Shanghai 2010 Expo Houtan Park

LANDSCAPE AS A LIVING SYSTEM

Text by Kongjian Yu
Images by Kongjian Yu and Turenscape

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PROJECT CREDITS

Location: Pudong, Shanghai City, China **Client:** Expo 2010 Shanghai China **Completion Date:** May 2010 **Architect/ Landscape Architect/ Urban Planner/ Hydrological Engineer/ Lighting Engineer:** Turenscape (Beijing Turen Design Institute) and Peking University Graduate School of Design **Contractor:** Shanghai Landscape Construction Company **Wetland Plant Scientists:** Shanghai University of Oceanography **Site Area:** 140,000 m^2

A living organism has the ability to adapt, change, and protect itself. Similarly, Houtan Park was designed as a living system with ecological services.

As one of the central green spaces of the Shanghai 2010 Expo, Houtan Park was designed not only as a revived ecological waterfront for the exhibition. It was also conceived with the flexibility to be transformed into an open public waterfront space for Shanghai afterwards. The 140,000-square-metre (or 14-hectare) site is located on the southern boundary of the Expo site between the east bank of the Huangpu River waterfront and Puming Road. A former steel manufacturing factory and boat repair facility remained on site when the design was initiated in early 2007. Construction was completed in October 2009, and the park opened to the public in May 2010.

The objectives of the park design were to: create a green Expo, accommodate a large influx of visitors during the exposition from May to October, demonstrate green technologies, transform a unique space to make the Expo an unforgettable event, and transition into a permanent public waterfront park after the Expo. Integrating a public space into such a degraded riverfront presented several design challenges.

Challenges

Pollution

This brown field, previously owned by the steel factory and shipyard on site, had largely been used as a landfill and lay-down yard for industrial materials. The bordering Huangpu River was severely polluted and designated as a Grade V water body, which is considered unsafe for swimming and recreation and devoid of aquatic life. The foremost design challenge was to remediate the site to create a safe and healthy public space in a limited timeframe.

Flooding

The site is relatively flat with an elevation of four to seven metres. An existing floodwall that was designed to protect against a 1,000-year flood event has a top elevation of 6.7 metres. The average tide elevation of the Huangpu River is 2.2 metres, while the average tide elevations during high and low tides are 3.3 metres and 1.2 metres respectively. The disparity between the water elevation and levee elevation of 3.4 to 5.5 metres had restricted public access to the waterfront.

A sloped riverfront design for the new park would have required more space than available and possibly erode, while maintaining the existing floodwall would have continued to prevent accessibility and leave the river devoid of aquatic life and habitat. Other major challenges associated with flood control were designing an ecologically sensitive riverfront and providing direct public access to the waterfront, while protecting the city from flooding.

Circulation

The Expo's west entrance was located on the southern boundary of Houtan Park and was the sole point of access to the waterfront and central green space at the Expo. Creating organised well-developed routes and gathering spaces were crucial to create a comfortable and safe pedestrian environment.

