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**| RESEARCH ARTICLE**

## **Design of Urban Lake Park from Ecological Perspective Explore: Tangjiawan Zhongshan Park as An Example**

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**| ABSTRACT**

The lake has long been an important ecological space in the city and a public open space that people are eager to get close to. Under the background of ecological civilization construction, it is of great significance to constantly explore how to give full play to the ecological value and humanistic service value of urban lakes and create urban lake parks where people and nature coexist harmoniously. From the ecological perspective, four requirements are put forward for the design of urban lake parks: ensuring water security and clean water quality, establishing a complete regional ecosystem, improving the level of biodiversity, and injecting people-oriented service functions. Taking Zhongshan park as an example, the corresponding strategies are applied to the park design, building a natural ecological lakeside leisure space and creating a safe, ecological, and dynamic urban lake park to help the healthy development of the city.

**| KEYWORDS**

Urban lake park; Ecological civilization; Landscape design; ecosystem; ecological value

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### **1. Introduction**

An urban lake park is an urban park located in an urban built-up area or suburb, with a certain scale of natural lakes, artificial lakes, or reservoirs as the main ecological matrix. Urban lakes are an important part of the urban ecosystem, an important spatial component of the urban landscape pattern, and an important medium and leisure space for residents to get close to nature. This kind of space has a high ecological value, which can conserve water, regulate regional climate, and improve the urban ecological environment [Wu, 2020]; At the same time, it is an important carrier of biological resources in cities, maintaining the diversity of urban species and organisms. High-quality water bodies, plants, and other natural elements in urban parks play a positive role in people's physical and mental health [Cheng, 2021]. Despite this, a large number of valuable urban lake resources are still not used properly. In some cities, there are large-scale water parks that mainly serve people's leisure and recreation functions, with weak ecology; In addition, some cities have serious water pollution, poor water quality, and few people come, which has become a negative space of the city, seriously affecting the healthy and sustainable development of urban human settlements. With people's increasing ecological awareness and requirements for a better living environment, it is of great significance to explore how to give full play to the ecological value of urban lake parks and find the balance between the ecological function of urban lakes and the humanistic service function.

#### **1.1 Ecological design requirements for urban lake parks**

##### **1.1.1 Guarantee water safety and clean water quality**

Water safety assurance and clean water quality are the most basic and intuitive demands for urban lake parks. Corresponding design should play a role in ensuring the lake's own flood control capacity, mitigating urban waterlogging, and purifying water quality. For urban lakes with flood control requirements, the connectivity with the surrounding river system should be strengthened to improve the flood control level of the revetment; Use vegetation buffer zone, rainwater grass planting ditch, ecological

embankment, rainwater wetland, and other ecological engineering measures with infiltration, diversion, and storage functions around the water body to make use of rainwater and alleviate urban waterlogging to a certain extent [Wang, 2020]; Through ecological purification measures such as setting forebay at water source inlet, arranging shoreline shape, and increasing wetland area, the ability of wastewater interception and self-purification of the water body is strengthened to ensure water quality [Li, 2017].

### ***1.2 Establish a complete regional ecosystem***

Lakes are important ecological patches in cities. The relationship between lakes and surrounding ecological corridors and patches should be strengthened from a regional perspective to give full play to their core role in the regional ecological network. Based on the regional ecological security pattern, identify the ecological core area of the urban lake park, divide the "conservation area buffer area activity area" in a circle way, and rationally arrange the ecological functions of the park, to determine the overall spatial structure of the park, extraction of key ecological spaces, functional space layout, etc.

### ***1.3 Improving biodiversity***

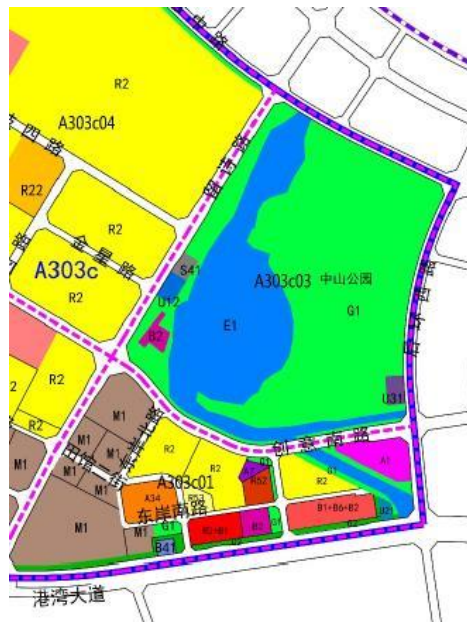
Biodiversity is an important factor affecting the stability and naturalization of ecosystems. In urban lake parks, there are usually natural patches with high ecological sensitivity, such as lakes, wetlands, and woodlands. Reasonable ecological design should be adopted to fully improve their biodiversity. By increasing the contact surface between the water body and land, such as zigzagging shoreline and increasing shoal wetlands, combined with the vertical transformation of nearshore and enriching revetment vegetation communities, a variety of habitats are provided for fish, amphibians, birds, and other organisms. Based on the current forest land, the forest land structure can be appropriately transformed and optimized by referring to the near natural forest land community to enrich the vertical structure of the vegetation community, appropriately increase the proportion of broad-leaved arbors and shrub grass layer plants, and create multiple habitat spaces for birds, small mammals and other animals [Zhao, 2018].

