6.3 Tree Well Filter

Overview

Description

Best uses
- Plazas, parks, roadways and parking lots where trees are desired.

Advantages
- Aesthetic
- Small footprint (in some designs)
- Blends with the landscape

Limitations
- Larger trees need more soil volume
- Higher installation cost
- Systems with high flow rate media are allowed *only in Special Projects*

Figure 6-19: Tree Well Filter (Credit: City of Menlo Park)

Tree well filters come in several types. They can be in boxes or open areas, with underground suspended pavement systems, or with proprietary high-flow rate media. Some tree well filters are in open-bottom systems that promote infiltration or in closed-bottom systems where infiltration is undesirable or infeasible, such as sites near structures, groundwater contamination, or high groundwater levels. Tree well filters are often installed along urban sidewalks as part of an integrated street landscape, but they are highly adaptable and can be used in most development scenarios. The top of the soil and mulch is set low enough that runoff from adjacent pavement can flow into the system. Tree well filters can also be constructed using suspended pavement system products (see Chapter 4 and Figures 6-24, 6-25 and 6-26).

A tree well filter's basic design is similar to that of a bioretention area or flow-through planter. It consists of an excavated pit or vault filled with biotreatment soil media, planted with a tree and sometimes with additional small plants, with Class 2 Permeable material and an underdrain. A tree well filter that uses biotreatment soil media and is designed for a stormwater runoff surface loading rate of 5 inches per hour is considered a LID treatment measure (either an infiltration or biotreatment measure, depending on its design). Suspended pavement systems can provide additional uncompacted soil volume for tree root growth under adjacent pavement areas as well as allowing for "underground" bioretention. If used as part of the stormwater treatment system, the areas under the pavement should be installed with the required minimum 18-inch depth of biotreatment soil media and underdrains as necessary.

High flow-rate tree well filters containing manufactured media with design loading rates greater than 5 inches per hour do not qualify as LID treatment measures and are only allowed for use in Special Projects, as described in Appendix J.

Siting

For strategies and examples of how to retrofit sites and parcels to include tree well filters, ***see sections 3.2 and 3.3 of the GI Design Guide***.

Remember that stormwater control measures should be located in areas that can be accessible at any given time for the purpose of operation and maintenance and inspections. Tree well filters should not be located on inaccessible private property such as residential backyards.

When paired with suspended pavement systems and BSM, tree well filters can be considered LID and can sometimes fit into constrained spaces. They can prevent pavement damage and heaving from tree roots, reducing trip and fall hazards. See discussion in Chapter 4 for more information on providing increased soil volumes. Figure 6-25 from the Ada County Highway District Stormwater Design Guidelines (from Boise, Idaho) shows a cross section detail for a street tree design with a suspended pavement system installed adjacent to the tree under a sidewalk, but the design can also be used in a parking lot or other paved areas on a private or public parcel.

Additional soil volumes can also be provided under pervious pavement systems. Pervious pavement allows the runoff to enter the suspended pavement system without a network of inlet pipes and can distribute the flow more evenly. The example in Figure 6-26 illustrates a location where a tree and a suspended pavement system is integrated into a project with pervious pavement. Three ways that trees, pervious pavement and suspended pavement systems can be integrated are:

1. Suspended pavement systems under pervious parking area pavement;
2. Suspended pavement systems under a pervious sidewalk adjacent to the tree planting areas; and/or
3. Suspended pavement systems under an adjacent roadway – typically a parking lane or gutter area.

Figure 6-20: A tree well filter along a roadway (top – Credit: City of Fremont); and high flow rate tree well filters in a parking lot (bottom - Credit: City of Emeryville)

Table 6-5: Recommended locations for tree well filters

Recommended Locations	Tree Well Filter
Parking Lot	●
Roof	
Driveway	●
Podium-level	
Close to building	●
Away from Buildings	●
Underground	

