8 Keys to Successful Urban Ecological Design

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The reintegration of natural systems into the urban fabric has become an essential component of urban design. Streams formerly channelized in concrete are being daylighted and naturalized. Stormwater that was quickly conveyed offsite is being retained to create wetlands. Landscapes designed solely for human use are being diversified to create riparian and coastal habitat. The result is a new kind of urban ecosystem that embraces human presence and activity while increasing environmental awareness, benefits and diversity.

Whether you're enhancing a remnant ecosystem, bringing habitat or ecological function back to a place where it was previously lost, creating a totally new environmental resource, or seeking innovative solutions to managing stormwater, challenges posed by urban ecological design are tremendous. Urban sites are impacted by a complex number of variables – and their size, soil conditions, and hydrology can often limit what you're able to achieve. These eight key approaches help lead to more effective design solutions for the enhancement, restoration and creation of urban wetlands, riparian corridors, and coastal environments.

Define your goals and establish a compelling vision to guide the design.

While urban natural systems can be designed to perform multiple ecological and social functions, they can't perform all functions effectively all the time. You need to carefully define your project goals, and craft a vision that maximizes the benefits of the ecological resource in its specific urban context.

Northerly Island Park in Chicago is a completely man-made landform in the general area where the Chicago River formerly discharged into Lake Michigan. This made it difficult to define ecological enhancement based solely on what would have occurred naturally here at some pre-settlement point in time. Historically, the Chicago River estuary would have been a marsh complex that transitioned into tall grass prairie. Dune communities were once common in the uplands south of Northerly Island. To the north, mesic woodlands, oak savannahs and ravines were common.

Northerly Island Framework Plan, Chicago, Illinois

Given Northerly's close connection to Chicago's museum campus and its role as an urban eco-park, the resulting framework plan vision was to create each of these major ecological communities on the island itself. The woodland and prairie communities and the wetland system located in the central part of the island are currently being designed as part of initial implementation. SmithGroupJJR also designed the island's proposed outer breakwater wave protection system as a reef, allowing the creation of fish habitat by adding rock of various size, and creating shelves at various depths in the proposed lagoon. While rock habitat would have been rather uncommon along the south shore of Lake Michigan (it is more reminiscent of habitat hundreds of miles to the north), this new and needed resource brings tremendous ecological value to the park and the city.

The design intent for Middlegrounds Metropark in Toledo, Ohio is to reconnect the community to the riverfront at a site that was once a thriving center for river-based commerce. The restoration and management of natural areas at Middlegrounds are intended to forge new recreational and interpretive opportunities between the community and its unique Maumee River heritage. Specifically, the wetlands in this plan have been designed to manage and cleanse stormwater and provide an interpretive message about water quality and wetland ecology.

Other areas of the Middlegrounds park site, including the shoreline and near offshore environment, have been designed with a focus on habitat restoration, including fish rearing and spawning areas. Terrestrial habitat restoration includes native prairie designed for migratory song birds, with the reestablishment of prairie functions that once existed on the site. Metroparks has subsequently embraced these ecological design initiatives as best practices they desire throughout their urban park systems.

Middlegrounds Metropark, Toledo, Ohio

Bring a comprehensive team of experts to the table.

Doing urban ecological design right requires a committed, interdisciplinary partnership among a diverse range of professional experts. Having a broad-based team of landscape architects, architects, engineers, planners and ecologists working together from day one is essential to project success.

This type of fully integrated design needs to guide and elevate all stages of the design process, including the early visioning and conceptual stages. Bringing forward as many ideas and opportunities as possible early on allows you to test them with the full design team and the client, developing a consensus sustainable program that is attainable, affordable and buildable. For Middlegrounds Metropark, the interdisciplinary evaluation of ecological design concepts during the concept phase helped identify metrics to support the initiatives, which are currently being carried forward to implementation.

Get the hydrology right.