### ***1.4 Injecting humanistic service function***

The design of an urban lake park should be based on the complete ecosystem, give consideration to the people-oriented service function, and build an ecologically sustainable and dynamic public space in the city. According to the requirements of environmental protection, the functional space that can meet the daily basic activities of residents, such as sports and fitness, and cultural exchanges, should be properly set in the area with low ecological sensitivity in the park; In the ecological buffer area, depending on the high-quality natural environment, combined with low interference facilities such as plank roads and small scenic spots, it provides a variety of natural recreation functions. The area closer to the ecological conservation area should strictly control the size and number of hard sites to reduce the impact on the regional ecological environment and natural style and generally form a spatial structure of functional sites embedded in nature, bringing visitors an immersive natural experience.

## **2. Overview of Tangjiawan Zhongshan Park**

Tangjiawan Zhongshan Park, located in Liushi Mountain, the east bank community of Tangjiawan Town, Zhuhai City, was founded on October 10, 1932. It was a supporting cultural facility that was prepared to improve the appearance of the Tang Family as a model county town of Zhongshan when Tang Shaoyi was in charge of the Zhongshan Model County. Later, construction was interrupted due to Tang Shaoyi's forced resignation in 1934, leaving only historical sites such as Zhongshan Park Gate, Late Jade Pavilion, and Bajiao Pavilion. In 2011, Zhuhai High tech Zone launched the first phase of the Tangjiawan Zhongshan Park site restoration and reconstruction project according to the deployment of the municipal party committee and the municipal government. On October 10, 2011, the completion and opening ceremony of the renovation project of Zhuhai Zhongshan Park was held, which was an important activity for Zhuhai to commemorate the 100th anniversary of the 1911 Revolution. The site is rich in natural resources. In addition to the wetland of lakes and reservoirs, there are also natural resources such as forest land. The overall landscape base is good, as shown in Figure 1. There are still some buildings and bare land on the site, which is not ecological enough.



**Figure 1.** Renewal unit planning of Liushishan old village reconstruction project on the east bank of high-tech zone  
 Image Source: Residential Environment Improvement Project in Liushishan District, Dong'an Village, High tech Zone



**Figure 2.** Tang Shaoyi Exhibition Hall  
 Image Source: Self drawn by the author

### 3 Ecological design strategy of urban lake park

#### 3.1 Rainwater flood management and water purification

The roads, squares, green spaces, water systems, etc. in the development site shall be coordinated so that the runoff from the site, roads, and green spaces will be systematically merged into the surrounding green space system and rivers, and low-impact development sewage interception and purification measures shall be taken before entering the water body. The park is designed to keep the state of the site before development as much as possible. Several unconnected ponds are merged into a larger water surface. At the same time, the excavated soil is piled on the island in the lake. At the same time, the existing ridge road is used to connect the island to the lake, and a small bridge is set to make the lake surface accessible for boating. At the same time, a west entrance is added to strengthen the external connection of the site, forming a ring road. An aquatic vegetation buffer zone with a length of about 10 meters shall be set around the normal pool level of Zhongshan Park. Two inlet and outlet box culverts with a scale of 2.5 m x 1.0 m and a length of 10 m shall be built at the old sluice for intercepting and purifying rainwater runoff. A remote control gate (steel dam gate) shall be set. The gate hoist can be set below the ground without affecting the surrounding landscape. The gate is opened every day to ensure that the water can be exchanged every day. When the water level outside the lake is higher than the water level inside the lake, the gate at the end of the box culvert is opened for water diversion, and the water body inside the lake is supplemented; When the water level outside the lake is lower than the water body inside the lake and the water body inside the lake needs to be drained, the box culvert gate is opened for drainage; In other times, the gate is closed, and the water level in the lake is maintained at 0.8m.

