

## Appendix A – Technical Design Guidance

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Technical guidance for each Best Management Practice (BMP) refers to a local established guide and includes further additions and deletions to tailor the practice for this program. Additions and deletions are made to simplify the process or customize it for the Upper Guadalupe River watershed.

### Target Volume Calculation:

The **Treatment Worksheet** can calculate Target Volume for individual drainage areas and the entire project. The following equation is used to calculate the Target Volume for each impervious drainage area.

$$\text{Target Volume (cubic feet)} = \text{drainage area (square feet)} \times \text{treatment rainfall (feet)} \text{ [Equation 1]}$$

Where:

Target Volume	= target volume to detain and treat
drainage area	= impervious area that flows to the treatment area
treatment rainfall	= 85-90% total average annual rainfall volume in storms up to this depth
depth	= 1.5"/12" = 0.125 ft

Example: What is the target volume for a roof with an area of 1,250 square feet?

$$\text{Target Volume} = 1,250 \text{ square feet} \times 0.125 \text{ feet} = \mathbf{156.25 \text{ cubic feet}}$$

### Bioretention

Bioretention areas are shallow basins that capture, hold and infiltrate stormwater runoff. Bioretention areas contain a forebay or pretreatment area to slow flow and capture large particles of sediment for easy maintenance. To infiltrate stormwater runoff, bioretention areas must have soils with a minimum infiltration rate. In areas where soils are not able to infiltrate at the minimum rate, the soils must be replaced using an approved bioretention soil mix. Bioretention areas are typically planted with native plants selected based on location within the bioretention area. Bioretention areas may have underdrains depending on local soils and other conditions. For the purposes of this program bioretention also includes bioswales which are linear in shape.

Follow design process from [San Antonio River Basin Low Impact Development Technical Guidance Manual 2<sup>nd</sup> Edition](#). (Design Process – Page B-8)

Additions and Deletions:

- Design Step 1 – Determine BMP Treatment Volume using UGRA Target Volume (Equation 1)
- Refer to reference design in Appendix B of this document

Use the following equation to calculate Treated Volume for bioretention.

$$\text{Treated Volume (cubic feet)} = A \text{ (square feet)} \times \text{Deq (feet)} \text{ [Equation 2]}$$

Where:

Treated Volume	= volume of stormwater treated
A	= area of bioretention basin (bottom)
Deq	= equivalent depth = ponding depth (feet) + [depth of bioretention soil (feet) x porosity] + [depth of drainage rock (feet) x porosity] = (D <sub>surface</sub> ) + (n <sub>media</sub> x D <sub>media</sub> ) + (n <sub>gravel</sub> x D <sub>gravel</sub> )
n <sub>media</sub>	= 0.35 for bioretention soil and sand
n <sub>gravel</sub>	= 0.4 for gravel/stone
D <sub>media</sub>	= depth of bioretention soil + sand
D <sub>gravel</sub>	= depth of drainage gravel/stone

## Permeable Pavement

Follow design process from [San Antonio River Basin Low Impact Development Technical Guidance Manual 2<sup>nd</sup> Edition](#). (Design Process – Page B-48)

Additions and Deletions:

- *Design Step 1* – Determine BMP Treatment Volume using UGRA Target Volume (Equation 1)
- *Design Step 2* – Fully lined systems are only required if sited near karst geology. Maximum drainage area to permeable area ratio 2:1. For example 200 square feet of concrete parking can drain to a permeable area of 100 square feet resulting in 300 square feet used for calculating Target Volume.
- *Design Step 3* – Eligible materials for this program include: Permeable interlocking concrete pavers (PICP), concrete grid pavers, plastic grid systems and pervious concrete. Porous asphalt is NOT eligible.
- Refer to reference design in Appendix B – Example Designs of this document.

Use the following equation to calculate Treated Volume for permeable pavement.

$$\text{Treated Volume (cubic feet)} = A \text{ (square feet)} \times \text{Deq (feet)} \text{ [Equation 3]}$$

Where:

Treated Volume	= volume of stormwater treated
A	= area of bioretention basin (bottom)
Deq	= equivalent depth
	= [depth of drainage rock (feet) x porosity] + [depth of sand (feet) x porosity]
	= (n <sub>gravel</sub> x D <sub>gravel</sub> ) + (n <sub>media</sub> x D <sub>sand</sub> )
n <sub>sand</sub>	= porosity, 0.35 for sand
n <sub>gravel</sub>	= porosity, 0.4 for drainage gravel/stone
D <sub>sand</sub>	= depth of sand (feet)
D <sub>gravel</sub>	= depth of drainage gravel/stone (feet)

## Rainwater Harvesting / Cistern

Rainwater harvesting is the collection and retention of stormwater runoff from impervious surfaces, typically roofs. Collected runoff is stored temporarily in an appropriate receptacle, either above or below ground. Collected runoff can be used for irrigation or slowly released to an area where it can infiltrate. Careful consideration is taken to make sure receptacles have appropriate foundations and are equipped to prevent the spread of disease vectors, especially mosquitos.

