

# Research of Urban Lake Ring landscape planning and design

## Case Study of Niushan Lake Tech-Eco City

Li Bi<sup>1</sup>

<sup>1</sup> *HuaZhong University of Science and Technology Wenhua College, Wuhan 430073, China*

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**Abstract.** Urban Lake is an important part of urban aqueous environment, which provides not only recreation for residents, but also high ecological service value as an ecosystem. Along with the increasing urbanization of our country and accelerating development and utilization of urban lake resource, sustainable landscape development is in urgent need. The sustainable landscape design of Niushan Lake Tech-Eco City is studied based on ecological, geographical, social, functional and economic principles, taken up from landscape, environment, ecology and other aspects, and following the sequence of waterscape to terrestrial landscape. Focus on the local ecological environment natural environment characteristics and architectural landscape characteristics, combine the local cultural tradition and the modern science and technology civilization, through proper landscape design to embody native culture. To create a comfortable, humanity and natural ecological park landscape environment of life, improve the life quality of producers. Strive for the development of the people and the environment to achieve harmony and balance.

## 1 INTRODUCTION

Along with the rapid development of socio-economy and the improvement of people's material and cultural life, the process of urbanization is speeding up. While urban socio-economy is developing, the city's natural ecological environment is deteriorating. Since 1970s, there have been energy crisis, ecological crisis, environmental crisis and the corresponding spiritual crisis, cultural crisis and social crisis. Many cities are driven by short-term economic interests, so that the complete massif, water and other valuable urban and peri-urban natural resources are constantly eroded, resulting in the city's ecological environment continues to deteriorate, and the original features of many different cities gradually become more and more similar, this phenomenon happens almost everywhere. Influenced by the theory of sustainable development, cities of twenty-first Century should not only provide the opportunity to increase the wealth, but also to meet transformation in ecological, environmental, cultural, scientific, technological and social aspects[1]. And urban lake, especially the one in landscape city, is often considered "the lung of the city", which is the key to optimize urban ecological environment, and highlight urban landscape characteristics. It is an important resource for urban development, with values in economy, culture, ecology many other aspects.

Wuhan is one of the biggest cities in the central region of China, the intersection of two rivers, water

and an excellent is typical of rivers, lakes, wetlands, ancient Yunmeng lake zone. The city's drainage network of existing lakes was arranged in a crisscross pattern, 166, 100 Urban Lake, known as the name [2]. With the acceleration of the urbanization process of Wuhan city circle, human activities will inevitably spread to the lake area, Wuhan's "City Lake" because of its unique landscape and ecological benefits, is the formation of urban lakes landscape construction boom. Under this background, the Chinese science and technology industry park plays an important role in creating the national environmental protection model city of Wuhan, East Lake, the important part of the new district. The relationship between a with environmental protection and ecological significance of the concept of green "City Lake" Lake Zone environmental landscape planning and design, it should be is the design of landscape, environment and culture of the Trinity, the China Science and Technology Industrial Park cattle mountain lake science and technology eco city as an example, the research of "city" and "mountain" and "water", combined with the development of tourism, the research areas around the lake landscape with different groups of the function and distribution of, of urban lake, with environmental landscape planning and design is discussed.

## 2 BACKGROUND STUDY

Chinese Science and Industrial Park has many lakes and ponds, the water area is 91.34 square kilometers, equals 41.96% of the total area of the park. There are two major lakes: Niushan Lake and Baoxie Lake. In the park industrial programming design, Lake Niushan is about to become a city lake

Located in Jiangxia District, Wuhan City, Hubei Province. Niushan Lake (30 degrees 19'N 114 degrees 32'E) has the area of 4000 square hectares, formerly was part of Liangzi lake water system, then separate from it after 1979. Niushan Lake has lush grass, and its surface area is 4166.6 hectare. To its south, there's Longquan Mountain and the Chuzhaowang cemetery and Longquanshan natural park. To its north, there are highway entrances of Jingzhu, Hurong and Wuhuang. Beautiful natural conditions, rich in aquatic resources, it's main function is to provide the aquatic habitat for those rare sea animals, as well as the fertilizing ground for fish and shrimp. After determination, the basic monitoring projects meet the standard of water quality in the surface water environment quality standard (GB3838-2002), and the standard rate of water quality is 100%, the water body is in good condition. Using the comprehensive nutrition index method to evaluate the water quality of cow mountain lake in 2012, the results show that the comprehensive nutrition index of the Niushan lake is 49, which belongs to middle nutrition. Main pollution sources for livestock and poultry manure, livestock waste is not without any treatment directly by natural sewage discharged into the ditch village simple sewage pond. The main source of pollution sources is planting industry pollution, crop planting need to use a certain amount of pesticides, fertilizers, pollutants through surface runoff into the lake, the direct impact on the lake water.

