Appendix III: Science City URBAN LANDSCAPE / INFRASTRUCTURE Design Approach

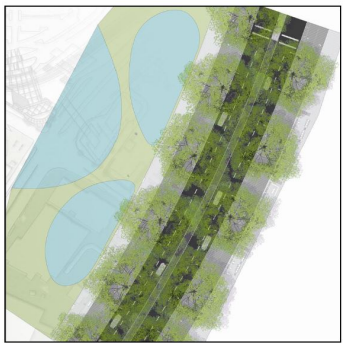
As part of the initial phase of this project, the Puerto Rico Science, Research and Technology Trust commissioned the final design and construction documents of the main urban roads of Science City. This project's physical development is based on an urban infrastructure that takes into account and give prioritizes the well being of its inhabitants and those who will make use of this area on a daily basis. The Science City addresses urban infrastructure through three typologies that give utmost importance to urban trees and vegetation, recognizing the vital importance of these in the development of any sustainable and socially responsible project.

Multifunctional urban corridors address the needs of pedestrian and vehicular traffic alike, and trees have an important role providing shade, creating clean air, lowering the temperature and creating usable and comfortable open space. Urban trees intercept and direct precipitation into the ground and take up storm water through their roots, decreasing runoff flood volumes. However, urbanization disrupts natural soil profiles, while root growth and urban canopy cover are greatly limited by soil compaction under pavement to meet load-bearing requirements. The Science City Streetscape showcases and compares three storm water management technologies, articulating them into an innovative hardscape design and its related infrastructural engineering. In our project, the three infrastructural strategies of Suspended Concrete Planks, Pervious Concrete over Structural Soil, and Vegetated Infiltration Sump, are related to the structural form and functions of three urban landscape typologies—the Boulevard, The Urban Forest Edge, the Parterre.

Three Urban Landscape / Infrastructure Typologies

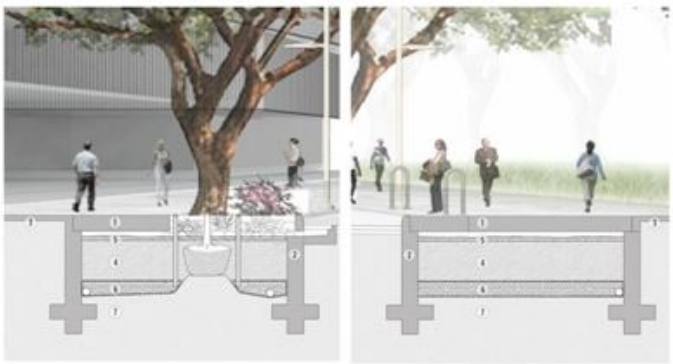
1. **THE SCIENCE CITY BOULEVARD**: The traditional avenue or boulevard, symmetrically planted on both sides, creates a sense of proportions and stately order to a variety of urban elements and functions. In the contemporary city, it has lost its multifunctional character when replaced by multiple lane roadways that sever delicate urban fabric. Moreover, the tree canopy at the edge can hardly define the wider space allocated for the automobile, marking a further separation between pedestrian life and

vehicular traffic. In a tropical climate like ours, this is an even larger loss because shade is vital in order to create habitable urban spaces. We want to challenge these problems by planting the species *Samanea Saman*, a tree that can achieve an 80-foot diameter canopy when its root system is provided with the space to develop, as the one we will have below the designed sidewalk system of suspended precast concrete planks.

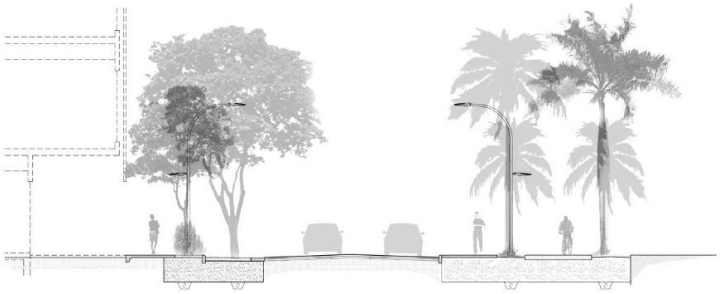


Storm water Management Technology: Cantilevered Planks

The idea of suspended pavement by means of structural cells over a relatively large volume of un-compacted urban soil volume has been strongly advocated by James Urban, among others, as the best approach to building long-lived urban landscapes. In the Saman Boulevard, the sidewalks are designed as if the concrete is a spanning deck surface. Prefabricated concrete planks are cantilevered over a below ground planter where a large trench of un-compacted soil is available to the roots of the *Samanea saman* trees to expand unrestrictedly. The soil functions as a storm water filtering and holding chamber in ways previously reserved only to natural areas. The runoff water enters the underground trench from lateral openings at the road curbs, and reaches the storm water system only after having fed all the root system of the trees.



