# Symbiotic Urban Water Systems:

## The Architectural Impact of Integrating Living Technologies to Manage Watershed Flows and Ecosystem Services




**Ali Abbaszadegan**

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## Living Roofs

Living roofs and roof gardens are vegetated roof surfaces that can help to improve the performance of the building by forming better acoustic quality in the interior and increasing the life of the roof membrane. Also, the system creates a greater aesthetic appeal and biodiversity. Green roofs fall into two categories: extensive and intensive. The extensive system is lightweight, has a shallow soil depth and small plants to serve ecological functions. Intensive green roofs can be as big as you want them to be and have roof top gardens with shrubs, trees and walkways to maximize accessibility and use. Planting methods can take on different shapes in different places due to local responses to plant use. It is also beneficial that innovative architecture compliment the green roof system to help maximize all sustainable infrastructure components.

## Wetlands

Wetland hydrology is associated with the spatial and temporal dispersion, flow, and physiochemical attributes of surface and ground water in its reservoirs. Based on hydrology, wetlands can be categorized as riverine (associated with streams), lacustrine (associated with lakes and reservoirs), and palustrine (isolated). Sources of hydrological flows into wetlands are predominately precipitation, surface water, and ground water. Water flows out of wetlands by evapotranspiration, surface runoff, and sub-surface water outflow. Hydrodynamics (the movement of water through and from a wetland) affects hydroperiods (temporal fluctuations in water levels) by controlling the water balance and water storage within a wetland.

Source: Richardson, JL, Arndt, JL & Montgomery, JA 2001, ‘Hydrology of wetland and related soils’ in JL Richardson & MJ Vepraskas (eds), Wetland Soils, Lewis Publishers, Boca Raton

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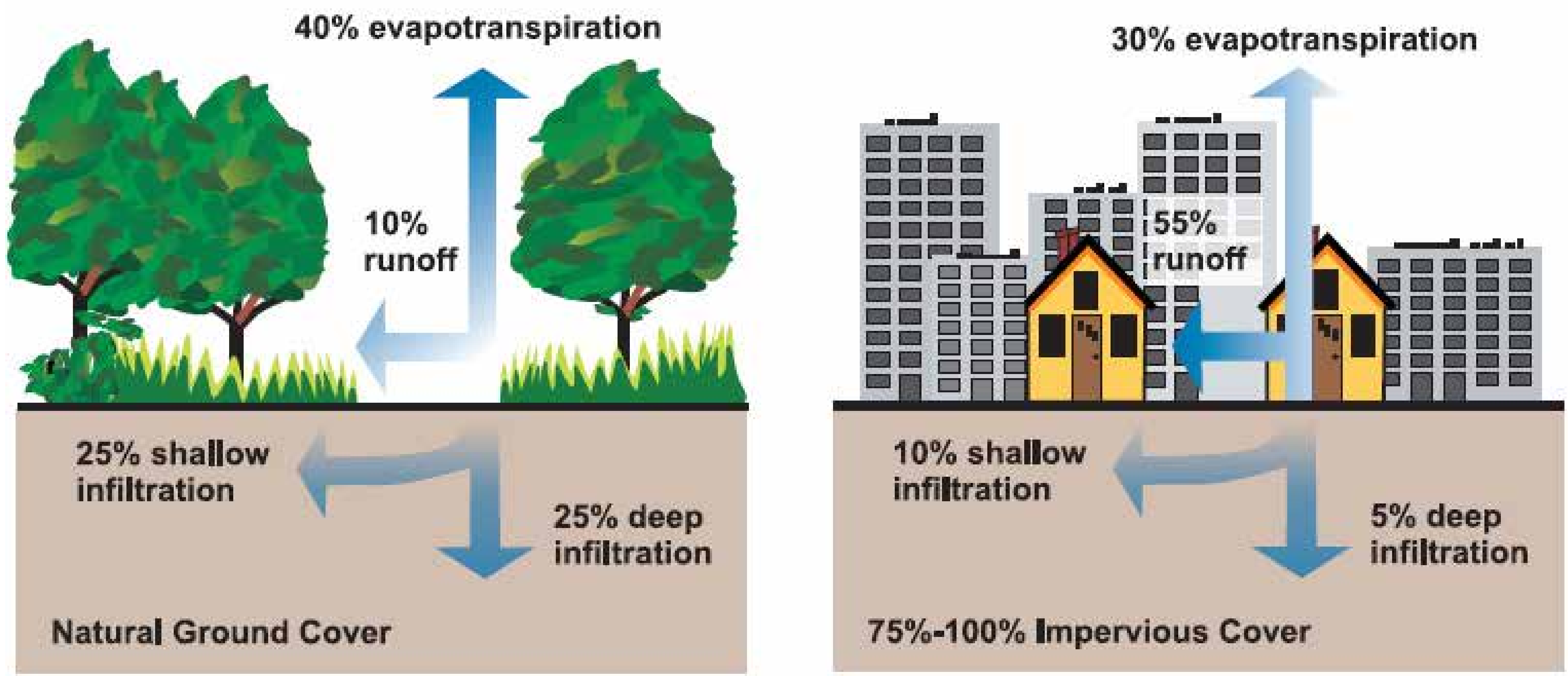



Source: U.S. Environmental Protection Agency, Washington, D.C. “Protecting Water Quality from Urban Runoff.” Document No. EPA 841-F-03-003

