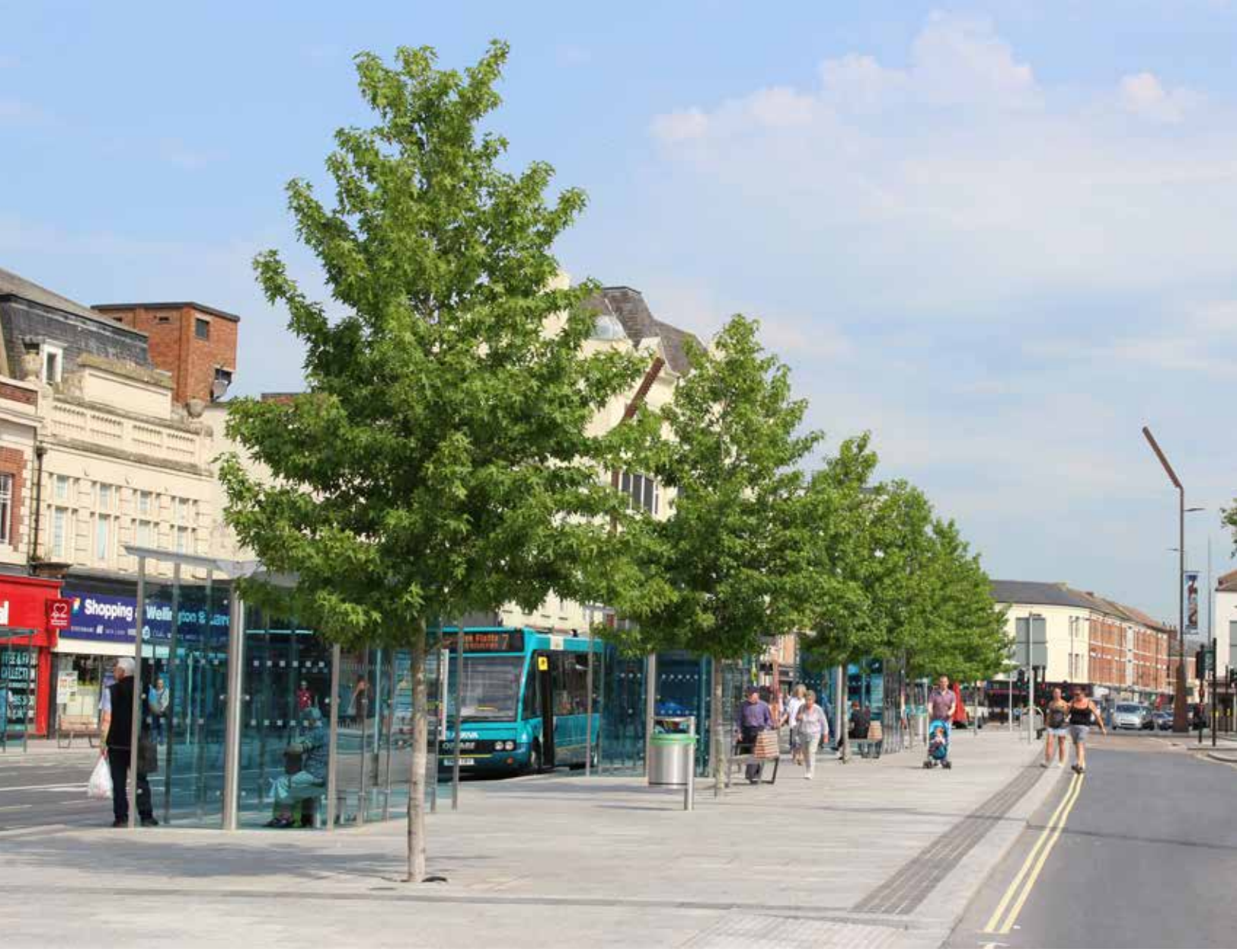


Analyzing Soil Under Pavement for Urban Tree Growth

Soil Cells vs Structural Soil

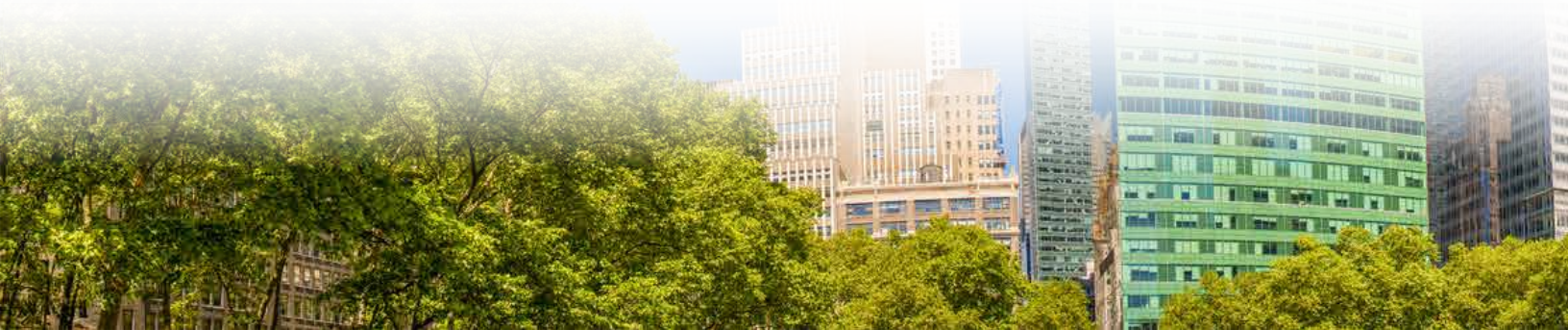
GreenBlue® URBAN

Establishing the future urban landscape

Field Trials

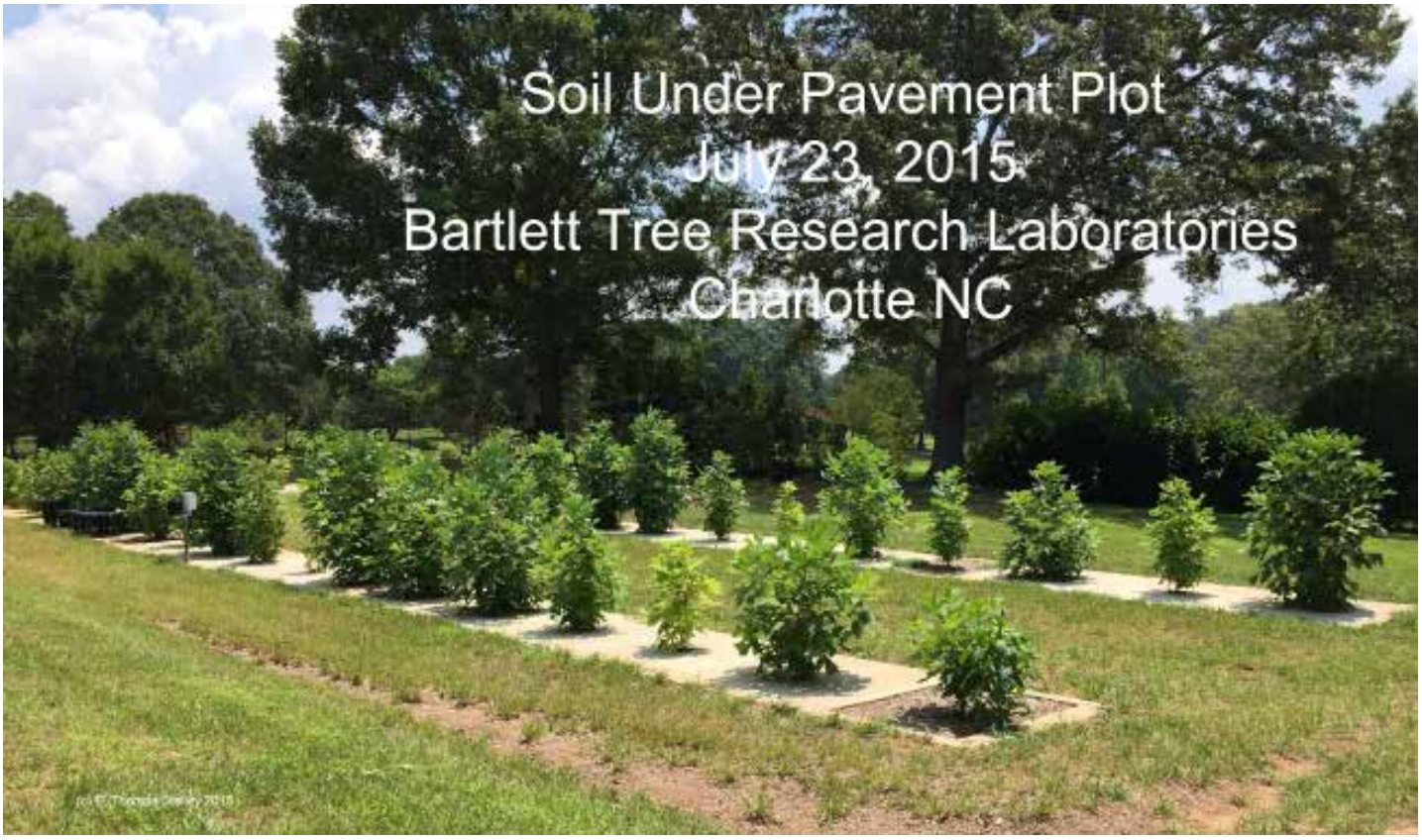
What is the best way to promote tree root growth in the soil under a sidewalk? It's a question that landscape architects, arborists, and related professionals from cities large and small have investigated over many years. Through such consideration, alternate solutions to increase rooting volume for street trees have been created with varying degrees of success.

In order to help minimize the guesswork and reduce real-life trials, third-party study conducted by research institutions and municipalities around the world have compared the effects on tree growth of various hardscape soil treatments. The applications in these research experiments tested soil cells and two different structural soil mixtures in controlled plots, with astounding results.



Bartlett Tree Labs – Charlotte, NC

The intent of the research is to study the tree growth effectiveness of several load-bearing soil options. In July of 2014, Tulip poplar trees were planted in two parallel 90 foot trenches, two feet deep and five feet wide, duplicating a city sidewalk. Six different subsurface soil treatments were installed, and the trenches were lined with Typar fabric to restrict root growth from encroaching outside of the intended trench. Wood barriers were constructed at five foot intervals to hold the fabric in place and separate the plots. Each plot contained approximately 42 cubic feet of soil, similar to what might be anticipated for a city sidewalk.



