Functional Green

An Ecosystem Service Performance Metric For Landscape Regulation

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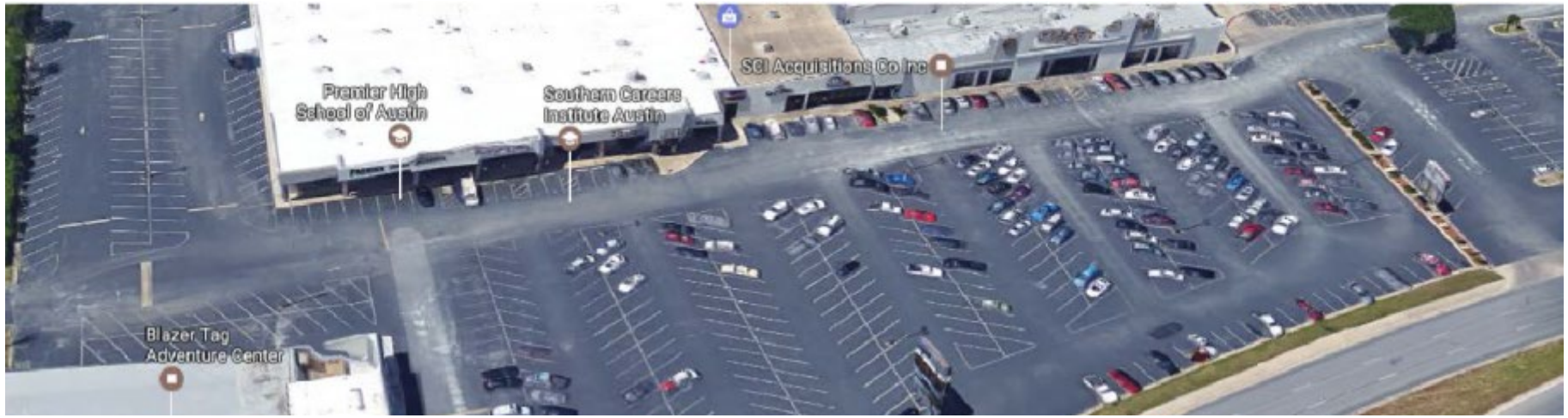
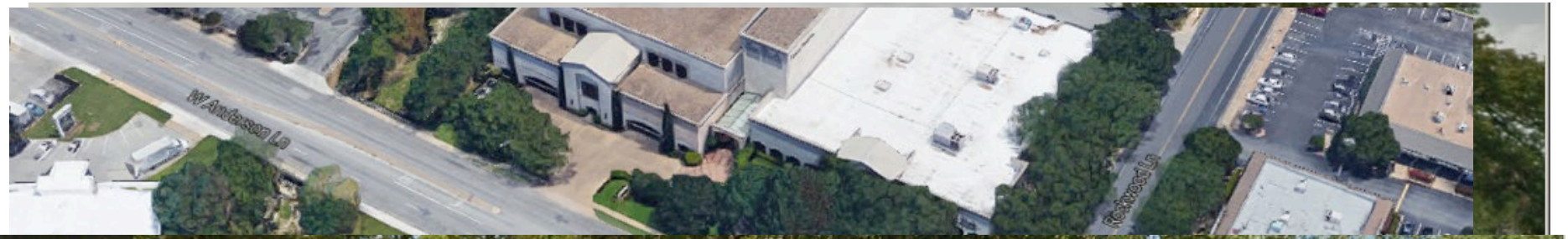
Learn About the

WATER QUALITY PROTECTION LANDS


Firestone


Premier High School of Austin
Southern Careers Institute Austin
SCI Acquisitions Co Inc
Blazer Tag Adventure Center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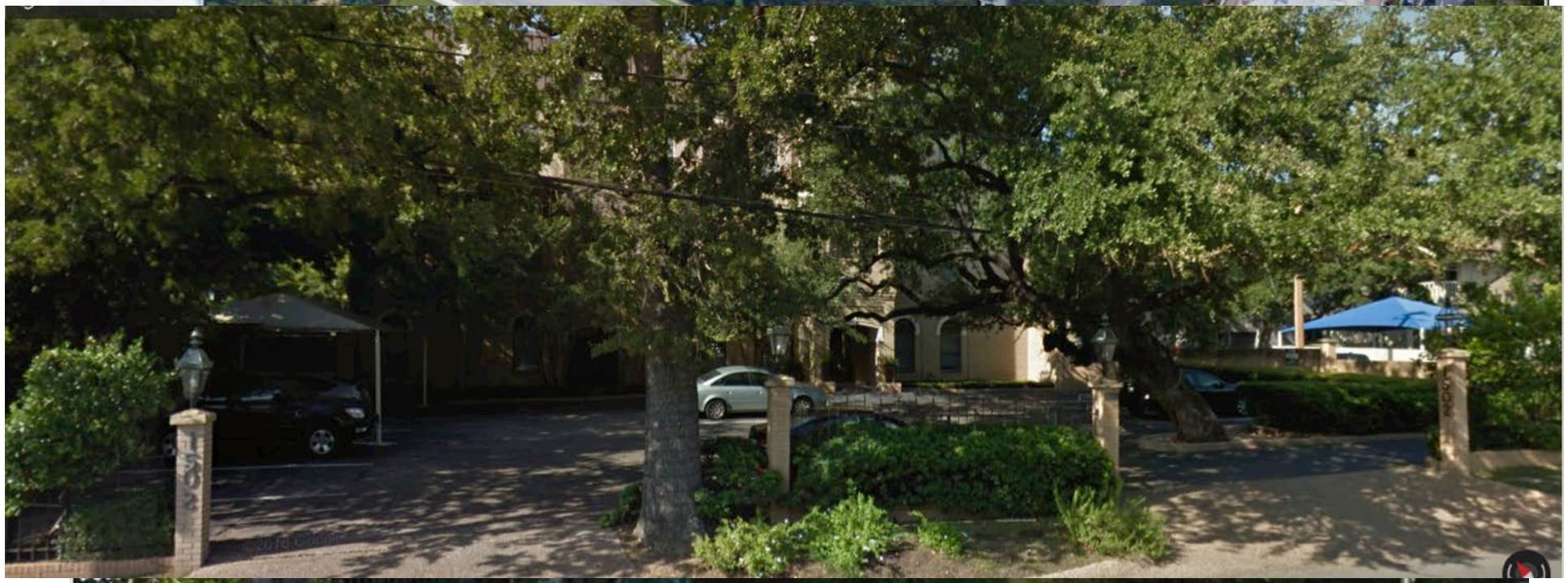