Transformation

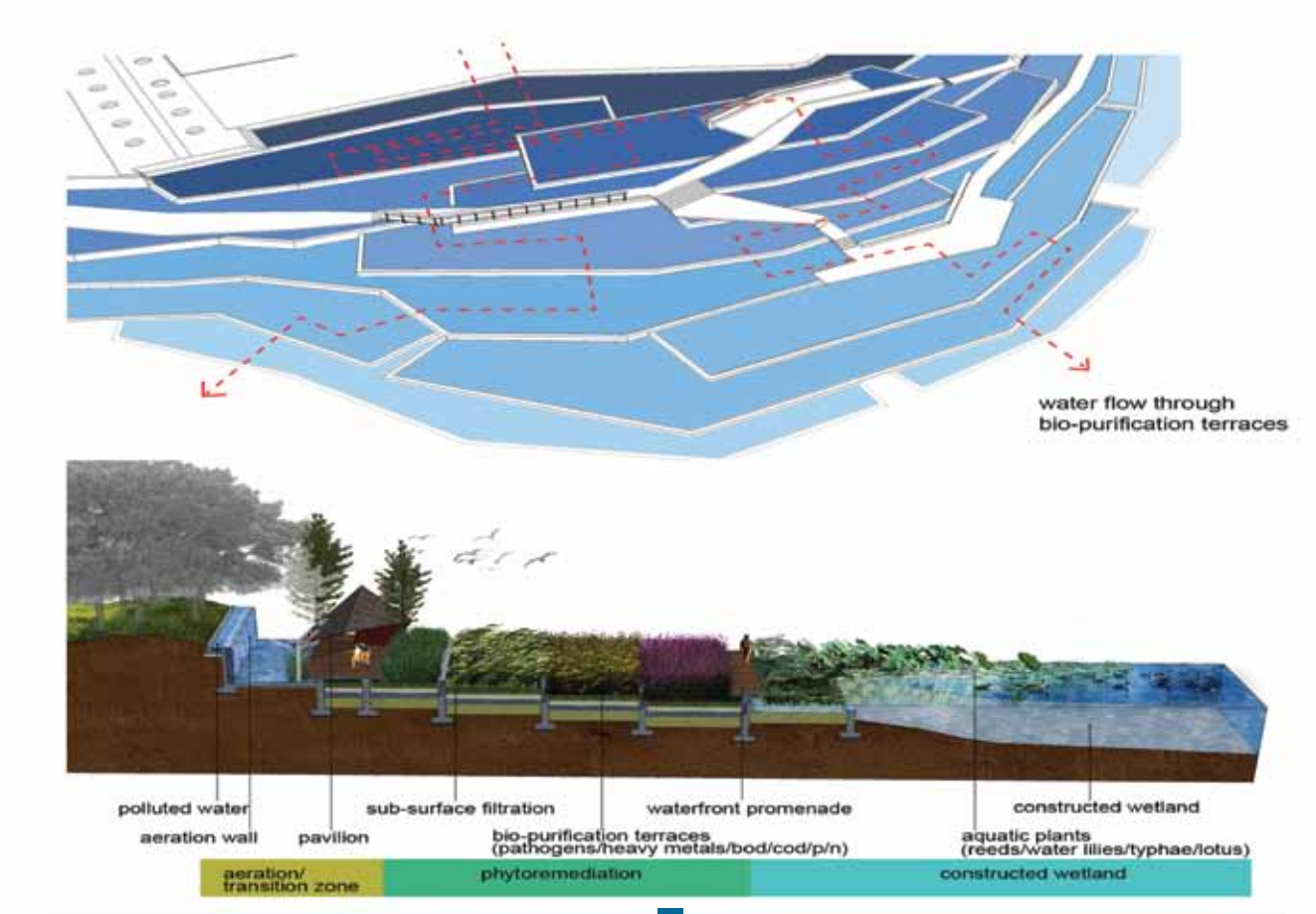
During the Expo, the site demonstrated the ideology of an ecological city: a productive and healthy urban public green space that simultaneously addresses pedestrian flows, safety, and evacuation routes. Major challenges included providing flexible strategies to address the practical aspects of the Expo and enabling a smooth and economical transformation into an ecologically sensitive and accessible public riverfront park after the Expo.

Identity

As Houtan Park was positioned between the World Expo exhibits and Huangpu River, it needed a distinct character to stand out among the dozens of bold exhibitions and to complement modern Shanghai. It also needed to provide a memorable outdoor experience while realising the more conventional ecological, circulatory, educational, and exhibition functions. The competing needs of the site were a great inspiration for the design.

Form

The site is narrow and locked between the Huangpu River and a main city thoroughfare. It was a challenge to effectively organise public spaces on this thin band of land, which averaged only 50 to 80 metres in width, with the narrowest portion only approximately 30 metres wide, over a long distance and water frontage of over 1,700 metres in length.



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Site plan showing water treatment sequence