Bartlett Tree Labs – Charlotte, NC

1) Control – soil mix compacted to 80% Proctor

2) Compacted Control – soil mix compacted to 95% Proctor to meet current standards for compaction under streets and structures

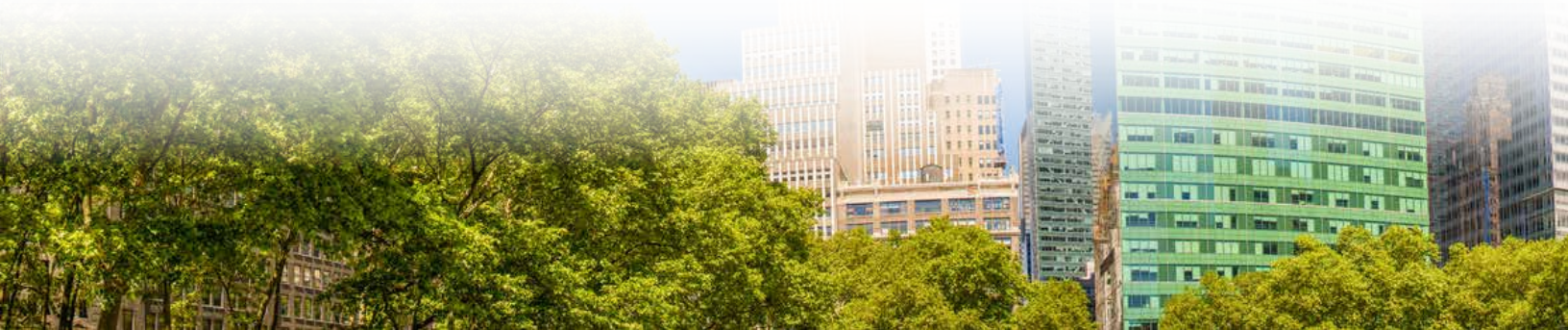
3) Silva Cells – soil mix compacted within the Silva Cell structure

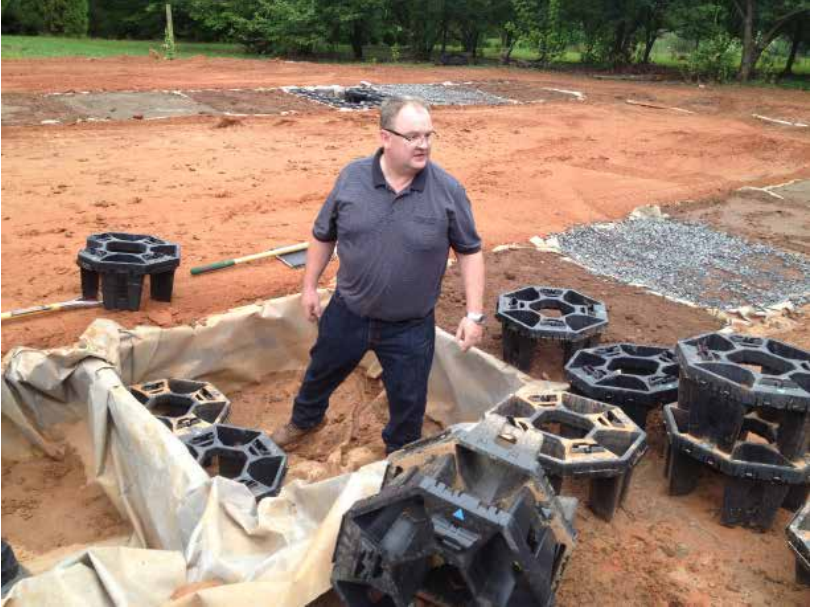
4) StrataCells – soil mix compacted within the StrataCell structure

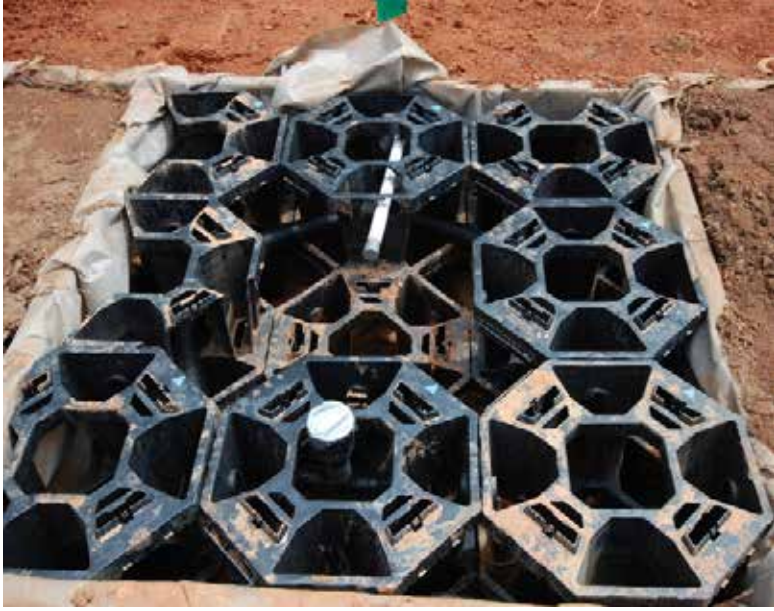
5) Sand Based Structural Soil – soil mix formula was four parts medium (concrete) sand, one part topsoil loam, and 1.5 parts mature compost - compacted to 94-96% Proctor (similar to Amsterdam soil)

6) Gravel Based Structural Soil – soil mix formula was 80% #5 stone, 20% soil mix, and .003% hydrogel – compacted to 95% Proctor (defined according to specifications of Cornell University publications for CU Structural Soil)

The plots were filled and compacted as noted above, and trees were planted in July 2014, and repeated six times, three per row, in a randomized pattern. A concrete walkway was then poured over the test plots to replicate a city sidewalk, with a hole left in the middle of the plot to accommodate the tree's trunk.