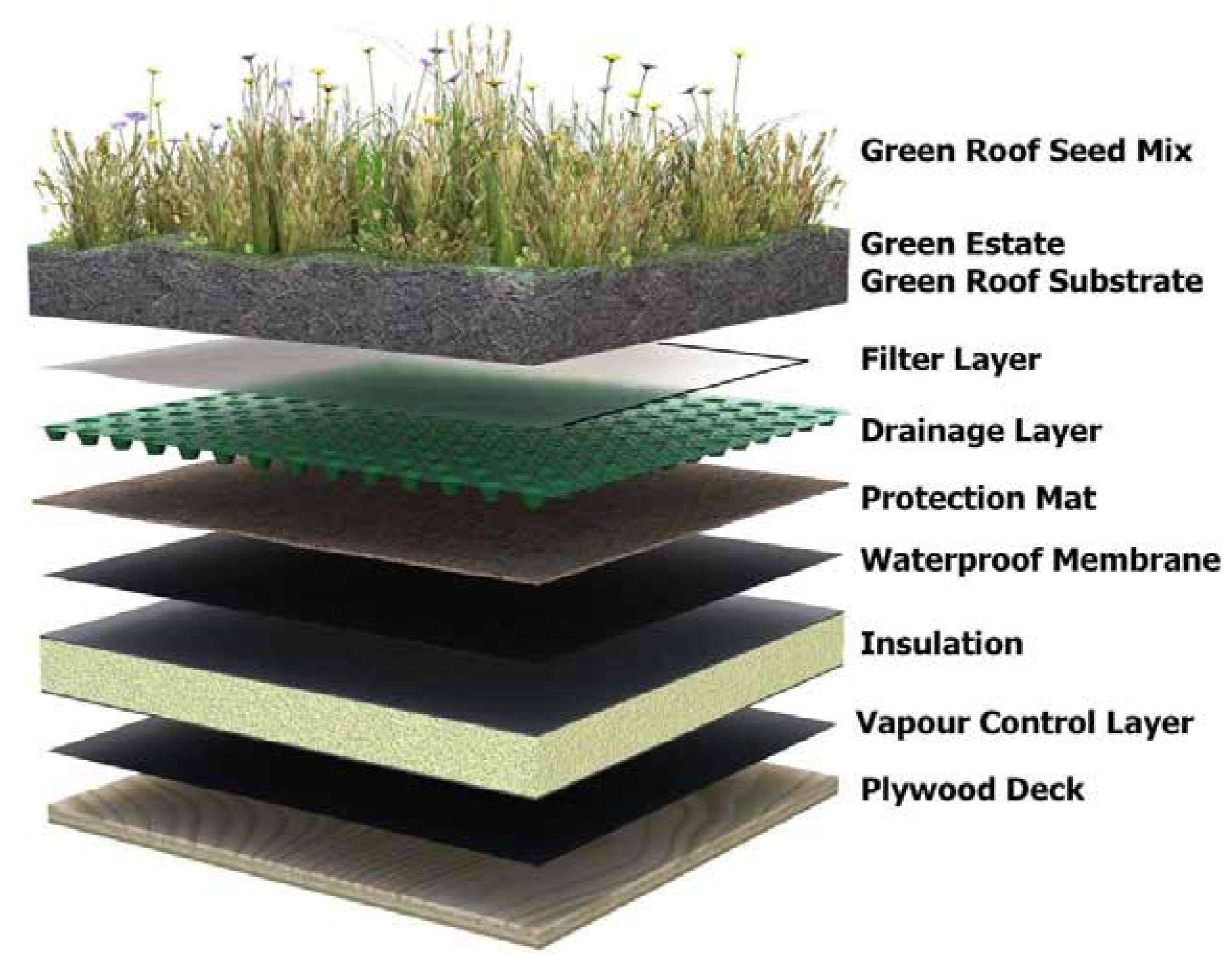
# Living Roofs / Integration

There are two types of green roofs. The Extensive system is lightweight, shallow soil depth and small plants to serve ecological functions. Intensive green roofs can be as big as you want them to be, real roof top gardens with shrubs, trees and walkways to maximize accessibility and use.

**Core Plants:**
-Low Maintanence
-Long Lived
-Exist is Shallow Substrate
-Do Not Need Irrigation
-Groundcover Habitat
-Open to All Installation Methods

**Succulent Mix:**
-Low Weight
-Low Inputs
-Low Nutrient Outfall
-Low Maintenance
-Limited Design Options

**Layers of a Green Roof:**
From top to bottom




Planting methods can take on different shapes in a multitude of places to help transform the Architecture into an adaptable tool to sequester carbon, reduce the heat island effect and manage storm water runoff.

# Living Roofs / Integration

**A green roof test plot at the University of Georgia retained 88% of precipitation for small storms (<1 inch), 48% for larger storms (>3 inches), and delayed the peak flow by an average of 18 minutes for 31 rain events between Nov 2003 and Nov 2004.**

Carter, Timothy L., and Todd C. Rasmussen. (2006). Evaluation of the hydrologic behavior of green roofs. Journal of the American Water Resources Association 42(5), 1261-1274.

**A Michigan State University study used test platforms to test the influence of roof slope (2 and 6.5%) and green roof media depth (2.5, 4.0, and 6.0 cm) on stormwater retention. For all combined rain events, platforms at 2% slope with a 4-cm media depth had the greatest mean retention, 87%, although the difference from the other treatments was minimal. The combination of reduced slope and deeper media clearly reduced the total quantity of runoff.**

VanWoert, Nicholaus D., D. Bradley Rowe, Jeffrey A. Andresen, Clayton L. Rugh, R. Thomas Fernandez, and Lan Xiao. (2005). Green Roof Stormwater Retention: Effects of Roof Surface, Slope, and Media Depth. Journal of Environmental Quality, 34(3), 1036-1044.

# Artificial Wetlands / Integration

A treatment wetland is an engineered sequence of water bodies designed to filter and treat waterborne pollutants found in storm water runoff or effluent.

In treatment wetlands aerobic and anaerobic biological processes can neutralize and capture most of the dissolved nutrients and toxic pollutants from the water, resulting in the discharge of clean water.

Many regulatory agencies list treatment wetlands as one of their recommended “best management practices” for controlling urban runoff. Treatment wetlands can also be used for sewage treatment.

Source: Wastewater Treatment Wetlands: Contaminant Removal Processes by William DeBusk, University of Florida, Institute of Food and Agricultural Sciences