Due to the Niushan Lake Tech-Eco City is located in Tangxun Lake Ecological Green wedge, in Wuhan City, the overall ecological protection framework is shouldering the important responsibility, so in the process of development and construction to the ecological protection in the first place. In order to ensure the Niushan lake water as class II water quality, to establish the ecological lakeshore buffer zones to reduce non-point source pollution. Application of riparian buffer zone for lake water pollution and eutrophication control and guarantee the safety of the drinking water and stabilize the banks and has very important practical significance in preventing soil and water loss and soil erosion, lakeshore buffer zones of application for land animals provides habitat and biological channels, has greatly improved the environment for the survival of aquatic organisms. Despite the city has been completed and start the part of the water and vegetation protection, because in the process of urban construction on the natural elements lack of knowledge, we believe that should be to "lake, forest, green" based, specifically from keep water ecological restoration and control lake, woodland construction three aspects of ring Niushan Lake region are an important natural space for ecological protection and recovery.

### **3 PLANNING AND DESIGN PRINCIPLES**

With the comprehensive consideration of functionality, landscape, ecology and other aspects of the city lake, the following principles need to be followed in the design process:

#### **3.1 The principle of ecology**

The word “ecological design”, has been promoted for a long time by designers, almost all of the design, whether it is landscape or architecture, cannot be separated from the ecology. Applied to the landscape design of Industrial Park City Lake, not only should consider how to make the best use of natural renewable energy, but can also make the industrial park landscape design as a mean of completing the perfect energy cycle of nature. Fully embodies the Industrial Park as an integral part of urban natural ecological characteristic and mechanism [3]. Human beings are always the main body and control, all the design is aiming for serving human beings, so there is emphasis on "people-oriented", but also need to respect the natural landscape design, as far as possible to maintain the existing ecological environment, promote the use of advanced ecological technology in the environment, to realize the combination of human and nature, is good for sustainable development.

#### **3.2 The principle of geography**

Niushan Lake science and technology city is an eco-city with the combination of living, leisure and other functions. Relying on the unique landscape resources, the city is focusing on details design, and it aims to build an eco-technological energetic new city which mainly rely on lakes and mountains. On the one hand, to build good natural mountains and rivers within the greater area in the city ecological structure and network; On the other hand, to make internal use of existing natural conditions and optimization areas around the lake with ecological and recreational environment. Lake area with a landscape design to highlight the "ECO + landscape" design principles to shape the landscape to shape human interaction space, make full use of the ecological environment of Niushan Lake, combined with the green landscape around the lake area, with advanced design concepts, modern forms, combined with Chinese classical garden aesthetics, form a unique personality of the city Lakeshore zone environment.

#### **3.3 The principle of socialization**

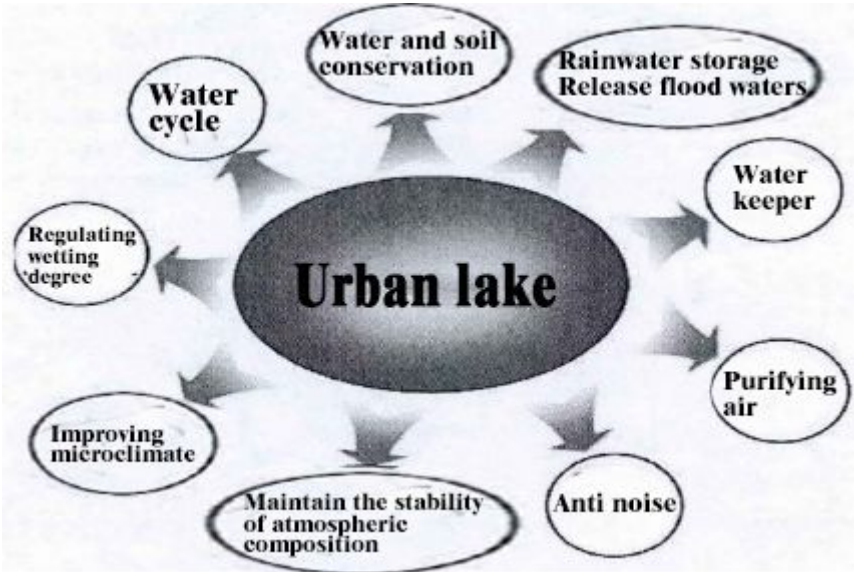
In landscape city "city lake" lake area, because of their unique landscape space form, certainly in the long history of urban development to reflect the rich culture of the city. It should always reflect people's attention and respect in the design, and create the most harmonious space. At the same time, we need to impart a cordial and pleasant environment landscape artistic influence, through the layout of urban space to the existing urban culture and promote the protection and integration of advanced outstanding culture, and integration of modern elements to be localized, reflecting the park cultural characteristics.