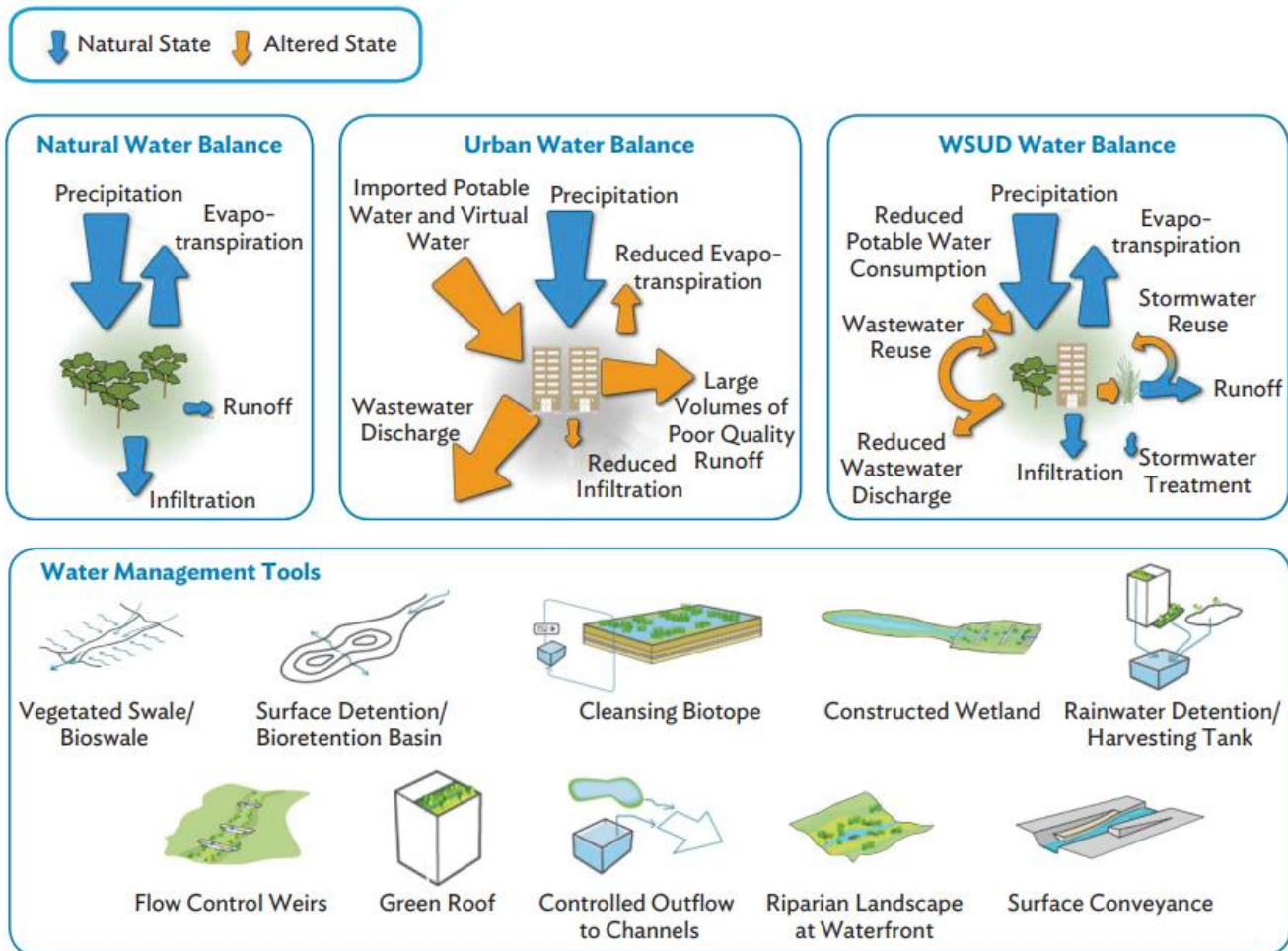
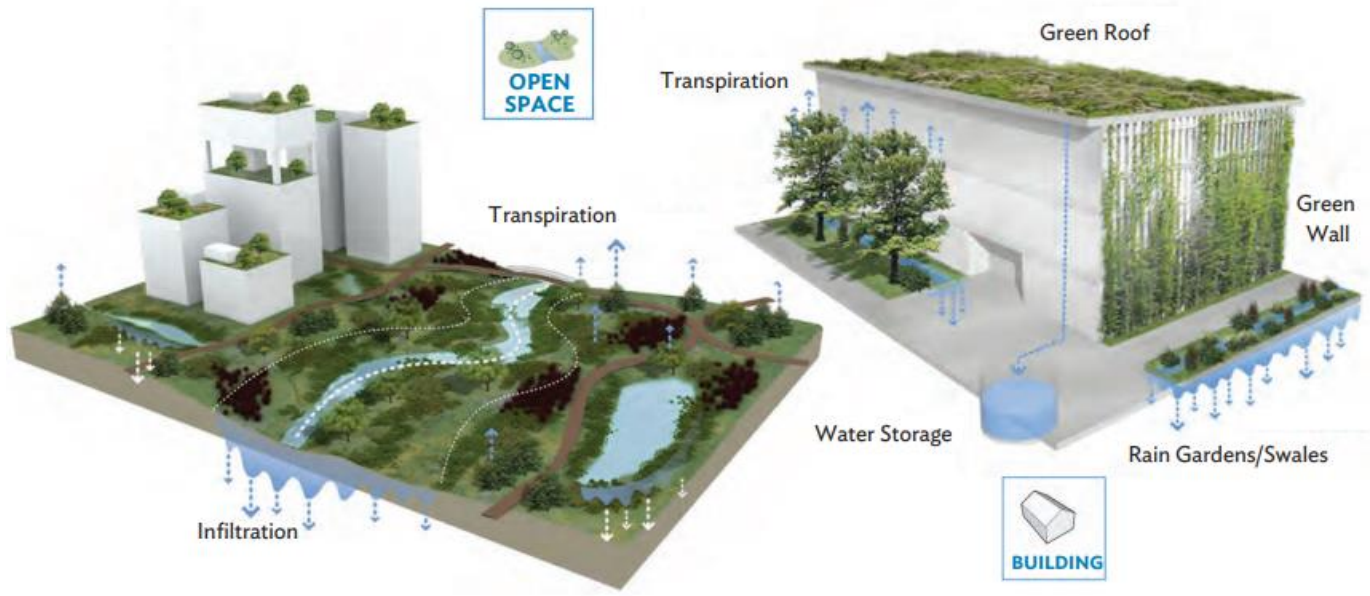


