DESCRIPTION OF MANAGEMENT MEASURES

Cypress Creek project

3/24/14

TR D

Appendix C: Description of Chosen Management Measures

Agricultural Management Measures

Livestock Water Quality Management Plan

Description

A water quality management plan (WQMP) is a site-specific plan developed through and approved by soil and water conservation districts (SWCDs) for agricultural and silvicultural lands (TSSWCB, 2012). Land treatment practices, production practices, management measures and technologies are combined in a customized suite to achieve a particular level of pollution prevention.

Details

Forested lands and wildlife are included in the WQMP, along with various grazing systems, nutrient management techniques, and erosion control to create a sustainable and low-maintenance system for the landowner.

Cost

$10,000/plan

Parameter Treated

Bacteria, TSS

Operational Support Available

Water Quality Management Plan (WQMP) Program- TSSWCB

Works Well with Other BMPs

Fencing Riparian Areas

Grazing Management Strategies

Figure 1. Restricting access to waterways is a part of the Livestock Water Quality Management Plan. Photo by Clean Annapolis River Project.

Groundcover Establishment- Agricultural

Description

Groundcover is any vegetation that grows over an area that provides protection from erosion and drought, generally defined as the layer of vegetation below the shrub layer. Grasses, shrubs, and other herbaceous plants are generally used as groundcover.

Details

Groundcover can provide forage for livestock and minimize invasive plant growth.

Water quality can be improved by providing adequate groundcover like grasses and trees on idle and degraded land, and by planting vegetation along stream banks.

Cost

- Range Planting- $16.5-90/ac
- Forage & Biomass planting (Seeding of Native Grasses)- $58/ac

Parameter Treated

TSS

Operational Support Available

Texas Environmental Quality Incentives Program (EQIP) - US Department of Agriculture (USDA) & Natural Resources Conservation Service (NRCS)

Works Well with Other BMPs

Grazing Management Strategies

Alternative Shade Structures

Figure 2. Rural groundcover includes increasing grasslands. Photo by LandsofTexas.com.

Grazing Management Strategies

Description

Grazing management strategies are used to improve pasture productivity, increase livestock growth, and protect riparian areas (Lyons et al., 2000; Clark, 1998).

Details

Many strategies exist to help mitigate pollution effects of livestock and animals to riparian areas. Examples include deferred rotation grazing and management intensive grazing, among others.

Managed grazing can enhance farm productivity while decreasing input expenses, all while protecting environmental conditions (Macon, 2002; Herrick et al, 2002; Paine et al 1999; Berton, 1998).

Cost

Prescribed Grazing- $4.09/ac

Parameter Treated

Nutrients, Bacteria, TSS

Operational Support Available

Lonestar Healthy Streams Program (LHSP)- Texas Water Resources Institute (TWRI), AgriLife Extension Service, & Texas State Soil and Water Conservation Board (TSSWCB)

Texas Environmental Quality Incentives Program (EQIP) - US Department of Agriculture (USDA) & Natural Resources Conservation Service (NRCS)

Water Quality Management Plan (WQMP) TSSWCB

Works Well with Other BMPs

Fencing Riparian Areas

Alternative Shade Structures

Figure 3. Impacts by different grazing strategies. Photo by TAMU.

Figure 4. Pondless storm water waterfalls can be incorporated into stormwater drainage or rainwater catchment systems. Photo by BJL Aquascapes, LLC.

Comprehensive Stormwater Assessment

Description

A comprehensive stormwater assessment is an excellent way for an urban area to assess its stormwater needs and incorporate BMPs and LID management strategies into a system-wide plan. A Storm Water Pollution Protection Plan (SWPPP) identifies controls, unique features of urban areas, and specific pollution prevention measures designed to minimize pollutants.

Details

Stormwater pollution is untreated contaminated water that drains from streets and surrounding landscapes.

Stormwater collection systems gather the untreated stormwater runoff to be re-routed and treated before releasing into the creek, removing sediments, salts, nutrients, organics, and oil and grease. A receiving or re-routing pipeline as an integral part of a stormwater control network can be installed to reduce erosion, conserve water, and protect water quality.

Cost

$20,000-35,000/survey

Parameter Treated

Water Quantity, TSS, Oil & Grease

Operational Support Available

N/A

Works Well with Other BMPs

Figure 5. City storm drain. Photo by City of Bothell, WA.

Low-Impacts Development Strategies

Pet Waste Ordinance & Stations

Figure 6. Sign at Bluff Lake Park, Denver, CO. Photo by Stuart Macdonald, National Trails Training Partnership, 2009.

Description

Effective campaigns have been developed to reduce pet waste problems by increasing awareness throughout the community, using public pressure, establishing city ordinances and fines, and providing materials such as bag stations for pet owners along popular walkways. While increased trash from picking up pet waste and the use of plastic bags has been a concern in some communities, ecologically sound alternatives like compostable bags do exist. **Can be integrated into a Water Quality Protection Ordinance or passed as a stand-alone ordinance.**

Details

Improperly disposed-of pet wastes can and often do wash into nearby waterways and storm drains from runoff flows.

Degradation processes of waste within the water not only deplete oxygen levels and release ammonia, a toxic combination for aquatic species, but do not break down harmful microbes such as bacteria, viruses, and parasites.

Within a populated watershed, the combined effect of multiple pets and their waste can severely impact a water body and the community that uses it.

In addition, pet waste carries nutrients that contribute to nutrient build-up and pollution.

Cost

- Ordinance- formative
- Collection Stations- $620/station installation, $85 annual/station

Figure 7. Dog litter station. Photo by Ashley Park Homeowner's Association, Chandler, AZ.

Parameter Treated

Nutrients, Bacteria

Operational Support Available

N/A

Works Well with Other BMPs

Fencing Riparian Areas

URBAN & STORMWATER MANAGEMENT MEASURES

Xeriscaping/Nativescaping

Figure 8. A nativescaped garden in Salt Lake City. Photo by Wasatch Front Regional Council.

Description

A part of **Lawn, Garden, and Landscape Strategies,** xeriscaping and nativescaping promote irrigation water-use efficiency. Multi-step landscape designs and maintenance practices that use low-water-use, or drought-tolerant, vegetation as the primary element in residential and commercial landscapes to replace traditional turf grasses.

Details

Xeriscaping and Nativescaping can be used to intercept urban runoff pollution by absorbing overland flows that may contain contaminants as well as reduce the need for fertilizers, a source of nutrient (nitrogen and phosphorus) pollution.

Figure 9. Residential xeriscaping. Photo by Steve Dodrill, Oregon State University Agricultural Experiment Station, 2008.

Cost

$125-270 plus $0-1/ft^2

Parameter Treated

Water Quantity, Nutrients

Operational Support Available

N/A

Works Well with Other BMPs

Landscape Mulching

Water-Intensive Turf Grass Regulation and/or Ban

Biofiltration/Rain Garden- yard scale

Groundcover Establishment

Habitat Conservation Areas- urban

Figure 10. Certified Wildlife Habitat in an Austin backyard. Photo by Joe Lamp'l, 2010.

Habitat Conservation Areas

Description

Habitat conservation helps to conserve, protect, and restore habitat areas for wild plants, animals, and conservation-reliant species to prevent fragmentation (reduction in range) and extinction while balancing water supply and commercial and residential development. Habitat Conservation Plans (HCPs) can be regional in scale (example: Hays County HCP) or the size of a backyard.

Details

Using native plants and certain species, HCPs attract a variety of wildlife such as songbirds and can include edible plants like blackberries.