2. **THE URBAN FOREST EDGE:** The landscape and hardscape treatment of the Laboratory Street is different on the two opposite sides of the road. Much like and ecotone, this difference reflects a transitional area where two dissimilar urban land uses meet and integrate. Unlike the unified, symmetrical space of the boulevard, the street here becomes an interstitial space with two very distinctive edge conditions that take predominance over the center. On the west side, where a dense building envelope will be developed, a "woodland" edge of various native tree species will articulate both sidewalk and linear parking spaces with their different height and form. On the east side, where a future park will be developed, the need for transparency calls for three different variety of palms arranged as an extruded linear space that has a complex cross section in its interior. *Roystonea borinquena, Acrocomia media* and *Carperntaria acuminate* palms alternate or shift dynamically along a bike path sprouting from a playful arrangement of trapezoidal flush planters that help orchestrate the curvilinear biking experience. As in the "woodland" on the opposite side, the palm roots system will interlace quickly holding up steady the palm trunks during hurricane because of the deep, wide and long trench of structural soil provided under the pervious concrete paving.



Storm water Management Technology: Pervious Concrete over Structural Soil

CU-Structural Soil is a patented mixture developed by Cornell University: 75% crushed angular stone 1" approx. size/ no fines (to provide the greatest large void space) and 24% soil are mixed with a small amount of hydrogel to prevent the soil and stone from separating during the mixing and installation process. This proportion insures that each stone touches another stone creating a rigid skeleton that can be compacted to 95% while the soil between stones remains un-compacted. In Science City Laboratory Road, we have specified such soil design at a min. depth of 30" under a pervious concrete paving that will facilitate runoff water infiltration through the whole surface of sidewalk, bike path or parking areas. Pervious concrete is a concrete paving made primarily of small aggregate and cement mix, with no sand. Most built projects to date have used impermeable paving over CU-Structural Soil, but we believe that tree growth will respond much better to the additional water infiltrating though the porous pavement during each small rain event.

3. **THE PARTERRE**: This landscape typology is derived from the "meadow" archetype or that stretch of open land cleared from the forest. Typically conceived as two-dimensional decorative pattern made of grass, clipped hedges or flowers, in this project it also acquires volume because of its underground water harvesting and storage functions. The ribbon shapes can be enjoyed from the road and from the building's upper floors, and give the impression of an abstract sculpted landform that emphasize and match closely the contour shaping and the movement of the water downhill. They are planted with Gama grass (*Tripsacum floridiana),* a robust, tufted herbaceous perennial that withstands both flooded and drought conditions. The grass acts as a dam or weir perpendicular to the water flow and thereby intercepts a large quantity of runoff going along the slope in specific areas. There will be no other plantings in the rain gardens with the exception of occasional scattered palms: the intent is to give the impression of a meadow or savanna landscape, very open, where the beautiful contrast between the short, rough textured lawn grass (Bermuda grass) and soft, fined textured silvery Gama grass will be the essence of the design.

Stormwater Management Technology: Vegetated Infiltration Sump

This storm water strategy carries often the name of bio-retention cell, or rain garden. It is a planted infiltration depression filled with permeable soil that intercepts and slows the erosive path of surface runoff water created by surrounding paved areas, and recharges the aquifer. While most rain garden projects focus on the functional and ecological aspect of the sump, creating informal depressions with all sort of drought tolerant plants that tolerate inundation, in Science City the formal aspect is an important design component: a drifting pattern is scattered in specific areas and becomes almost the signature of the project grounds. The sculpted depressions also permeate the sloping grounds of the Comprehensive Cancer Center, under construction, eliminating the need for a large and unsightly detention pond and reducing storm water volumes to a fraction to be diverted in rain tanks under the parking lot.