

6. Management Measures

The following sections describe the BMPs approved by the Stakeholder Committee for immediate implementation, for future threats to water quality, their groundwater protection strategy, the education and outreach component necessary to inform the public and continue community support, and the monitoring plan that will inform the Stakeholder Committee about WPP effectiveness and new threats.

The estimated pollution reductions shown in Figure 30, Figure 28 and Figure 29 are the desired stakeholder target concentrations. The management measures will be implemented over several years in order to achieve the estimated load reductions needed to meet water quality goals in both Cypress Creek at the confluence with the Blanco and the identified priority reaches of the creek and its tributaries. This analysis is submitted to satisfy Element C of the EPA 9-element criteria for watershed-based plans. Modeling outputs show that the three reaches shown in the figures below are expected to have instream nitrogen concentrations above stakeholders' acceptable targets (the purple line in the figures below labeled Target 2 represents the stakeholders' allowable maximum limits for instream nitrogen loadings). Without BMPs put in place over time to mitigate increased loadings from changes in land use, instream nitrogen concentrations will far exceed allowable limits.

In Figure 28 and Figure 29, the implementation of stakeholder selected management measures and BMPs is estimated to prevent any significant increases in nitrogen loadings. Subwatersheds 4 and 7 are expected to drastically increase in residential density. In subwatershed 4, the percentage of land use classified as residential is less than 1% but grows to 18% in the future scenario. Residential land use area in subwatershed 7 is expected to grow from just over 1% to 15%. Modeling shows that these two subwatersheds contribute high loads of nitrogen now and in the future if no BMPs are implemented. Initial BMPs are shown in Table 21.