Creating backyard habitats by replacing lawns with native plants not only benefits wildlife but is easier to maintain. Programs such as the Texas Parks and Wildlife Texas Wildscapes Program and Best of Texas Backyard Habitats are excellent avenues for guidance and even offer certification.

Cost

- Average land value cost of purchase (~$8500/ac) or up to $750 annually to maintain.
- For urban, 1/2 ac = between $100-400 to establish
- Maintenance (urban) = <$50/year

Parameter Treated

Nutrients, Bacteria, TSS

Operational Support Available

Texas Wildscapes Program- Texas Parks and Wildlife Department (TPWD)

Best of Texas Backyard Habitats- Texas Parks and Wildlife Department (TPWD)

Works Well with Other BMPs

Lawn, Garden, and Landscape Strategies (all)

Nutrient & Fertilizer Management

Figure 11. Riparian forest buffer next to farm. Photo by NRCS.

Description

Excess nutrients easily washed into water bodies and streams after stormwater events can deleteriously alter aquatic ecosystems and contaminate drinking water supplies. Appropriate use of fertilizers, limited exposure of soils, and disposal or processing of livestock waste can help maintain healthy habitats. As a part of **Lawn, Garden, and Landscape Strategies,** Nutrient & Fertilizer Management should utilize educational outreach, regulations, certification programs, and monitoring efforts to emphasize a holistic approach.

Details

Site-specific pre-application planning and calculated dosing may require Education & Outreach initiatives.

Nutrient discharges from livestock should be biologically processed through bio-retention ponds or vegetative buffer areas.

Cost

Costs of educational outreach, certification programs, water quality monitoring, and any regulatory processes

Costs to livestock producers, businesses, and utilities are site-specific.

Parameter Treated

Nutrients, Bacteria, TSS

Operational Support Available

N/A

Works Well with Other BMPs

Agricultural Management Measures

Urban & Stormwater Management Measures

Non-Domestic Animal/Wildlife Management Measures

Sedimentation Management Measures

Figure 12. Fertilizer spreader. Photo by Danny Lipford.

URBAN & STORMWATER MANAGEMENT MEASURES

Water-Intensive Turf Grass Regulation and/or Ban

Figure 13. A Dallas home replaces a portion of its turf grass with xeriscaping. Photo by Dallas Morning News.

Description

A part of **Lawn, Garden, and Landscape Strategies,** water-intensive species require a lot of time, money, and resources to keep a carpet-like appearance. Several mixes of drought-adapted species exist in Texas that provide the same appearance and function of non-native monocultures without requiring high weed-management inputs or watering. Mixes of native turf grasses mean less mowing, less watering, and less weeding.

Details

Traditional lawns are often populated with non-native grasses that can be maintenance and water-intensive.

Water-intensive species such as St. Augustine succumb easily to pests and disease, while Bermuda grass can be invasive and requires constant mowing.

Cost

- Ordinance development + Cost to replace grass per household/ft^2
- Incentives = $20 for every 100 ft^2 replaced with natives
- Up to 1/2 staff person salary for project management/enforcement

Parameter Treated

Nutrients, Bacteria, TSS

Operational Support Available

N/A

Works Well with Other BMPs

Xeriscaping/Nativescaping

Landscape Mulching

Figure 14. This Buffalograss mix (L) grows slower and has fewer weeds than Bermudagrass (R). Photo by Lady Bird Johnson Wildflower Center.

Biofiltration/Rain Garden- yard scale

Groundcover Establishment

Habitat Conservation Areas- urban

Non-Domestic Animal/Wildlife Management Measures

Urban Wildlife Management – Deer

Description

Wildlife management for deer through Habitat Management (nutrition) and Population Management (age, genetics, population control) plays a key role in managing deer herd health. Quality habitat provides a healthy nutritional foundation and South Texas produces quality deer because of its incredible nutritional diversity.

Figure 15. Urban deer. Photo by The Durango Home Team.

Details

Local biologists can assist with a census as well as with building a management strategy for an urban area.

"Healthy habitat provides the ground work for good nutrition, cover from predators and hunters alike, and protection from the hot south Texas summers" (TPWD, 2012).

Supplemental feeding to increase densities above carrying capacity is strongly discouraged. Likewise, clearing too much brush, removing desirable species, disturbing saline soils, and spraying for weeds may have detrimental effects to the quality of local deer herds.

Although selective harvesting is an effective population management tool, greater success and management options can be made through quality habitat efforts. Managing buck:doe ratios, fawn production, deer densities, and age structure are used alongside selective harvesting.

Cost

Cost of Census + consequent solutions

Parameter Treated

Nutrients, Bacteria

Operational Support Available

Texas Parks and Wildlife Field Biologists

Works Well with Other BMPs

Habitat Conservation Areas

Figure 16. Deer in San Antonio suburbs. Photo by Texasdeerhunter.com.

Alternative Brush Control- Prescribed Burns

Figure 17. Prescribed burn in Texas. Photo by The Nature Conservancy.

Description

Prescribed burning is the application of fire to wildland fuel (grass & brush) under confined and controlled conditions. Using controlled burns as an alternative method of brush control is an effective technique to clear brush without destroying grass and brush root systems. When plants are living, these root systems keep fine sediments and topsoil in place. Using fire to clear brush and grass not only leaves those roots in place but contributes layers of ash and charred remains to act as aggregates and fertilizer.

Details

Native grasses and their root systems have evolved to survive wildfires in Texas; often this practice does not kill grass but rejuvenates growth.

Sediment, ash, charred remains, and leaf litter remain to help build soil and diminish sediment loss.

Prescribed burning diminishes destruction from wildfire and mimics natural processes.

Cost

$15-25/acre (excluding labor)

Figure 12. New growth after fire. Photo by Mary Ann Melton.

Parameter Treated

TSS

Operational Support Available

Texas Wildlife Association (TWA)

The Nature Conservancy (TNC)

Texas Forest Service (TFS)

US Department of Agriculture (USDA) & Natural Resources Conservation Service (NRCS)

Texas AgriLife Extension Service (TAMU)

Works Well with Other BMPs

SEDIMENTATION MANAGEMENT MEASURES

Riparian Buffer

Figure 19. Riparian Buffer. Photo by NRCS.

Description

Riparian buffers are areas of vegetation adjacent to water bodies that are installed and managed to maintain stream channel and shoreline integrity. Buffers reduce upland sources of pollution through entrapment and filtering activities. Buffers also help to absorb flood pulses and stabilize streambanks while providing habitat for aquatic species.

Details

Losses of riparian areas affect shoreline integrity, resulting in physically and chemically degraded streams and undermining development values.

Degraded riparian areas can lead to increased flooding, decreased aquatic life, and even soil and land loss.

Steps can be taken to preserve or enhance existing buffers; for example, delineating buffer boundaries and establishing management zones within the buffer or buffer performance augmentation through BMP pre-flow integration.

Cost

- EQIP Average- $130,000/river mile ($64,000-$350,000 range), or
- $70-170/acre

Parameter Treated

Nutrients, Bacteria, TSS, Oil & Grease, Velocity Flows/Flooding

Operational Support Available

Texas Environmental Quality Incentives Program (EQIP) - US Department of Agriculture (USDA) & Natural Resources Conservation Service (NRCS)

Works Well with Other BMPs

Habitat Conservation Areas- rural

Groundcover Establishment

Sedimentation Management Measures

Riparian Setbacks

Description

Riparian setbacks are a zoning tool used to maintain riparian functions such as flood control and groundwater protection. Riparian setbacks exclude development and related soil disturbing activities within a set distance from a stream. They provide a cost-effective alternative that minimizes the need for storm water infrastructure and engineered solutions to flooding, erosion, and water.