# Artificial Wetlands / Integration

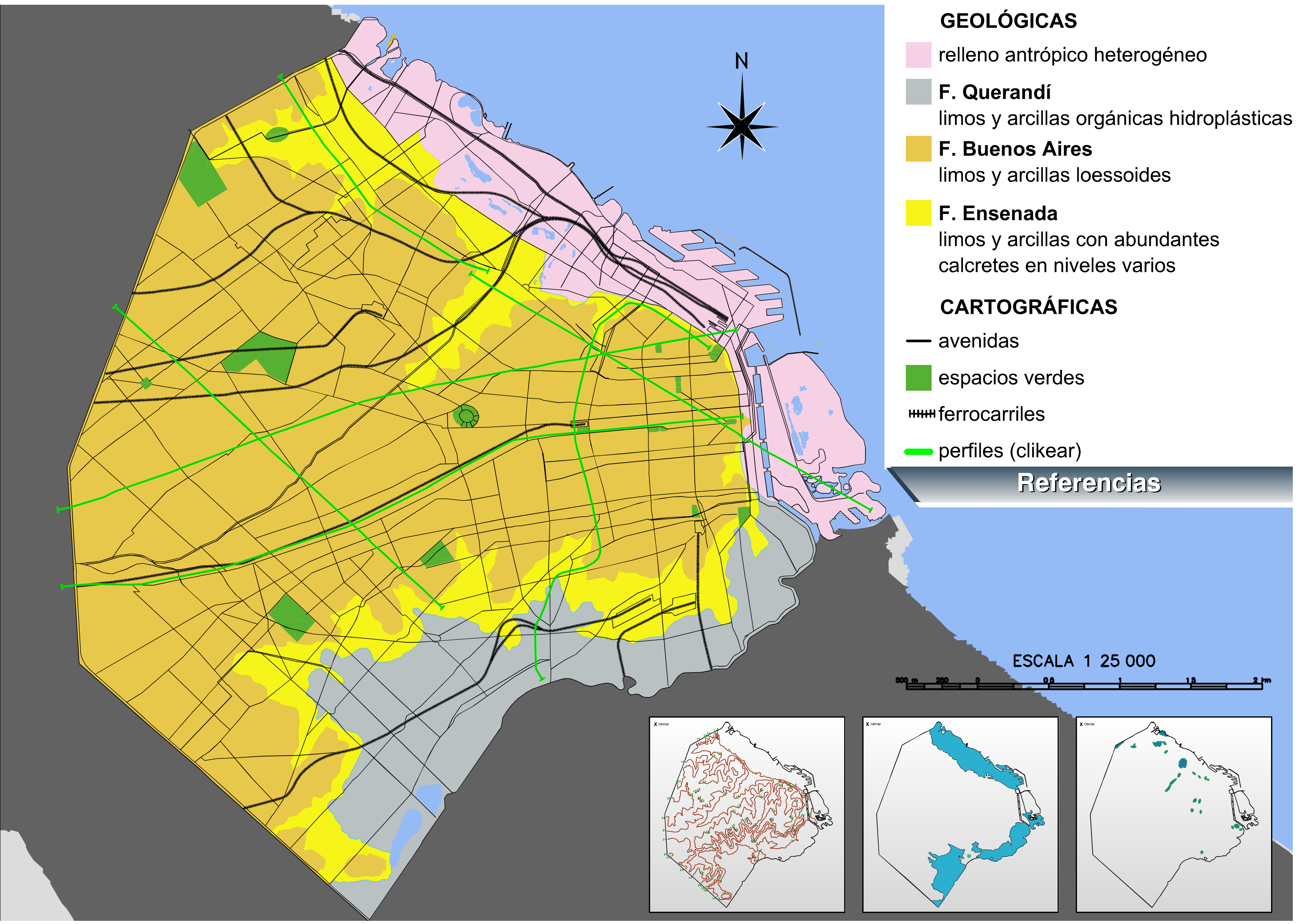
**Results from a multi-year study demonstrate that a constructed stormwater wetland is effective in removing phosphorus, nitrogen, total suspended solids, copper, and E. coli in stormwater runoff. The 0.4-ha wetland has 20 plant species and treats an 18.2-ha suburban watershed. Phosphorus, nitrogen, and suspended solids were removed nearly year-round, with removal of total suspended solids highest during the summer. Performance of the wetland was consistent over two-year-long periods four years apart, though no maintenance was performed on the wetland.**

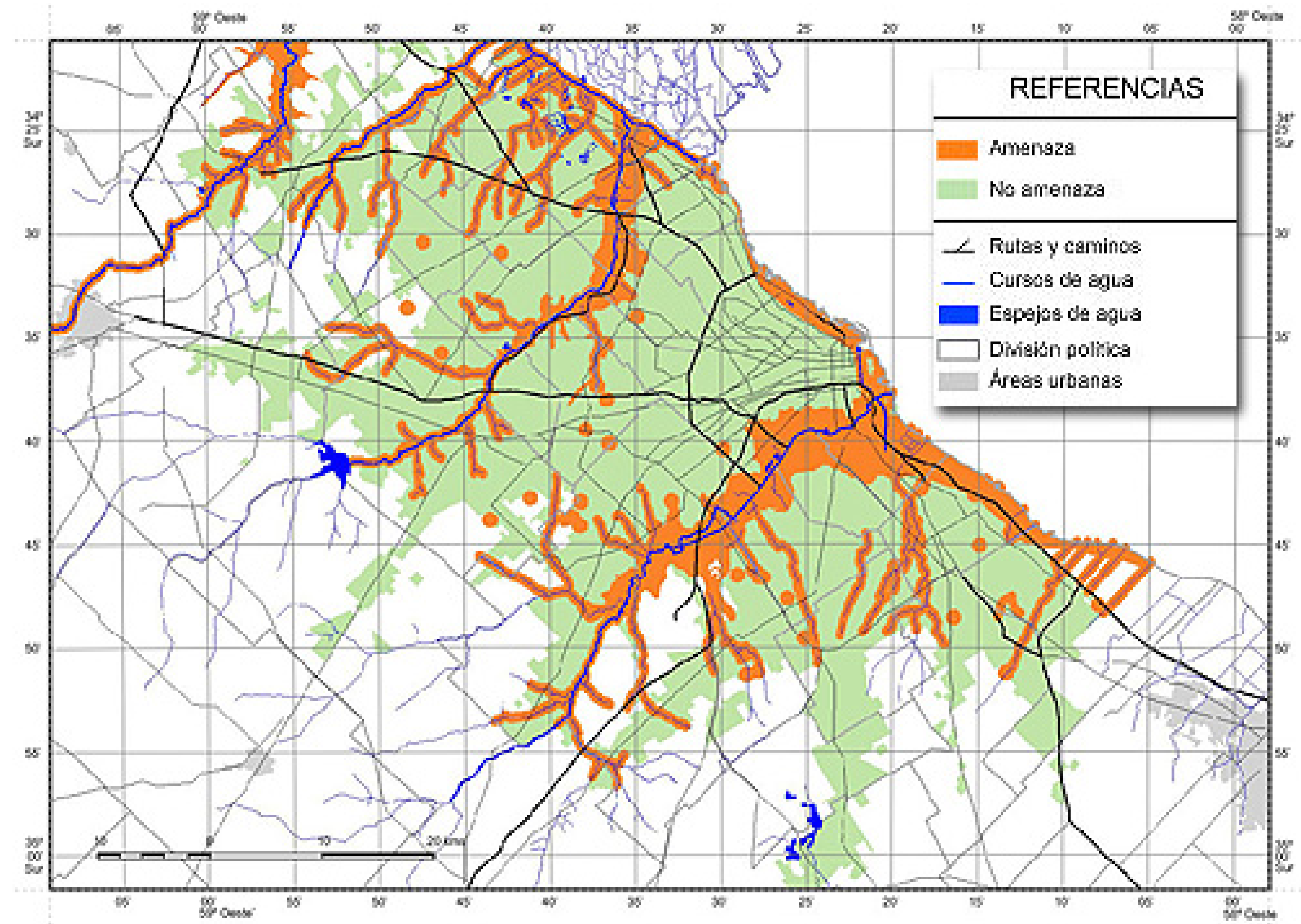
Wadzuk, Bridget M., Matthew Rea, Gregg Woodruff, Kelly Flynn, and Robert G. Traver. (2010). Water-quality performance of a constructed stormwater wetland for all flow conditions. Journal of the American Water Resources Association, 46(2), 385-394.