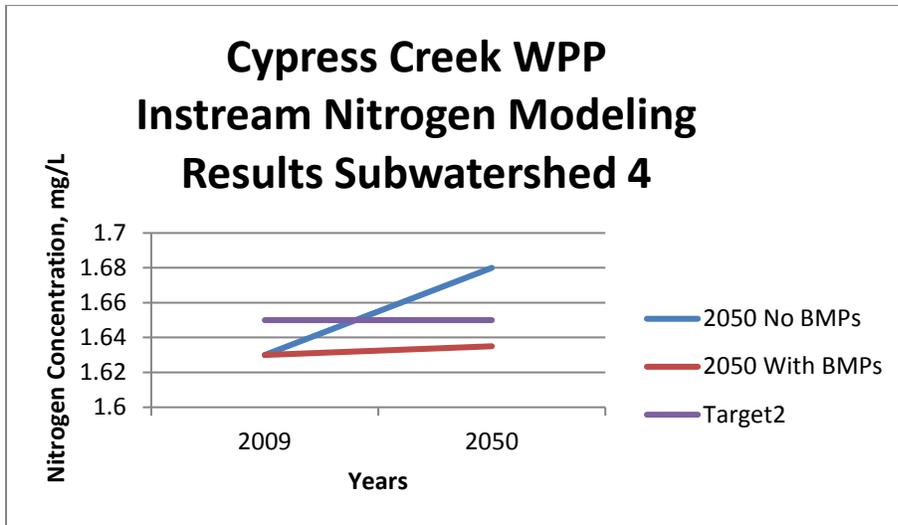


Figure 28. Instream Nitrogen Concentration in Subwatershed 4

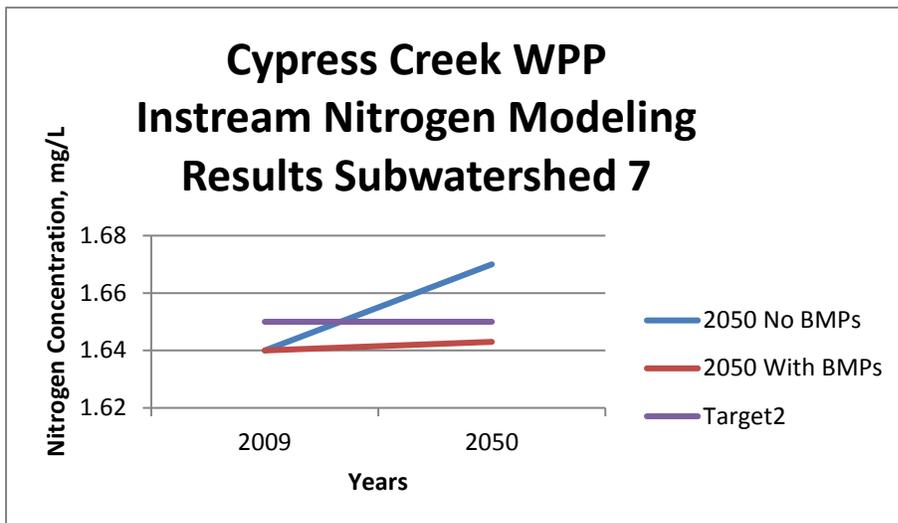


Figure 29. Instream Nitrogen Concentration in Subwatershed 7

Residential land use area in Subwatershed 2 is expected to grow from less than 10% to more than 42%. In addition, a 7% increase in commercial land use is also expected. Figure 30 shows that the initially selected BMPs will prevent significant increases in loadings, however modeled nitrogen loads are still slightly above stakeholder targets. Adaptive management activities performed in the first three years of implementation and biannually afterwards include updating model results and the review of additional best management practices. Despite heavy nitrogen concentrations from this this subwatershed, nitrogen loads at the confluence of Cypress Creek and the Blanco River are expected to be below stakeholder targets. Initial BMPs are shown in Table 21, and additional BMPs for future implementation are shown in Table 26.

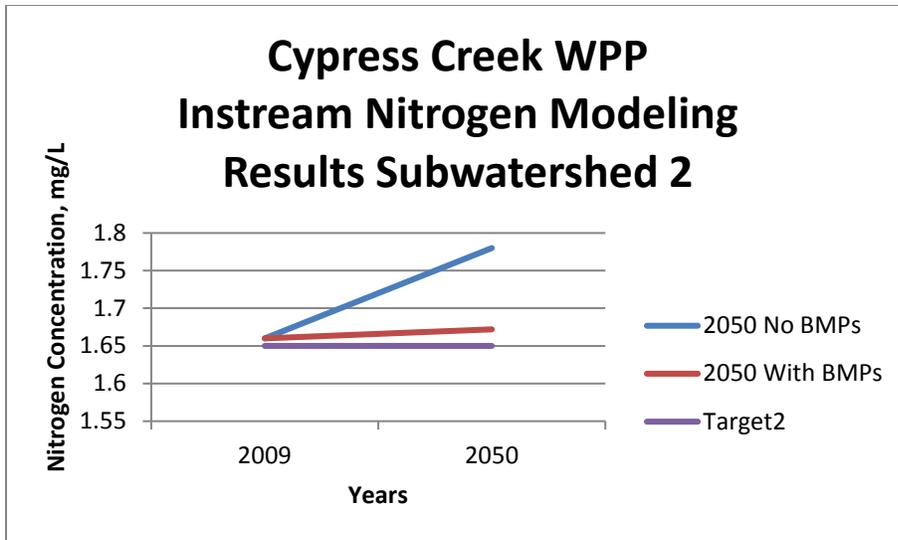


Figure 30. Instream Nitrogen Concentration in Subwatershed 2

BMPs for Immediate Implementation (Year 1-3)

The Cypress Creek community has been actively engaged in protecting their creek. Through the watershed protection planning efforts the Stakeholder Committee determined that initial implementation activities should focus on stormwater assessments, implementing demonstration BMPs, retrofitting and maintaining existing and recently built BMPs and coordinating existing community, city and county efforts in order to address current threats to water quality. These initial actions will demonstrate the WPP to the community. BMPs were chosen that will mitigate nitrogen and TSS levels affected by current urbanization in the watershed and target priority sub-watersheds. Additional existing city, county and private water quality protection programs are represented in **Description of Management Practices** below.

