelihood of impacting water quality. An unnamed tributary of Andrews Branch passes through and drains much of this neighborhood before it flows into Andrews Branch and Porter Creek that meets with Bunton Branch just before entering Plum Creek upstream of the Uhland water quality monitoring site. Pre-application meetings were held with the TWDB Economically Distressed Areas Program. This program provides funding for water and wastewater projects in economically distressed and disadvantaged areas. However, the program requires adoption and use of model subdivision regulations by both the City and County. Through an extended assessment process, it was determined that Hays County had several areas where recently approved and adopted revisions to county development regulations were not sufficient to meet TWDB program requirements. As a consequence, no funding could be obtained through this program.

Subsequently, AgriLife Extension worked with Hays County and the City of Buda to conduct a socioeconomic survey of Hillside Terrace residents and develop an application for the TWDB CWSRF Intended Use Plan for 2012.The survey indicated an annual median household income of $25,500, and qualified the project area as a disadvantaged community with potential to receive up to 70% loan forgiveness. The project is categorized as a nonpoint source project which also places it in a separate ranking category of NPS projects. The Hillside Terrace project for $5,600,000 ranked third in the NPS projects category with a score of a 71, but the small amount of loan forgiveness money was all utilized by the first project. The project was invited to apply for a loan in the full amount of the project, but the City and County declined the loan for this round and will apply again next year if they potentially can receive some of the loan forgiveness funding. Another potential future funding option for wastewater and water issues in the watershed that will be explored is Texas Department of Agriculture's Community Development Block Grant funds.

Wastewater in the Counties

One significant obstacle to addressing septic system contributions to water quality impairment is the general lack of septic system maintenance and inspection requirements. While authorized agents for septic systems in Hays and Caldwell Counties and City of Uhland require newer aerobic systems to have quarterly maintenance contracts and reporting by licensed professionals, conventional systems do not have the same requirements. 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 individual. 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 counties are notified of these generally by complaints turned in by neighbors due to standing water and smell.

Hays County has been tracking their complaints and violations in a database which shows that since 2008, over 208 systems have been in inspected and were in violation and have completed the necessary measures to be back in compliance, by repairs, pumping, disconnecting additional structures or installing new systems.

Due to staff turnover in Caldwell County the history of complaints, violations, and compliance could only be determined from January 2011. Information was available on 37 violations investigated by the County Sanitarian of suspected septic system violations. There have been 21 cases that have been resolved and have their systems back in compliance, nine cases still pending, 7 cases in Justice of the Peace Court. The Caldwell County District Attorney conducted a raid that resulted in 17 cases of septic system violations. Five of the 17 cases have installed new systems, 7 have moved their mobile homes from the area, and the remaining 4 cases are pending.

Caldwell County has a Certified Sanitarian working on OSSF inspections and permitting and an enforcement officer that follows up on violations. There were only a total of 83 new permits requested in 2011 between January 1 and November 30, 2011. Numbers of new OSSF permits did not increase in 2011 as speculated, which would have created the need and revenue for additional staff.

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 also provides financial incentives to implement certain BMPs prescribed in the WQMPs. 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. Initial landowner interest in the program was very low. Most producers have not been in a position to assume new financial obligations during the difficult economic times and in the midst of the extreme drought. Overall, livestock numbers and crop production activities in the watershed have been much lower than in previous years.

These recent weather patterns have substantially affected pollutant loading characteristics in the primary agricultural subwatersheds. Decreased plant cover likely resulted in greater loss of soil and associated nutrients in many areas when rainfall occurred. Although fewer numbers of livestock may have reduced overall bacteria loading during this period, remaining animals may have concentrated near riparian areas with perennial water sources that often provided the only source of forage. Producers are keenly aware of the need to replace lost vegetative cover and continue to seek options for rehabilitating their properties.

AgriLife Extension and the SWCD Technician have promoted interaction between the Steering Committee and the U.S. Department of Agriculture – Natural Resources Conservation Service (USDA-NRCS) Local 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 USDA-NRCS in allocating EQIP county base funds and with resource concerns for other USDA Farm Bill programs.

The Caldwell-Travis SWCD and TSSWCB continue to investigate and adjust the suite of approved management practices for the program as requests from landowners are received and evaluated. While the maximum reimbursement rate for financial incentives (funded through the 319(h) grant) are set at 60%, the Caldwell-Travis SWCD will continue to adjust the average price of practices to remain competitive with current market rates.