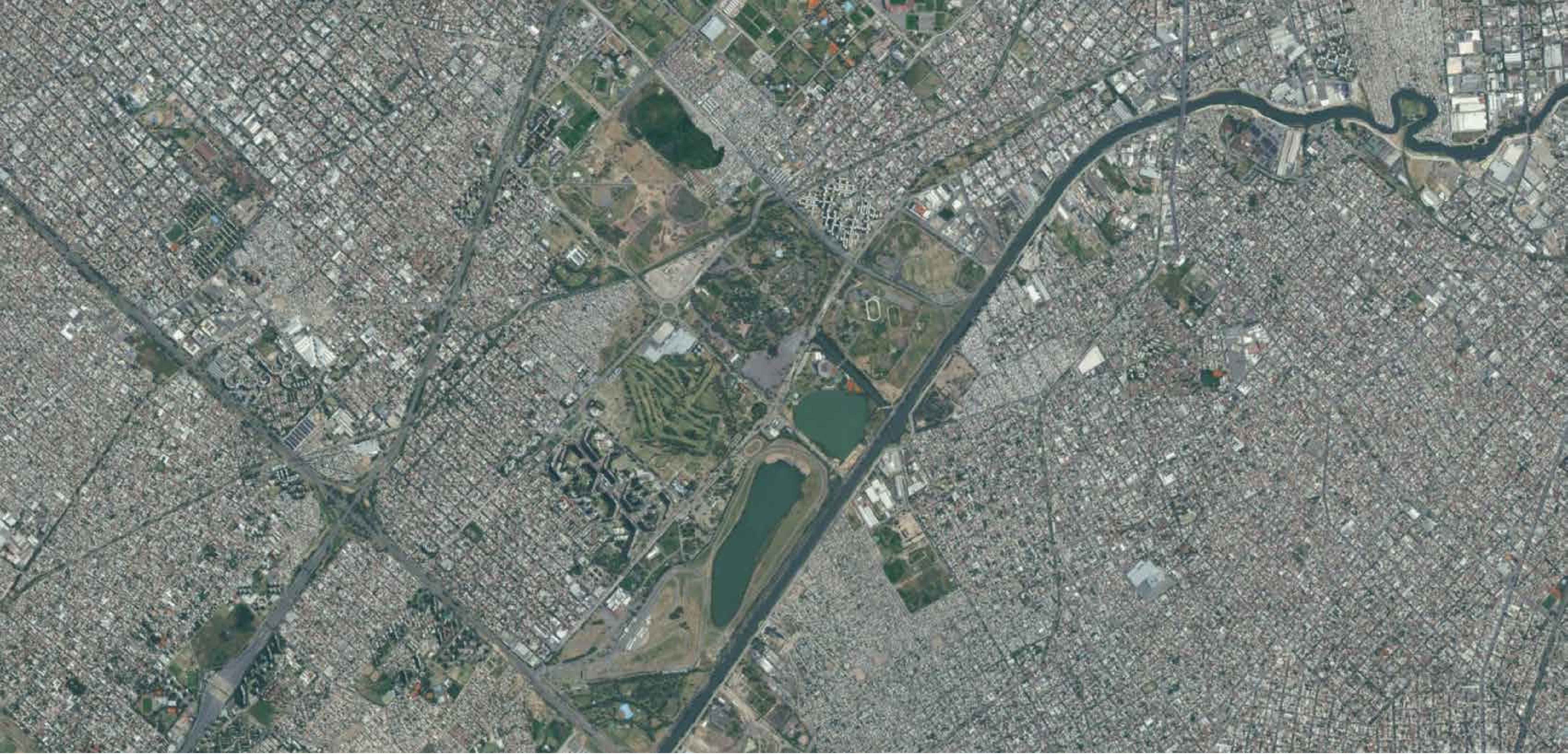
# Water at the MACRO scale


Rio de la Plata
Pilot Area
Airport (EZE)

# Geology and Pollution





# Aerial Comuna 8

# Green Space

# Tree Coverage in Public Areas

# Tree Coverage in Public Areas

**The monetary benefits of urban trees outweigh their maintenance and other associated costs. In a study of five U.S. cities, each dollar invested in urban trees returned between $1.37 and $3.09 in benefits. Benefits measured include energy savings, atmospheric $CO_2$ absorption, air quality benefits, stormwater runoff reduction, and aesthetic and other benefits gauged by measuring increases in real estate values.**

**McPherson, Greg, James R. Simpson, Paula J. Peper, Scott E. Maco, and Qingfu Xiao. (2005). Municipal forest benefits and costs in five U.S. cities. Journal of Forestry 103(8), 411-416.**

# Stormwater Drains

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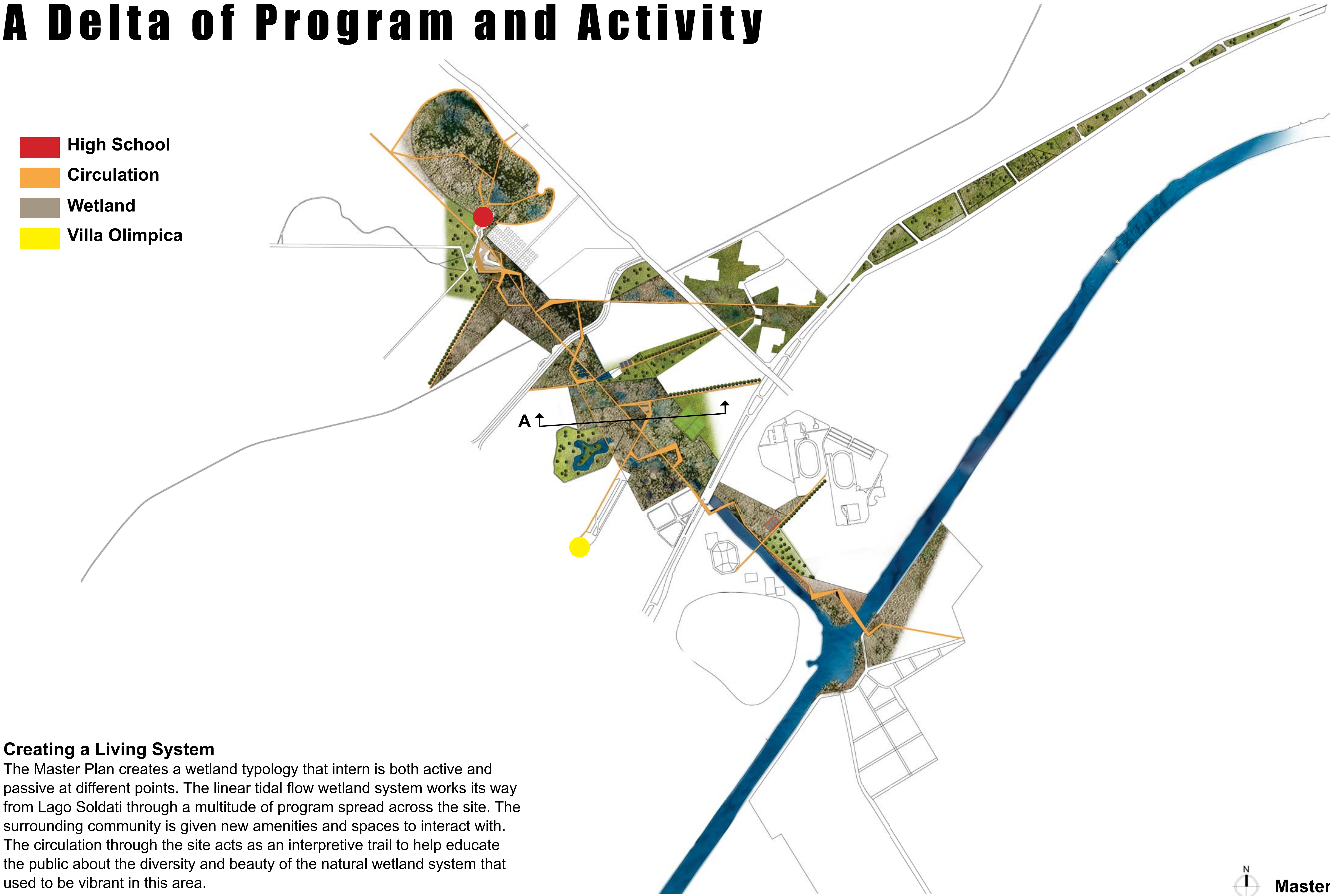
# A Delta of Program and Activity