Strategies for funding vary, and include cash and in-kind contributions at the city and county level, as well as resources from NGO and private entities. Additional funding for implementation and maintenance are outlined below in Section 12, Financial and Technical Assistance. Wimberley, Woodcreek and Hays County have each pledged to implement the following BMPs pending finalizing formal financial agreements during the Interim period (Table 21). Correlating milestones are discussed below in Section 11, Milestones and Measures of Success.

Table 21. BMP Toolbox for Initial Implementation, years 1-3

Surface Water Quality BMPs	Responsible Party	Indicators of Success ***	Subwatershed	Average Estimated Cost [@]	Total Value
Rain Water Harvesting at County Buildings Installation and maintenance	Hays County	Decreased TSS, Improved Water Conservation	41	Installation \$30,000 Maintenance \$6,000/year	\$72,000
Rain Water Harvesting at City Hall Installation and maintenance	Woodcreek	Decrease TSS, Improved Water Conservation	2	Installation \$30,000 Maintenance \$6,000/year	\$36,000
Rain Water Harvesting at Nature Trail Park Installation and maintenance	Wimberley	Decrease TSS, Improved Water Conservation	46	Installation \$30,000 Maintenance \$6,000/year	\$36,000
Rain Water Harvesting at Community Center Installation and maintenance	Wimberley	Decrease TSS, Improved Water Conservation	46	Installation \$30,000 Maintenance \$6,000/year	\$36,000
Rain Water Harvesting at Jacobs Well Center Installation and maintenance	WVWA \$	Decrease TSS, Improved Water Conservation	41	Installation \$30,000 Maintenance \$6,000/year	\$36,000
Bio-swales at JWNA 500 lin ft	Hays County \$	Decreased TSS	41	Installation \$10,000/swale Maintenance \$12,000 /year	\$64,000
Riparian Buffers at JWNA 1/4 river mile	Hays County \$	Decreased TSS, Decreased <i>E. coli</i>	41	\$350,000/river mile	\$87,500
Vegetative filter strips JWNA ¼ acre	Hays County \$	Increased community awareness	41	\$350/acre/year	\$437.50
Pet Waste Stations	Wimberley, Woodcreek and Hays	Decreased <i>E. coli</i>	12, 14, 15, 39, 40, 41, 44	Installation \$620/station Maintenance \$85 /station/year	\$1325
Low Impact Development at Jacobs Well Center in the form of Net Energy Zero Lodging	WVWA \$	Limiting Impervious cover increases, Improved Water Conservation	41	\$15,000/project	\$15,000
Swales and Gabions at Jacobs Well Center 250 lin ft	WVWA \$	Decreased N, Decreased TSS	41	Installation \$5,000/swale Maintenance \$6,000 /year Gabion Installation: \$200/yard ³	\$20,200
Blue Hole existing BMPs:	Wimberley	N, TSS	46	\$50,000/yr	\$150,000