Design and Sizing Guidelines

Treatment Dimensions and Sizing

- Flows in excess of the treatment flow rate should bypass the tree well filter to a downstream inlet structure or other appropriate outfall.
- Tree well filters cannot be placed in sump condition; therefore, tree well filters should have flow directed along a flow line of curb and gutter or other lateral structure. Do not direct flows directly to a tree well filter.
- Tree well filters with BSM (LID):
    - It is recommended that a tree well filter with BSM be sized to be 4% of the contributing impervious surface area; i.e., the area of impervious surface multiplied by the 0.04 sizing factor will equal the required surface area of the tree well filter. This sizing factor is derived from the flow-based treatment standard (runoff from 0.2 in./hr. intensity rainfall) and a required surface loading rate of 5 in./hr. Alternatively, if there are site constraints, tree well filter sizing may be calculated using a volume-based treatment method or a combination flow- and volume-based treatment method. Larger sized systems will allow for a larger tree species.
    - The number of trees to be provided will vary with the size of the treatment area and the size of the canopy of the expected tree species at maturity. It is recommended that a minimum of one tree for each 100 square feet of surface area be provided for smaller trees with increased spacing for larger tree species so that branches do not overlap. Smaller understory plants can provide treatment between trees when spacing exceeds 10 feet.
- High flow rate tree well filters (non-LID):
    - The system should be reviewed by the manufacturer/local supplier before installation. High flow rate tree well filters should be sized based on the loading rate of the media. The manufacturer should certify the ratio of impervious area to treatment area for the project. For example, Filterra states that a tree well filter of 6 x 6-feet can treat 0.25 acres of impervious surface. However, a more conservative loading rate may be used.
    - The tree species will typically be of small stature due to the constrained box environment and lack of large volume of rootable soil. Larger boxes will allow for more soil volume and possibly increased tree health. Typically one to two trees per unit are used.
    - High flow rate tree well filters are available in multi-sized pre-cast concrete drop in boxes. Sizes range from 4 x 6-feet up to 6 x 12-feet boxes. The required size of the box is based on the size of the tributary impervious surface and the permeability of the filter media. The product must be certified by the Washington State Technical Assessment Protocol – Ecology (TAPE) program, General Use Level Designation (GULD) for Basic Treatment, and sized based on the certified design operating rate[32].

Inlets to Treatment Measure

- Flow may enter the treatment measure (see example drawings in Section 5.13):

[32] For more information, see: https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Stormwater-permittee-guidance-resources/Emerging-stormwater-treatment-technologies#tape

  - As overland flow from landscaping (no special requirements);
  - As overland flow from pavement (cutoff wall required);
  - Through a curb opening;
  - Through a curb drain;
  - With a drop structure through a stepped manhole (See Section 5.6);
  - Through a bubble-up manhole or storm drain emitter; and/or
  - Through a roof leader or other conveyance from building roof.
- Where flows enter the biotreatment measure, allow a change in elevation of 4 to 6 inches between the paved surface and biotreatment soil media elevation, so that vegetation or mulch build-up does not obstruct flow.
- Splash block, concrete aprons, grouted rock cobble, pea gravel rock mulch, or plants should be installed to dissipate flow energy where runoff enters the treatment measure.
- Curb openings should be a minimum width of 18 inches (or 12" if allowed by the municipality) with the number and locations designed so that runoff is dispersed throughout the bioretention area or through the use of a flow spreading system.
- Bubble-up emitters and pipes to bubble-up emitters should have weep holes to avoid standing water inside after storm events.

Figure 6-21: Tree well filter with curb-cut inlet. This tree well filter also features an overflow bypass (Source: University of New Hampshire Environmental Research Group, 2006)

Vegetation

- Suitable tree species are identified in Appendix A planting guidance and general tree guidance is provided in Sections 4.1.3 and 5.7. Small-stature tree species are typically recommended for high flow rate tree well filters due to the small amount of soil volume available and the containerized system minimizing the connection to natural systems and stability. Larger-stature species can be used where increased soil volumes are provided.

- Use integrated pest management (IPM) principles in the landscape design to help avoid or minimize any use of synthetic pesticides and quick-release fertilizer. Check with the local jurisdiction for any local policies regarding the use of pesticides and fertilizers.
- Irrigation should be provided, as needed, to maintain plant life. If irrigation cannot be provided, then watering by hand should be accommodated weekly through plant establishment – typically through the first six months depending on the season and levels of precipitation.
- Trees and vegetation do not block inflow, create traffic or safety issues, or obstruct utilities.

Soil and Drainage Requirements Specific to Tree Well Filters

- If the permeability of the media exceeds 5 inches per hour, use of the tree well filter is not considered LID and will not be allowed, except for Special Projects (see Appendix J).
- An underdrain system is required for tree well filters.

