



ADVANTAGES OF USING PERMEABLE PAVERS ABOVE SILVA CELLS

Prepared by:



Using Silva Cells can at the same time:

1. Provide uncompacted tree rooting volume under HS-20 load bearing surfaces, allowing for larger and healthier trees than would otherwise be possible in urban areas with limited open space

AND

2. Use this underpavement tree rooting volume to provide sustainable stormwater management by directing surface stormwater to these tree soil volumes. With this technique, sustainable stormwater management is possible even in urban areas with limited open space, where providing sustainable stormwater management can be challenging (see, e.g. section on using trees with Silva Cells for Sustainable Stormwater Management on p. 211 of 2012 LID Technical Guidance Manual for Puget Sound).

Advantages of Using Silva Cells With Pervious Pavers For Stormwater Management

Using pervious pavers above the Silva Cell system maximizes stormwater volume, rate, and quality benefits, and also minimizes installation and maintenance labor required.

Maximizing Stormwater Volume, Rate, and Quality Benefits

In addition to the volume and water quality stormwater benefits provided by large trees grown in Silva Cells, pervious pavers provide the following stormwater benefits:

Increase stormwater volume storage

Trees grown in Silva Cells provide stormwater volume benefits through interception, evaporation by the tree, and storage in the soil in the Silva Cells. Storage capacity of bioretention soils like those typically used in Silva Cells ranges from 20-40%. The 2012 Puget Sound Low Impact

Development Manual recommends modeling porosity of bioretention soils as 40%.

The aggregate layer under pervious pavement also provides stormwater storage, in addition to that provided in the Silva Cell soil. The aggregate reservoir under the pervious pavement (above the Silva Cells) typically provides storage equal to 40% of the aggregate volume. According to the 2012 LID Technical Guidance Manual for Puget Sound, "Initial research indicates that properly designed and maintained permeable pavements can virtually eliminate surface flows for low to higher intensity storms common in the Pacific Northwest...A six year University of Washington permeable pavement demonstration project found that nearly all water infiltrated various test surfaces for all observed storms (Brattebo and Booth, 2003). Observed infiltration was high despite minimal maintenance conducted."

Improve water quality

Both the tree and the soil in a Silva Cell system clean runoff that filters through a Silva Cell system. Pollutant removal rates are very high, similar to those of bioretention systems. Since pervious pavement also cleans runoff water, adding pervious pavement on top of a Silva Cell system improves water quality even more than a Silva Cell system alone.

If all runoff drains through the pervious pavement and no underdrains are used, 100% of pollutants are reduced.

If underdrains are installed when pervious pavement is used over Silva Cells, there will rarely be any flow out the underdrains. Any runoff that does leave the site will be cleaner than runoff from a traditional pavement.

Pervious pavement research has found the following removal rates for runoff from pervious pavement underdrains:

- 89-98% lead removal (Dierkes et al, 2002 in 2012 LID Technical Guidance Manual for Puget Sound)
- 74-98% dissolved cadmium removal (Dierkes et al, 2002 in 2012 LID Technical Guidance Manual for Puget Sound)
- 89-96% dissolved copper removal (Dierkes et al, 2002 in 2012 LID Technical Guidance Manual for Puget Sound)
- 72-98% dissolved zinc removal (Dierkes et al, 2002 in 2012 LID Technical Guidance Manual for Puget Sound)
- 97.6% motor oil (Pratt et al, 1999 in 2012 LID Technical Guidance Manual for Puget Sound)
- 74% TSS removal - upper and lower 90% confidence bounds are 93% and 33%, respectively – (8 studies provided through correspondence with the Interlocking Concrete Pavement Institute (ICPI), in draft Minnesota Stormwater Manual Pervious Pavement Updates)
- 45% phosphorus removal - upper and lower 90% confidence bounds are 65% and 24%, respectively (7 studies provided through correspondence with ICPI, in draft Minnesota Stormwater Manual Pervious Pavement Updates)

Minimizes Installation and Maintenance Labor Required

To use Silva Cells for stormwater management, stormwater is generally directed to the Silva Cells either through pervious pavers or through distribution pipes. Pervious pavers eliminate the need to install and maintain (clean) distribution pipes. They also eliminate any chance of the distribution pipes clogging.

Other Benefits

Additional benefits of using pervious pavers above Silva Cells include:

- *Rain that falls on the pervious pavement installed above Silva Cells is more readily available to the trees than rain that falls on impervious pavement.*
Rain that falls on pervious pavement above Silva Cells drains straight into the soil in the Silva Cells and becomes available for the tree to use. Rain that falls on impervious pavement cannot flow through the pavement into the soil below, so it will not become available to the tree. Pervious pavement allows more air circulation into tree soil than impervious pavement
- *Aesthetics*
- *Reduced Ice Formation Under Frozen Conditions*
Research at the University of New Hampshire has shown that because pervious pavers drain so quickly, less ice forms, so less salt is needed. Lower salt use benefits the trees, pavement, and water quality. According to the 2012 LID Technical Guidance Manual for Puget Sound, "Ice buildup on permeable pavement is reduced and the surface becomes free and clear more rapidly compared to conventional pavement. For Western Washington, deicing and sand application may be reduced or eliminated and the permeable pavement installation should be assessed during the winter months and the winter traction program developed from those observations."
- *Increased flow of rain through pervious pavement vs. impervious pavement flushes more de-icing salts out of the soil*
Because much more rain flows through pervious pavement than through impervious pavement, de-icing salts are flushed out of soils under pervious pavement much better than from soils under impervious pavement. This minimizes the negative effects of salt on the soil and trees.



Above: Images of trees installed with Silva Cells and Pervious Pavers in combination with concrete sidewalk in downtown Minneapolis, MN, streetscape



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