However, policies of participating agencies have in some cases made adjustment of approaches and tailoring programs to local needs difficult. For example, scientific research has shown that alternate shade structures can reduce nutrient and sediment loading to streams related to livestock management. Unfortunately, there is not an NRCS-approved Practice Standard for Texas which sets forth the criteria necessary to ensure the practice achieves its intended purposes. Without a practice standard, financial incentives cannot be provided through either TSSWCB or NRCS. The TSSWCB and Texas A&M University are working to provide the NRCS with the necessary scientific basis to develop a practice standard for shade structures in Texas. An ongoing study at Texas A&M (funded by the TSSWCB) indicates that shade structures may reduce the percent of time cattle spend in riparian areas by 11-31% and thus are expected to result in similar reductions in direct deposition of manure and associated bacteria and nutrients into these areas. It is hoped that this study, which will conclude in May 2012, will result

in the needed policy change. Federal and State agencies provided technical assistance and financial incentives to agricultural producers should seek modifications to existing programs as soon as possible to enable inclusion of new and innovative practices that have been documented to be effective by scientific research.

Adjustments to the program have included an increase from $10,000 to $15,000 maximum per farm for financial incentives. Additional practices with BMP codes for the field office technical guide have been added to the approved list including the well pumping plant (533) and critical area planting (342). The issue of cross fencing along streams/water ways for stream exclusion was resolved in March 2011 by addition of a provision for "fences installed to protect stream health."

The current list of approved practices for funding through the 319(h) grant includes the following:

- Prescribed Grazing (528): Manages the controlled harvest of vegetation with grazing animals to improve or maintain the desired species composition and vigor of plant communities, which improves surface and subsurface water quality and quantity.
- Riparian Herbaceous Buffers (390): Establishes an area of grasses, grass-like plants, and forbs along water courses to improve and protect water quality by reducing the amount of sediment and other pollutants in runoff as well as nutrients and chemicals in shallow groundwater.
- Grassed Waterways (412): Natural or constructed channel shaped or graded and established with suitable vegetation to protect and improve water quality.
- Riparian Forest Buffers(391): Established an area predominated by trees and shrubs located adjacent to and up-gradient from watercourses to reduce excess amounts of sediment, organic material, nutrients, and pesticides in surface runoff and excess nutrients and other chemicals in shallow groundwater flow.
- Watering Facilities (614): Places a device (tank, trough, or other watertight container) for providing animal access to water and protects streams, ponds, and water supplies from contamination by providing alternative access to water.
- Field Borders (386): Establishes a strip of permanent vegetation at the edge or around the perimeter of a field to protect soil and water quality.
- Filter Strips (393): Establishes a strip or area of herbaceous vegetation between agricultural lands and environmentally sensitive areas to reduce pollutant loading in runoff.
- Nutrient Management (590): Manages the amount, source, placement, form, and timing of the application of plant nutrients and soil amendments to minimize agricultural nonpoint source pollution of surface and groundwater resources.
- Conservation Cover (327): Establishes permanent vegetative cover to protect soil and water resources.
- Stream Crossings (578): Creates a stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles, improving water quality by reducing sediment, nutrient, organic, and inorganic loading of the stream.
- Cross-Fencing (382): Facilitates the implementation of a rotational grazing system by creating multiple fields for forage utilization by livestock. This practices improves forage and stream health by excluding livestock from areas for a given period of time.

- Pipelines (516): Facilitates the transportation of water source to a watering facility for livestock.
- Water Well (642): Provides groundwater that will be transported and used by livestock.
- Pasture and Hayland Planting (512): Establishes a permanent vegetative cover of improved grasses, either seeded or vegetative, to be utilized by livestock for forage.
- Rangeland Planting (550): Establishes a permanent vegetative cover of native grasses to be utilized by livestock for forage.

Through dedicated efforts of the local SWCD Technician, participation has begun to increase, with eight plans certified and an additional five in development since being hired over 2 years ago. The SWCD Technician has developed a program brochure, publications, and three press releases. The current listing of certified plans and plans in development for each subwatershed may be found in Table 5 (livestock operations) and Table 6 (cropland operations). Continued emphasis will be placed on outreach to the agricultural community to increase program participation.

The WQMP goals of the WPP have been more difficult to reach due to the low initial interest in the program, difficult economic situation, drought cycles, and the loss of time in the hiring and training of the technician. Changes in the goal totals may need to be shifted to the remaining years in order to reflect the current status of the program.

Table 5. Recommended number of management plans for livestock operations by subwatershed.