Soil and Drainage Considerations for All Biotreatment Systems

- Consideration of groundwater level and placement of the underdrain:
    - If there is less than a 5-foot separation between the bottom of the facility and the seasonal high groundwater level, or infiltration is not allowed due to other site constraints, an impermeable liner should be placed between the Class 2 Perm and the bottom of the facility and the underdrain placed on top of that liner.
    - If there is at least a 5-foot separation between the bottom of the facility and the seasonal high groundwater level, and geotechnical conditions allow infiltration, the facility should be unlined and the underdrain should be raised at least 6 inches above the bottom of the Class 2 Perm to allow storage and infiltration of treated water.
- To avoid excess hydraulic pressure on subsurface treatment system structures:
    - The depth to seasonal high groundwater level should be at least 5 feet from the bottom of the structure.
- A geotechnical engineer should be consulted for situations where the bottom of the structure is less than 5 feet from the seasonal high groundwater level.
- Soil used in the tree well filter must meet the BASMAA biotreatment soil media (BSM) specification included in Appendix K if the project is a Regulated Project. Check with municipality for any additional requirements.
- An underdrain system is required where infiltration is not feasible or where it's limited.
- Filter fabric should not be used around the underdrain or between the BSM and the Class 2 Perm layer. Class 2 Perm performs the function of filter fabric (keeping the BSM from exiting the system through the underdrain) but is less prone to clogging.
- Install and maintain a 3-inch layer of composted arbor mulch (also called "aged mulch") in areas between plantings. Rock mulches such as river cobble or pea gravel, or other mulches that resist floating may be used, but large rock mulch, such as cobble, should be used sparingly and only where absolutely necessary. Dyed, "micro-bark", or "gorilla hair" mulches, as well as chipped wood mulch from recycled pallets and dimensional lumber, are not recommended. See Sections 4.9 and 6.3 of the GI Design Guide for more information on mulch.

- The underdrain should consist of a solid perforated or slotted HDPE or PVC pipe connected to a cleanout pipe(s) and to a storm drain or discharge point. Solid HDPE or triple-walled HDPE pipe, with smooth inner and outer layers and a corrugated middle layer, are recommended. The cleanout should consist of a vertical, rigid, non-perforated, non-corrugated PVC or HDPE pipe, with a minimum diameter of 4 inches and a watertight cap fit, raised or flush with the ground, or as required by municipality. There should be adequate fall (min. 0.5% slope) from the underdrain to the storm drain or discharge point. See Section 5.14 for more information on underdrains.
- The underdrain should be placed at the bottom of a 12-inch thick layer of Caltrans Class 2 permeable material, or similar municipality-approved material. See Section 5.14 for more information on Class 2 permeable material.

Construction and Maintenance Plans

Construction Requirements for All Biotreatment Systems

- Minimize compaction of existing soils if the system will be infiltrating water. Protect BSM and whole system from construction traffic and compaction.
- Protect the area from construction site runoff. Runoff from unstabilized areas should be diverted away from biotreatment facility.
- ***For additional construction guidelines, see Chapters 2, 4 and 5 of the GI Design Guide***. Specifically, see Sections 4.3 through 4.9 for construction strategies for dealing with slopes, overflows, poor soils, utilities, runoff capture, etc.

Remember

Maintenance Considerations for All Treatment Measures

- See Chapter 8 for specific maintenance guidance. Specifically, see Section 8.3.3 for maintenance concerns specific to tree well filters.
- A Maintenance Agreement should be provided and should state the parties' responsibility for maintenance and upkeep.
- Prepare a maintenance plan and submit with Maintenance Agreement. Maintenance plan templates are in Appendix G.