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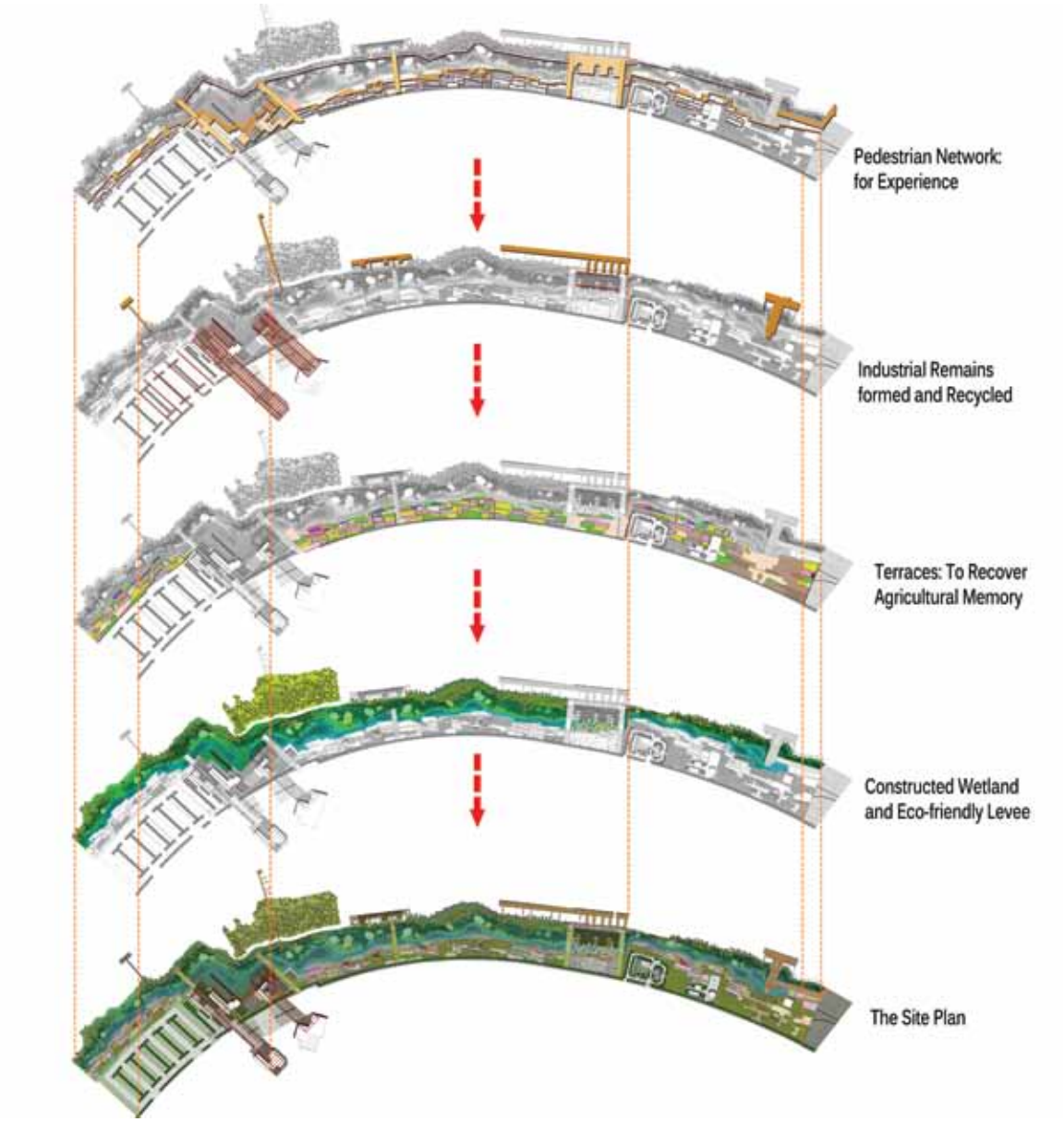

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The park's multiple functions and ecosystem services are layered and integrated.

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Design Concept and Strategy: A Living System

A living organism has the ability to adapt, change, and protect itself. Similarly, Houtan Park was designed as a living system with ecological services. These include: provisioning services (including food, water, and energy production); regulating services (such as water purification, carbon sequestration, climate regulation, waste decomposition, detoxification, crop pollination, and pest and disease control); supporting services (such as nutrient dispersal and cycling, seed dispersal, and primary production); and cultural services (including cultural, intellectual, and spiritual inspiration, recreational experiences, ecotourism, and scientific discovery). The resulting design is a contemporary high-performance and low-maintenance landscape.

The park design comprises several levels of landscape layered to: organise the space; integrate the ecosystem services of the park; interpret the site's agrarian history and potential; express the unique industrial character of the park; and address access and circulation challenges. The timeline, spatial context, and amenities of the landscape are built upon these layers. Layering the ecological landscape with the region's agricultural and industrial heritage creates an environmentally sensitive post-industrial landscape that speaks about the past, present, and future of Shanghai. A network of paths and places weaves these layers of landscape into an integrated system. Since the 2010 Expo and after, this trail has created many pleasant experiences for visitors to the park.