Surface Water Quality BMPs	Responsible Party	Indicators of Success ***	Subwatershed	Average Estimated Cost [@]	Total Value
maintenance performed by 1 contractor; 2-4 x/year	\$				
Rain Gardens at Brookeshire Brothers lot ½ acre ft pond	Wimberley	N, TSS	46	\$25,000/pond	\$25,000
Pervious Sidewalks at Old Kyle Road, Oak Drive 1500 ft ²	Wimberley	TSS	46	Installation \$2460 Maintenance \$240	\$2700
Rain Gardens – Community Center ½ acre ft pond	Wimberley	N, TSS	46	\$25,000/pond	\$50,000
Rain Garden at Hog Creek near confluence (City land) ½ acre ft pond	Woodcreek	Decreased TSS, Increased Community Awareness	10	\$25,000/pond	\$25,000
Riparian Buffer at The Lodge ¼ mile	Private and Woodcreek Stakeholder Committee \$ *****	Decreased TSS, Decreased <i>E. coli</i>	45	\$350,000/river mile	\$87,500
Xeriscaping at Jacobs Well Center 200 ft ² /project	WVWA \$	Decreased N, Improved Water Conservation	41	\$40,000/project	\$80,000
TPWD ESSS Recommended BMPs	TPWD \$	--	Watershed Wide	--	--
Demo riparian buffer BMPs at Camp Young Judea ¼ mile	Private Woodcreek	Decreased TSS, Decreased <i>E. coli</i>	42	\$350,000/river mile	\$87,500
Demo Green Roof at Jacobs Well Center. Roof area 2500 ft ²	WVWA \$	Decreased TSS, Improved Water Conservation, Increased Community Awareness	41	\$25/ ft ²	\$62,500
Demo BMPs at Water Tower, “Triangle Park”, Old Kyle Road Rotary Club and Augusta Drive/Augusta Lane site (e.g. rainwater harvesting system, 200 ft ² of xeriscaping, ½ acre ft rain gardens, and/or 1500 ft ² of pervious sidewalks)	Wimberley, Woodcreek	Decreased TSS, Increased Community Awareness	2, 44	\$26,000/project ****	\$130,000



Surface Water Quality BMPs	Responsible Party	Indicators of Success ***	Subwatershed	Average Estimated Cost [@]	Total Value
Implementation of the Wimberley Master Plan	Wimberley \$	Initial step toward improving WQ	City of Wimberley Wide	\$100,000/assessment/yr	\$200,000
Stormwater Engineering assessment	Wimberley/ Woodcreek \$	Initial step toward improving WQ	12, 14, 15, 39, 40, 41, 44	\$100,000/assessment	\$100,000
Existing Stormwater Management - (Phase I) Engineering Assessment to retrofit existing stormwater management	Hays County	Initial step toward improving WQ	To Be Determined	\$100,000/assessment	\$100,000
Existing Stormwater Management - (Phase II) Implement Retrofitting existing stormwater infrastructure	Hays County	Decreased N, Decreased TSS	To Be Determined	\$600,000/project	\$1,200,000
WQ Protection Ordinance Enforcement (1 FTE)	Woodcreek \$	Decreased N, Decreased TSS, Limits increase in impervious cover	Watershed Wide	\$50,000/yr	\$150,000
Comprehensive assessment of potential WQ Ordinance enhancements (1 PTE)	Woodcreek \$	Initial step toward improving WQ	Watershed Wide	\$25,000/yr	\$75,000
Wastewater Treatment Solutions: Collection and Treatment System to serve central Wimberley	Wimberley \$		To Be Determined	Up to \$9,000,000	\$9,000,000
Small Scale Waste Water Treatment and Re-use at Jacobs Well Center	WVWA \$	Mitigate effects of OSSF on WQ; Decreased <i>E. coli</i> , Decreased N	41	\$125,000/project	\$125,000
Comprehensive assessment of potential Karst Feature Protection Code enhancement (1 PTE)	Woodcreek \$	Initial step toward improving surface and ground/source WQ	Watershed Wide	\$25,000/yr	\$50,000
Natural Trail Signage	Wimberley	Education	46	\$700	\$700
Installation of 6 "Entering Watershed" Signs on Roadway*	Hays County \$	Increased community awareness	To Be Determined	\$200/sign	\$1200
Watershed Coordinator 1 FTE	Wimberley, Woodcreek and Hays	Increased community awareness	Watershed Wide	\$50,000/year ¥	\$150,000
Enhanced Water Quality	Wimberley,	Initial step	Watershed Wide	\$25,000/yr	\$75,000



Surface Water Quality BMPs	Responsible Party	Indicators of Success ***	Subwatershed	Average Estimated Cost [@]	Total Value
and Groundwater Modeling (CC-DSS) 1 PTE	Woodcreek and Hays \$	toward improving WQ			