Region	Subwatershed	Animal Units	Farms	Conservation Plans Needed	Certified Plans	Plans in Development
Uhland	UH-1	493	10	6	0	0
	UH-2	403	8	5	0	0
	UH-3	731	15	10	0	0
	Region Total	1628	33	21	0	0
Lockhart	LO-1	1024	20	3	0	0
	LO-2	327	7	1	0	0
	LO-3	717	14	2	0	0
	LO-4	852	17	3	0	0
	LO-5	882	18	3	0	0
	LO-6	1751	35	5	0	0
	LO-7	2019	40	6	0	0
	LO-8	506	10	2	0	0
	LO-9	828	17	2	0	0
	LO-10	1117	22	3	0	0
	LO-11	1308	26	4	0	0
	Region Total	11329	227	34	0	0
Luling	LU-1	168	3	1	0	0
	LU-2	748	15	6	1	0
	LU-3	498	10	4	0	0
	LU-4	322	6	3	0	0
	LU-5	1257	25	10	1	0
	LU-6	1879	38	15	1	0
	LU-7	694	14	6	0	0
	LU-8	1027	21	8	0	2
	LU-9	542	11	4	0	1
	LU-10	600	12	5	1	0
	LU-11	1020	20	8	0	0
	LU-12	1787	36	15	0	0
	LU-13	999	20	8	0	0
	LU-14	1662	33	14	1	0
	LU-15	1173	23	10	2	0
	LU-16	1124	22	9	1	0
	LU-17	344	7	3	0	0
	LU-18	986	20	8	0	0
	LU-19	2348	47	19	0	1
	LU-20	1981	40	16	0	0
	LU-21	989	20	8	0	0
	Region Total	22147	443	182	8	4
Total		35101	702	237	8	4

Table 6. Recommended number of management plans for cropland operations by subwatershed.

Region	Subwatershed	Cropland Acres	Farms	Conservation Plans Needed	Certified Plans	Plans in Development
Uhland	UH-1	1374	6	2	0	0
	UH-2	930	4	1	0	0
	UH-3	569	2	1	0	0
	Region Total	2873	12	4	0	0
Lockhart	LO-1	1138	5	2	0	0
	LO-2	149	1	0	0	0
	LO-3	433	2	1	0	0
	LO-4	1163	5	2	0	0
	LO-5	1374	6	3	0	0
	LO-6	742	3	2	0	0
	LO-7	1117	5	2	0	0
	LO-8	1890	8	4	0	0
	LO-9	742	3	2	0	0
	LO-10	222	1	0	0	0
	LO-11	1117	5	2	0	0
	Region Total	10087	44	20	0	0
Luling	LU-1	4059	18	0	0	0
	LU-2	2171	9	0	0	0
	LU-3	2623	11	0	0	1
	LU-4	3143	14	0	0	0
	LU-5	148	1	0	0	0
	LU-6	72	1	0	0	0
	LU-7	1106	5	0	0	0
	LU-8	1890	8	0	0	0
	LU-9	742	3	0	0	0
	LU-10	88	1	0	0	0
	LU-11	500	2	0	0	0
	LU-12	240	1	0	0	0
	LU-13	289	1	0	0	0
	LU-14	88	1	0	0	0
	LU-15	506	2	0	0	0
	LU-16	24	1	0	0	0
	LU-17	70	1	0	0	0
	LU-18	351	2	0	0	0
	LU-19	72	1	0	0	0
	LU-20	30	1	0	0	0
	LU-21	351	2	0	0	0
	Region Total	18563	86	0	0	0
Total		31523	142	24	0	1

Wildlife and Non-Domestic Animal Management

Feral hogs have established themselves across much of the southern United States, and their range continues to expand rapidly into neighboring regions across the country. 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 (i) prevent the introduction of invasive species; (ii) 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." *Only four* terrestrial vertebrate species were classified by the USDA National Invasive Species Information Center as invasive species. One of these is the feral hog, *Sus scrofa*. In addition to Executive Order 13112, the USEPA Office of Wetlands, Oceans, and Watersheds (OWOW) have a *Strategic Action Plan for Invasive Species*, addressing certain strategic goals:

- control invasive species, both aquatic and terrestrial, affecting aquatic ecosystems,
- create education and outreach opportunities, and including certain priority actions:
- encourage the inclusion of invasive species in existing monitoring programs,
- control the spread of invasive species and promote public understanding using education and outreach tools,
- review all uses of OWOW funding to explore using OWOW assistance agreements to target invasive species problems impacting aquatic systems, and,
- estimate the economic impacts of invasive species affecting the aquatic environment.