Figure 3. Ecological analysis of natural systems

Image Source: A. Hoban and T.H.F. Wong. 2006. WSUD Resilience to Climate Change. Paper presented at the first Australian National Hydropolis Conference. Perth. 8–11 October



**Figure 4.** Ecological analysis of natural systems

Image Source: Nature-Based Solutions for Cities in Viet Nam: Water Sensitive Urban Design  
<https://www.adb.org/sites/default/files/publication/535016/nature-based-solutions-cities-viet-nam.pdf>

### 3.2 Overall ecological function layout

In combination with the regional ecological network and relevant upper-level planning, identify the surrounding key ecological patches and corridors. Through the ecological background investigation of the site, and in combination with the ecological function requirements of the surrounding areas, such as ecological contact needs, biodiversity functions, protection functions, rain and flood management, and water quality purification, the key ecological space identification, and ecological function space layout are carried out, as shown in Figure 5, to ensure the good ecological environment of the site itself and link with the surrounding green space. The overall layout is carried out around the needs of biodiversity, combining the current site characteristics and the habitat space characteristics of target species, comprehensively considering the site planning and use functions, and reasonably arranging various types of biological habitats. The site is dominated by a fish habitat, amphibian habitat, migratory birds, and wading birds habitat; In the east of the site, there are existing forests where songbirds and small mammals live.