Typical Design Details

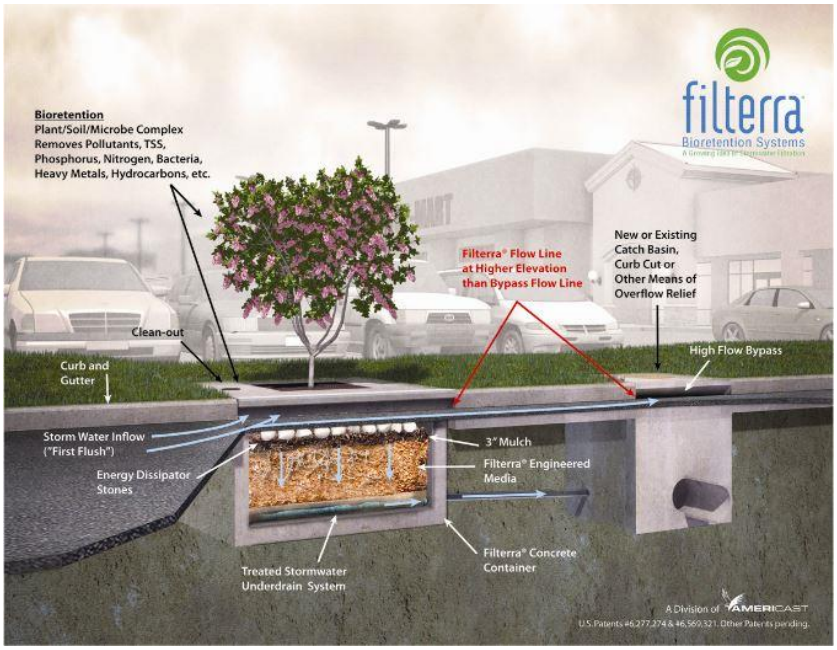

Figure 6-22: Cut Away View of a high-flow rate tree well filter- the use of this photo is for general information only and is not an endorsement of this or any other high flow rate stormwater treatment device. (Source: Contech Engineered Solutions, 2019).

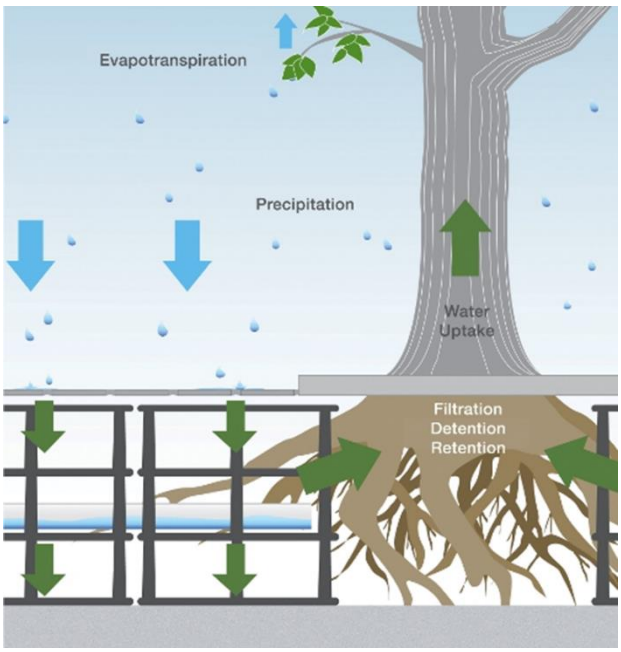

Figure 6-23: Schematic of modular suspended pavement system and a tree well filter. (Courtesy of: Deeproot Green Infrastructure, LLC).