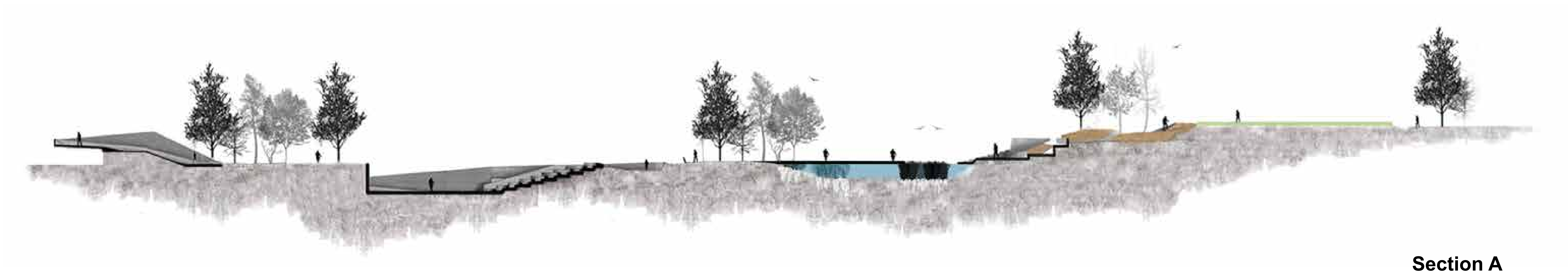



## Creating a Living System

The Master Plan creates a wetland typology that intern is both active and passive at different points. The linear tidal flow wetland system works its way from Lago Soldati through a multitude of program spread across the site. The surrounding community is given new amenities and spaces to interact with. The circulation through the site acts as an interpretive trail to help educate the public about the diversity and beauty of the natural wetland system that used to be vibrant in this area.