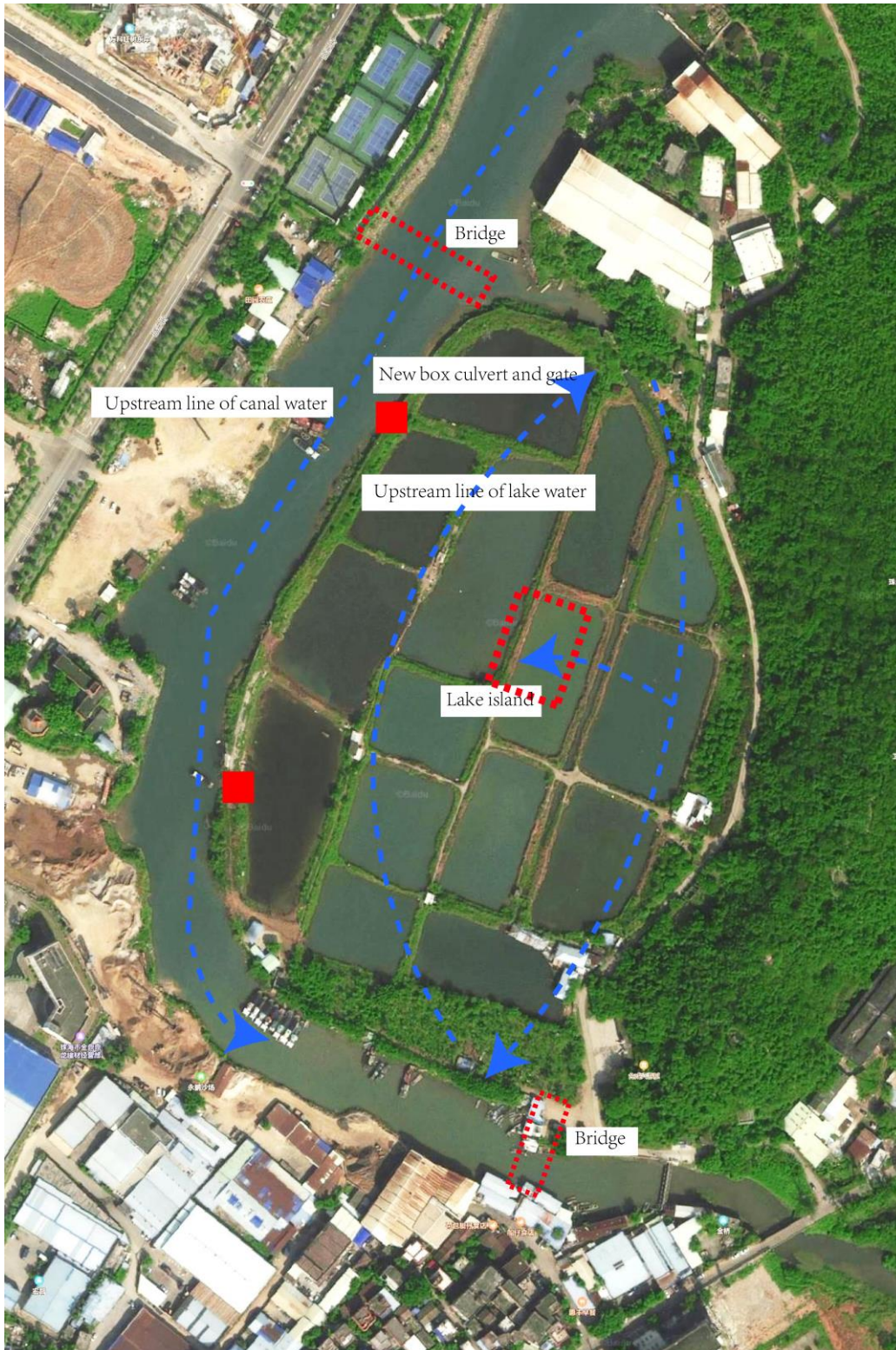
### 3.3 Construction of diversified habitats

Based on the biological background survey, the local species resources and the corresponding habitat types are analyzed, and the habitat space in the site is built in Partition. The site habitat is roughly divided into two categories: pond reservoir wetland habitat and forest habitat. Taking the habitat construction of the Tengku wetland as an example, according to the habitat requirements of the target species, the revetment in the wet area of the reservoir is designed in a targeted and diversified way, and the habitat space of the site is enriched through vegetation planting mode and nearshore vertical transformation. Most fish habitats require high-quality water quality, and aquatic plants planted near the shore of wetlands can be used as spawning shelters for fish; The island in the lake in the wetland area serves as the habitat for migratory birds, and different levels of wetland plants are planted on the shore to protect them; The habitat of waders should be located in a flat, shallow shore area. The plants near the shore should be harvested and renewed regularly to provide foraging and resting places for waders in different seasons; Gravels are placed at the bottom of flat, shallow banks to create a still water or slow flow environment and provide an environment for amphibians to spawn.