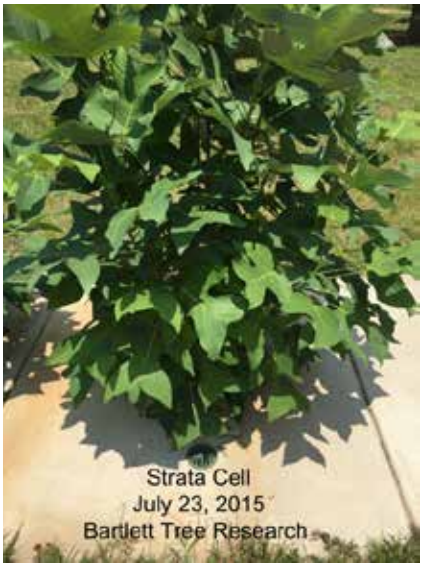


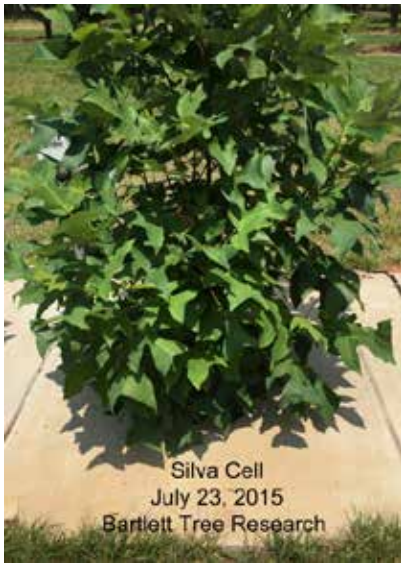
1 Year Review

The height and spread diameters clearly illustrate that soil cells significantly outperformed all the other methods, with StrataCells showing the most tree growth. The speed at which such drastic results have been determined is of great interest to the research, since other studies performed by Bartlett Tree Experts has taken numerous years before significant results started to show.

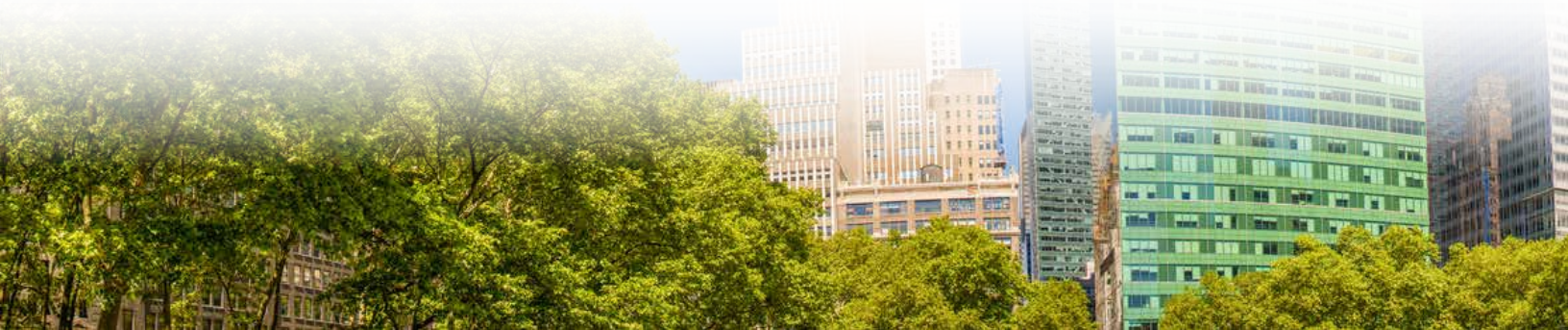
Dr Thomas Smiley, an Arboricultural Researcher at Bartlett, directed the research which was originally intended to be a five to ten year study. However because of significantly obvious results after just one year, a much faster than expected conclusion has been made and the study has been condensed.

“We are seeing large differences in tree growth and health in the Soil Under Pavement plot that we installed in summer of last year,” explains Dr Smiley. Even before the summary of growth data was completed, Dr Smiley underscored that “the photos tell most of the story.”





After one year, the initial tree growth data was collected and the tree height, diameter, condition, dieback, and leaf color were all measured. Leaf moisture and chlorophyll fluorescence were also determined. The first year’s growth indicated the startling results indicated in the abbreviated list below. The results were calculated by measurement of each of the six soil treatments.



1½ Year Review

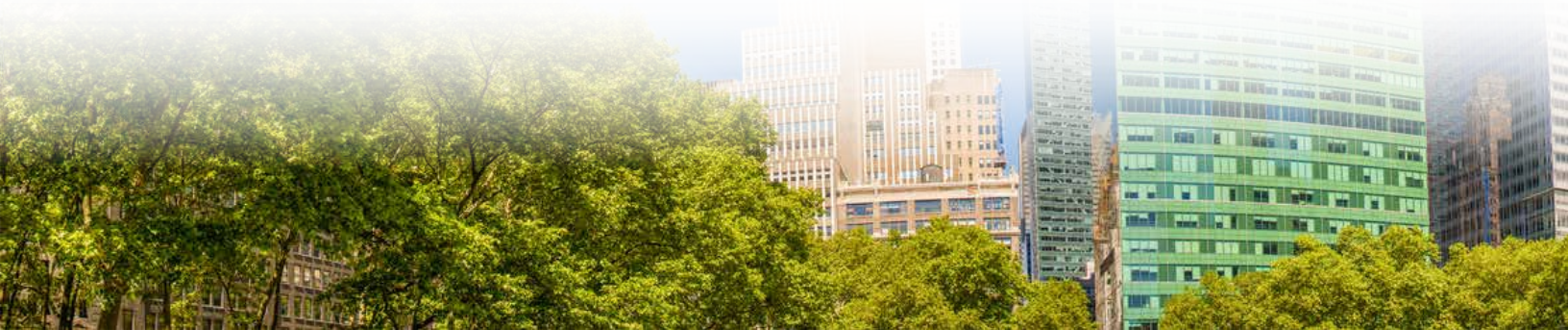
1) Control	51 cm (22 inches) height, 18 cm (7 inches) spread
2) Compacted Control	9 cm (3 inches) height, 8 cm (3 inches) spread
3) Silva Cells	85 cm (34 inches) height, 29 cm (30 inches) spread
4) StrataCells	88 cm (36 inches) height, 25 cm (25 inches) spread
5) Sand Based Structural Soil	42 cm (17 inches) height, 18 cm (7 inches) spread
6) Gravel Based Structural Soil	33 cm (13 inches) height, 12 cm (5 inches) spread