#### **3.4 The principle of function**

Niushan Lake Tech-Eco City is one of the two important tech-eco cities in Donghu Demonstration Area, positioning as new lake ring eco-city, providing public service function, equipped with tourism services and high-end commercial facilities.

Niushan Lake Ring possesses great landscape, scope and profound cultural accumulation. Hence it is very ideal and suitable for urban residence. Urban lakes occupied a lot of urban land natural resource. In order to get the most of this limited resource, it should carry corresponding urban functions under cost efficient policy along with other land resources. Especially while the urban environment is deteriorating, urban lakes should utilize its own advantage, maintain ecosystem, provide open space and build a graceful city image, fulfill its main landscape function as recreation, resort and ecological patch. The development of the lake area can drive the economic growth of the city and boost property, tourism and other industries.

The urban lake should meet the following functions: (1) Ecological function: preserve the biodiversity, adjust urban humidity Adjust urban temperature and humidity, supplement urban groundwater; inhibit lakeshore pollutants as a buffer zone. Urban lake ecological value is showed in Figure 1. (2) Aesthetic function: urban lake should improve urban landscape diversity as an important element of the natural environment, enrich urban spatial pattern. (3) Recreational function: the design of the urban lake ring should integrate more activities, based on the original natural landscape, such as boating, lake ring bike paths and other water recreational sports. (4) Spiritual and cultural function: water space design should be the media of aesthetic urban landscape, urban history and culture, including the city's charm and aura.



**Fig .1** The ecological value of the city lake

### 3.5 Economic Principles

The construction of urban lake ring is a long-term work, which involves social, economic, ecological sustainable development. While utilizing a variety of urban lake ring landscape resources, the planning should ensure its regenerating mechanism, focus on energy and material saving, pay attention to the rational use of land resources, and maximize the use of new materials, new technology and new equipment to achieve cost efficiency, energy and material recycling, site self-sustaining, evolution and sustainable development of the waterfront environment. The important guarantee of sustainable urban development is sustainable urban lake landscape construction, in order to inherit the importance of the urban aqueous system of urban history.

## 4 PLANNING AND DESIGN CONCEPTS

Niushan Lake region possesses advantageous natural conditions and ecological environment, which carries education promotion of eco-industrial zone development traditional cultural heritage and urban recreational agriculture. The landscape design of lake zone should integrate ecological culture, ecological agricultural resources and ecological environment, based on a new ecological philosophy and market demand, in order to create a combination of traditional and modern cultural and ecological commercial tourist attraction.

The overall plan of China Science and Technology Industrial Park presents a multi-group style, that is to build the "three bays, four islands, two rings, the north and south cores" spatial pattern. Niushan Lake area uses "north eco-core + wedge corridor" eco system Layout mode, to form "ring protection, lake greenbelt, corridor network, green city" layout. The entire lake zone planning and design follows the natural and ecological principles, combining protection of Niushan Lake ecosystem with overall framework of the park in the industrial park level. Ecologically, emphasis patch, corridor protection; on transportation aspect, build internal tourism transport system, and strengthen the connection and transition of tourist traffic and urban traffic in the lake district. The density of the main buildings should be low, with more buffer zone by retreating the buildings; planting different plants to prevents lake contaminants , strengthen the protection of natural ecological landscape.

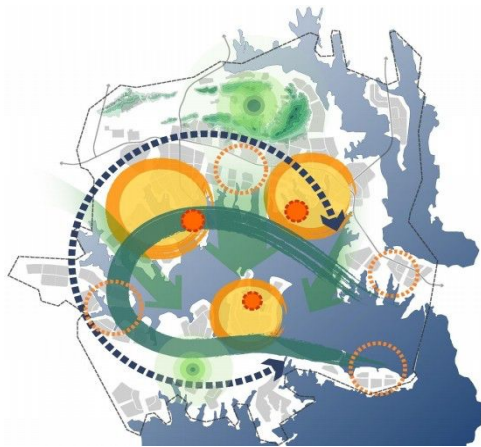
Specifically, Niushan Lake area landscape design should coordinate with the general condition and the overall style. Each element landscape should be united in the overall environment; create a culture atmosphere of ecological environment, focusing on eco-geographical environment and local landscape architectural features; mining, refining and promoting traditional regional culture, and combing modern hi-tech life style, reflected through the suitable landscape ultimately, in order to improve the cultural taste of the park environment; setting humane and convenient-managed public facilities, so that the residents and the tourists could feel the most real concern.