Ecological Landscape

The design preserved a rare remnant 400-square-metre (or 4-hectare) natural wetland located along Huangpu riverfront. The existing and proposed vegetation community—which is composed of lush willows and reeds—removes pollutants, prevents bank erosion, and creates bird and aquatic habitats. The existing concrete levee was reconfigured as a tidal river wetland, planted with native wetland species to ecologically improve flood control and reinforced with a permeable riprap. This constructed wetland runs through the length of the park.

Purification wetland

Currently, the Huangpu River's water is designated as Lower Grade V, the poorest grade on the national water quality scale of I to V. In the park design, water from the Huangpu River is diverted using pumps to the constructed wetland for treatment. Starting from the upper bank in the riparian zone, the water will be biologically treated to an improved Grade III via a series of wetland cells that facilitate settling, aeration, and vegetative and microbial processes.

The treated river water was used safely for landscape irrigation and other non-potable uses throughout the Expo. Full-scale pilot testing results indicated that Houtan Park's treatment wetland has the ability to treat over 2,400 tons of water per day. In addition to its water treatment capabilities, the wetland has also created new waterfront bird and aquatic habitats and offers great recreational and educational opportunities for adults and children.

Resilient flood control

The constructed wetland also acts as an additional buffer between the Huangpu River and the city to absorb and retain floodwater between the 20-year and 1,000-year flood event levees. Gradually lowering from Puming Road to the wetland stream, the terraced design of the constructed wetland reduces the relative elevation change between the city and the river and subsequently the strength requirements for the levee. The ecologically sensitive riprap system that replaced the concrete retaining wall was designed to encourage the emergence of native vegetation and new habitats.

Valley landscape

The valley terrain formed by the constructed wetland was planted with native trees to form a serene pastoral landscape, a quiet refuge within a bustling metropolis. The valley meanders through a series of stairways, boardwalks, and platforms, while large swathes of native wetland plants surrounds visitors in what has become a relic landscape.

Native vegetation

Recreating a native landscape using a myriad of wetland plants and wildflowers formed a lush and biologically productive wetland riverfront designed to become a carbon sink.

Three Dimensions of Cultural Meanings Conveyed

Agricultural heritage

From the Tang dynasty to Shanghai's opening as a port city in 1843, Houtan has witnessed 1,200 years of the rise and fall of the agricultural economy along the Huangpu River, making its agricultural heritage an important design consideration for the new park.

Designed as a transition zone between the constructed wetland


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1. Built on a former industrial site, Houtan Park is a regenerative living landscape on Shanghai's Huangpu riverfront. It comprises a constructed wetland that cleanses polluted water and provides an ecological food control strategy.

3. Bands of filtering wetland plants.

4. The aqueduct and cascade wall conduct and aerate the water from the Huangpu River.

6. Visitors can walk along the terraced wetland. The Hanging Garden and a folded steel pergola structure are seen in the background.

7. In traditional Chinese rice paddies, water and fertilisers are retained to nurture the crops. In the case of the wetland, plants absorb elements from the nutrient-rich river water.

8. A riprap replaced the existing concrete wall to create a more resilient and eco-friendly waterfront.

9. The Floating Garden is a landscaped observation platform for recreation. It overlooks the Huangpu River.

10–12. Crops are grown in the terraces every season to absorb nutrients from the Huangpu River. The landscape is filled with rapeseed flowers in spring, sunflowers and rice in summer and fall, and buckwheat in winter.

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and Puming Road, the terraced belt was inspired by China's famous terraced agricultural fields. The park's terraced fields address the drop in elevation of three to five metres from the road while aiding in aerating, settling, and purifying the river water. Agricultural crops symbolic of Shanghai's past and wetland plants with water-purifying capacities were selected to create an urban agricultural garden rich with seasonal changes.

Memories of agrarian culture are evoked throughout the seasons with scenes of the golden blossoms of the rapeseed flowers (*Brassica capestris*) in spring, splendid sunflowers in summer, the fragrance of rice in fall, and the green clover (Chinese milk vetch or *Astragalus sinicus*) in winter. The design evokes nostalgia for the productive earth, reconnects the urban dweller to the land, and provides an educational venue for the children of Shanghai to learn about agriculture and ecosystems.

The terraced structure also increases the diversity of the landscape. The vegetation reinvigorates the waterfront for a richly textured pedestrian experience. People enter the wetland through the paths traversing the fields and experience the agricultural landscape nestled around an ecologically sensitive constructed wetland. The paths, like capillaries of a sponge, greatly improve the pedestrian flow into and throughout the park.