4 Year Review (Root Growth)

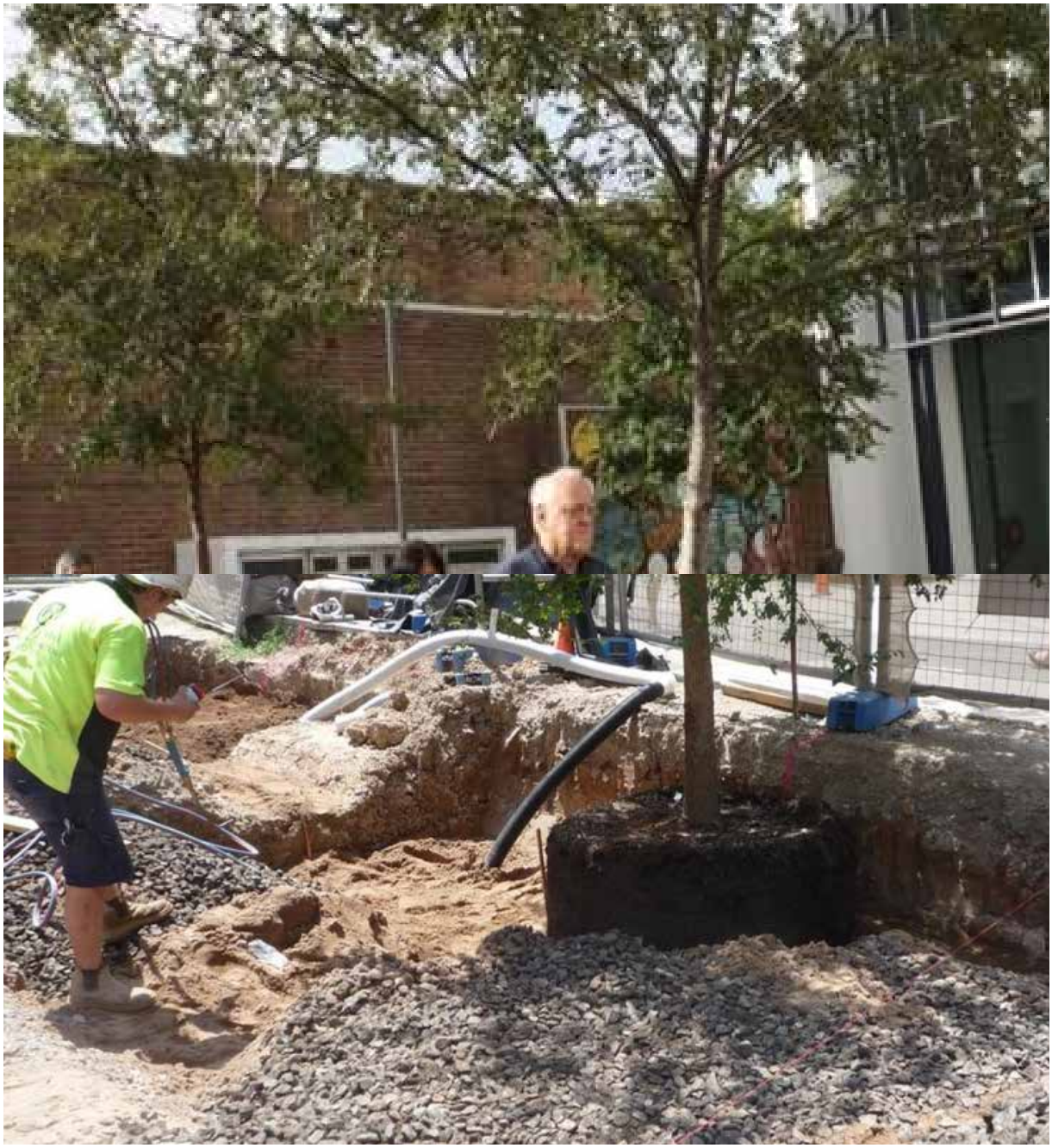
Root Growth in Soil Cells

Root Growth in Structural Soil

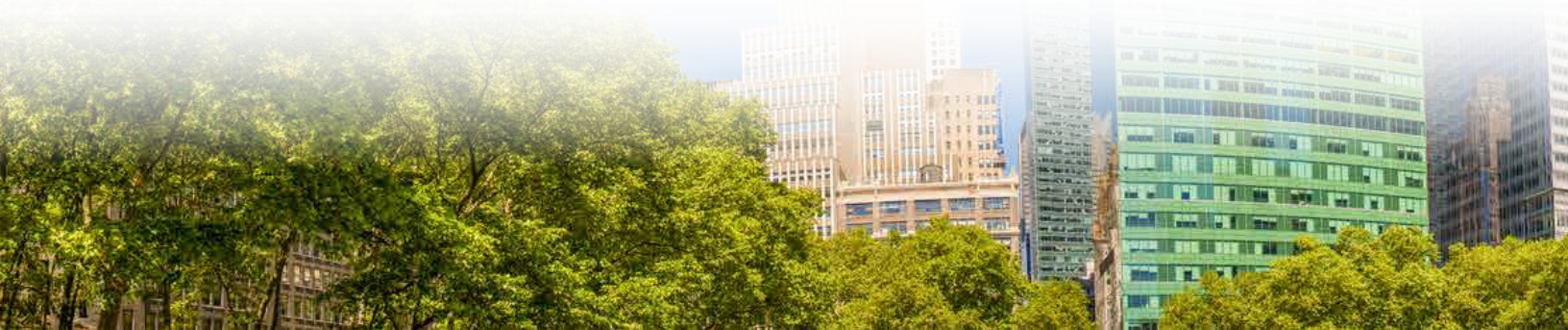
City of Ashfield – Ashfield, Australia After 1½ Years in Soil Cells



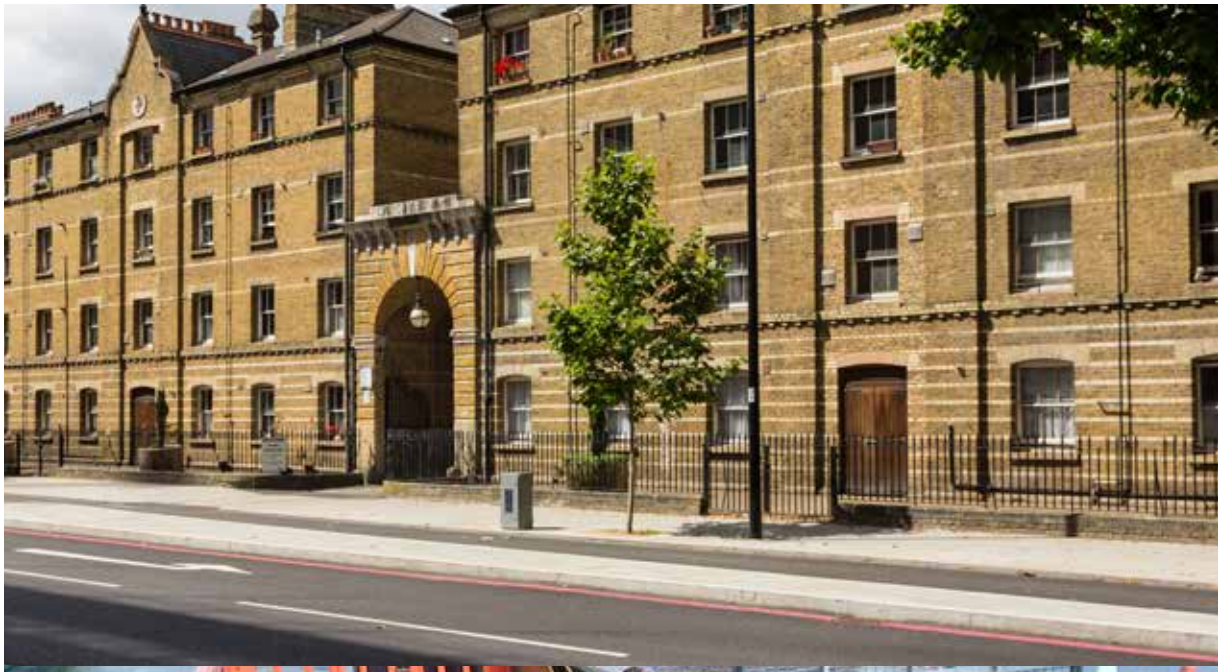