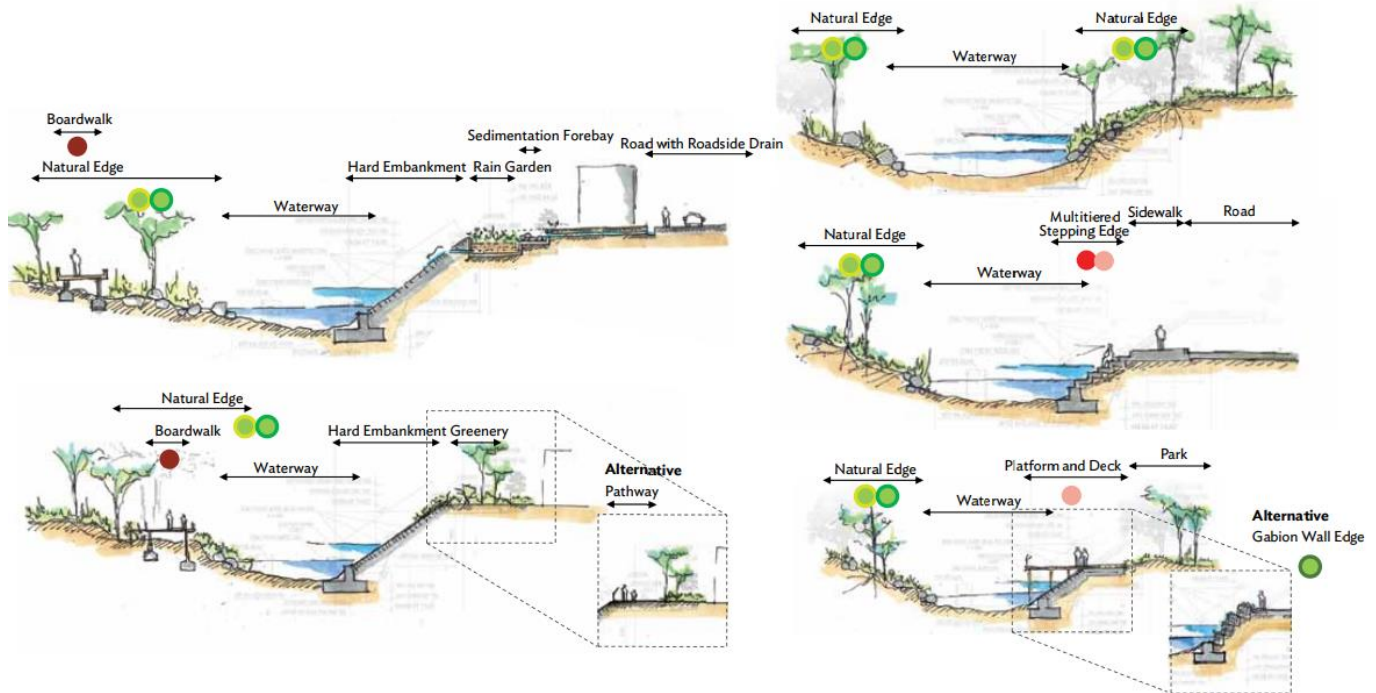
### 3.4 Vitality function setting

In combination with the current situation of landscape ecological spaces in the park, such as lakes, wetlands, woodlands, etc., three distinctive walking paths will be built to provide a wetland experience, forest wandering, and flowers and plants viewing. All kinds of footpaths combine plank roads and small recreation nodes to connect with corresponding natural recreation activities, bringing people into nature from the hustle and bustle of the city. The park can carry out three kinds of theme activities around nature, such as wetland science popularization, plant cognition, bird observation, and other knowledge science popularization activities; Leisure and health activities such as walking around the lake, forest yoga, parent-child camping; Gardening experience, nature

photography and other experiential activities. All kinds of activities can be carried out freely by the park management office, non-governmental organizations, or individuals, depending on the site in the park, with various forms of organization.



**Figure 5.** Tang Shaoyi Exhibition Hall  
Image Source: Self drawn by the author



**Figure 6.** Key Water Sensitive Urban Design Components

Image Source: Nature-Based Solutions for Cities in Viet Nam: Water Sensitive Urban Design  
<https://www.adb.org/sites/default/files/publication/535016/nature-based-solutions-cities-viet-nam.pdf>

#### 4 Conclusion

The lake park is an important green open space in the city. It needs to give consideration to the development of its ecological value and humanistic service value and promote the harmonious coexistence of humans and nature in the city. Taking Zhongshan Park as an example, this paper proposes an ecological approach to ensure water security and cleanliness, establish a complete regional ecosystem, improve biodiversity, inject humanistic service functions, and discuss the way to build such parks with ecological sustainability and functional vitality. Urban lakes of different regions, types, and scales are different. As a precious and unique natural space in the city, urban lake parks should also be explored in a more in-depth and local way to promote the healthy development of urban ecology and constantly improve the quality of human settlements.

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