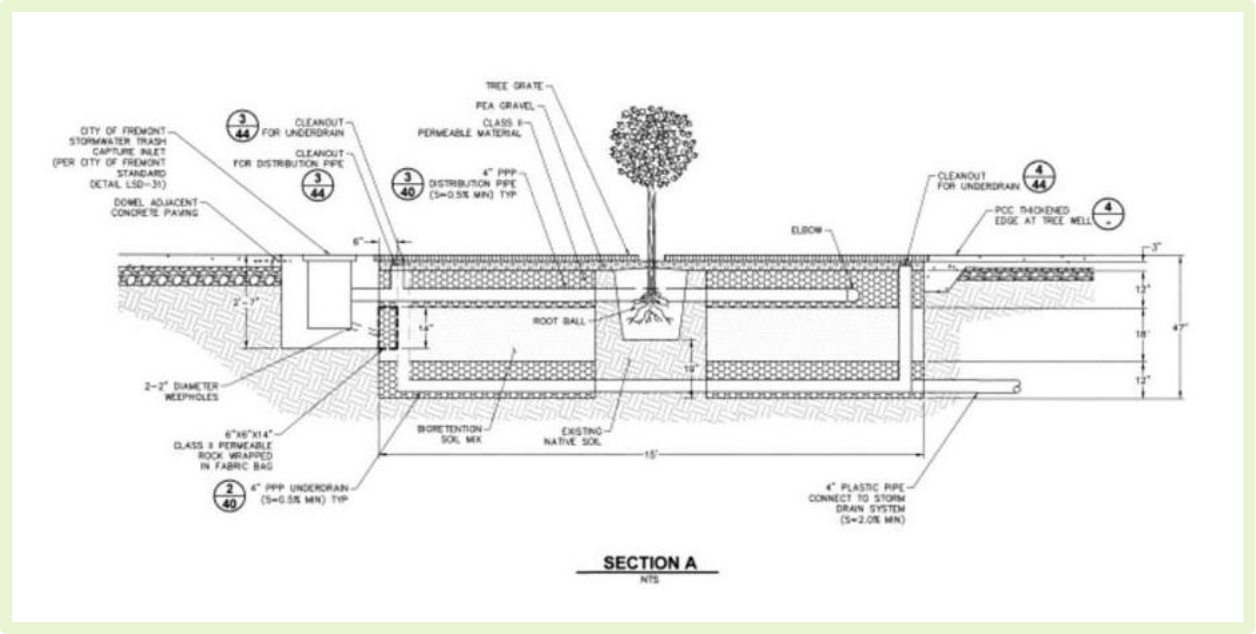

Figure 6-24: Cross Section Detail of a tree well filter with an integrated trash capture device (Credit: City of Fremont)