**These BMPs have been identified as candidates for implementation in the first few years of implementation. Once commitments are finalized, the table and descriptions will be updated to include site specifics, estimated cost and schedule for implementation.*

****The goal of the plan is to meet Stakeholder Targets. At a minimum, State water quality standards are to be met during implementation*

*****\$50,000 is average cost of demonstration costs come from the following average project costs: rainwater harvesting system (Installation \$30,000; Maintenance \$6,000/year), Xeriscaping (\$40,000/project) rain gardens (\$25,000/pond) and/or pervious sidewalks (Installation \$2460; Maintenance \$240)*

****** Identified as a possible site for BMP implementation on private land. Stakeholder Committee will work with landowners during adaptive management.*

¥ Level of commitment and salary to be determined by Interim Committee

@Literature based values. To be updated with storm water assessment

\$ Funding pledged by local entities

Description of Best Management Practices

Descriptions below are based on efforts by the Stakeholder Committee, Wimberley, Woodcreek and Hays County. Conversations were held during Stakeholder Committee Meetings and at meetings between TCEQ, City and County staff. The Meadows Center staff was present at all meetings and provided notes of the meetings/discussions to the Stakeholder Committee. Locations for many of the BMPs are mapped in Figure 31.



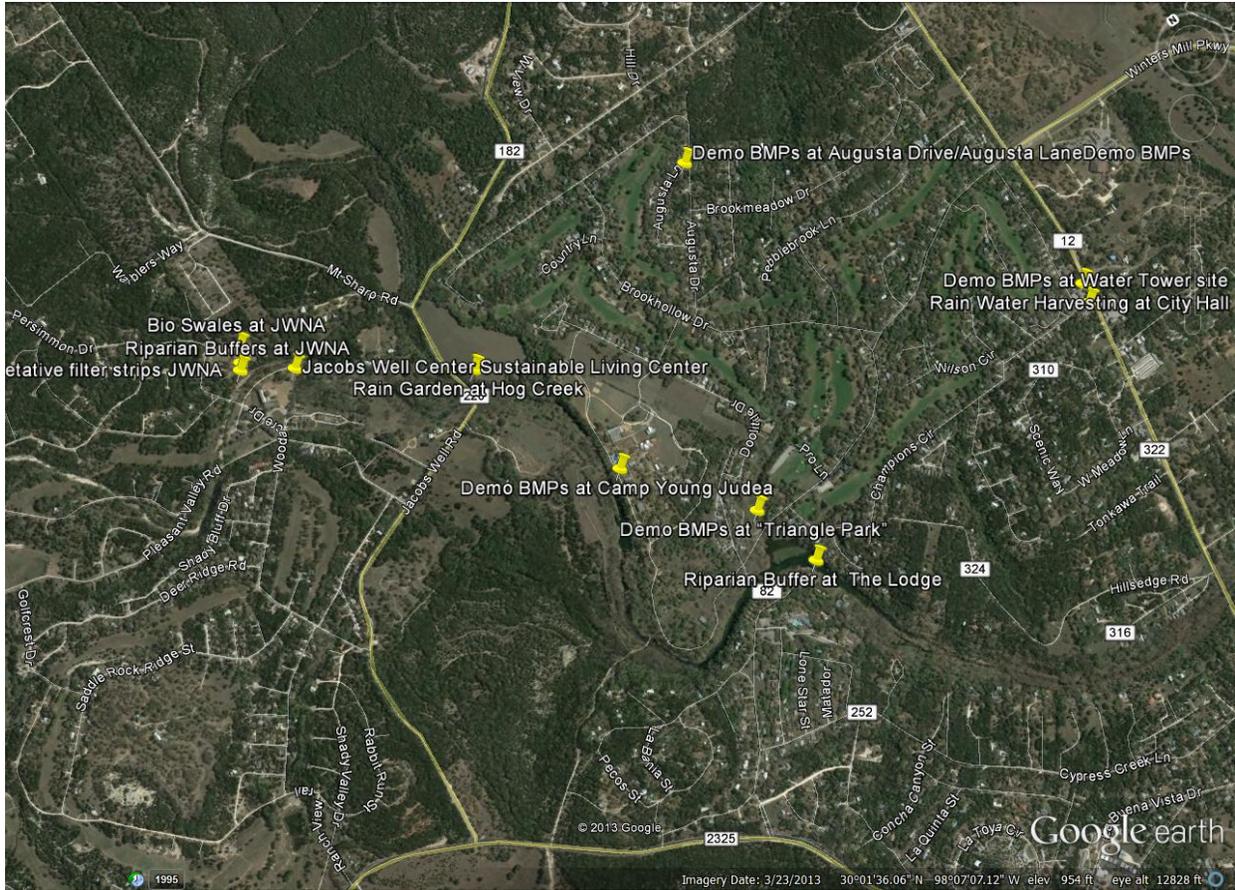


Figure 31. BMP Sites

Hays County

Bio-swales at Jacobs Well Natural Area (JWNA)

At least 3 bio-swales will be implemented by 2015 utilizing TPWD funding. Their locations are based on the community approved JWNA Master Plan.

Riparian Buffers at Jacobs Well Natural Area

These are being implemented by the County. Master Naturalists have already begun planting trees and working on the site. Maintenance is needed to ensure the buffers are able to establish themselves. These buffers are near Jacobs Well close to the low water crossing. Buffers cited according to JWNA Master Plan.

Vegetative Filter Strips

These are already being implemented by the County. Maintenance is needed to ensure filter strips are able to establish themselves. Vegetative filter strips are cited according to JWNA Master Plan.

Watershed Road Signs

The county is willing to install five watershed road signs purchased with project funds. Each sign says “Inside Cypress Creek Watershed Environmentally Sensitive Area”. The signs will be placed at strategic locations on county roads within the watershed. The Stakeholder Committee will determine the best locations for the signs.