Figure 20. Healthy riparian zone Photo from watershedbmps.com

Details

Riparian setback ordinances should be developed with the assistance of technical experts.

May be addressed when stakeholders cover current rules on setbacks and the Sedimentation Management Measures, which include Riparian Buffers.

Cost

Unknown

Parameter Treated

Nutrients, Bacteria, TSS, Oil & Grease, Velocity Flows/Flooding

Operational Support Available

Unknown

Works Well with Other BMPs

Riparian Buffers

Karst Feature Protection Measures

Description

Karst recharge features offer a window to underlying aquifers and the interaction between surface and groundwater. NPS pollution can impact groundwater supplies, affecting local groundwater users and surface water features that depend on groundwater discharges. Land uses that contribute to change in local water tables such as well pumping, modification of natural drainage patterns, and inadequate stormwater management can accelerate sinkhole subsidence and flooding. With minimal effort, protecting Karst features can have far-reaching safety and water quality effects for the community and environment.

Details

- Should include karst formation mapping, local hazard mitigation planning, and comprehensive planning in relation to water quality and safety.
- Buffers around such features create setbacks for development, OSSFs/septic systems, wells, and appropriate stormwater-systems and should be determined by a certified geologist and/or engineer. Communities can develop Capital Improvements Planning to strategically steer development away from environmentally sensitive areas, or refer to Hays County Conservation Development Rules (Ch. 765).
- Vegetation within this buffer should be preserved to help filter nonpoint source contaminants and sediments entering features. Specialized metal grates can be installed to help prevent litter and for safety reasons while allowing native animals their historic access. Efforts by local certified divers can help clean-up efforts in such features that may have been used for dumping.

Cost

Gate feature & build park- $10,000-12,000 + monthly management fee ($100-300; includes regular inspections & mitigation for problems)

Parameter Treated

TSS, Nutrients, Bacteria

Operational Support Available

Texas Cave Conservancy

Hays County Incentives (stormwater quality management feature)

Figure 21. Fenced-off cave entrance. Photo by Monfort Bat Cave & Conservation Foundation, National Geographic Daily News.

SEDIMENTATION MANAGEMENT MEASURES

Hays County Conservation Development Rules (critical environmental features)

Works Well with Other BMPs

Land Conservation Measures

Rock Berms/Gabions in High Flow Areas

Description

Similar in design to weirs, rock berms or gabions can be used to slow stormwater runoff which allows suspended sediments to filter and settle. By installing them sequentially and spatially, the constructs mimic natural pool-and-riffle hydrology: as running water slows in each pool, fine sediments settle out, clarifying the water as it passes through. This effect is naturally occurring in gravel bed streams such as Cypress Creek, but can be maximized through forced constructs.

Details

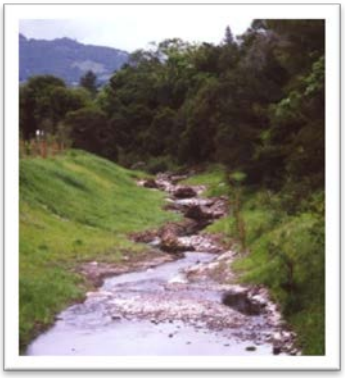
- Should only be used in upper or dry portion to diminish possible impacts to fish or aquatic life and recreational safety.
- May limit installation to more developed drainage areas so as not to impact aesthetic and visual aspects of the Creek.
- Beneficial to water table and nearby tree growth effects.
- Have the potential to alter flow regime.
- Sediments can eventually build up to help vegetate the structures.

Figure 22. Rock berm installations on dry drainage area. Photo by Lake Superior Streams: Grassed Swales.

Cost

$200/yard^3 (includes labor, stone, equipment, & baskets)

(Terra Aqua, Inc., 2012; installers)



Parameter Treated

TSS, Metals (minimizing erosive effects of storm pulses)

Operational Support Available

Hays Co. Transportation Dept.

TxDOT

Works Well with Other BMPs

Sedimentation Management Measures

Figure 23. Pool and riffle construct. Photo by California Dept. of Water Resources: Jolly Giant Creek- Arcata, CA.

SEDIMENTATION MANAGEMENT MEASURES

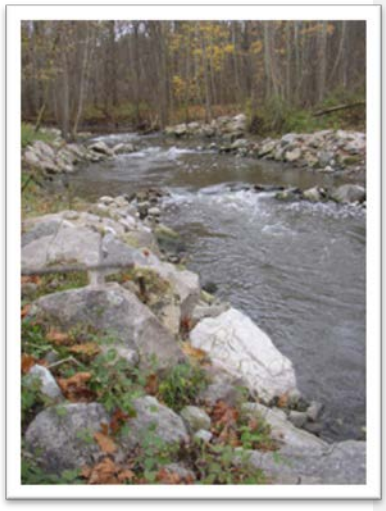
Rock Weirs (Cross-Vane)

Description

Weirs create a low-lying barrier across a water-body intended to slow the flow of water that acts as a grade-control structure. This create a 'falls'-type effect that increases oxygen in the downstream area and decreases the activity of the water upstream allowing suspended solids and sediments to settle. The combination of these effects decreases nutrient loads, suspended sediments/solids loads, and increases the dissolved oxygen content in downstream waters. While many weirs are large (relative to Cypress Creek) and require heavy engineering, other low-impact designs (Minimum Energy Loss weirs) can be constructed using limestone media with less invasive efforts.

Details

- Requires permits & engineers for proper installation (CWA Section 404 Permit & Nationwide Permit 27)
- Possible impacts to fish or aquatic life can be mitigated through design.
- Using local substrate/rocks can be more ecologically and economically beneficial than traditional weir constructs (such as v-notched wood planks or concrete).
- Beneficial to water table and nearby tree growth effects.
- Have the potential to alter flow regime.



Cost

$2,000-20,000/ installation (cost depends on size/amount of materials and labor needed; includes materials, labor, design, & permitting processes)

Parameter Treated

TSS, Nutrients

Operational Support Available

NRCS Water Resources Programs

Private restoration organizations (RiverBank Ecosystems, Inc.)

Works Well with Other BMPs

Sedimentation Management Measures

Figure 24. Constructed rock weir. Photo by EPA's Great Lake Areas of Concern: Black River.

Septic Replacement Program

Description

When maintenance cannot solve a septic or OSSF problem, the system might need to be replaced. A Septic Replacement Program can incentivize system owners to help pay for the cost while supporting local and county efforts to bring systems and waterways into compliance.

Details

A replacement program off-sets replacement costs while benefiting waterways as well as city, county, and local environmental health.

Assessment, guidelines, and resources (including alternatives) need to be coupled with funding and regulatory hurdles.

Cost

$3500/5500- 10,000 per system

Parameter Treated

Nutrients, Bacteria

Operational Support Available

N/A

Works Well with Other BMPs

Septic Maintenance Program

High-Performance Biofiltration Septic Alternative

Waste Water Treatment Plant

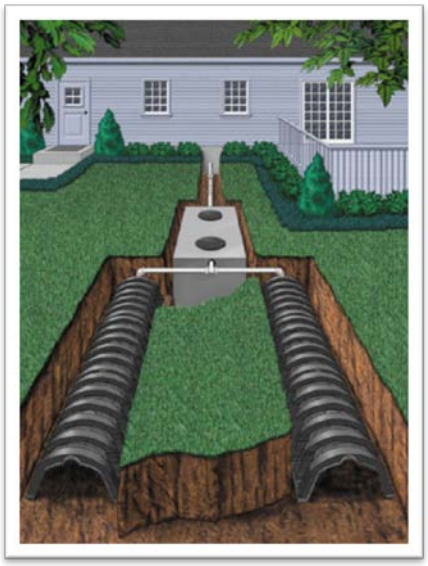


Figure 25. Traditional septic system. Photo by Genderationy.com.