## 5 MAIN LANDSCAPE DESIGN AND EFFECT ANALYSIS

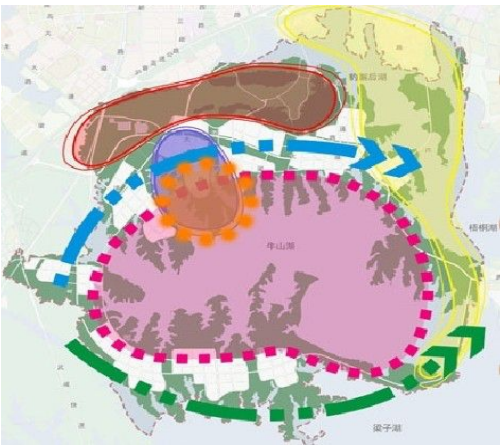
### 5.1 Niushan Lake landscape structure

the spatial structure of overall planning of Niushan Lake ecological park can be summarized as "two rings, two belts, three sections." The two rings: Lake Ecological recreational ring consisted of more than twenty annular peninsulas, and the inner ring is the integrated functional development, as shown in Figure 2.; two zones: two industrial tourism zone constituted by the themed park , Niushan Lake Hubei section of creative industries and tourism and the south Niushan tourism and leisure industry ring; three sections: the eastern sports culture sector, the north ecological and cultural sector and the western urban culture sector, shown in Figure 3.

Niushan Lake area landscape pattern exhibits three functional areas: (1) sports and cultural groups in eastern sector as a dynamic area around the lake area, such as water sports, low-altitude sports project. (2) Two industrial tourism belts as static cultural industrial base, which is recommended not to arrange exhibition, Expo and other dynamic tourism projects. (3) Northern sector surrounded by the two mountain. And it is the ancient royal family and literati's health resort, which can be planned for the high-end healthcare ecological areas.



**Fig .2** Spatial pattern of Industrial Park



**Fig .3** The space layout of Niushan Lake District

### 5.2 The main content of the regional landscape planning and design

In cities, city lakes landscape composition can be divided into two categories- material and non-material. From the point of urban landscape design theory, material landscape is made up of regional landscape, landscape axis and landscape nodes correspondingly. In this section, Niushan Lake will be introduced through water landscape, transitional landscape and surrounded landscape.

#### 5.2.1 Water Landscape

Almost every lake has its own personality and style. The shape, sound, color, shadow and extrinsic visual elements of water will deliver different psychological feeling and consequently, forming different visual effects. The water quality of Niushan Lake is good, together with Longquan Mountain, they formed a unique landscape structure which enhances the beauty of the water body. Shaping the landscape of such region requires the following: a reasonable treatment with lake water, organization of land and water classic, dividing the landscape space; and striving to alleviate the monotonousness of the water space, riching the landscape level, creating tortuous landscape featured areas; by using multiple lakeshore line approach to expand Lakeside space and to achieve ecological integration lakeshore and water bodies, and to fix the beautify the lakeshore. For the shallow water area, by taking the advantage of the floated, submerged plant communities, stocking aquatic microorganisms, animals and restoring aquatic ecosystem, together with landscape design, it will create a picturesque landscape.

#### 5.2.2 Transitional landscape

Transitional landscape refers to the range of landscapes that are affected by the water level changes, mainly indicating the lake surrounded wetlands and embankments, platforms, plank roads, bridges and some lake extended pavilions and galleries.

View Point: the waterside hydrophilic trails, platforms, bridges, and waterfront buildings, etc., are providing people with variety free overview of the lake and enjoyment the water landscape, open

space interaction with rainwater which emphasizes the intimacy between man and nature; man and Lakes.