Industrial heritage

Shanghai is the birthplace of industrialisation in China, and the city has witnessed the nation's modern industrial emergence and growth. The factory and cargo pier were the few but important industrial structures that had remained on site. This infrastructure was preserved, reclaimed, and recycled—using extraction, infill, and interspersion methods—to celebrate the site's industrial past.

The factory building structure located to the south of the Houtan Park and north of the temporary car park has been reclaimed as a multiservice centre, called the "Hanging Garden", which hosts a mix of bars and cafés. Two building structures from the former steel factory that ran across Puming Road were originally designed for reuse as a unique entrance to the Expo and Houtan Park. However, only one was approved to be integrated into the Hanging Garden.

The cargo pier was located in the middle section of Houtan Park near the preserved wetland. Since it is no longer operational, it has been reclaimed as a "Floating Garden", also known as the "Reed Platform". Today it is an observation platform where visitors are immersed in the wetland with views of Shanghai's skyline.

An industrial-style installation was constructed using steel panels reclaimed from the site. It comprises a series of folded panels that parallels the stream valley, casting shadows and framing views. The panels were also used on the boardwalk as a paving material. These modern industrial art pieces merge with the wetland vegetation and landscape pattern as a juxtaposition of the site's past and present.

Prophecy of the ecological civilisation

As a vision for the post-industrial era, the park design promoted a low-carbon landscape, emphasising low-cost and sustainable construction and maintenance processes. Unlike more conventional engineered designs, the Huangpu riverbank was designed to be environmentally sensitive; clay was used for the lake bottom as a naturally impermeable material to aid in the establishment of a self-sustaining wetland and riparian habitat. A wide variety of wetland species and crops was used for water purification to increase biomass production to in turn operate a low-cost and low-maintenance water treatment system. The park design used recycled materials, such as old bricks, tiles, and biodegradable bamboo flooring, to minimise the project costs and integrate innovative energy-efficient technologies into the architecture.

Experience Network

By incorporating ecosystem services into an urban environment, Houtan Park has enhanced the understanding and stewardship of nature in a reclaimed public space and hopes to extend this new conscience throughout China and the world. The design integrates agrarian, riparian, and biological systems within a pedestrian network, enabling a rich experience through a textured space.

Pedestrian system

With safety, convenience, and flexibility as the principal priorities for circulation, the pedestrian system was organised as a main loop with six roads bisecting the wetland and multiple footpaths diverging off the main route. This system ensures seamless connections from the city to the wetland park. It not only successfully managed the massive pedestrian influx during the Expo within the site, but also ensured a pleasant and accessible urban park afterwards. This main loop connects to the footpaths and secondary roads so that visitors have options when exploring the park, but remain closely connected to the main route.

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Links and nodes

The links and nodes of Houtan Park can be divided into three categories: platforms, masses, and containers. Platforms are conceived as gathering spaces. They include the Hanging Garden plaza transformed from the former factory that acts as the central piece of the park's service centre; the Floating Garden plaza transformed from the former cargo pier; and the Water Gate Pier plaza that acts as the only entrance from the river. Masses refer to trees and bamboo massing throughout the park that compress and open up spaces along the path. They create unique experiences of "going through" and "penetrating" the landscape. Enclosed by groves, containers are spaces for exhibition or resting, where modern art and reclaimed industrial elements are located.

Conclusion

Houtan Park demonstrates a new ecological water treatment and flood control method, and it demonstrates how the landscape as a living system can provide multiple ecosystem services for society and nature. The post-industrial design is a unique productive landscape that evokes reflections of the past and the future of the ecological civilisation, paying homage to a new aesthetic based on low-maintenance and high-performance qualities. CG

13 Some 13 mainly native plant species were planted on the wetland, and spontaneous vegetation is welcome. After one year, 17 new bird species were found to have inhabited this park.

14. The constructed wetland creates a quiet valley where people can access the stream of river water. The Huangpu River and tall buildings are seen in the background.

15. The Floating Garden was designed around the former cargo pier—with new shade-casting structures, fences, seats, screen walls, and planters.

16. The wetland holds the polluted water, as the first step in the water filtration sequence. Visitors can observe the process.

17. View of constructed wetland from the northeast to southwest ends of the park.