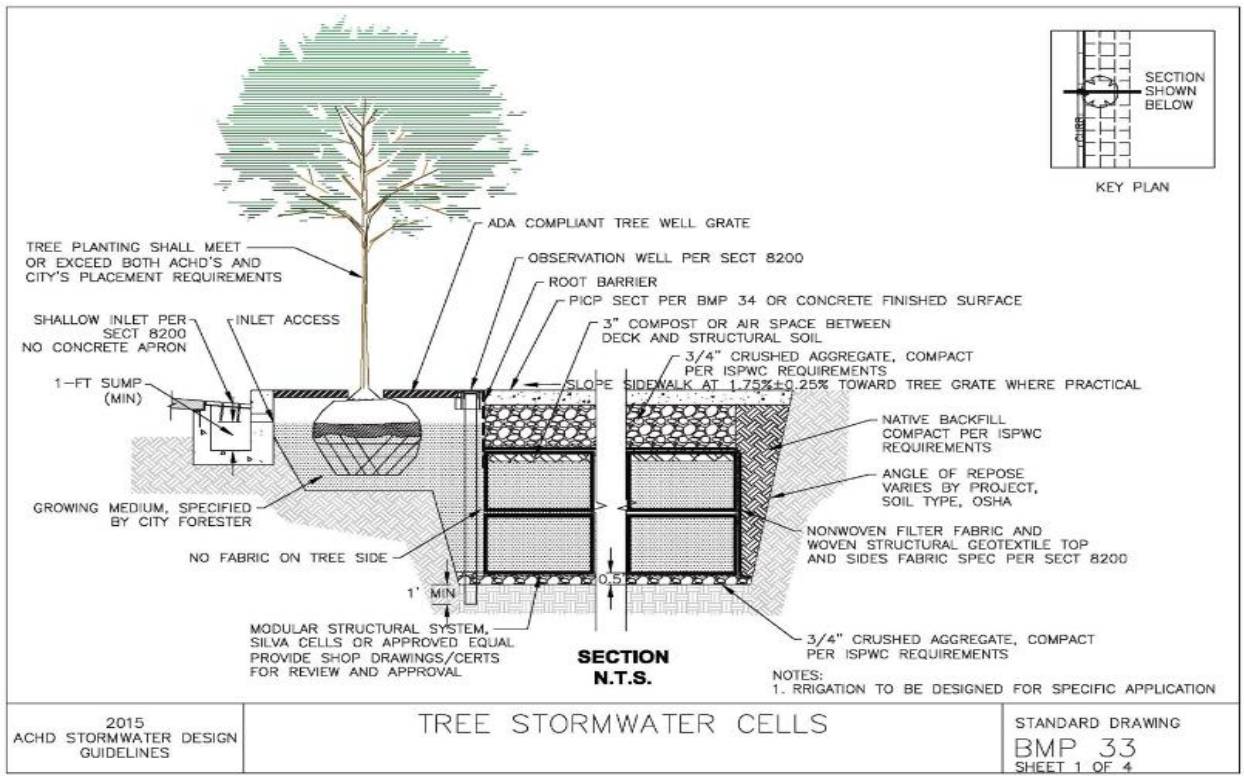

Figure 6-25: Cross Section Detail of a tree well filter with suspended pavement system installed under sidewalk (Credit: Ada County Highway District Stormwater Design Guidelines)

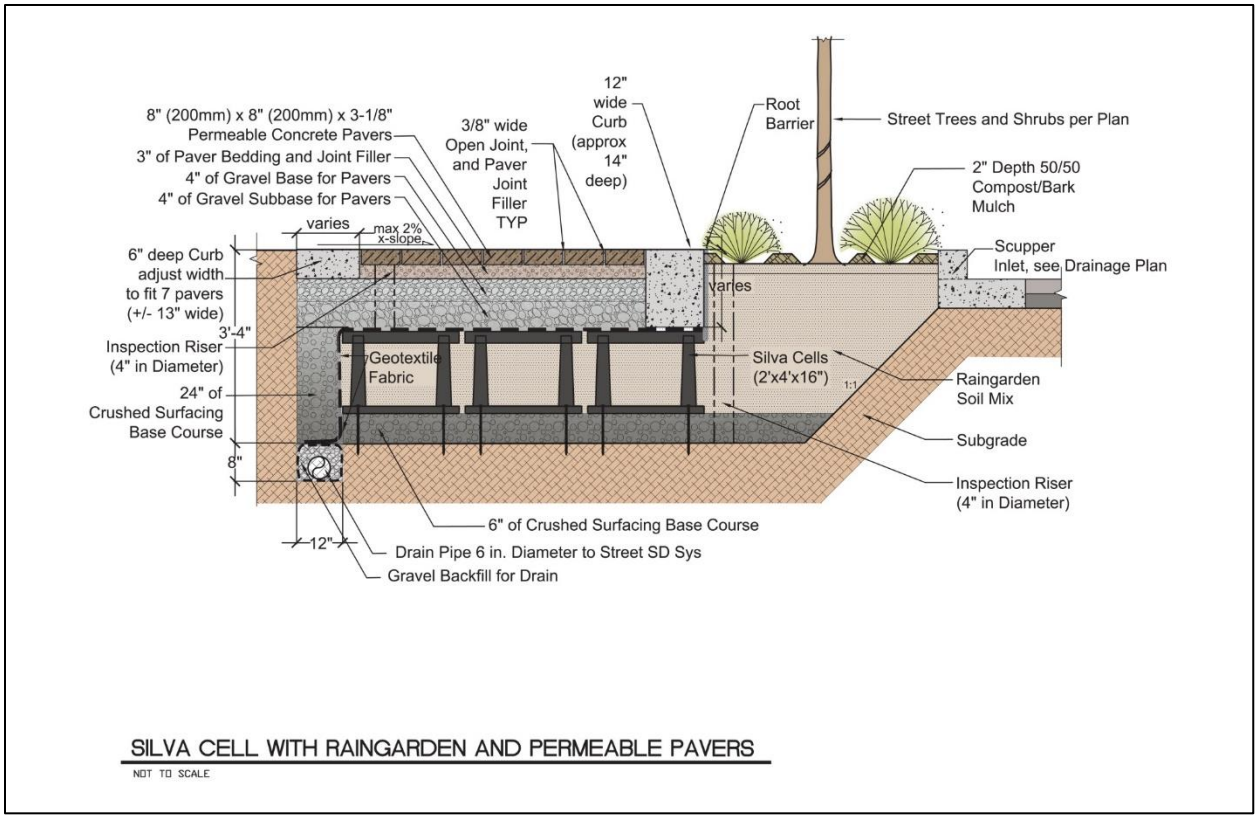

Figure 6-26: Cross Section detail of a tree well filter with Silva Cells under pervious pavement (Courtesy of: DeepRoot Green Infrastructure, www.deeproot.com)