Waste Water Treatment Plant- Wimberley

Description

The City of Wimberley has identified a need for a wastewater treatment plant (WWTP) within city limits and surrounding extra-territorial jurisdiction (ETJ). Efforts to establish this WWTP have been initiated; funding issues, however, have stalled this necessary service.

Figure 26. Wastewater treatment plant. Photo by Arcata Wastewater Treatment Plant & Wildlife Sanctuary, CA.

Details

Research and examination of hurdles to accomplishment is needed.

Funding opportunities need to be identified.

Design should allow for future tertiary-level modifications toward return effluent to accommodate increased population and associated loadings.

Cost

$4,330,000- Current price

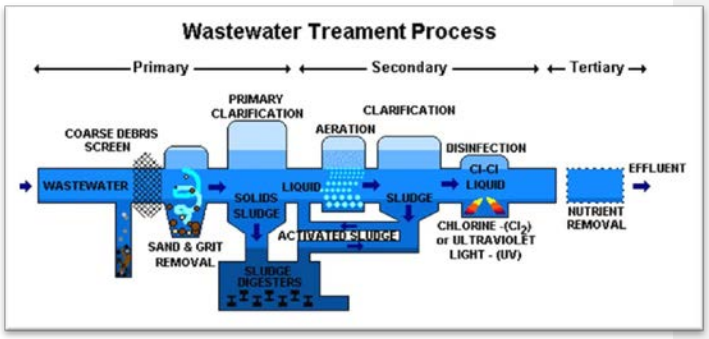


Figure 27. Primary, secondary, and tertiary treatment levels. Photo by The Water Treatments.

Parameter Treated

Nutrients, Bacteria

Operational Support Available

Guadalupe-Blanco River Authority (GBRA)

City of Wimberley

Texas Water Development Board (TWDB)

Works Well with Other BMPs

Septic Maintenance Program

Septic Replacement Program

High-Performance Biofiltration Septic Alternative

Low-Impact Development (LID)

Description

Low-Impact Development is a land-planning design approach that aims to preserve natural hydrologic regimes through innovative development while satisfying drainage and flood requirements. LID encompasses multiple design practices, focusing on new development and later shifts focus on existing developed areas to find opportunities for retrofitting (Pitzer, 2011). A LID strategy is basically a suite of development BMPs such as Rain Gardens or Dry Ponds that help guide new development and retrofit existing development to reach the development goals of an area.

Effects of LID include:

- Reduced flooding and erosion associated with urban runoff;
- Reduced 'heat island' effect;
- Enhance property values;
- Reduce costs of municipal stormwater infrastructure (Beckman, 2009).

Details

LID strategies help developers work with a community to achieve impact goals.

Cost

Varied

Parameter Treated

Water Quantity, Nutrients, Bacteria, Metals, TSS, Oil & Grease, Velocity Flow/Flooding

Operational Support Available

N/A

Works Well with Other BMPs

See listed LID Management Measures below.

Figure 3. Parking Lot Impervious Design Strategies can help reduce runoff as an element of Low-Impact Design. Photo by EPA.

Biofiltration/Rain Garden

Figure 4. Biofiltration/Rain Garden slows storm water runoff from parking lots. Photo by Temple–Villanova Sustainable Stormwater

Description

A part of **Lawn, Garden, and Landscape Strategies,** biofiltration systems incorporate bioretention systems with plants and organic media with a conventional filtration system. A bioretention system is a stormwater BMP that uses a biologically active filtration bed to remove contaminants. This variation has been studied and utilized within the Austin area with great success. **Can be development, residential or yard scaled.**

Details

Biofiltration provides an aesthetically-pleasing opportunity for pollutant uptake, especially nutrients, by vegetation.

The combination of the presence of plants and a submerged zone with a carbon-sourced filter helps remove pollutants from surrounding areas.

It is recommended to use this BMP in areas that are shaded, close to a water source, or within the wet portion of the watershed.

As biofiltration medium dries, gaps between soil particles increase due to cracks and macro-pore development and filtering efficiencies are reduced. Therefore, removal efficiencies may vary before and after a storm event (Limouzin, *et al.*, 2011).

Cost

$50,000/ 1 af pond (Brown & Schueler, 1997)

$125-270 plus $0-1/ft^2

Comment [MCC1]: Confirm #s and replace accordingly

Parameter Treated

Nutrients, Bacteria, TSS, Metals, Oil & Grease

Operational Support Available

N/A

Works Well with Other BMPs

Xeriscaping/Nativescaping

Parking Lot Impervious Design Strategies

Description

Establishing design strategies that reduce surface area of parking lots and integrate runoff treatment practices help to reduce adverse impacts while satisfying parking demand. Examples include:

- Redesigning building and parking lot layouts for efficiency.
- Number of spaces reflecting actual demand and designing additional 'spillover' parking areas to handle peak demand (incorporated with alternative paving techniques to increase infiltration).
- Converting parking lot islands to bio-retention areas.
- Disconnecting impervious areas with vegetated areas or other features
- Incorporating functional landscaping and runoff treatment practices installation, such as infiltration basins, filter strips, dry swales, or detention practices.

Details

Parking lots are efficient at concentrating and delivering pollutants to receiving waters, exacerbating erosion problems, and acting as a repository for pollutants like nutrients, trace metals, and hydrocarbons.

Cost

- Capital- $\$1.64/ft^2$
- Operation & Maintenance- $\$0.16/ft^2$

Parameter Treated

Nutrients, TSS, Oil & Grease

Operational Support Available

N/A

Works Well with Other BMPs

Permeable Pavement Options for Light Traffic Areas

Permeable Interlocking Segments

Porous/Pervious Pedestrian Walk-ways

Vegetative Filter Strips

Figure 30. Pervious Parking Lot. Photo credit unknown.

Porous/Pervious Pedestrian Walkways

Description

A part of **Permeable Pavement Options for Light Traffic Areas**, Porous or Pervious Pavement is concrete with a high percentage of void space that allows rapid percolation of liquids through the pavement. Operating as an infiltration system, it consists of specially formulated mixtures of Portland cement, uniform graded coarse aggregate, potable water, and air entraining agents. Its purpose is to reduce volumes and peak rates of runoff associated with urban-type development which in turn reduces potentials for sewer overflows, downstream channel erosion, and subsequent sediment pollution.

Details

Water quality is also improved by filtration and bacterial action.

Ground water recharge is aided.

Grid pavements serve the same purpose as pervious pavement by allowing water to percolate back into the soil during rain events. Grid pavements are not designed for areas with high traffic volumes or heavy equipment, but are excellent for residential driveways and overflow parking areas not used on a daily basis.

Maintenance involves periodic vacuuming or jet-washing to remove sediment from pores (US EPA, 1999).

Cost

$2-7 ft^2 + base material

Maintenance- Vacuum sweeping

Parameter Treated

Nutrients, TSS, Metals

Operational Support Available

N/A

Works Well with Other BMPs

Permeable Pavement Options for Light Traffic Areas

Permeable Interlocking Segments

Figure 31. Porous/pervious concrete vs. impervious concrete. Photo by Mike Kepka, San Francisco Chronicle.

