Ecological Landscape Design for the Water Body in the Jasmine Capital of Qianwei County

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Keywords: water body; ecological landscape; water system; design.

Abstract: Water landscape is one of the most important scenes in a park. This paper analyzes the current situations of the water body in the Jasmine Capital of Qianwei, including the water quality, as well as its spatial distribution and changing trend. The design combines the functions of sightseeing and ecosystem construction with water quality maintenance, and integrates ecological construction with combined-flow ecological wetland and water system circulation, in order to achieve the goal of the ecological landscape design of the scenic spot.

1. Introduction

The Jasmine Capita in Qianwei County is an idyllic complex built by the county. Using jasmine flowers as the industrial basis, it aims to build a world level Jasmine Exposition Park. The Water Project of the Jasmine Capital is located at the entrance of the main gate. The whole water body is fish-shaped with an area of about 56600 m^2. Its geographical location is very important and it is one of the main scenes of this area. At present, there is no special reservoir or river which serves as the water source of the water body. The lake, which used to be a farm pond, mainly relies on rainwater and surface runoff to supplement. At present, the water body is seriously polluted; the water quality is turbid and eutrophic.

2. Causes of Water Pollution in the Jasmine Capital

First, the water body lacks the power of water source and presents the characteristics of poor fluidity. The water body cannot be renewed in time, which leads to the pollution of water body caused by the accumulation of pollutants.

Second, in the surrounding area there are agricultural planting parks, as well as livestock and poultry farms. Organic pollutants and surface soil flow into the water body with precipitation such as rain and snow. A few man-made garbage are discarded, resulting in the re-pollution of water after a long time. It is necessary to consider a long-term comprehensive treatment method to solve the pollution.

Third, the water body was used to be a fish pond with many kinds of fish in large population. The unreasonable feeding method led to the accumulation of fish food and excreta, as well as turbidity and thick silt.

Fourth, the water body do not have complete ecosystem. Besides wild vegetation which grows naturally, it lacks proper plant allocation, especially the application of aquatic plants which can purify nitrogen, phosphorus and potassium in water. It cannot form a good landscape effect.

Fifth, at present, the management system is imperfect. The water garbage and bottom silt are too thick, which need to be cleaned up and disinfected in time.

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Figure 1. Current Situations of the Water Body and Pollutant Sources around the Site

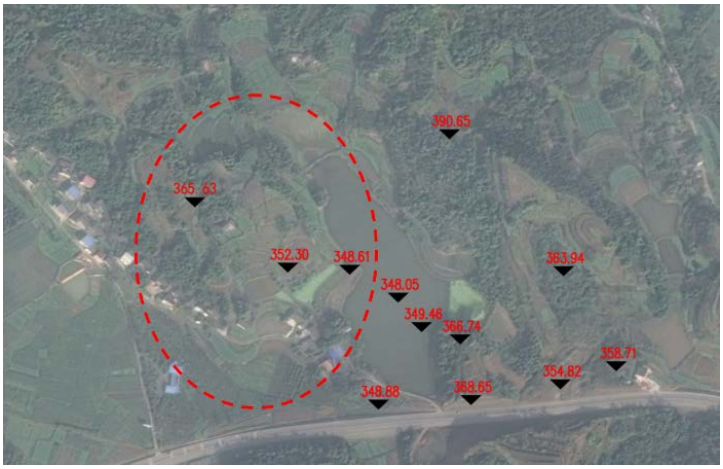

Figure 2. Elevation Plan of the Current Situation of the Lake in Qianwei

3. Basic Situation of the Water Body

With an area of about 37605 m^2, the water body shows the feature of high in the northwest and low in the southeast, as well as high in the south and low in the north. The lake bottom shows a fluctuation of 1.5 m. According to the topographic map provided by the first party, part of the elevation is drawn, and part of the elevation is 42 m^2 above the water surface. There are agricultural lands around the lake; in the future, these places will be used to grow jasmine and serve related industries. The daily water supply of the lake mainly depends on rainwater and the surface runoff, so the agricultural non-point source pollution caused by the surface runoff needs to be dealt with. Sediment, garbage, dust, road pollutants, agricultural fertilizers, irrigation canal fertilizers, and pesticides can directly pollute the water body after entering the lake through surface runoff, resulting in the deterioration of the water ecological environment. The single structure of the aquatic ecosystem also results in the low self-purification capacity of the water body.