Altered hydrology is often the biggest stressor to ecosystems and wetlands in urban settings. In more natural systems, hydrology is driven by seasonal precipitation patterns and groundwater fluctuations. Coastal and wetland plants have evolved and adapted to these natural hydrologic cycles. In urban areas, water levels fluctuate much more frequently and with more intensity than these plants are used to. They can become stressed or fail in such flashy conditions. While soils are also extremely important, most urban ecosystems (riparian environments, in particular) will succeed or fail due to whether the hydrology is correctly accounted for in the design.

Over 97% of the wetlands once prevalent along the Detroit River have been lost to development. Part of the Milliken State Park and Harbor, Lowland Park in downtown Detroit recreates a pre-settlement Detroit River wetland edge in a post-settlement environment. Because this is a clay lined system on capped, contaminated soils, first-flush rain events are diverted into a pretreatment basin before flowing overland into the wetland, which captures and cleanses the urban stormwater runoff. Extensive hydrologic modeling was used to predict water levels throughout the year, taking into account precipitation as well as evapotranspiration. This critical analysis tool helped establish the limits for specific emergent and wet meadow wetland plant communities leading to a more sustainable design solution.

Seasonal flooding of the Red and Cumberland Rivers had prevented the community of Clarksville, Tennessee from realizing the full potential of its waterfront. For Clarksville's Liberty Park and Marina project, hydrologic analysis guided the development of all facilities, which were sited and designed to withstand periodic flooding and inundation. Hydrology was particularly critical for the design of a new fishing pond fringed with wetlands. The pond design embraces annual flooding as an important natural event, utilizing flood-prone plant species and allowing for beneficial sediment deposition. The pond provides effective stormwater treatment, mitigates the loss of lower-quality wetlands elsewhere on site, and provides an attractive, accessible open-space amenity for the public to enjoy. While native plantings filter runoff and improve habitat, an engineered control structure at the pond outlet helps maintain the proper water level.

Liberty Park and Marina, Clarksville, Tennessee

It is just as important to account for hydrologic impacts upstream and downstream from your site. For the Central Park project in Carmel, Indiana, a downstream culvert was creating a backwater condition that supersaturated the banks of the stream, which then sloughed into the creek once the waters receded. While this backwater condition could have been corrected by installing a much larger downstream culvert, analysis showed the backwater condition was also reducing downstream flooding. The final design only slightly increased the culvert size, reducing rather than eliminating the backwater condition and retaining the beneficial flood mitigation downstream.

Go native.

Use the indigenous ecological communities in your region as the template from which to design your urban ecosystem or habitat. While you will often have numerous sources of native species from which to choose, it is highly beneficial to select those with the optimal local genotype for your site conditions. Studies have shown that specific species have become genetically adapted to their local soil conditions and local climate, including temperature extremes and growing season length. The use of these well adapted natives also prevents non-local genotypes from invading adjacent natural areas, preserves the local genetic material of often declining native species, and creates better quality habitat. It is important to identify suppliers that utilize sustainable collection practices, removing only a small percentage of local seed and propagating live plants in a nursery condition rather than harvesting from nature.

The Nina Mason Puliam Rio Salado Audubon Center in Phoenix, Arizona is an outstanding example of the benefits that come from this native

approach. Scarred from years of construction activity, this project transformed the upper riverbanks of the Rio Salado from brownfield site to a model of mitigation. Restoration of habitat was the design team's highest priority. Because the site had been left graded and virtually barren, the environment was recreated from the ground up, with more than 2-½ acres of new habitat. The project establishes four Sonoran Desert habitat zones, created by carefully orienting bioswales and replanting with strictly native vegetation. This diverse landscape not only educates visitors about the various habitats naturally found along the river, it immediately brought back the wildlife; the number of native bird species on site soared from 40 to 180.

Design around and maximize connection to green space.

There are many opportunities to create thriving ecosystems in an urban setting. These opportunities increase when you intentionally integrate your design within a larger network of open spaces and greenways to provide more connections for wildlife, waterways, and stormwater management.