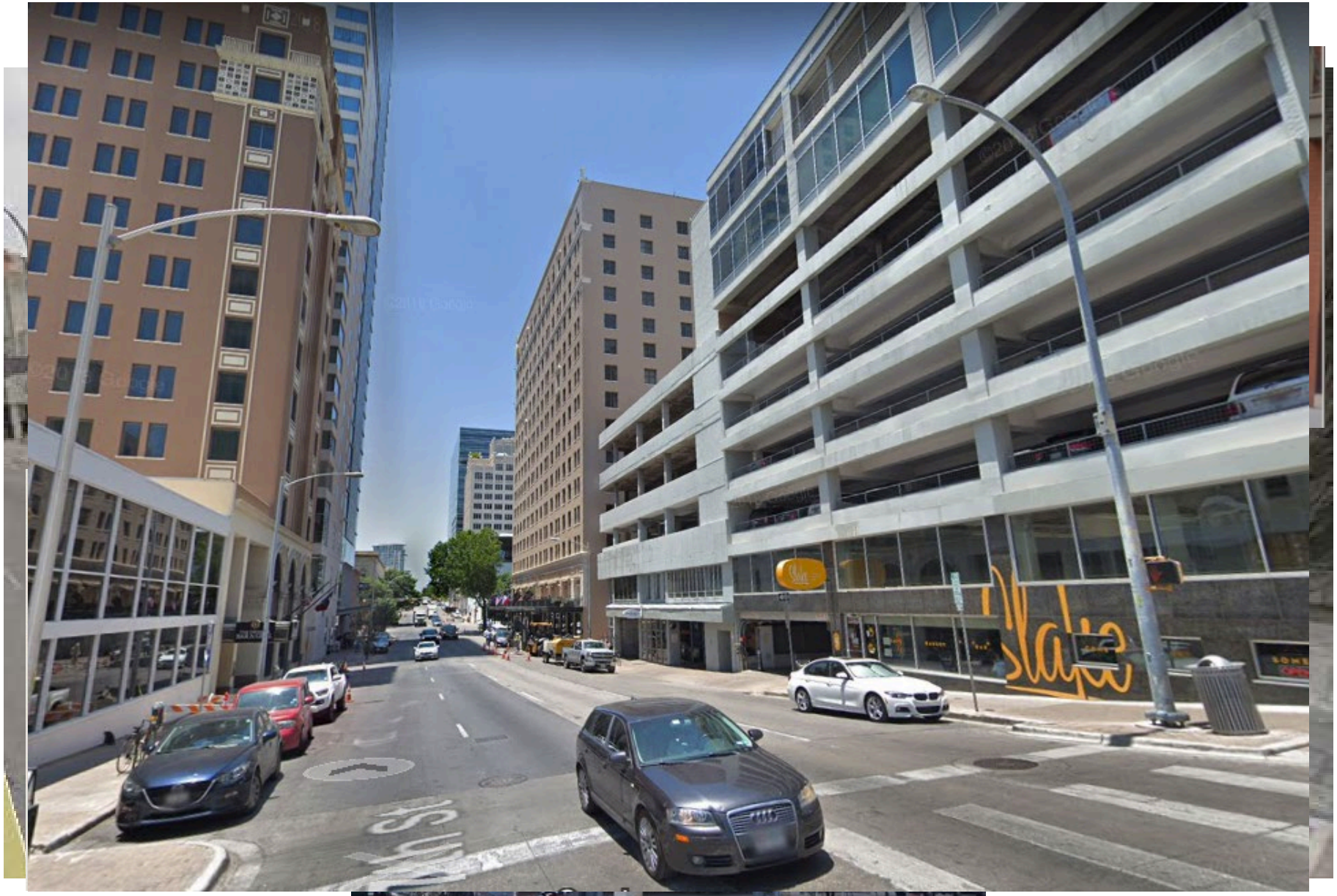

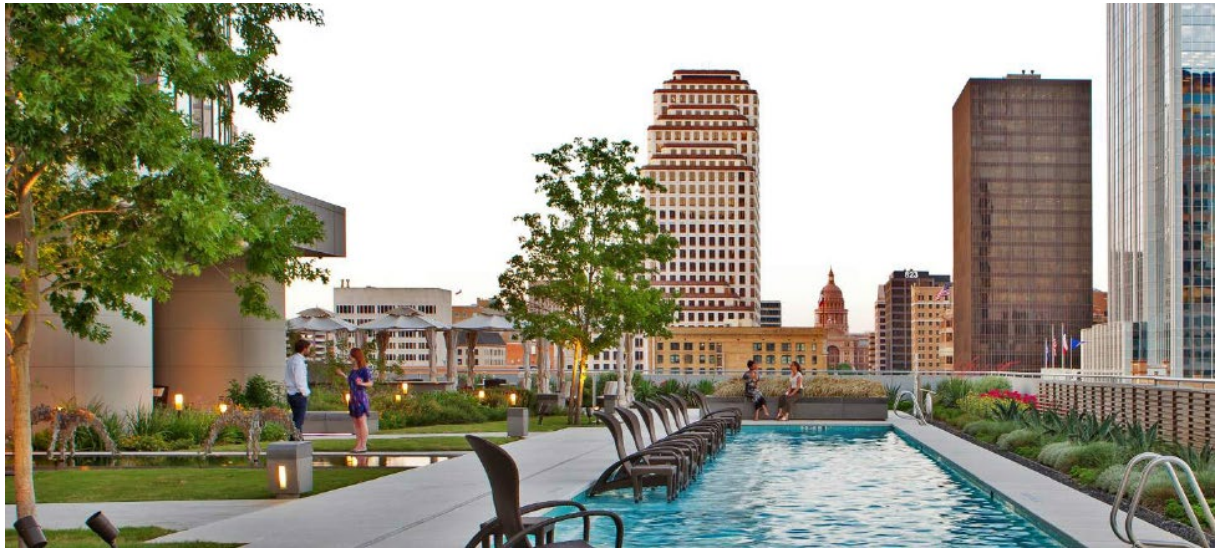

A Code on Ecosystem Services

Prescriptive  Performative

Prescriptive  Performative

Ecological Performance

Biotope Area Factor

Berlin, Germany

Stockholm Royal Seaport BAF

Stockholm, Sweden

Green Infrastructure Toolkit

North West England

Seattle Green Factor

Seattle, Washington

Green Space Factor

Malmö, Sweden

Green Area Ratio

Washington, D.C.

Team of staff experts

Landscape Elements

- Existing Tree
- Newly Planted Tree
- Green Roof (Intensive & Extensive)
- Rain Garden
- Vegetated Wall
- Shrubs / Ornamental Grasses/ Perennials
- Ground Cover
- Porous Pavement
- Cistern

Ecosystem Services

- Microclimate regulation
- Carbon storage and sequestration
- Air pollutant removal
- Stormwater retention
- Water filtration
- Habitat/biodiversity
- Human well-being

Consultant team

Heather Venhaus
Regenerative Environmental Design

Ed MacMullan
ECONorthwest

Amy Belaire
Ph.D.

Table 4. Range of Estimated Biophysical Benefits for Green Roofs in Austin, Texas

Ecosystem Service Type	Range of Estimated Biophysical Benefits in Austin, Texas	References
Microclimate regulation and mitigation of urban heat island effects	On a per-roof basis: maximum temperature reduction of 45-54° F for roof surface temperatures (compared to non-vegetated roofs) At broader scales: 1.6-5.4° F reduction in ambient air temperatures with widespread green roof implementation	Alexandri & Jones 2008, Susca et al. 2011, Santamouris 2014, Meek et al. 2014