Low-Impact Development Management Measures

Rainwater Harvesting Strategies

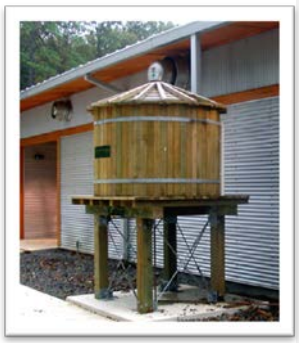


Figure 32. 700 gal rain cistern for the Camp Aldersgate Commons Building, Little Rock, AR. Photo by M.Littrell, Wilcox Group Architects.

Description

Rainwater harvesting, capture, collection, or reuse used as water quantity management strategy that can also be used for water quality management. Harvested rainwater can be used (and reused) in the household and with lawn, garden, and landscape activities. **Can be used to retrofit existing buildings or in new development as a Low-Impact Design Management Measure.**

Details

Utilizing rainwater alleviates groundwater level impacts by storing water for later use during drier times.

Groundwater abundance and associated spring flows are both directly related to surface water quality in the Cypress Creek watershed.

Without pumps, drip irrigation can be used on household properties, reducing runoff amounts that can contribute nutrient loadings to streams.

Rainwater also maintains a lower pH value, maintaining a slight acidity absent of urban chlorine treatment, conditions that native plants prefer.

Cost

- Generally $1/gallon
- Range of $2,500-30,000 + 2% of cost for annual maintenance
- Roof RO Structure (inc. rain gutters & downspouts) - $3.25/lin. ft.
- Rain Barrel= $50-75 + $5/year for maintenance

Parameter Treated

Water Quantity, TSS

Operational Support Available

Hays County Rainwater Harvesting Program

Works Well with Other BMPs

Low-Impact Design Management Measures

Water Conservation Program for Water Providers

Special Groundwater Management Area (SGMA) with Limited Drawdown

Figure 33. A rain barrel with sealed leaf/mosquito screen lid, spigot and connection to downspout. Photo by Lake County, IL Stormwater Mgmt. Commission

Low-Impact Development Management Measures

Vegetative Filter Strips

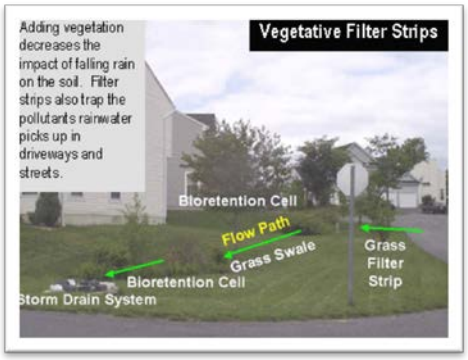


Figure 5. Vegetative Filter Strip. Photo by EPA.

Description

"Vegetative filter strips are areas of land with vegetative cover that are designed to accept runoff as overland sheet flow from upstream development" (EPA, 2005). Vegetative cover encourages sediment settling and pollution removal.

Details

Vegetated filter strips are more appropriate for overland sheet flow (water that flows across a graded or uniformly sloping landscape) and are not as productive at filtering concentrated flows.

Can be used as pre-treatment practices before water flows enter infiltration basins or trenches.

Should be used on smaller areas: as runoff flows over the ground surface, flow concentrates to form rivulets, moving too rapidly to be effectively treated by filter strips. Use slopes between 2-6% that do not remain wet and do not have high clay content which constricts infiltration for proper treatment.

Strips should be at least 25 ft. in length and should be designed with a pervious berm at the toe of the slope. Native perennial grasses should be used for vegetation.

Figure 6. Urban vegetative filter strip. Photo by Center for Neighborhood Technology.

Cost

- Average- $7/lin. ft. seed, $22/lin. ft. sod
- $13,000-30,000/acre- $0.30/ft^2 seed, $0.70/ft^2 sod ($3.20-7.41/m^2)
- Maintenance- $350/acre/year
- Native Filter Strip by EQIP- $255/ac

Parameter Treated Nutrients, TSS

Operational Support Available

Texas Environmental Quality Incentives Program (EQIP) - US Department of Agriculture (USDA) & Natural Resources Conservation Service (NRCS)

Water Quality Management Plan (WQMP) - TSSWCB

Works Well with Other BMPs

Low-Impact Design Management Measures

Low-Impact Development Management Measures

LID Sedimentation Measures

Description

Various physical installations and techniques can be used to reduce sedimentation problems in waterways. When utilized as a LID strategy, sedimentation measures can be required in new development processes as well as re-development or retrofitting efforts.

LID Sedimentation Measures include sub-BMPs:

- Groundcover Establishment
- Erosion Control Fabric
- Landscape Mulching
- Tree Protection
- Engineered Swales

Details

Costs associated with sedimentation measures can increase overall development costs as well.

Benefits include diminished flooding effects in waterways, increased aquatic biodiversity, increased property values, and increased riparian aesthetics after development is completed.

Cost

See sub-BMPs listed above

Parameter Treated

TSS

Operational Support Available

Cities and County

Groundcover Establishment- Urban

Description

A part of **Lawn, Garden, and Landscape Strategies,** groundcover is any vegetation that grows over an area that provides protection from erosion and drought, generally defined as the layer of vegetation below the shrub layer. Vines, grasses, shrubs, moss, and other herbaceous plants are generally used as groundcover.

Figure 36. Urban landscaping groundcover. Photo by Bonnie Plants.

Details

Groundcover can be an aesthetically pleasing method to suppress weed growth and can consist of non-living substances (for example, plastic sheeting or landscaping fabric).

Water quality can be improved by providing adequate groundcover like grasses and trees on idle and degraded land, and by planting vegetation along stream banks.

Cost

- Sod= $0.08-0.60/ft^2
- Seed= $25/lb or $120/5lb, @ 1lb/1000ft^2 for short mix
- $1-2/ft^2 soil prep
- Other groundcover plants= $5-7/ft^2

Figure 37. Urban groundcover. Photo by Harvard University.

Parameter Treated

TSS

Operational Support Available

Texas Environmental Quality Incentives Program (EQIP) - US Department of Agriculture (USDA) & Natural Resources Conservation Service (NRCS)

Works Well with Other BMPs

Grazing Management Strategies

Alternative Shade Structures

Erosion Control Fabric

Description

A part of **LID Sedimentation Measures**, Erosion control fabrics address surface erosion by keeping soils in place that have been removed of vegetation. Erosion control fabrics prevent slope erosion, minimize stream channel scouring, and help stabilize shorelines until vegetation can be established.

Details

Photo- or Biodegradable fabrics can be left on the ground while synthetic fabrics that need to be removed can disturb new vegetation growth.

Continuous contact with soil is necessary and can be achieved on rocky soils with landscaping staples or biodegradable stakes (corn-based or wood).

Native vegetation seeds can be sewn underneath fabric.

Care should be taken to minimize wildlife entanglement.

Cost

- $35/880 ft^2 (4'x220' roll) or $0.04/$ft^2$
- Price does not include labor

Parameter Treated

TSS

Operational Support Available

Cities and County

Works Well with Other BMPs

LID Management Measures

Groundcover Establishment

Wattles

Landscape Mulching

Straw Bale Barriers

Figure 7. Jute erosion control fabric is coupled with straw wattles to minimize sedimentation. Photo by US Silt & Site Supply.

Landscape Mulching

This BMP is effective for both landscaped areas and pathways.

Description

A part of **Lawn, Garden, and Landscape Strategies,** mulch is a collection of decayed detritus, such as leaves, straw, or chipped wood, and is spread on the ground to protect the roots of newly planted plants. As mulch decomposes, it provides organic matter prompting soil to aggregate, increasing aeration, biological activity, moisture retention, and improving soil structure (Rakow, 2010).