Clarksville's Liberty Park and Marina project started as a smaller idea, but was expanded to encompass a 130-acre regional recreational destination including new event facilities, environmental education opportunities and an extension of the city's riverwalk system. Detroit's Milliken State Park and Harbor is tied into the East Detroit RiverWalk and a series of major greenway corridors. Portage, Indiana's Lakefront Park and Riverwalk leveraged the site's proximity to the Indiana Dunes National Lakeshore to create an award-winning park that is jointly managed with the National Park Service. The ecological benefit of all these projects has been greatly enhanced by their interconnection to a larger greenway system.

Lowland Park at William G. Milliken State Park and Harbor, Detroit, Michigan

Educate, tell a story and engage the community.

Education and interpretive facilities are an essential part of urban ecological design. Creative exhibits and strong storytelling help demonstrate the value of urban ecological restoration and enhancement, fostering understanding and support for future initiatives. However, many successful projects leverage more than just interpretive panels. On-site programming and special events help create a new generation of educated users through tours, classes and hands-on experiences.

At the Oden State Fish Hatchery in Petoskey, Michigan, interpretation was taken to a higher level by creating outdoor classrooms that educates users on stream channel ecology and native fish species. At Detroit's Lowland Park, the recreated habitats and interpretive displays teach about the ecologies of streams and wetlands, upland meadows, woods and pine stands, as well as the stormwater filtering benefits. A future visitor center will expand on this environmental education, with underwater viewing chambers, a fishing pond, and tours of fishing vessels in historic dry docks. The environmental significance of the project and its cultural connection and legacy are greatly enhanced by this multifaceted educational approach.

Make sure you have boots on the ground during construction.

Urban wetlands and riparian corridors are dynamic systems that are not entirely predictable. While detailed designs and specifications are critical, no project can anticipate all the potential conditions or issues that might surface during construction. That is why it is so important to provide construction oversight – so that designers and contractors can work together to make the right adjustments to meet project goals.

The traditional contractor bid/award process does not always lead to the selection of companies with ecological construction experience and the proper level of knowledge, integrity and focused attention. For example, construction difficulties with one of our stream restoration projects resulted in the dismissal of a contractor due to their lack of attention to restoration details and maintenance. Careful hands-on coordination and construction oversight from the design team led to the selection of a qualified replacement and an outstanding built result.

Some of these potential construction problems can be minimized by a more rigorous bidding process. We now have prequalification statements in our specifications to more thoroughly define the contractor's minimum qualifications. We require detailed bid submittals to address standards for materials, management plans to address long-term care, source verifications for native plants and seed, and testing procedures to verify seed. While this does not eliminate the importance of being on site during construction, it helps make sure your contractor is a collaborative partner who truly understands the ecological requirements of your project.

Anticipate maintenance and management needs and monitor the results.

While green infrastructure often requires less long-term maintenance than gray infrastructure (roads, sewers, utilities, etc.), it still needs to be actively maintained and managed. This maintenance is most critical up front, when the new native landscape is establishing itself. It also requires specialized expertise. It is extremely important to identify these special maintenance needs up front, and make sure there's a clear plan and budget for managing the resource. It is also important to establish measurable criteria and benchmarks that can be monitored over time to assess and demonstrate project success.

The Gilkey Creek project in Flint, Michigan daylighted and restored a half-mile stretch of stream that had been enclosed in a culvert for 25 years, routinely causing significant flooding problems downstream. Performance data demonstrates the project's success. The reengineered creek eliminated flood-related restoration and clean-up costs by more than 95 percent. It reduced impervious surfaces and stormwater runoff by 22 percent, relying on natural systems to control all storm runoff. It slashed long-term maintenance costs by 50 percent, by converting 6.6 acres of pavement and lawn to native landscapes. These kinds of results make for more than a great success story; they help leverage the long-term funding required to properly manage and maintain a valuable ecological resource.

It is also important to identify metrics that quantify success of habitat restoration efforts, and to account for the necessary monitoring costs. For the Belle Isle project in Detroit, we targeted herpetofauna and fisheries habitat development as a critical function of the design. Pre and post-construction monitoring to assess restoration success are being implemented as part of the project.

Gilkey Creek Restoration, Flint, Michigan

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