City of Ashfield – Ashfield, Australia After 1½ Years in Structural Soil



Borough of Southwark – London, UK
After 2 Years in Soil Cells



Borough of Southwark – London, UK
After 2 Years in Structural Soil

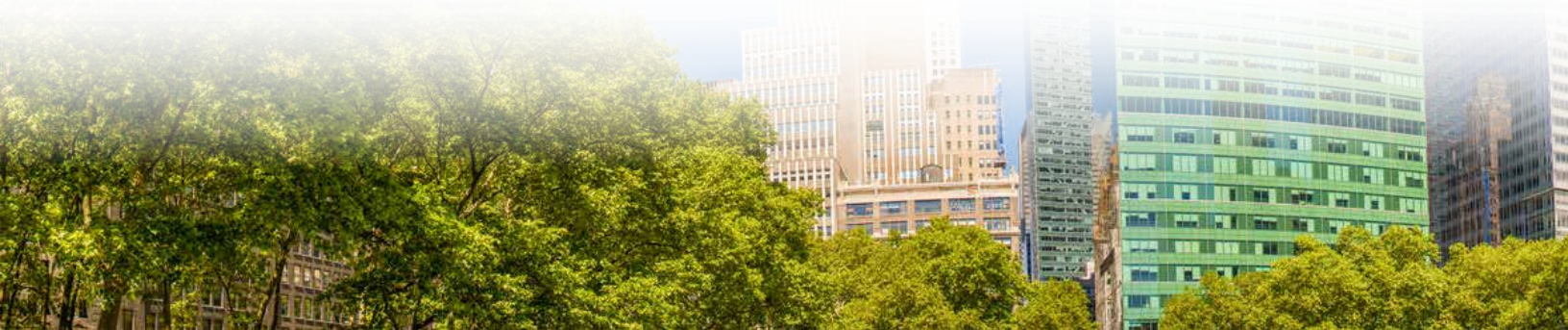


What Are Soil Cells?