Details

Mulches perform three basic functions: reduce soil loss, suppress weeds, and protect against temperature extremes.

Mulch also helps break the impact of water droplets, reducing soil erosion from water impact and increasing infiltration of moisture into underlying soils.

Figure 8. Stone walkway through mulched landscaping. Photo by First Light Landscaping, Cannon Falls, MN.

- Apply to pathways in parks, habitat areas, neighborhoods, and other public spaces.
- Apply to all ground in new development that is not covered with vegetation.
- Vegetation or edging-barrier should be used at the toe of covered slopes to discourage mulch loss during rains.

Cost $10-19/yard bulk

Parameter Treated TSS

Operational Support Available

Hays County

Works Well with Other BMPs

Xeriscaping/Nativescaping

Water-Intensive Turf Grass Regulation and/or Ban

Biofiltration/Rain Garden- yard scale

Groundcover Establishment

Habitat Conservation Areas- urban

Figure 40. Mulched pathway. Photo by Riverview Stone Landscape Supply.

Engineered Swales

Description

Closely resembling bioretention cells, detention ponds, or biofiltration/rain gardens, swales are basically broad shallow open ended ditches or channels. The most common application of swales is generally alongside roads, streets, and highways. They are often lined with grasses and wildflowers which help the swales retain pollutants and clean stormwater runoff from the roads. Vegetated swales are considered Green Infrastructure since they take the place of curb & gutter systems.

- Designed to slow runoff, promote infiltration, and filter out pollutants & sediments.
- Vital part of integrated stormwater management.
- More cost effective than conventional curb & gutter drainage systems.
- Needs regular mowing and should incorporate rock berms/gabbions (sometimes called "check dams") when possible.
- Can be a requirement or highly-suggested practice for new development.

Cost

- $4.50-8.50/lin ft w/ seed
  $15-20/lin ft w/ sod
  Annual maintenance = $1/lin ft seed, $2/lin ft sod (does not include clearing, leveling, filling, if required) (Lichten, 1997)
- $10/lin. ft. installation
  $200/year for maintenance (900 ft^2 veg swale)
  (CWRA, 2008)
- $12,000/acre (UNHSC, 2007)

Figure 41. Dry swale. Photo by Virginia DCR Stormwater Design Specification Manual, No. 10.

Parameter Treated

TSS, Nutrients, Metals, Oil & Grease, & Turbidity

Operational Support Available

N/A

Works Well with Other BMPs

Vegetated Filter Strips

Weirs

Rock Berms/Gabbions

Groundcover Establishment- Urban

Tree Protection

Description

A tree protection guideline, requirement, or ordinance aims to protect, conserve, and enhance existing trees and natural landscape that are healthy and contribute to the community's and ecology's well-being. Preservation of trees contributes to overall quality of life and environment, including air and water quality, the health of aquifers, river corridors, and property values. More specifically, healthy trees contribute to stormwater management efforts, erosion and dust control, noise reduction, and wildlife habitat.

Details

- Can require a landscape plan to obtain a building permit.
- Can delineate between acceptable and unacceptable trees (i.e. Native Oaks vs. Texas Cedar (*Juniperus ashei*) or Ligustrom).
- Can require protection standards such as fences or frames around preserved trees during construction, limits on excavation or soil impaction within a protective zone, or replacement of trees.
- Incentive-based plans may be used to encourage preservation of existing trees in development or existing communities.
- Contributes to healthier and more balanced deer populations and wildlife diversity.

Cost

$660-$3,500 average cost of selective thinning with some protection measures such as barricades

(Seila and Anderson, 1982; adjusted for inflation)

Parameter Treated

TSS, Nutrients, Water Quantity, Flow

Operational Support Available

TreeFolks- Various classes, workshops, and programs

Texas Master Naturalists

Works Well with Other BMPs

Habitat Conservation Areas- Urban & Rural

Riparian Buffers, Landscape Mulching

Urban Wildlife Management- Deer

Figure 42. Protected tree. Photo from Austin Parks Foundation Blog.

Water Quantity & Other Management Measures

Rainwater and Soil Moisture Sensor Incentive

Description

Rainwater and soil moisture sensors turn home and business automatic irrigation systems on and off, minimizing water waste. Rain sensors detect rainfall when it occurs and can be wired or wireless. Soil moisture sensors serve a similar purpose by inhibiting unnecessary irrigation by preventing sprinkler systems from watering well irrigated soil. These sensors have proven to be a cost-effective strategy to make landscape watering more efficient.

Details

High-end sensors can be cost prohibitive.

Figure 43. Rain sensor. Photo by Practically Green.

Cost

$13-200, depending on level of technology

Parameter Treated

Water Quantity

Operational Support Available

Clean Water State Revolving Fund

Works Well with Other BMPs

Water Conservation Program for Water Providers

Rainwater Harvesting Strategies

Lawn, Garden, and Landscape Strategies

Special Groundwater Management Area or Zone

Description

The formation of a Special Groundwater Management Area or Zone (SGMA/Z) would allow groundwater within the Cypress Creek watershed to be managed within more sensitive parameters than Groundwater Management Area (GMA) 9's Desired Future Condition (DFC). Spring flows within this watershed cease to flow after a 5 ft. drawdown, while GMA 9's DFC allows an average 30 ft. drawdown over 50 years. Because surface waters within this watershed are dependent on spring flows, and because residents, businesses and water providers within the basin all rely solely on groundwater for use, a SGMA/Z should be formed and managed based on the 5 ft. drawdown sensitivity described above.

Figure 44. Cypress Creek basin and topography. Map by RSI.

Details

Investigation into legal and funding issues to form the Cypress Creek SGMA/Z should be initiated by stakeholders in partnership with the residing groundwater authority, Hays-Trinity Groundwater Conservation District (HTGCD).

Every effort on part of HTGCD should be given to work closely and effectively with stakeholders within the basin to accomplish water quality and quantity goals through conjunctive management.

Current water quality goals cannot be attained without sufficient water quantity flows.

Cost

Unknown

Parameter Treated

Water Quantity

Operational Support Available

Hays-Trinity Groundwater Conservation District (HTGCD)

Local, regional, and state organizations, agencies, and stakeholders

Works Well with Other BMPs

Watershed Coordinator

Water Conservation Program for Water Providers

Description

Figure 45. Incentives for water retrofits can be offered in a conservation program. Photo by Brampton Guardian.

A regionally customized Water Conservation Program for water providers within the basin should be established to not only conserve water but to help meet the community half-way on conservation efforts. Unique water problems and ongoing efforts are specific to the Hill Country area. A publicly-available and regional water conservation program should include:

- Supply side measures,
- Leak audit efforts,
- Public involvement in local and county water conservation strategies,
- Supportive presence at local events, charities, and water conservation coordination efforts,
- Publicly-available increased drought contingency plan, and
- Publicly-available funding strategies for measures listed above.

Details

A Water Conservation Program for Water Providers regionally customized creates goodwill, shows matching effort to solve regional water problems on behalf of the provider, and shows fiscal and resource management responsibility.

Cost

$30,000-60,000/year + benefits- Cost of Water Conservation & Outreach Coordinator (could also be an absorbed position)

Parameter Treated

Water Quantity

Operational Support Available

Alliance for Water Efficiency, American Water Works Association and Texas Water Development Board

Works Well with Other BMPs

Water Conservation Pricing Strategies, Watershed Coordinator

Water Conservation Pricing Strategies

Description

Conservation pricing strategies utilize price signals as incentive for reducing water consumption. These strategies promote economically-efficient water use by individual consumers: incremental pricing structures and water meters increase conservation behavior. Tiered-pricing structures or increasing block rates can decrease overall water consumption without decreasing revenues if implemented properly.