Follow design process from [San Antonio River Basin Low Impact Development Technical Guidance Manual 2<sup>nd</sup> Edition](#). (Design Process – Page B-137)

Additions and Deletions:

- *Design Step 1* – Determine BMP Treatment Volume using UGRA Target Volume (Equation 1)
- *Design Step 2* – Concrete foundation is required for cisterns exerting greater than 2000 pounds per square foot. All foundations must be reviewed by an appropriate design professional which may require a geotechnical evaluation to determine the structural load capacity of the soil. Foundation design must be part of signed and sealed construction plans.
- *Design Step 3* – The Water Quality Volume must be released to a vegetated area meeting the requirements outlined in Table B-9-2 on page B-149. If the Water Quality Volume is used for irrigation purposes on a system with an irrigation controller, then it may be held and used during scheduled irrigation cycles, otherwise the Water Quality Volume must be released to an appropriate vegetated area over a period of 2 – 6 days (48 – 144 hours). The Water Quality Volume must never be held more than 14 days after the last rain event to provide storage for future rain events.
- Refer to reference design in Appendix B – Example Designs of this document

Use the following equation to calculate Treated Volume for Rainwater Harvesting.

*Treated Volume (cubic feet) = volume of cistern [Equation 4]*

Where:

Treated Volume = volume of stormwater treated

Volume of cistern = stated volume of cistern

## Vegetated Filter Strip

A vegetated filter strip is a vegetated area that receives runoff from an adjacent impervious area, usually a street or parking lot. The drainage area must be level and provide surface flow perpendicular to the edge draining to the vegetated filter strip. The vegetation in the strip can be turf or a combination of native plants if the plant size and placement does not concentrate flow of runoff in the filter strip. There are limitations to slope and dimensions; refer to design reference.

Follow design process from [Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices](#) (Design Process – Page 3-55)

Additions and deletions:

- Temporary Vegetated Filter Strips are not eligible for this rebate program.

Vegetated filter strips infiltrate and treat some stormwater. This program assumes 60% of the generated volume is considered treated. Use the following equation to calculate Treated Volume.

*Treated Volume (cubic feet) = drainage area (square feet) x treatment rainfall (feet) x 60% [Equation 5]*

## Riparian Buffer

A riparian buffer includes the soil, rocks, and vegetation located on the bed and banks of creeks, streams, rivers and lakes. This area functions to filter stormwater as it drains to the waterbody. Vegetation on the banks stabilize the soil and slow flood flows while retaining groundwater and filtering runoff. Cobble, rocks and dead vegetation in the channel slow the flow in channels which also reduces erosion.

The design guidance to restore or preserve a Riparian Buffer is outlined below. Use this resource to learn about riparian areas:

[Your Remarkable Riparian Owner's Manual](#)

*Design Step 1 – Determine location of riparian buffer.*

A riparian buffer must be located adjacent to the receiving waterbody. The buffer length follows the boundary between the water body and the project site. The buffer width is the distance along the boundary for the entire length of the buffer.

*Design Step 2 – Determine dimensions*

- Riparian Buffer Length: the length of the riparian buffer may be the entire length of the property that borders the waterbody. Up to 15% of the total border length can be set aside as a targeted access point to the waterbody.
  - Riparian Buffer Length = length of boundary between property and waterbody – length of targeted access point
- Riparian Buffer Width: the width of the riparian buffer is determined using the equation below:
  - Riparian Buffer Width = Edge of water body to boundary of riparian buffer
  - Applicants are encouraged to design using the entire Riparian Buffer Width of at least 30 feet, 50 feet or more is preferred.

*Design Step 3 – Conduct plant inventory of riparian buffer*

Conduct a plant survey that details quantity and species of plants. Spreading plants, grasses and ground covers can be specified using area estimates. List of plant resources:

- <https://www.wildflower.org/plants/>

*Design Step 4 – Identify noxious and invasive plants identified by Texas Department of Agriculture*

Compare the plant inventory from Step 4 to the list of Texas Department of Agriculture Noxious and Invasive Plants. List available at these links:

- [https://texreg.sos.state.tx.us/public/readtac\\$ext.TacPage?sl=R&app=9&p\\_dir=&p\\_rloc=&p\\_tloc=&p\\_ploc=&pg=1&p\\_tac=&ti=4&pt=1&ch=19&rl=300](https://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=R&app=9&p_dir=&p_rloc=&p_tloc=&p_ploc=&pg=1&p_tac=&ti=4&pt=1&ch=19&rl=300)
- [https://tpwd.texas.gov/huntwild/wild/species/exotic/prohibited\\_aquatic.phtml#plant](https://tpwd.texas.gov/huntwild/wild/species/exotic/prohibited_aquatic.phtml#plant)

*Design Step 5 – Prepare management plan*

Develop a management plan which addresses the following:

- Restrict activities and uses for riparian buffer.
  - Area should not be used for any of the following activities:
    - Water access
    - Trails
    - Boat ramps
    - Parking
    - Any activities that may compress soil
    - Mowing – See Riparian Buffer Operation and Maintenance
- Management of noxious and invasive plants
- Restoration plan (if applicable)
  - Develop a planting plan for native trees, shrubs, and ground cover

Resources available at these links:

- [https://tpwd.texas.gov/landwater/water/aquatic-invasives/aquatic\\_invasive\\_plants.phtml](https://tpwd.texas.gov/landwater/water/aquatic-invasives/aquatic_invasive_plants.phtml)
- [https://tpwd.texas.gov/landwater/water/aquatic-invasives/streamside\\_restoration.phtml](https://tpwd.texas.gov/landwater/water/aquatic-invasives/streamside_restoration.phtml)
- [Remarkable Riparian Owner's Manual](#)
- [https://www.austintexas.gov/sites/default/files/files/Watershed/riparian/riparian\\_template.pdf](https://www.austintexas.gov/sites/default/files/files/Watershed/riparian/riparian_template.pdf)
- [https://www.hillcountryalliance.org/wp-content/uploads/2021/09/HCA\\_RiparianPlantingGuide\\_2021.pdf](https://www.hillcountryalliance.org/wp-content/uploads/2021/09/HCA_RiparianPlantingGuide_2021.pdf)