Rainwater Harvesting

The County has determined several sites for rainwater harvesting opportunities and demonstrations at county facilities located within the watershed.

Retrofit Existing Stormwater Management

The County has pledged to explore opportunities for an updated and enhanced stormwater assessment for areas of the watershed under the County’s jurisdiction.

Retrofit Existing Stormwater Infrastructure

The County has pledged to explore retrofitting existing stormwater infrastructure to better mitigate stormflows, if feasible. This includes right of way limitations. An engineering assessment will be required.

Hays County Storm Water Management Program

The County has created a program to reduce storm water pollution by educating the public, monitoring for illicit discharges into storm sewers and monitoring construction and post-construction of new and redeveloped projects for storm water quality.

Hays County Ordinances:

- **Chapter 715:** Protection of Local Water Resources/ County Regulation of OSSF Facilities
The County requires demonstrations of the ability of new subdivision plat developments to meet water and wastewater availability requirements before accessing local water supply, with an emphasis on groundwater protection. The County must approve all OSSF systems before installation or adding new users to a preexisting OSSF system by showing that County and TCEQ standards will be met.
- **Chapter 725:** Floodplain Easements
The County has set aside all areas it has identified as a floodplain as public easements.
- **Chapter 735:** Floodplain Protection
The County has created measures to protect the floodplain from improper development and alteration. By restricting alteration of the floodplain the county plans to reduce erosion, shifting flooding to unintended areas and reduce the financial loss caused by floods to the public and county.
- **Chapter 721:** Low Lot Density Incentive
Developers are allowed to build country lane roads to service a development if the plots are larger than five acres, which incentivizes rural low density development.

- **Chapter 765: Conservation Easements**
The County’s minimum requirements for conservation easements increase amount of protected acres.
- **Chapter 761: Water Conservation Incentives**
The County has created economic incentives for encouraging water conservation features, open space preservation, low intensity development, construction of storm water quality management features, rainwater harvesting facilities, construction of groundwater recharge enhancement structures, and cedar/ash juniper removal plan and wastewater reuse plumbing to individual lots.