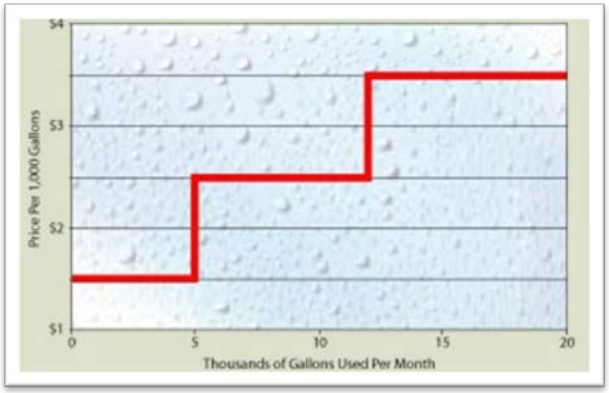


Figure 46. Block rate structure. Photo by Southwest Florida Water Management District.

Details

Tiered-pricing structures can set incremental prices sufficiently high to offset possible financial losses realized from lower water-use level prices that are set below average cost.

Cost

Cost of water supplier staff allocation

Parameter Treated

Water Quantity

Operational Support Available

Alliance for Water Efficiency, American Water Works Association and Texas Water Development Board

Works Well with Other BMPs

Water Conservation Program for Water Providers

Watershed Coordinator

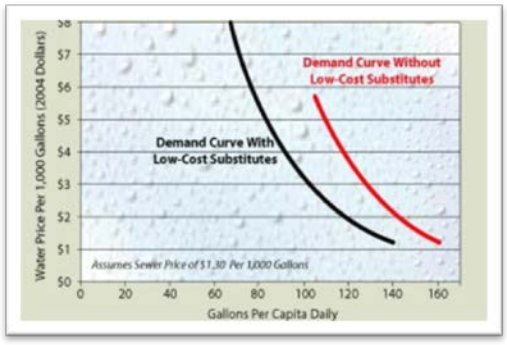


Figure 47. Impact of changes in water pricing. Photo by Southwest Florida Water Management District.

Watershed Coordinator

Figure 48. Cypress Creek downstream from Jacob's Well. Photo by RSI.

Description

A Watershed Coordinator position is necessary to direct implementation of the WPP as well as to secure funding and coordinate education and outreach efforts. Monitoring efforts will need to be coordinated to analyze BMP effectiveness and to ensure water quality compliance within the basin.

Details

Coordinator will need knowledge and experience in project administration and tracking, watershed assessments, water quality monitoring and/or modeling, watershed protection management practices, obtainment and management of grant funding, stakeholder facilitation, public outreach, information dissemination (web, newspapers, radio, events) and volunteer coordination.

Skills in working with local, state, and federal agencies, organizations, technical writing, and experience in leadership are a requirement.

Cost

$60,000/year including benefits.

Parameter Treated All

Operational Support Available

Texas State Soil and Water Conservation Board (TSSWBC)

Texas Commission on Environmental Quality (TCEQ)

US Environmental Protection Agency (US EPA)

Texas Water Development Board (TWDB)

River Systems Institute (RSI)

State, local, and municipal governments

Works Well with Other BMPs

Water Conservation Program for Water Providers

Water Quantity & Groundwater Protection

Rock Weirs (Cross-Vane)

Description

Weirs create a low-lying barrier across a water-body intended to slow the flow of water that acts as a grade-control structure. This create a 'falls'-type effect that increases oxygen in the downstream area and decreases the activity of the water upstream allowing suspended solids and sediments to settle. The combination of these effects decreases nutrient loads, suspended sediments/solids loads, and increases the dissolved oxygen content in downstream waters. While many weirs are large (relative to Cypress Creek) and require heavy engineering, other low-impact designs (Minimum Energy Loss weirs) can be constructed using limestone media with less invasive efforts.

Details

- Requires permits & engineers for proper installation (CWA Section 404 Permit & Nationwide Permit 27)
- Possible impacts to fish or aquatic life can be mitigated through design.
- Using local substrate/rocks can be more ecologically and economically beneficial than traditional weir constructs (such as v-notched wood planks or concrete).
- Beneficial to water table and nearby tree growth effects.
- Have the potential to alter flow regime.
- To be used in dry portions of the watershed

Cost

$2,000-20,000/ installation (cost depends on size/amount of materials and labor needed; includes materials, labor, design, & permitting processes)

Parameter Treated

TSS, Nutrients

Operational Support Available

NRCS Water Resources Programs

Private restoration organizations (RiverBank Ecosystems, Inc.)

Works Well with Other BMPs

Sedimentation Management Measures

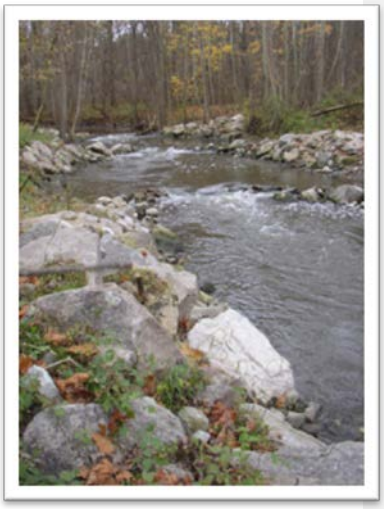


Figure 49. Constructed rock weir. Photo by EPA's Great Lake Areas of Concern: Black River.

Karst Feature Protection Measures

Description

Karst recharge features offer a window to underlying aquifers and the interaction between surface and groundwater. NPS pollution can impact groundwater supplies, affecting local groundwater users as well as surface water features that depend on groundwater discharges. Land uses that contribute to change in local water tables such as well pumping, modification of natural drainage patterns, and inadequate stormwater management can accelerate sinkhole subsidence and flooding. With minimal effort, protecting Karst features can have far-reaching safety and water quality effects for the community and environment.

Details

- Should include karst formation mapping, local hazard mitigation planning, and comprehensive planning in relation to water quality and safety.
- Buffers around such features create setbacks for development, OSSFs/septic systems, wells, and appropriate stormwater-systems and should be determined by a certified geologist and/or engineer. Communities can develop Capital Improvements Planning to strategically steer development away from environmentally sensitive areas, or refer to Hays County Conservation Development Rules (Ch. 765).
- Vegetation within this buffer should be preserved to help filter nonpoint source contaminants and sediments entering features. Specialized metal grates can be installed to help prevent litter and for safety reasons while allowing native animals their historic access. Efforts by local certified divers can help clean-up efforts in such features that may have been used for dumping.

Cost

Gate feature & build park- $10,000-12,000 + monthly management fee ($100-300; includes regular inspections & mitigation for problems)

Parameter Treated TSS, Nutrients, Bacteria

Operational Support Available

Texas Cave Conservancy

Hays County Incentives (stormwater quality management feature)

Hays County Conservation Development Rules (critical

Figure 50. Fenced-off cave entrance. Photo by Monfort Bat Cave & Conservation Foundation, National Geographic Daily News.

environmental features- mentioned in definition only)

Works Well with Other BMPs

Land Conservation Measures

SEDIMENTATION MANAGEMENT MEASURES

Rock Berms/Gabions in High Flow Areas

Description

Similar in design to weirs, rock berms or gabions can be used to slow stormwater runoff which allows suspended sediments to filter and settle. By installing them sequentially and spatially, the constructs mimic natural pool-and-riffle hydrology: as running water slows in each pool, fine sediments settle out, clarifying the water as it passes through. This effect is naturally occurring in gravel bed streams such as Cypress Creek, but can be maximized through forced constructs.