Carbon storage and sequestration	Storage: 0-67.7 kg C/m^2 depending on plant type, substrate, and age of roof	Getter et al. 2009, Whittinghill et al. 2014
Air pollutant removal	Per unit area: 85 kg of pollutants removed per hectare of green roof per year (8.5 g/m^2), with 0.65-1.01 g SO_2/m^2, 2.33-3.57 g NO_2/m^2, 1.12-2.16 g PM_{10}/m^2, 4.49-7.17 g O_3/m^2 At broader scales: Up to 2046 metric tons of pollutants removed per year for widespread green roof implementation	Yang et al. 2008, Currie et al. 2008
Stormwater retention and runoff reduction	On a per-roof basis: 44-88% of rainfall volume retained per storm and 43-78% of rainfall volume retained annually At broader scales: 15-45% reduction in runoff volumes with widespread implementation	Carter et al. 2007, Simmons et al. 2013, Glass 2007, Berndtsson et al. 2010, Harper et al. 2015, Morgan et al. 2013, Meek et al. 2014
Water filtration	Mixed results for water quality. Although total concentrations may be higher in effluent, the total loads are lower due to high runoff volume retention.	Rowe et al. 2011, Ahiablame et al. 2012
Biodiversity	Green roofs can provide habitat for a relatively high diversity of invertebrate species, including native pollinators, and increase functional connectivity for these species	Colla et al. 2009, Tonietto et al. 2011, Madre et al. 2013, Braaker et al. 2014
Human well-being	Potential to reduce noise pollution and provide green views to building occupants	Van Renterghem & Botteldooren 2009, Oberndorfer 2007