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. An estimated $51.7 million in agriculture damage is caused by feral hogs annually. Effects of their activities on water resources include increased sediment, bacteria and nutrient loads, algae blooms, oxygen depletion, and bank erosion. In areas where high numbers of 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. Because of the problems posed by feral hogs it was proposed in a component of a TSSWCB CWA §319(h) grant proposal to hire a Texas Wildlife Services position for direct control. Texas Wildlife Services (TWS), a unit of Texas AgriLife Extension Service, is the primary State agency charged with responsibility for controlling feral hog populations in Texas (Chapter 825 of the Texas Health and Safety Code). TWS accomplishes this through direct control efforts in cooperation with individual landowners, private entities, counties, and state and federal agencies. Through a cooperative agreement with USDA-Animal and Plant Health Inspection Service (APHIS), TWS carries out federal mandates for wildlife damage management in Texas on behalf of USDA-APHIS. Though this agency has worked with other dangerous or invasive species in the past, much of their current effort is focused on controlling feral hog populations across Texas.

However, due to concerns over feasibility and public perception, a component of a TSSWCB CWA §319(h) grant proposal to hire a Texas Wildlife Services position for direct control of feral hogs was not funded by the EPA. However, in light of the importance of managing feral hogs for environmental benefits, the grant was reconfigured to support an AgriLife Extension Assistant to

provide one-on-one feral hog management education and offer technical assistance to landowners as they sought to control feral hog damage on their properties. More information on these outreach efforts can be found in the outreach and education Chapter below. The Plum Creek Watershed Partnership will continue to work with those State agencies that have responsibilities associated with feral hogs in order to advance the discussion with EPA regarding the alignment of established federal priorities for invasive species control (Executive Order 13112 and EPA OWOW Action Plan) with available grant programs (i.e., 319(h)).

Feral Hog Control

In addition to the management education supported through TSSWCB CWA §319(h) funds, the Partnership was able to secure cooperation from Texas Wildlife Services with financial support from the Texas Department of Agriculture to conduct aerial control of feral hogs (Table 7). Through flights conducted in January, February, and March 2010, a total of 372 hogs were removed from approximately 40,000 acres in 22 subwatersheds identified in Table 7. The Extension Assistant worked with Texas Wildlife Services staff and local officials to identify area landowners and solicit participation. Prior to the effort, landowners in the control area completed a cooperative agreement permitting aerial control. This project was very popular among participating landowners and served to strengthen interest in cooperative management. Follow-up has occurred with these landowners through letters, phone calls, and site visits. It is hoped that similar efforts will continue in the future, but funding will need to be acquired.

To increase effectiveness, future efforts should be directed toward achieving participation of a high percentage of area landowners to increase controlled acreage and manage contiguous properties. Due to the high mobility and large range of feral hogs, these animals can quickly move in from unmanaged properties to repopulate those that have undergone hog control. This may be minimized by participation of contiguous properties as feasible in the management area to eliminate potential refuge areas. Additionally, the full burden of controlling feral hogs realistically cannot be placed solely on land-owners. Continued assistance from state and federal agencies will be necessary to address this challenge. Here again, innovative strategies are urgently needed to promote progress and success in spite of traditional program limitations. In Alabama, USDA-NRCS is piloting the use of federal Farm Bill financial assistance funds to combat feral hogs (http://www.al.nrcs.usda.gov/programs/whip/feral_hog.html). The Plum Creek Watershed Partnership will work with USDA-NRCS to explore the feasibility of this effort in Texas.

In 2009, AgriLife Extension identified significant initial interest from the Texas Hunters for the Hungry Program and the Texas Department of Criminal Justice regarding the incorporation of harvested feral hogs into the food supply for community groups, low-income families, and inmates. A proposal for TSSWCB §319(h) CWA funds was developed to support an environmental and economic analysis of feral hog damage and harvest. However, a number of concerns regarding logistics and marketability stalled the proposal. In July 2011, the Texas Department of Agriculture solicited proposals for a pilot program for harvesting feral hogs and distributing pork products to feed food-insecure Texans.

Table 7. Recommended number of feral hogs to be removed and number of hogs that have been removed by subwatershed. The ♦ denotes subwatersheds flown during aerial control that removed 372 hogs.