Soil cells manufactured by GreenBlue and our affiliate companies are the world's only large soil cells made from 100% recycled plastic. They can be stacked to various heights and shapes during construction, as required. RootSpace are load-bearing modules that clip together to form a skeletal matrix that is filled with soil to provide uncompacted rooting volume for trees. They can be spread laterally as wide as necessary including under vehicular traffic areas with minimal surface coverage. The weight of the paving and any surface loading is transferred downward through the RootSpace structure to the compacted base at the bottom of the tree pit while the soil within the cell structure remains uncompacted to allow for healthy tree root establishment.

Utilizing soil cells for tree planting also provides a stormwater treatment function. Rainwater runoff can enter the system through pervious paving, drains, catch basins, and the opening around the tree trunk.

GreenBlue soil cells support paved surfaces of any kind and can meet AASHTO H-20 loading requirements with proper engineered surfaces above. Irrigation and aeration systems, as well as local utility ducts, can be integrated into the soil cell layout.



Comparing Costs

There is sometimes misconception that structural soil such as “CU Soil” and soil cells have similar capabilities and provide similar benefits to trees, therefore leading to the two products being specified as equal alternatives. However, this is simply not factual.

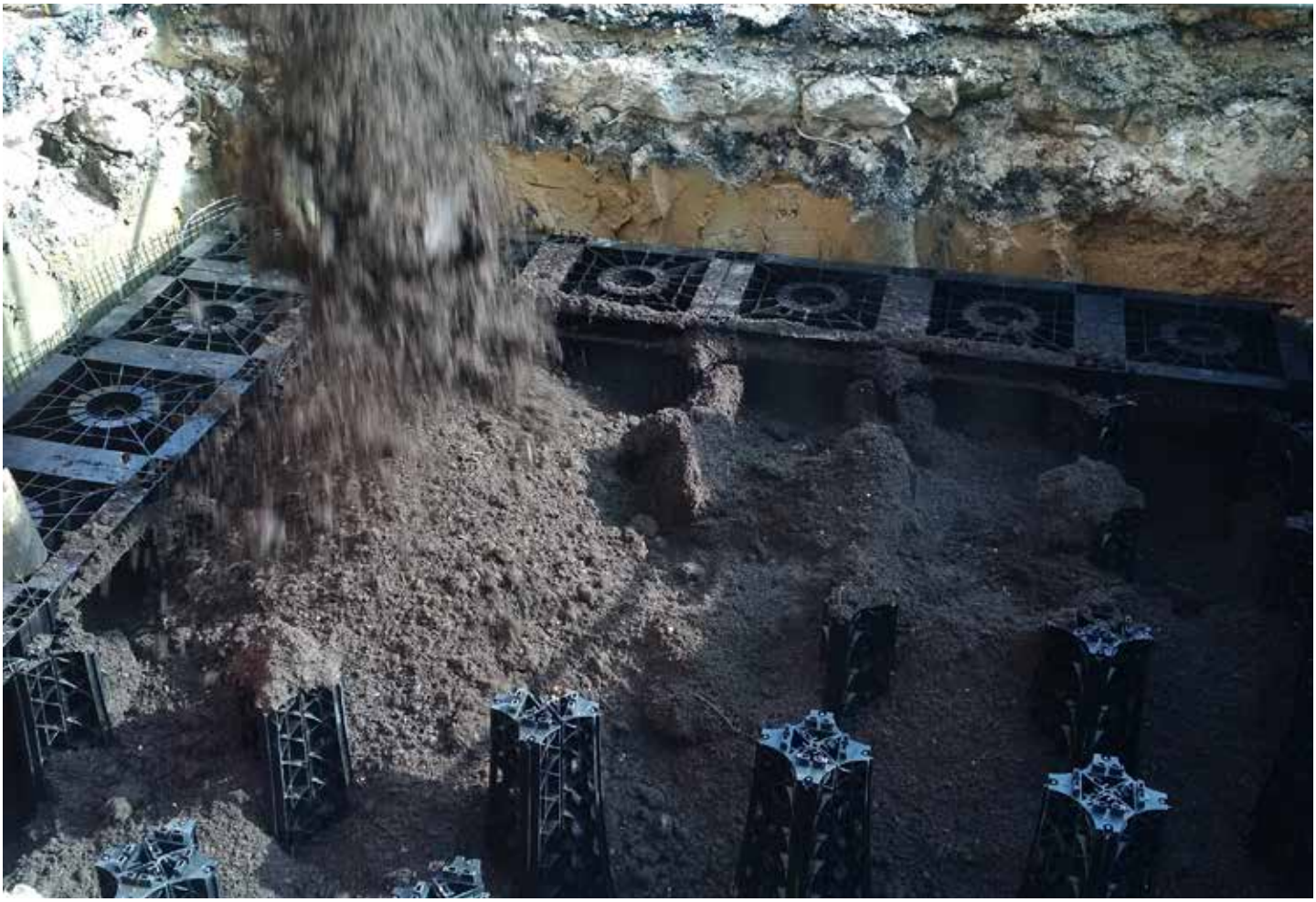
Structural soil is made up of 80% crushed stone and 20% soil which coats the rock, compacted to 95% proctor density. The compacted rock provides approximately 30% void space for soil, which remains uncompacted as the compaction force and surface load is transferred through the stone. Tree roots then grow in the soil-filled voids. Structural soil is very limited in the amount of soil that ot provides because of the large amount of rock the matrix contains. Trees may grow well in it at first, but once the soil in the matrix is exhausted, the trees begin to decline.