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Table 5. Range of Estimated Values of Economic Benefits of Green Roofs in Austin, Texas

Economic Benefit	Range of Values of Economic Benefits for Austin, Texas	References
Building Cost Savings	May extend the life of the roof underlayment by 20 years or more.	EPA 2000
Development Cost Savings	Developers may use green roofs to meet certain development requirements or earn a density bonus credit.	City of Austin No Date
Energy Savings	Expected reduction in energy demand and cost. Magnitude dependent on existing energy efficiency of the building and properties of the green roof. Buildings that are already well-insulated likely will experience more limited energy benefits. Energy savings are greatest for the first floor below the roof, with decreasing benefits up to four stories below the roof.	Blackhurst et al. 2010
Carbon Sequestration	$44-$239 per metric ton of Carbon	Interagency Working Group 2016
Nitrogen Dioxide Removal	$0.13-$0.33 per kg	Nowak et al. 2016
Small Particulate Matter	$0.04-$0.09 per kg	Nowak et al. 2016
Avoided Stormwater Runoff Costs to City of Austin	$2 per cubic foot of stormwater diverted from system	American Forests 2002
Avoided Stormwater Runoff Fee Assessed to Property Owners	Up to a 72% reduction in the monthly drainage charge assessed by the City of Austin. Actual savings depends on site-specific factors.	
Impacts on Property Values	Up to 6% increase in rental rates, which may increase property values	GSA 2011
Avoided Costs of Ecological and Species Habitat Management	Unquantifiable, but likely positive. Higher value for positive effects on habitat for sensitive species	
Avoided Health Care Costs, Improved Human Well-being	Unquantifiable, but likely positive if green roof is within view or accessible. Positive relationships have been measured at a national scale, attributing benefits of access to green space to reduced healthcare costs and improved quality of life arising from improved newborn health; reduced incidence of ADHD; improved school performance; reduced crime; and improved cardiovascular health.	Wolf 2015

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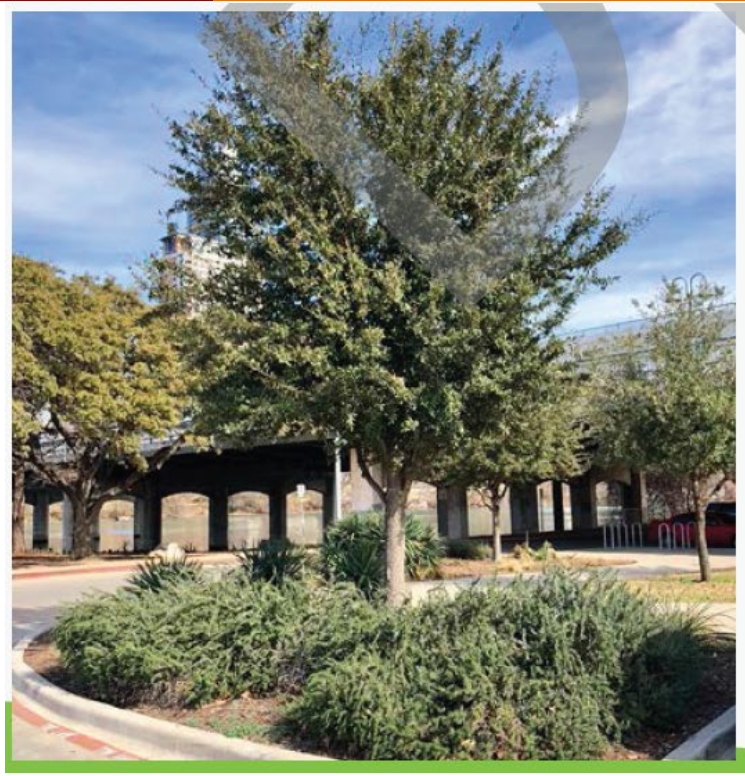
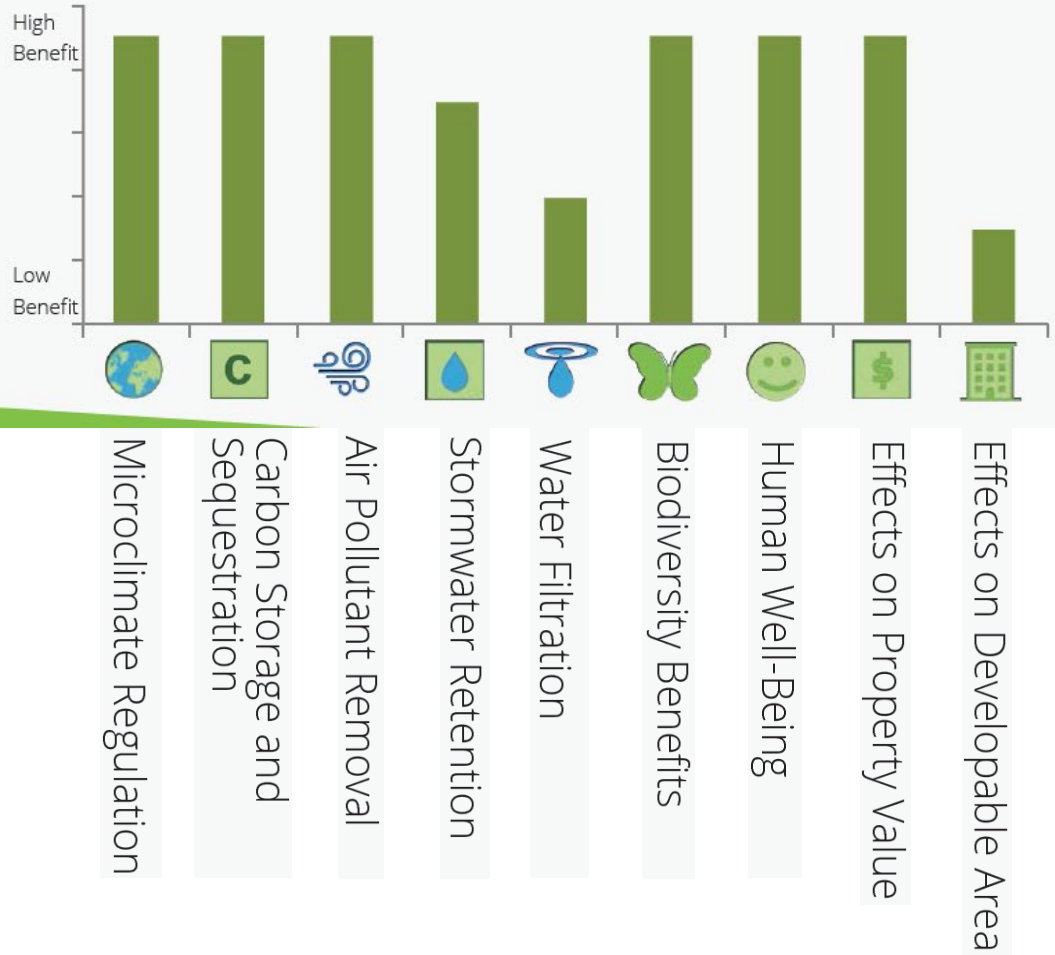