Wimberley

Water Quality Protection Ordinance

The City of Wimberley’s Water Quality Protection Ordinance already has protections in place, including impervious cover limits. The City is open to enhancing the ordinance to include metrics to quantify pollution mitigation. This will not include new ordinances or regulations; rather it will be a planning tool for decision makers to use when managing urbanization in the watershed.

Stormwater Assessment

Stormwater assessment for the City of Wimberley. The results of this assessment will be used to site BMPs in the interim period and to help site BMPs carried out under Adaptive Management. Stakeholder have expressed concerns about a bat colony under the Ranch Road 12 bridge in downtown Wimberley and 2 storm water drains that flow directly into Cypress Creek during storm conditions. The goal of the storm water assessment is to determine alternative flow routes and identify mitigation measures.

Wastewater Treatment Plant (Solutions)

The City of Wimberley is formally reviewing options for increasing wastewater processing, including a wastewater treatment plant and decentralized approaches. The city hosted a Wastewater Stakeholder Committee to review and assess three types of possible collections systems, including feasibility and cost projections. As the city moves forward with any required water quality sampling, engineering reviews or feasibility studies and other related activities, the WPP Interim Stakeholder Committee will track progress and incorporate the City Council’s approved actions into WPP activities.

Rain Gardens – Community Center

Demonstration rain gardens at Wimberley Community Center. This site is ideal to highlight the benefits of rain gardens while demonstrating the effectiveness of mitigating stormflows and pollution (Resource Media, n.d.).

Rain Water Harvesting – Community Center

The Wimberley Community Center is an ideal location to demonstrate the benefits of a rain water harvesting system/strategy because of its close proximity to Cypress Creek. Rain water harvesting at this site will also mitigate nitrogen and TSS in runoff from the building and parking lot.

Rain Gardens – Brookshire Bros. parking lot

The Stakeholder Committee has identified the parking lot for the Brookshire Bros. Grocery Store as an ideal candidate for rain gardens to mitigate runoff from the parking lot because of the size of the parking lot and proximity to Cypress Creek. This site is adjacent to the Community Center site above. A strategy to have these sites work together could result from the stormwater assessment.

Blue Hole – Sustainable SITE, BMP maintenance

Blue Hole has received certification as a sustainable site from the Sustainable Sites Initiative (SITES). Water Quality BMPs on site will require maintenance and monitoring.

Wimberley Comprehensive Plan

This comprehensive plan is a long-range planning tool to guide City government in meeting the expectations of residents, business owners and visitors over the next 20 years. By and large the goals laid out in the plan are to maintain the small town atmosphere of Wimberley and maintain its natural scenic beauty while allowing for growth. To accomplish this, they are using zoning and new building requirements to prevent overly commercial or unsightly growth. Some methods include preventing construction on hills and ridgelines and the creation of zoning districts, making sure the entire city is zoned according to their desired outcome. In the past their zoning has been somewhat irregular leading to small scale commercial construction and residential areas in a somewhat mosaic fashion and may be further utilized by the city to further discourage large commercial development and to maintain the historical feel of the city.

Pervious Sidewalks

Pervious sidewalks can be implemented along Old Kyle road and Oak Drive.

BMP – Old Kyle road

Potential site for demonstration BMPS in “pocket park” includes, rain gardens, rainwater harvesting, nativescaping, xeriscaping, swales, mulching, pervious pathways and sidewalks.

Nature Trail Signage

Signage at Nature Trail Park. Refer to *Education and Outreach* section.

Rainwater Harvesting at Nature Trail Park

Structure at Nature Trail Park is ideal for rain water harvesting.

Demonstration BMP at commercial site in Wimberley

A commercial lot in Wimberley is a candidate for implementing a demonstration BMP. Ace Hardware and/or Brookshire Bros parking lots ideal due to their visibility in a high traffic area and require stormwater management to prevent run off into Cypress Creek. BMPs include rain gardens, vegetative filter strips, pervious cover and others.

