

Missoula's Urban Trees

Trees planted in boulevards, medians, parks, and public spaces provide a valuable resource to the City of Missoula and its residents. Trees improve air quality and human health, mitigate urban heat island effect, reduce energy costs, absorb stormwater runoff, provide wildlife habitat, and maintain the City's character, among many other benefits. In order to align the City's standard operating procedures with industry-wide best management practices, a review of tree planting methods was conducted.

Protecting Our Investment

Urban trees face many challenges that compromise their health, prevent them from reaching their full size, and shorten their lifespans, which in turn reduces the wealth of benefits they could provide to the City. The most common challenge is lack of access to adequate volumes of quality, uncompacted soil. In recent decades, several innovative methods for planting trees have been tested and popularized that promote the success and longevity of trees in highly urbanized areas by increasing their access to soil and/or reducing soil compaction.

Recommended Tree Planting Methods

Suspended pavements, structural soils, expanded planting pits, and several complementary planting technologies are recommended for application in Missoula. Trees planted in increased, uncompacted soil volumes using these methods could provide significantly greater benefits to the City.



Suspended Pavements allow trees and infrastructure to coexist while providing optimal growing conditions for trees.



Structural Soils allow trees and infrastructure to coexist, but may not improve growing conditions for trees as much as suspended pavements or expanded planting pits.



Expanded Planting Pits improve growing conditions for trees, but reduces the ground surface that can be used for pavement.

These methods can also be used in combination with each other to further enhance the benefits to trees.

Soil Volume Recommendations

In order to maximize the tree's health, growth, longevity, and accompanying eco-benefits, the following soil volumes are recommended for use with each proposed planting method and size class of tree in Missoula. (Volumes include a maximum depth of five feet with the specific size based on tree rooting depth.)

Recommended soil volumes (cubic feet) by planting method:

TREE CLASS TYPE	SUSPENDED PAVEMENT (SOIL)	STRUCTURAL SOIL (SOIL/ GRAVEL MIX)	UNCOVERED PLANTING PITS (SOIL)
Class I (Small <30')	500	2,500	500
Class II (Medium 30–60')	1,000	5,000	1,000
Class III (Large >60')	1,500	7,500	1,500

Size classes refers to tree stature and mature canopy spread.

Other Technologies

Several other technologies were explored that could be used in combination with suspended pavements, structural soils, or expanded tree planting pits.

These complementary technologies include:

- Permeable pavements
- Root barriers
- Air gaps (aka "burrito wraps")
- Stormwater inlets
- Roof drains

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TECHNICAL REPORT
Tree Planting Methods
in Urbanized Environments

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Plan(t)ing for SUCCESS

Planning the Best Ways to Plant
Trees in Urban Areas

City of Missoula Forestry Division

Suspended Pavements



Prevent Soil Compaction with Pillars or Cells

- Suspended pavements, also referred to as structural cells, help to protect a tree's root system by transferring the weight of the load-bearing pavement surrounding it to a lower level beneath the roots using pillars or cells.
- Research has proven this to be **the most effective planting method for trees** in highly urban environments, leading to faster growth, greater health, and longer lifespans compared to both conventional planting methods and other proposed alternatives.
- These systems can be installed during either new or retrofit construction. Several ready-made products are available for purchase (e.g., Silva Cells®, Stratavault®), or they can be constructed locally.
- Many cities have successfully implemented suspended pavements already, such as Boise, ID; Minneapolis, MN; Charlotte, NC; and Knoxville, TN. In some of these cities, trees were planted in suspended pavement in the 1980's or earlier and continue to perform well. Additionally, several cities in Ontario and British Columbia, Canada, require their use in city guiding documents.

Structural Soils

Prevent Soil Compaction with Engineered Gravel

- Structural soils can also support trees in developed areas by incorporating particles of gravel into the soil. The gravel supports the load-bearing pavement above while the interspersed soil remains available for trees.
- Although planting trees in structural soils is possible, they are only appropriate in certain situations because the benefits to trees are minimal compared to suspended pavements or uncovered planting pits.
- The industry standard soil-to-gravel ratio is roughly 20:80. This means that in order to provide a tree with the same amount of soil that it would have in a conventional or suspended pavement system, five times as much volume of mixture must be used. Structural soil mixes can be purchased (e.g., CU-Structural Soil™) or created locally.
- Structural soils are typically utilized in climatic regions with high rates of precipitation where trees are being used as a tool for stormwater management. Cities such as Brooklyn and Ithaca, NY; Olympia, WA; Birmingham, AL; and Blacksburg, VA, are currently using structural soils to plant trees.



Uncovered Tree Planting Pits



Improve Tree Planting Conditions with Increased Soil Volume and Exposed Surface Area

- Another approach to mitigating the difficulties faced by urban trees due to lack of quality non-compacted soil is to simply increase the amount of available soil in the planting space and refrain from paving too close to it. In place of pavement, the surrounding area can be mulch, turf, or other landscaping.
- Research has shown a positive relationship between the size of the planter space opening and tree size, measured by trunk size (diameter) and canopy area. The common industry practice is to provide two cubic feet of soil per anticipated square foot of mature tree canopy. This method benefits trees and requires minimal structural interventions compared to suspended pavements and structural soils.
- Cities, both nationally and internationally, such as Bellevue, WA; Columbus, OH; and Prince William County, VA, currently require uncovered tree planting pits with increased minimum soil requirements in their policy documents.