EXISTING TREES AND LARGE, MEDIUM, AND SMALL TREES

Factor: 0.4 - 0.8

Cost: $$

Existing trees receive the highest factor score because of the high level of benefits they provide. Newly planted trees receive credit based on their estimated size at maturity (small, medium, and large).

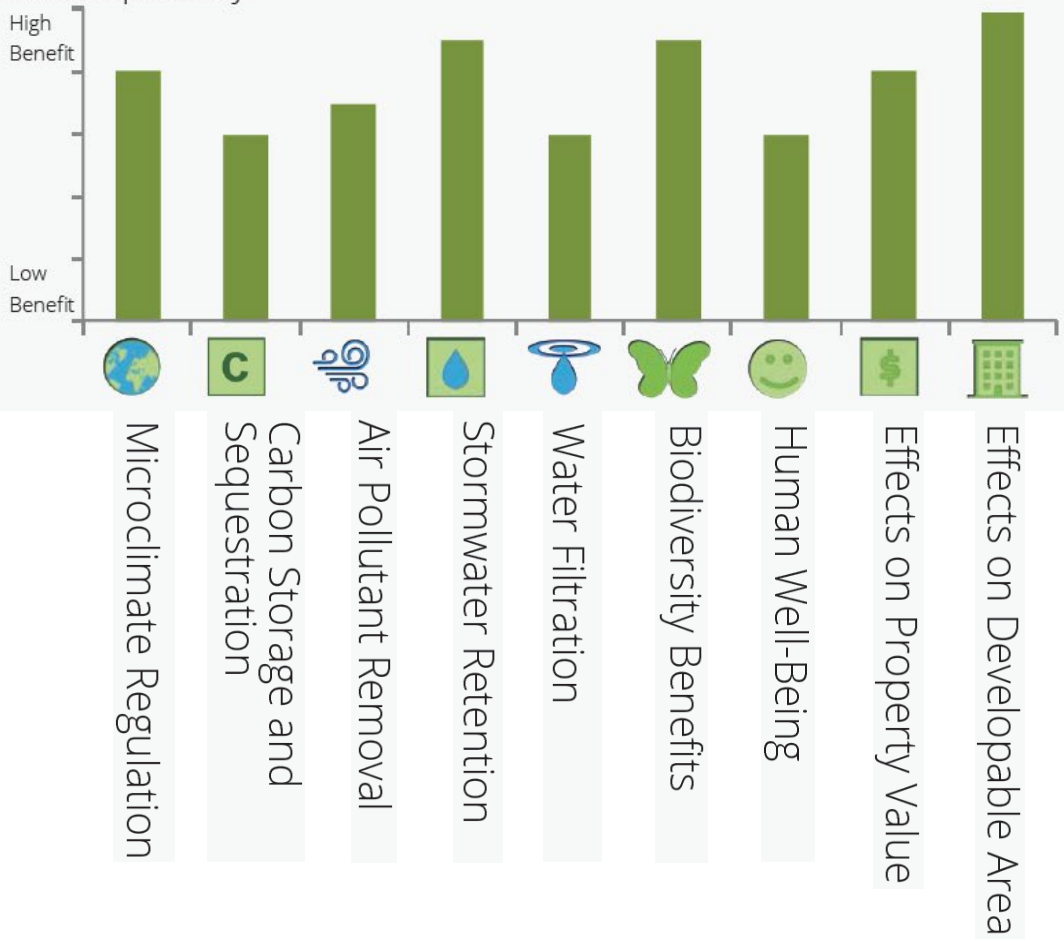


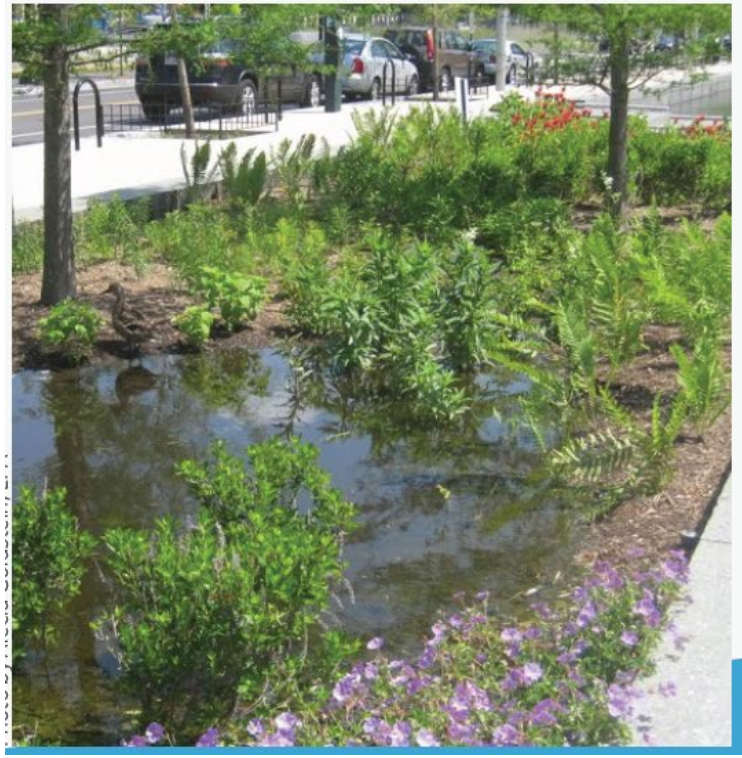
EXTENSIVE AND INTENSIVE GREEN ROOF

Factor: 0.5 - 0.6

Cost: $$$ - $$$$

Green roofs cover buildings, parking garages, and other elevated surfaces with a vegetated surface and growing media. Projects can use both extensive (media less than 7" deep) and intensive (media 7" deep or greater) green roofs. Additional credit for the plantings in the green roof is counted separately.