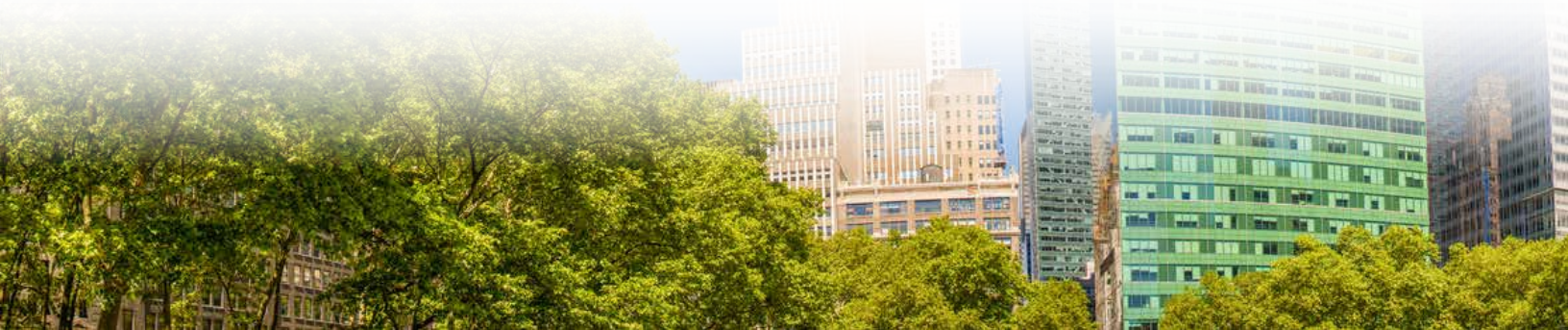
When determining the overall cost of the system, it must be figured in terms of the soil volume provided, as only the soil (and not the rock) is providing rootable space for trees. Meaning that the actual cost per cubic foot of soil in soil cells such as RootSpace is usually less than the equivalent soil volume of structural soil.

Conclusion

Since this study is ongoing, the final conclusion is undetermined. However, as previously stated, the photos of these various study cases tell most of the story, and after such few number of years. Soil cells have proven by far to be the best option for planting trees in hardscape surrounds.

So when calculating the use of structural soil and making predictions on tree growth, only the amount of soil in the mix (approximately 20%) should be considered as rooting volume. Meaning that value engineering recommendations to substitute equal volumes of structural soil in place of soil cells should not be accepted.



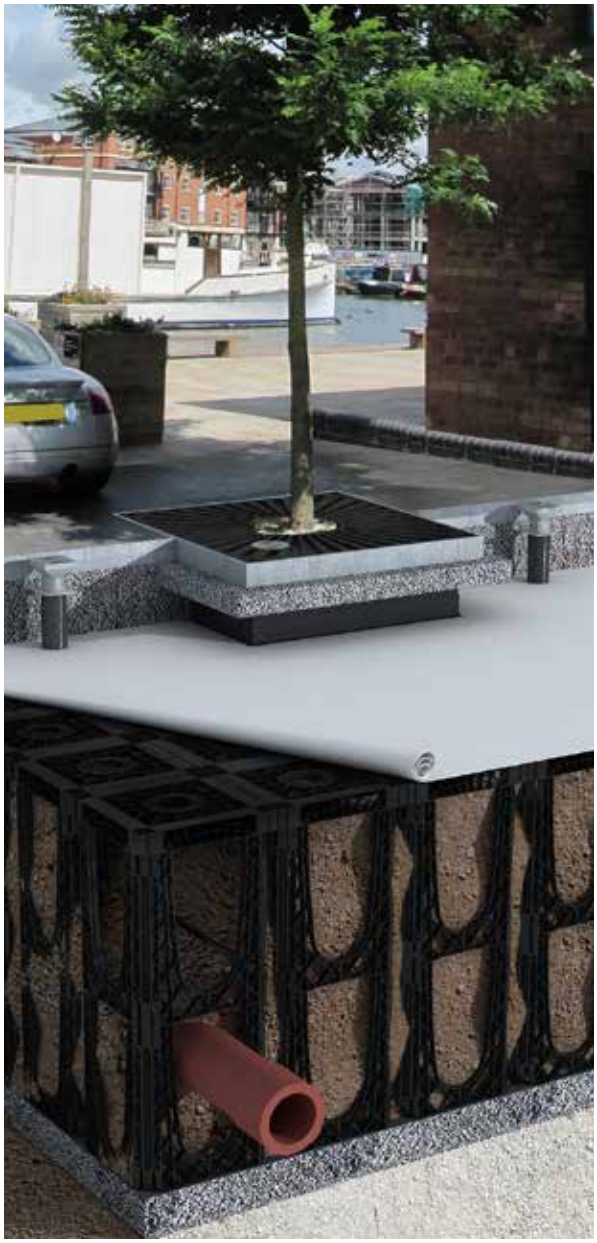


About GreenBlue Urban

Founded in 1992, GreenBlue Urban was established to conduct research into urban tree planting practices and provide solutions to assist trees in their battle to thrive in urban areas.

With the goal of drastically improving urban planting success and increasing leaf canopy in cities, GreenBlue tirelessly analyzed the challenges, the causes of failure, and the reasons for premature mortality in urban trees. We then examined the negative impact that poor planting can have on urban infrastructures. Having identified the key issues in both of these areas, we systematically researched the solutions for those issues and designed practical products and systems to address them.

Coupled with that, is the integration of stormwater management into urban tree planting, to reduce runoff and sustainably manage stormwater in our urban areas. The GreenBlue ArborFlow decreases stormwater quantity, while increasing quality. Learn more at www.greenblue.com.



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