Master Plan

# A Delta of Program and Activity



Section A

# Water at the SITE scale

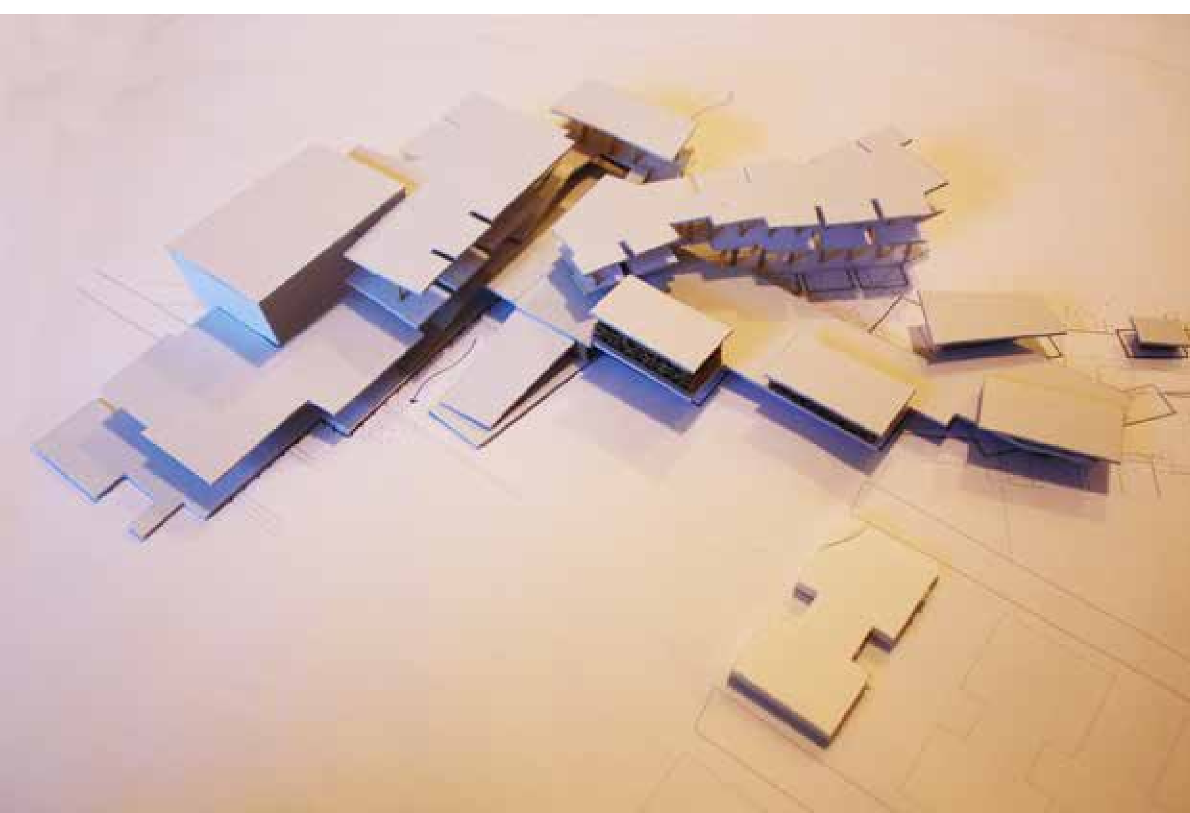

Site

# Living Architecture and Ecological Urbanism =

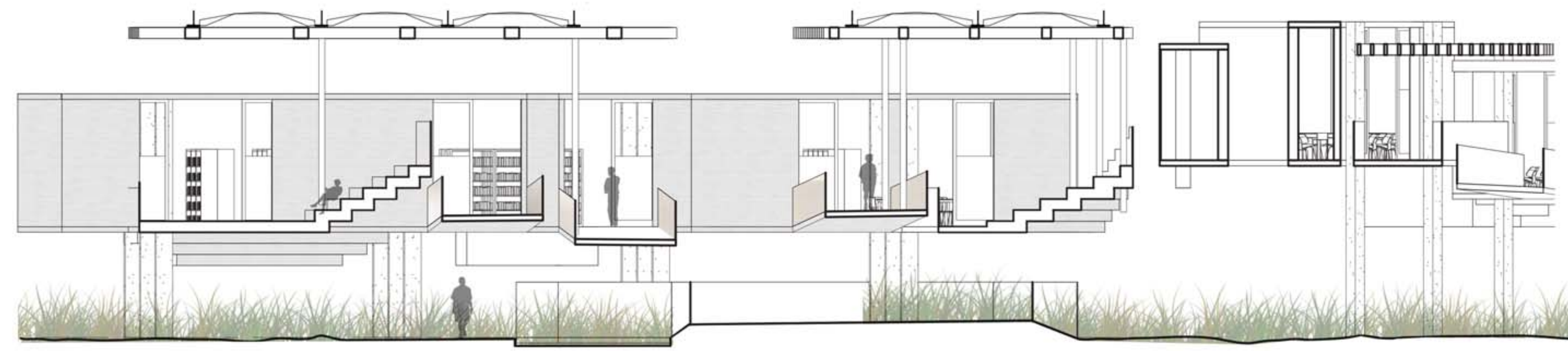
# Colegio De Los Piletones

## Tectonic Morphology

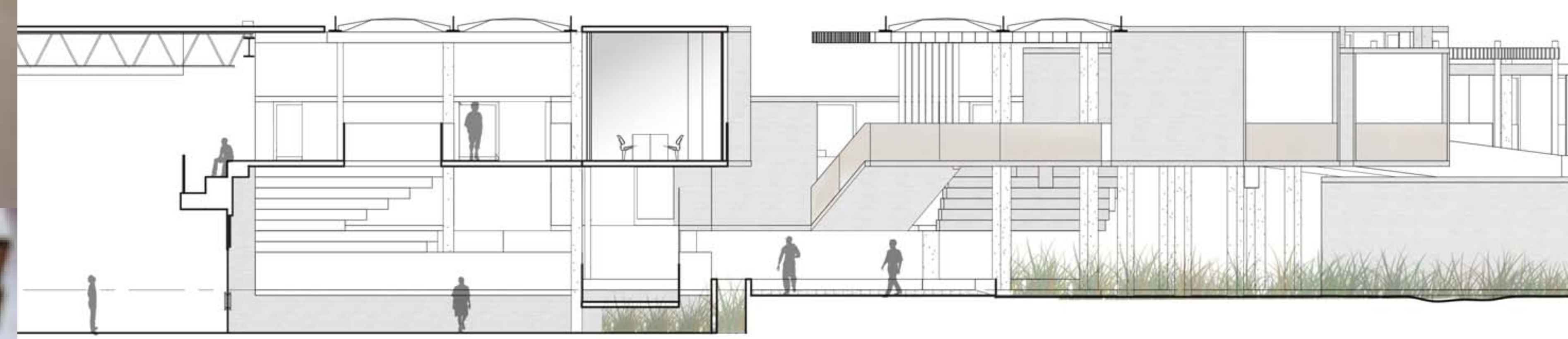
The building uses traces of the informal settlements that are around the area to create a sense of place to the overall concept. The main idea is to push the building into the wetland that is created to form a strong relationship with nature as well as be able to act as an interpretive trail from one end of the neighborhood to the other. The building will act as a community social gathering space that will help tie the two divided sides together. This will happen at the location of Lago Soldati, which is currently an environmental hazard due to its lack of maintenance and negligence. By placing the building inside Lago Soldati there is an opportunity to reverse the current cycle of deterioration and turn the ephemeral lake into a working wetland system that can have the ability to heal itself. The building allows this to happen by the amount of site work and program necessary for the school. By placing it here the design of the site is forced to accommodate the sustainable systems placed within and around the structure.



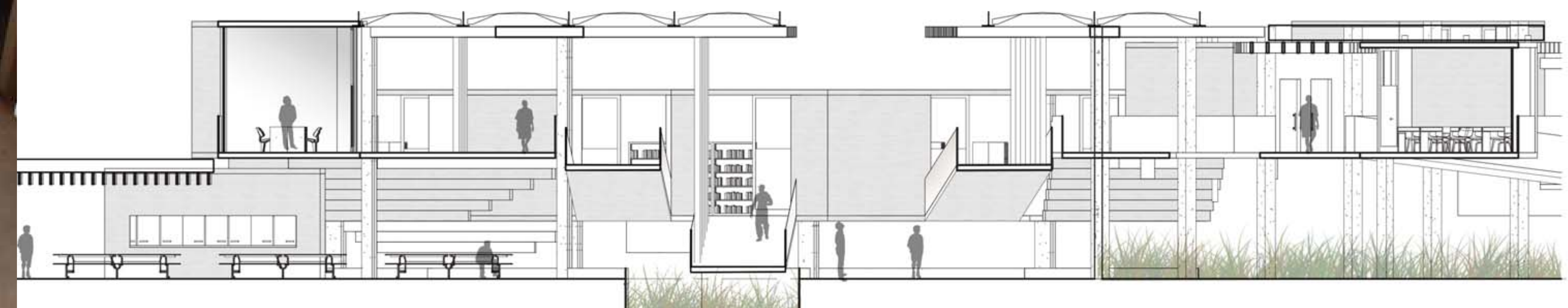
# Architectural Impact to Living Systems