Region	Subwatershed	Total Hogs	Reduction Goals for Hogs	Online Reporting of Hogs Removed	Locations of 2010 Aerial Control
Uhland	UH-1	127	83	1	♦
	UH-2	89	58	0	♦
	UH-3	192	125	0	♦
	Region Total	408	266	1	--
Lockhart	LO-1	167	25	0	0
	LO-2	67	10	0	0
	LO-3	122	18	0	0
	LO-4	90	14	0	♦
	LO-5	96	14	0	0
	LO-6	184	28	0	0
	LO-7	207	31	0	♦
	LO-8	53	8	6	♦
	LO-9	114	17	0	0
	LO-10	159	24	0	0
	LO-11	177	27	0	0
	Region Total	1436	216	6	--
Luling	LU-1	98	40	0	♦
	LU-2	111	46	0	♦
	LU-3	87	36	0	♦
	LU-4	119	49	0	♦
	LU-5	146	60	1	♦
	LU-6	316	130	1	♦
	LU-7	130	53	21	♦
	LU-8	146	60	0	♦
	LU-9	90	37	0	♦
	LU-10	93	38	19	0
	LU-11	173	71	0	♦
	LU-12	280	115	0	0
	LU-13	131	54	0	♦
	LU-14	177	73	0	0
	LU-15	206	84	0	0
	LU-16	220	90	0	♦
	LU-17	40	16	0	♦
	LU-18	139	57	0	♦
	LU-19	239	98	14	♦
	LU-20	194	80	171	♦
	LU-21	160	66	36	0
	Region Total	3295	1353	263	--
				270	**372**
Total		5139	1835	**642**	

Wildlife Surveys

The role of wildlife in the deposition of *E. coli* is not well understood. Although water quality studies incorporate wildlife data, the data often lack a clear connection between wildlife density and *E. coli* deposition. Minimal understanding of species-specific fecal pollution and the role of species density on water quality complicates attempts by natural resource managers to adjust wildlife populations to improve water quality. While some research has been conducted to establish animal densities and bacteria loading potentials in other watersheds, no new wildlife surveys have been conducted in the Plum Creek watershed beyond the use of the online feral hog reporting system (described in Outreach and Education).

A project funded by TSSWCB with 319(h) grant funds was conducted on Cedar Creek in Brazos County with the goal to determine the impact of free-ranging mammals (in general and species-specific) on *E. coli* loads in the floodplain. The objectives were to determine the density of important free-ranging wildlife in the study area, investigate fecal deposition rates, and determine fecal *E. coli* loads for each species. Mark-recapture and mark-resight surveys were conducted for population density estimates (2008–2009) for meso- and large mammals in the study areas. Fecal samples were collected from study species for *E. coli* analysis. Transects were walked to determine spatial distribution of fecal material. The study combined the highest and lowest seasonal density estimates with conservative estimates of fecal deposition rates and found that white-tailed deer, raccoons, and feral hogs deposited the most fecal material into the watershed. Using the fecal samples, project collaborators at Texas A&M University found that raccoons and Virginia opossums had the highest mean CFU/gram of fecal material of sampled species. Overall, it was estimated that raccoons potentially deposited the most *E. coli* per square kilometer, followed by feral hogs, Virginia opossums, and white-tailed deer. Raccoons were larger potential contributors than mammals like feral hogs and white-tailed deer likely because they stay near water and are known to defecate in water sources. White-tailed deer defecated frequently and in relatively large amounts; however, they had relatively low *E. coli* concentration in their fecal material (Parker 2010).

There is a broadly recognized concern that direct deposition of fecal material from bird and bat species inhabiting bridges spanning waterways can contain bacteria concentrations multiple orders-of-magnitude higher than relevant water quality criteria. This concern of higher pollutant levels is especially pertinent regarding bacteria sampling where collection of water samples is from a bridge or in proximity to a bridge. To address this issue TSSWCB is funding a project entitled *Instream Bacteria Influences from Bird and Bat Habitations of Bridges* to test the hypothesis that bridges containing significant numbers of roosting and nesting birds and bats increase ambient bacteria concentrations of streams under low flow conditions as compared to the situation where roosting and nesting is absent. The results of this project have the potential to prove or disprove sampling bias for bacteria collected from bridge locations under certain environmental conditions. Further, the results of the project have the potential to inform the selection of stream sampling locations in future projects to minimize potential biases in bacteria results and aid in the identification and quantification of other sources contributing fecal pollution to waterbodies. While this project is not being conducted in the Plum Creek watershed, results will be presented to the Partnership and incorporated in the WPP through adaptive management.