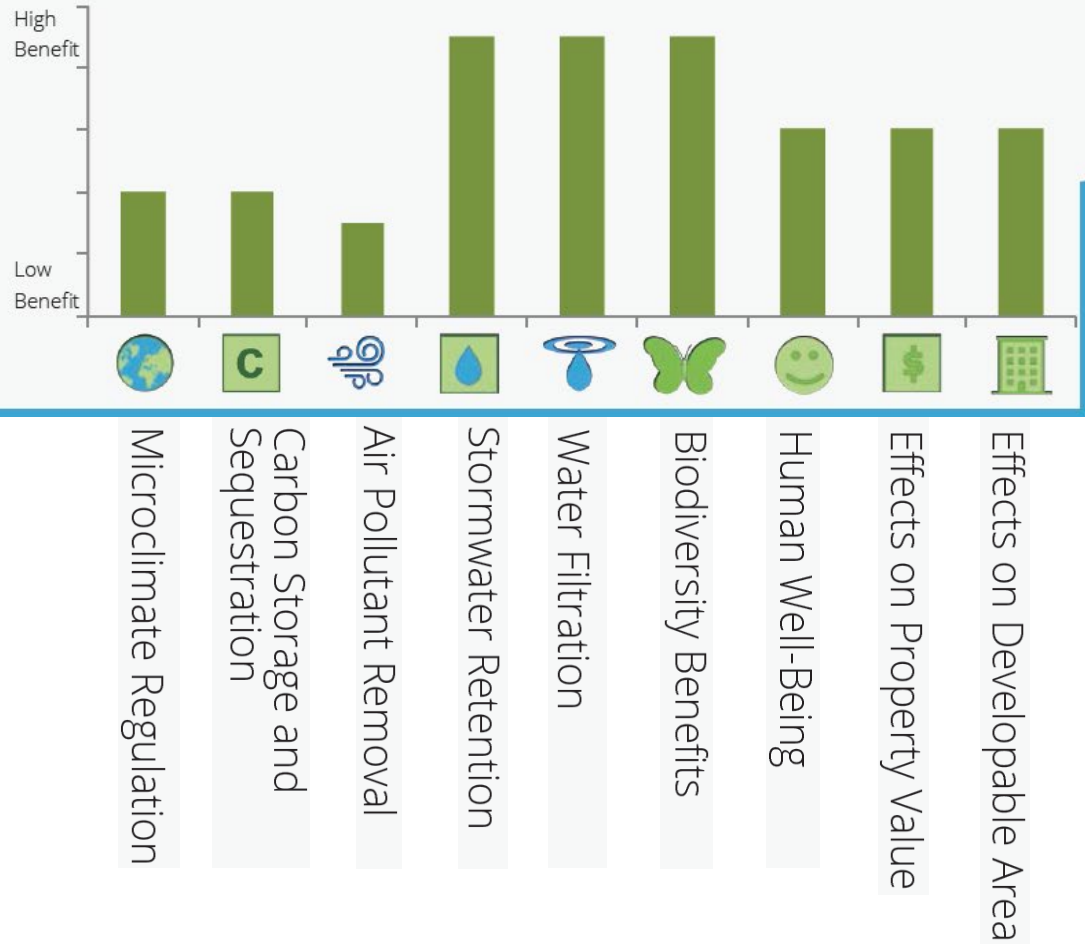


RAIN GARDEN

Factor: 0.3

Cost: $ - $$

A rain garden is a vegetated, depressed landscape area designed to capture and infiltrate and/or filter stormwater runoff. Rain garden media is either native soil or biofiltration media. Additional credit for the vegetation in the rain garden is counted separately.

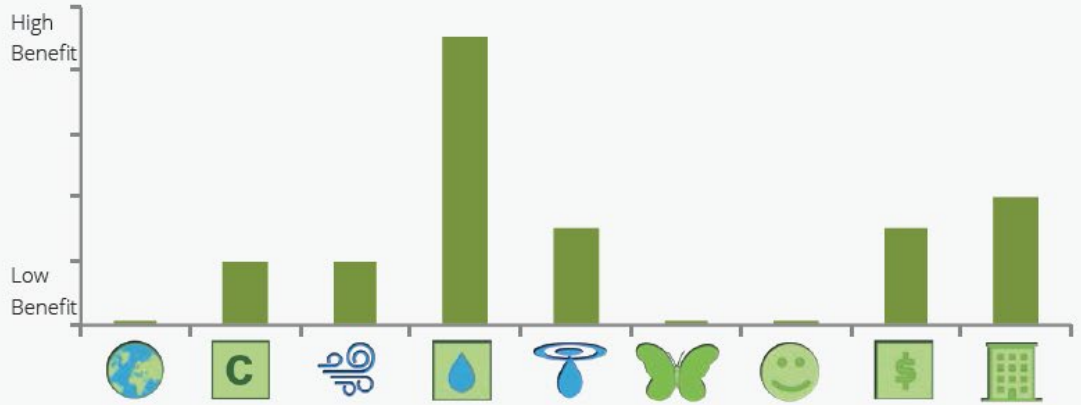


CISTERN

Factor: 0.3

Cost: $$ - $$$

Cisterns can be located above or below ground and provide a reservoir for temporarily storing rainwater or a/c condensate. Credit is given for the storage capacity of the cistern.



Microclimate Regulation

Carbon Storage and Sequestration

Air Pollutant Removal

Stormwater Retention

Water Filtration

Biodiversity Benefits

Human Well-Being

Effects on Property Value

Effects on Developable Area

	LANDSCAPE ELEMENTS	FACTOR
1	Existing Trees	0.8
2	Newly Planted Tree: Large	0.6
2	Newly Planted Tree: Medium	0.5
2	Newly Planted Tree: Small	0.4
3	Shrubs / Ornamental Grasses / Perennials	0.3
4	Ground Cover	0.2
5	Extensive Green Roof	0.5
6	Intensive Green Roof	0.6
7	Rain Garden	0.3
8	Porous Pavement	0.4
9	Vegetated Wall	0.5
10	Cistern	0.3
11	Auxiliary Water Irrigation	0.2
12	Pollinator Resource	0.1
13	Suspended Pavement System	0.2

$$\text{FUNCTIONAL GREEN SCORE} = \frac{\left(\text{Area (sq. ft.) of Landscape Element A} \times \text{Factor A} + \text{Area (sq. ft.) of Landscape Element B} \times \text{Factor B} + \text{Area (sq. ft.) of Landscape Element C} \times \text{Factor C}\right)}{\text{Total Area (sq. ft.) of Site*}}$$

	LANDSCAPE ELEMENTS	FACTOR
1	Existing Trees	0.8
2	Newly Planted Tree: Large	0.6
2	Newly Planted Tree: Medium	0.5
2	Newly Planted Tree: Small	0.4
3	Shrubs / Ornamental Grasses / Perennials	0.3
4	Ground Cover	0.2
5	Extensive Green Roof	0.5
6	Intensive Green Roof	0.6
7	Rain Garden	0.3