**Short Section Through Circulation Canyon**

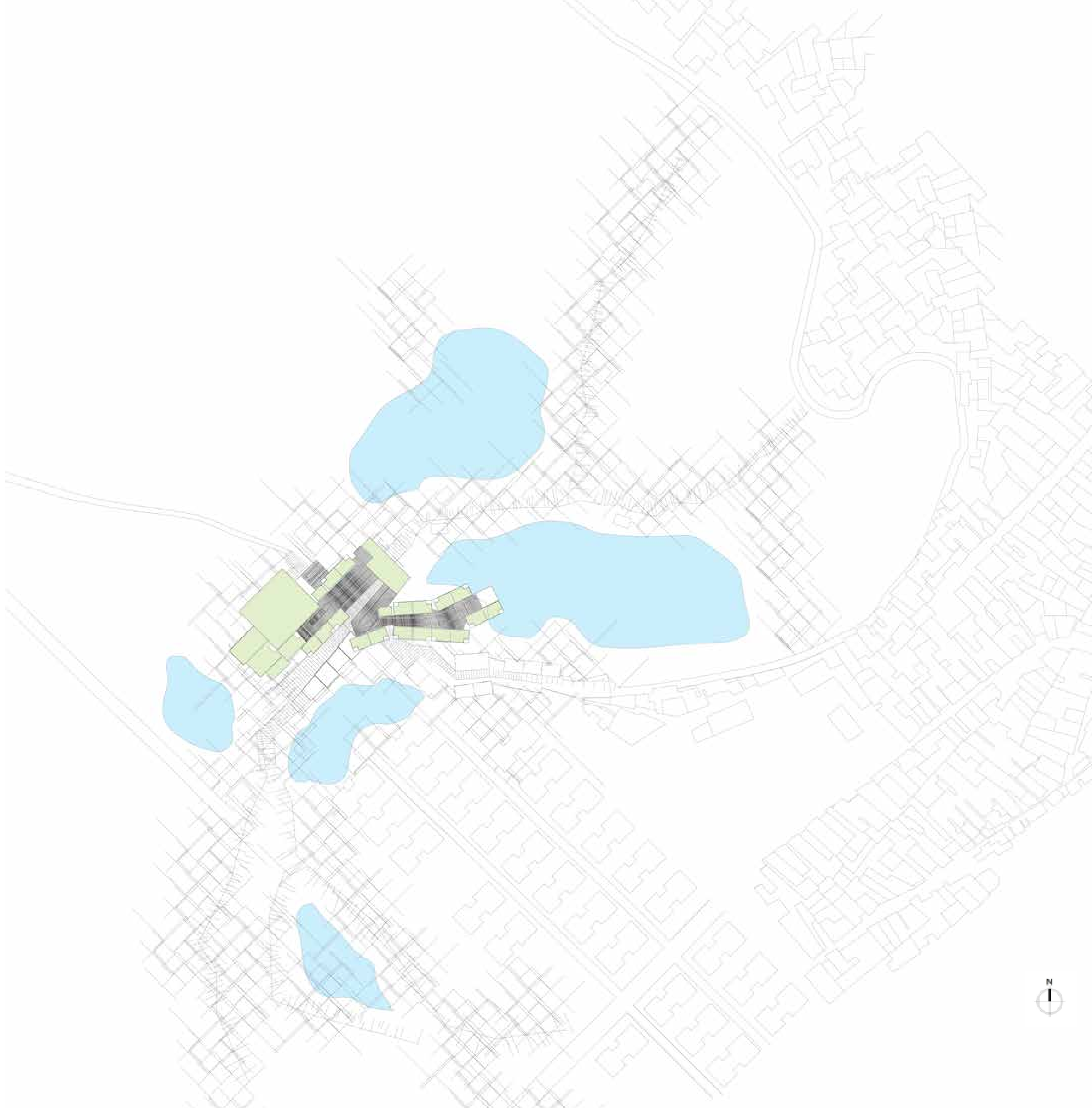


**Short Section Through Gymnasium**



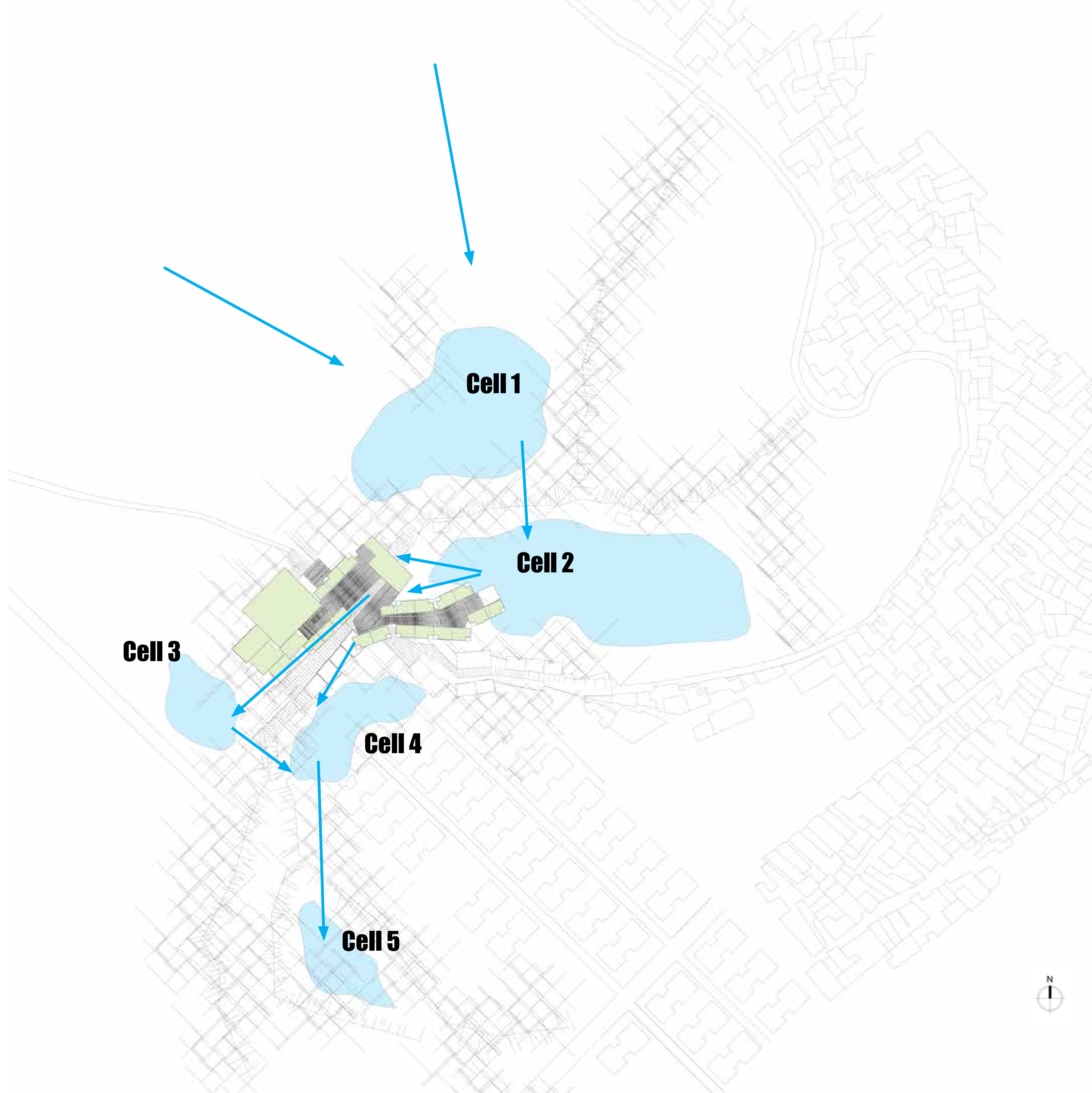
**Short Section Through Cafeteria**

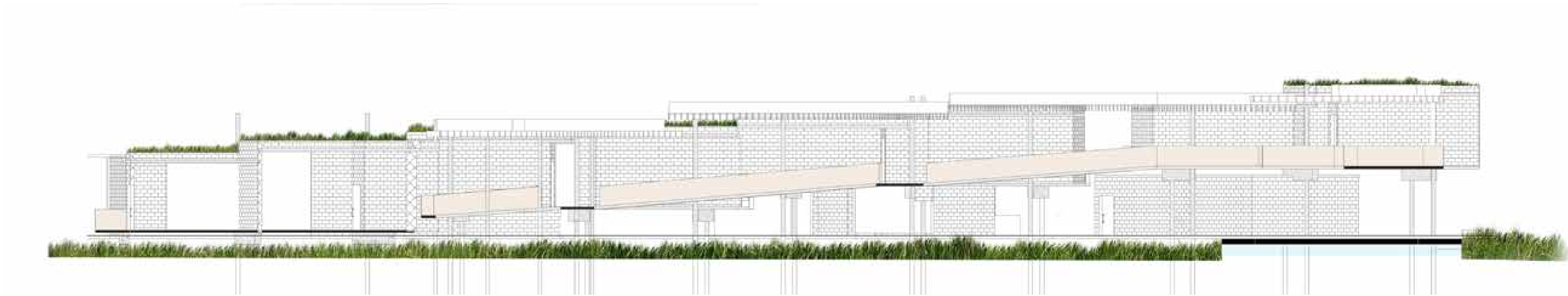
# Site Plan



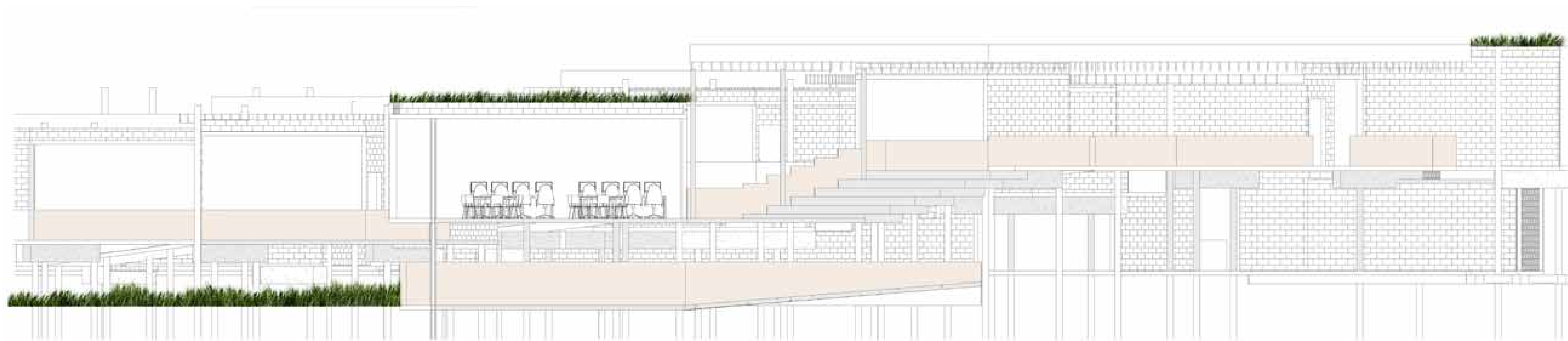
# Site Plan

**Waterflow**

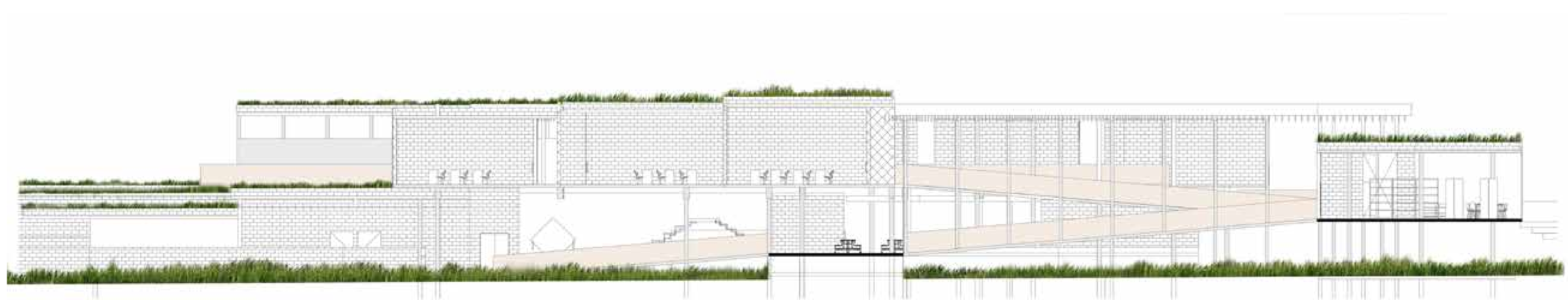




**Section Cut Trough Classroom Hallway to Wetland**



**Section Cut Trough Library to Amphitheater**



**Section Cut Trough Canyon Wetland**

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# Living Architecture and Ecological Urbanism

True resource use independence is not just about ecological restoration, or more energy efficient buildings, but a cohesive renewable living system for humans that is sustainable, comfortable, economic and beautiful

+ecosystem +value -climate change

# Living Architecture / Necessity + Outcomes + Benefits

The post industrial revolution society pushed nature out of its path as much as it could to achieve success in advancing science and technology. Now that the consequences of global warming and pollution are clear, it is time for designers to rethink the value of nature in urban and rural areas and how to incorporate advances in technology to benefit nature rather than dismissing it. There are many technical and beneficial applications for green roofs that can mitigate the negative environmental impacts of our built environment. We have lost nature within high density areas and causing extensive damage to ecosystems. All indigenous societies across the globe incorporated natural systems into their civilizations to create maximum efficiency and sustainability that met their needs and have allowed us to be where we are today. Unsustainable and low efficiency systems combined with population growth are jeopardizing the future of the next generation. It is time to rethink the standard and to build up the natural environment around us rather than take it down. Green roofs are a tool that can help to put our ecosystems back into balance. With proper planning, design, installation and maintenance a green roof has the ability to provide many benefits toward a building as well as its surrounding landscape context.




**Understand living system technologies in a way that allows full design creativity and control to better enhance not only the architecture of the site, but the overall health and welfare of the surrounding community**

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# Thank You!