Woodcreek

Stormwater Assessment

The results of this assessment will be used to site BMPs in the interim and implementation phases and to site BMPs carried out under Adaptive Management.

Water Quality Protection Ordinance

The City of Woodcreek's Water Quality Protection Ordinance already has protections in place, including impervious cover limits. The City is open to enhancing the ordinance to include metrics to quantify pollution mitigation. This will not be a new ordinance or regulation; rather it will be a planning tool for decision makers to use when managing urbanization in the watershed.

Code Enhancement – Impervious Cover Limits

Code can be enhanced to include metrics that quantify the water quality benefits of implementing rain water harvesting systems or decreased impervious cover. This will not be a new ordinance or regulation; rather it will be a planning tool for decision makers to use when managing urbanization in the watershed.

Code Enhancement – Karst Feature Protection

Known recharge features exist in Woodcreek. These features are protected under the existing ordinance, but the City sees the benefit to enhancing protections. This may be couple with above code enhancements. Land could be banked around specific karst recharge features.

Demonstrations BMPs – Water tower

Water Tower site next to City Hall is ideal for its high visibility and runoff mitigation potential. Area Master Naturalists are coordinating with the Stakeholder Committee and the City to develop and install BMPs and educational signage at this site. BMPs include rain gardens, rainwater harvesting, nativescaping, xeriscaping, swales, mulching, pervious pathways and sidewalks.



Demonstrations BMPs – City Owned Land

City owned land at Augusta Drive and Augusta Lane is an ideal site for demonstration BMPs. Could also be used for above mentioned code enhancement.

Demonstrations BMPs – City Owned Land “Triangle Park”

City owned land at Triangle Park will have demonstration BMPs installed. Potential BMPs include alternative grass and land cover, rain gardens, rainwater harvesting, nativescaping, xeriscaping, swales, mulching, pervious pathways and sidewalks. Could also be used for above mentioned code enhancement.

Demonstrations BMPs – City Owned Land adjacent to Hog Creek

City owned land is will have demonstration BMPs installed. Potential BMPs include alternative grass and land cover, rain gardens, rainwater harvesting, nativescaping, xeriscaping, swales, mulching, pervious pathways and sidewalks. Could also be used for above mentioned code enhancement. More information needed.

Wimberley Valley Watershed Association

BMPs from Jacobs Well Center for Sustainable Living Master Plan

The Wimberley Valley Watershed Association hosts a sixteen acre site called *The Retreat*, which demonstrates the principles of sustainable living and inspires environmental stewardship by connecting people to the natural environment. In addition to providing a venue for environmental and sustainable living retreats and workshops, the retreat will be a demonstration site for rainwater harvesting, water treatment and reuse systems for on-site bathroom facilities, and additional low impact tent structures, as well as Net-Zero Lodging, swales and gabions for overland flow and karst feature protection, commercial scale xeriscaping, and a demonstration green roof. The site will be used for public tours, as a training facility for rainwater collection design and installation, and as an educational site for school and university programs.

The Meadows Center for Water and the Environment

Cypress Creek Decision Support System (CC-DSS). The Meadows Center developed a decision support that incorporates information from modeling efforts, stakeholder input and priorities, and watershed characteristics to allow the stakeholder group to assess best management practice (BMP) options to maximize their impacts on reducing NPS pollution. Through an iterative, collaborative process involving stakeholders, the DSS is being developed to incorporate a database management system, biophysical and socio-economic models, evaluation criteria developed in stakeholder workshops, and a graphical user interface to aid decision makers in understanding the results of the model outputs. Training will be provided for how to use the DSS and on how to modify the model(s) and evaluation criteria so that it may be adapted to changing future needs. The Stakeholder Committee will work to continue using the CC-DSS during implementation. As



new data is collected and added to the CC-DSS decision makers will be able to use the results to see the effects of new development and urbanization and make decisions that protect water quality based on the science used to develop the watershed protection plan.