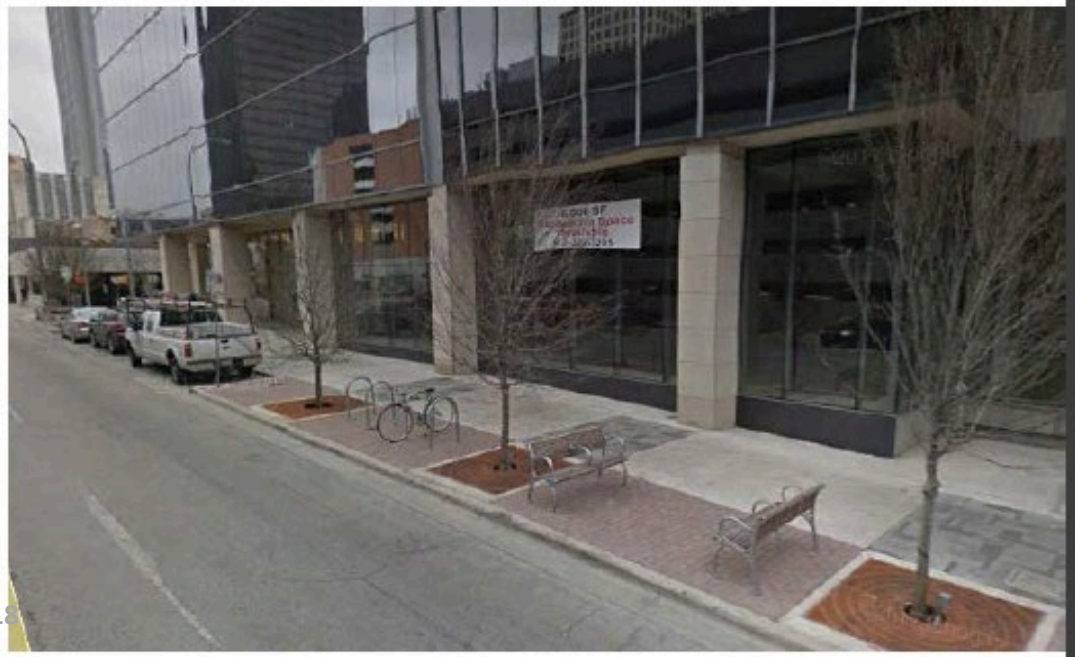
South Congress Hotel
1603 S Congress Ave.

Size: 0.95 acre
IC: 95%
Score: 0.31
Existing landscape

Landscape elements

- Planted trees (70%)
- Shrubs/Perennials (12%)
- Groundcover (1%)
- Vegetated wall (13%)
- Extensive greenroof (2%)
- Pollinator resources (2%)

* Numbers represent the percent of the 0.3 target score provided by each landscape element



5th & Colorado
Downtown

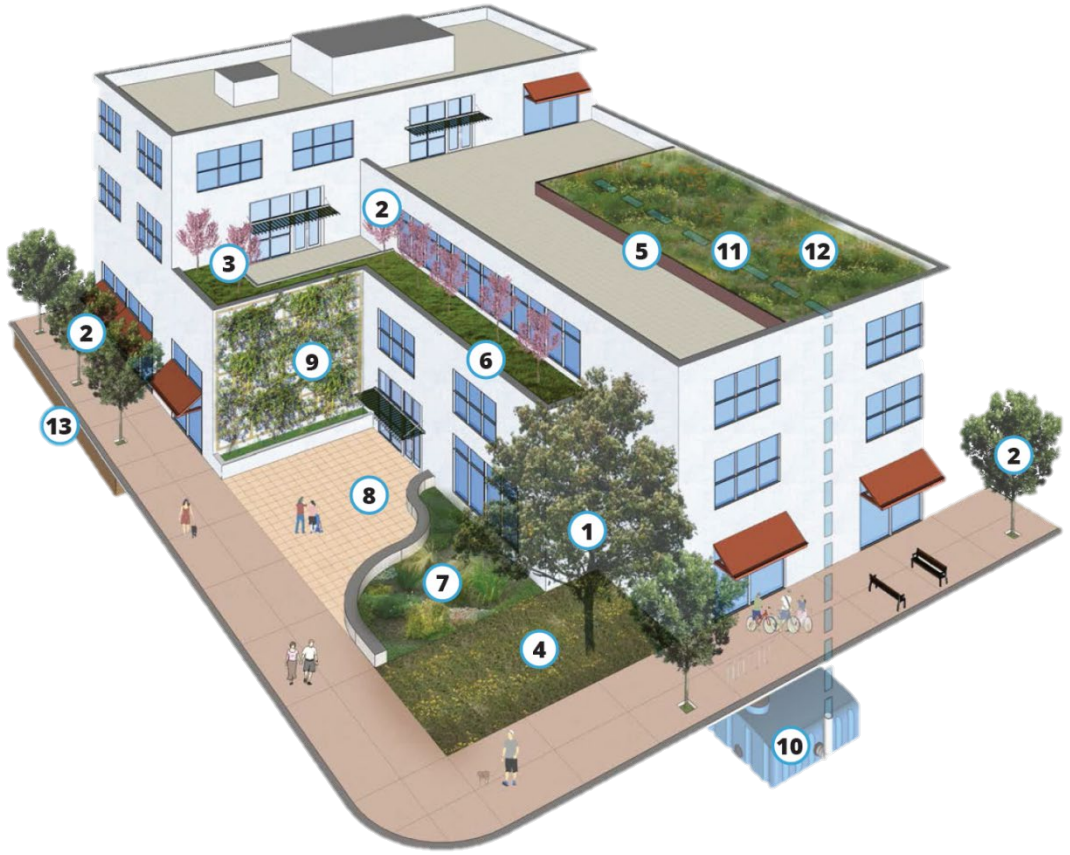
Size: 0.66
IC: 100%
Score: 0.11
Existing landscape

Existing landscape elements

- Planted trees (38%)
- Enhanced soil (3%)

Additions needed to reach 0.3 target:

- Extensive green roof (29%)
- Perennials (17%)
- Cistern (7%)
- Aux. irrigation (6%)



Questions?

Thank you

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