Details

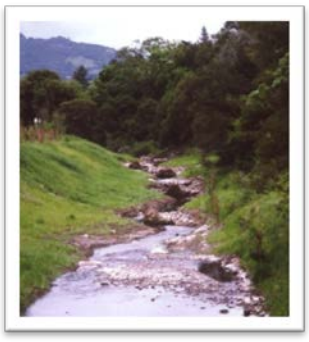
- Should only be used in upper or dry portion to diminish possible impacts to fish or aquatic life and recreational safety.
- May limit installation to more developed drainage areas so as not to impact aesthetic and visual aspects of the Creek.
- Beneficial to water table and nearby tree growth effects.
- Have the potential to alter flow regime.
- Sediments can eventually build up to help vegetate the structures.

Figure 51. Rock berm installations on dry drainage area. Photo by Lake Superior Streams: Grassed Swales.

Cost

$200/yard^3 (includes labor, stone, equipment, & baskets)

(Terra Aqua, Inc., 2012; installers)



Parameter Treated

TSS, Metals (minimizing erosive effects of storm pulses)

Operational Support Available

Hays Co. Transportation Dept., TxDOT

Figure 52. Pool and riffle construct. Photo by California Dept. of Water Resources: Jolly Giant Creek- Arcata, CA.

Works Well with Other BMPs

Sedimentation Management Measures

LAND CONSERVATION MANAGEMENT MEASURES

Conservation Easements

Description

A flexible and effective means of conservation to protect private property is the conservation easement: a voluntary legal agreement ensuring maintenance of a property according to the landowner's wishes. An agreement is held between the "grantee" and the landowner, who voluntarily restricts certain uses to protect specific aspects of the property. The grantee can be a qualified conservation land trust or governmental entity. Conservation easements can be used as a tool to adjust a property's value while preserving a landowner's desired rights and benefiting Texas' natural areas.

- Individually crafted to reflect unique qualities of land/ needs of the landowner.
- Assists landowners to protect wildlife/ecology, farm/ranching practices, open spaces/scenic areas, historic buildings or archaeological sites.
- Landowner retains legal title to property & determines which land uses to continue or restrict (for example, to subdivide, develop, change use, or manage resources).
- Landowner grants grantee the right to periodically monitor terms of easement.
- Property with a conservation easement can be bought, sold, and inherited, but easement is still tied to land.
- Consultation with a knowledgeable accountant or tax professional is advised.

Cost

- Average annual stewardship costs $780/easement ($430-$1500 range) (PTLA, 2011)
- ~$27,500 total estimated up-front cost (MLT, 2009)

Parameter Treated

Water Quantity

Operational Support Available

Texas Land Trust Council

Hill Country Alliance, The Nature Conservancy, Ducks Unltd., Hill Country Land Trust, and other NGO conservation organizations

Grassland Reserve Program- USDA & NRCS

Wetlands Reserve Program- USDA & NRCS

Guadalupe-Blanco River Trust

Hays County Conservation Development Rules (Ch. 765)

Works Well with Other BMPs

Agricultural Management Measures

Low-Impact Development Management Measures

Wildlife Management Measures

Sedimentation Management Measures, Water Quantity & Other Management Measures

LAND CONSERVATION MANAGEMENT MEASURES

Purchase of Development Rights (PDRs)

Description

Purchase of Development Rights (PDR) compensates landowners for development value of the property. "Under a PDR, a farmland owner voluntarily sells the development rights (known as a conservation easement) to a government agency or private land trust and receives compensation in return for the restrictions placed on the land. The farmer retains title to the land and can sell or pass along the farm, although the use of the land is limited to farming and open space." (Daniels, 1998) As urban areas grow, development steadily displaces natural habitats and scenic open spaces. Land fragmentation is a significant factor affecting Texas' landscape and high estate taxes often force property heirs to sell parts of all of a family's property.

- Amount available to purchase the easement is often less than the value of the easement. Amount of benefit is generally the value of the conservation easement less the amount paid.
- Includes permanent or time-restrictive easements.
- Some may require financial or value match.
- Added benefit is prevention of using existing groundwater supplies for newly developed municipal supply.
- Consultation with a knowledgeable accountant or tax professional is advised.

Cost

Dependent on program or easement agreement

Parameter Treated

Water Quantity (additionally prevents water quality impacts associated with development/increased impervious cover)

Operational Support Available

Farm & Ranch Lands Protection Program- USDA NRCS

Wetlands Reserve Program- USDA NRCS

Grassland Reserve Program- USDA NRCS

Farm & Ranch Lands Conservation Program- Texas GLO

Works Well with Other BMPs

Urban & Stormwater Management Measures

Agricultural Management Measures

Figure 53. Rangeland under a PDR. Photo by Charlottesville Tomorrow.

Land Conservation Management Measures

Landowner Incentive Program

Figure 54. Scenic view of Texas Hill Country. Photo by Van Chaplin.

Description

Landowner Incentive Programs (LIPs) offer funding opportunities to assist private landowners to implement natural resource conservation practices on their land. LIPs focus on projects that aim to create, restore, protect, and enhance habitat for at-risk or endangered species. LIPs also support activities that positively affect riparian areas and watersheds. Through cost-sharing, a percentage of project costs are covered by the sponsoring agency while the landowner can contribute through various forms of matching.

- No acreage restrictions.
- Projects with greatest benefit to targeted watersheds, those offering long-term protection and monitoring, and those with higher-than-minimum landowner contribution receive priority.
- Many projects funded under this program qualify as approved BMPs in the Cypress Creek.
- Consultation with a knowledgeable accountant or tax professional is advised.

Cost

- <$5,000 to >$50,000
- Cost share minimum of 25% (in-kind labor, materials, monetary, etc.)
- Optional non-federal sources may supplement federal funds

Parameter Treated

Water Quantity (additionally prevents water quality impacts associated with development/increased impervious cover)

Operational Support Available

Traditional Statewide LIP Funding Series- TPWD, Community Riparian Enhancement- US FWS & TPWD

Works Well with Other BMPs

Agricultural Management Measures

Low-Impact Development Management Measures

Wildlife Management Measures

Sedimentation Management Measures, Water Quantity & Other Management Measures

Land Conservation Management Measures

Cypress Creek Land Trust

Description

"A land trust is a local, regional, or national charitable organization that protects land for its natural, recreational, scenic, historic, or productive value." (TLTC 2010) The land trust could be the holder of the conservation easements or they could hold real property (see p.36 on Texas Land Trust Council Conservation Easement Guidebook). An abundance of parcels 10 acres or less presents a challenge to traditional land trusts; a small trust that specifically aims to bundle smaller acreages into larger easements may be more feasible and offer a more customized and local service for landowners within the basin.

- Works with landowner to customize terms of conservation easement while meeting landowner's personal and financial goals.
- Trust is responsible for monitoring property and ensuring the terms of the agreement are being followed through scheduled (usually annual) assessments.
- Can work with landowner to create flexible goals and objectives (important for agricultural or recreational uses, or invasive species issues).

Cost

$70,000+/year (Cost of employing director position) + cost of startup (filing & legal fees)

Parameter Treated

Water Quantity (additionally prevents water quality impacts associated with development/increased impervious cover)

Operational Support Available

Texas Land Trust Council

Works Well with Other BMPs

Conservation Easements

Purchase of Development Rights

Landowner Incentive Program

Figure 55. Dunn Ranch-Wildlake, Napa County. Photo by Napa County Land Trust & Auberge Resorts.

Groundwater Protection Plan