Binhu buffer zone is defined as the establishment of various types of plants along the coast of the lake, including the forests, vegetable fields, or other types utility land types. Thanks to its special geographical location, it is utilized for pollution prevention and treatment; riparian landscape creation; habitat provision; ecological corridor connections; soil habitats, soil and water conservation and many other uses. According to the study of Huang Shen Fa (2008), the filtering function of Binhu buffer zone can effectively trapping the suspended matter of the runoff water and degrading nitrogen and phosphorus nutrients of the seepage water, and degrading the pesticides and weeding agents of the runoff water through the soil, and different plants and slopes bring different effects on buffer zones' pollutants purification effect. Meanwhile, the applications of Binhu buffer zone provide habitats for land animals and biological channels which have greatly improved the living environment of aquatic organisms. In the United States, a large number of applications of Binhu buffer zone bring very objective ecological and economic benefits. During the construction of buffer zone, the rationality of the construction of plant communities also needs to be taken into consideration. Each community of the plant is made up of different life forms of plants. The structural space can be divided into vertical and horizontal structure. Generally, the simpler the vegetation structure, the lower the capacity for self-regulation and updates, and thus offering worse ecological stability. The total reduction in the number and types of vegetation would affect its role of water purification and slope fixing. So Niushan Lake buffer zone chooses common type of plants that demonstrate effectively soil and water conservation ability; outstanding nitrogen and phosphorus absorption capacity; developed root system; high survival rate; long growth cycle and low cost of planting as selecting criteria. In the case of same purification effect, the priority will be given to the native species or localized alien species, this will help to improve the harmony between the buffer zone vegetation and wild animals, and hence improve the ecological function of the buffer zone.

Architecture: pavilion, gallery, house, bridge, plank and other forms of construction, are considered to be the most important artificial factors of lakes landscape. There is large number of hydrophilic buildings near Niushan Lake, with the multi-functions including locating near the water, extending into the water, diverting water indoor and building island onto the water.

### *5.2.3 Surrounded landscape*

The surrounded landscape of city lakes is determined mainly by the tone of urban park landscape, which is made up of water surrounded trails, artificial construction buildings, environmental facilities and waterfront green corridor and some other components.

Lakeside green area is the main region of landscape shaping. Functioning as natural barriers, lakeside green area is coordinating the relations between the lake and the city. The design in this area expanded the use of green space along the lake as much as possible, to form a continuous green belt with good green space and thus improved the environment quality of the landscape. As for the species, taking developing rich, multi-level of green system by using trees, flowers, and grasses, and primarily based on trees as principle, to enhance the sense of waterfront green space layering level, so that to demonstrate both uniform overall appearance, and also changes of rhythm. This is done in terms of increasing in soft ground and vegetation cover, planting tall trees to provide shade and reducing heat radiation. The industrial waste produced during the industrial production process, the tourists' waste and non-point source water pollution are the main causation of the pollution of the city lakes. Therefore, reasonable planning of park greening can not only improve the coverage of green, but also effectively purify the air and prevent sources of pollutants being throw into the lake.

Lake trails: the design of waterfront road should be combined with the actual situation of water systems; to organically connect the road traffic, public transport, site traffic together to strengthen the tie with the surrounded green land, service facilities so that to maximize the proximity of residents and visitors to the surface of the water. Niushan Lake coastline is 113 kilometers' long, in addition to the entertainment and activity areas, pedestrian paths, long bike paths and an improved lake recreation road in the Lake District zone can also be constructed. Such trails are the viewpoints when people are doing sports. They provide powerful viewpoints at all time, and also function as the lake hydrophilic control shaft. They are also the main places to view the landscape and the organization of the waterfront. These trails offer especially unique views for a curved waterfront shoreline like Niushan Lake.

Environmental Facilities pieces: this includes primarily service pieces- for example, rubbish bins, service department, administration department, toilets, commentary and identification pieces, such as indication signs, guide signs, advertising, leisure facilities - such as galleries and pavilions, benches and chairs, automatic drinking utensils; ornamental pieces-such as fountains, rockery, sculpture and so on; green sketch pieces-such as flower boxes, flower beds and other planting container and telecommunications facilities- such as light boxes, phone booths and temporary charging area.

Lakeside campus landscape is acting as the unique water landscape space, which is one of the most critical factors that show the quality of the ecological park. Therefore, the landscape design of the Lake District should consider the arrangements of terrain, lake drive, surroundings, relation of water and plant design elements appropriately to form a high quality visualized landscape; and as a result, making Niushan Lake a high quality recreational attraction and resource of tourism.

## 6. CONCLUSION

A successful eco-technology industrial park must reflect the cultural and historical context of the city; a mature eco-technology industrial park is inseparable from humanity, ecological and sustainable development of landscape design. Niushan Lake is in a good ecological environment, along with the rapid economic development of the ecological park, we need to be cautious about the environmental protection, rational exploitation of resources but meanwhile maintain the unique characteristics of the park, so that to achieve a harmonious and balanced development between the human and the environment. And eventually we can shape a comfortable, humane, livable ecological park landscape environment which improves the quality of lives for producers and increases the tourists' senses of belonging so that promotes a comprehensive development of the park.

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