4. Design Objectives for the Water Quality in Jasmine Capital

The transparency should be 0.5-1.5m. The main indicators of COD, BOD5, DO and NH3-N should reach the level of Class III of surface water, and TP should reach the level of Class IV-V of surface water.

Number	item	Water Quality Design Objectives of Nanhu Lake	Note
1	transparency	05-1.5m	Class B-C Water Quality Standard for Scenery and Recreation Area
2	Chemical Oxygen Demand (COD)	20mg/L	Class III Standard for Surface Water
3	Five-day Biochemical Oxygen Demand (BOD_5)	4mg/L	
4	Dissolved Oxygen (DO)	5mg/L	
5	Ammonia Nitrogen (NH_3-N)	1.0mg/L	
6	Total Phosphorus (TP)	0.1-0.2mg/L	Class IV-V Standard for Surface Water

Figure 3. Reference Standards for Water Quality Design Objectives

Note: 1. *Environmental Quality Standards for Surface Water* (GB 3838-2002); 2. *Water Quality Standard for Scenery and Recreation Areas* (GB12941-91) class B: mainly applicable to national key scenic areas and those not in direct contact with the human body

Figure 4. Water Quality Standards

Through the construction of clear water ecosystem, the diversity of aquatic biological species should be enriched; suspended solids should be reduced; transparency of the water body should be improved; eutrophication of the water body should be prevented; the requirements for water quality should be guaranteed; good landscape on and under water surface should be created. [1-7]

After the implementation of the project, the water quality should achieve following objectives.

First, main water quality indicators for the lake area should meet the surface water quality standard III.

Second, the water transparency should be no less than 1.2m; the turbidity should be no more than 10NTU; obvious odor and abnormal water color are unacceptable; it should meet the requirements of landscape water.

Third, the aquatic biodiversity should be high; the water body should be full of vitality; the aquatic ecosystem should be healthy, stable and long-lasting.

Figure 5. Water Quality and Landscape Requirements

5. Water Body Design

5.1 Water circulation design

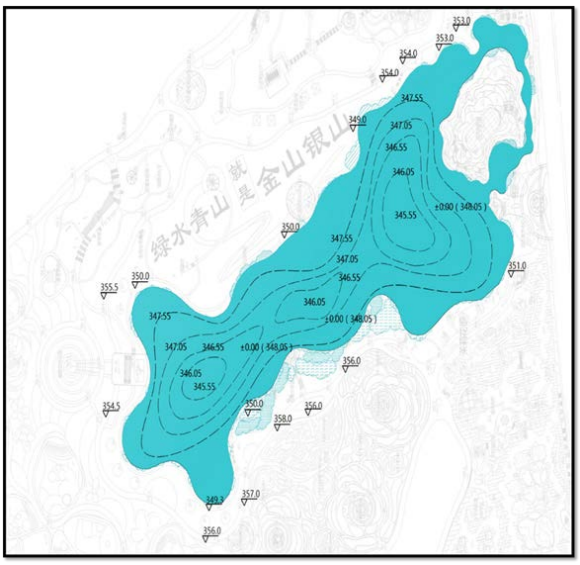

Figure 6. Vertical Plan of the Underwater Topography of the Lake

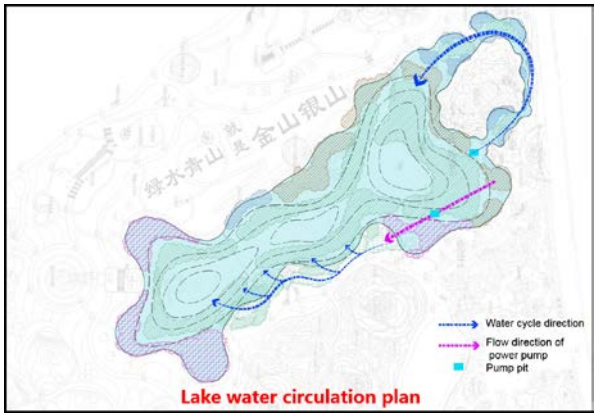

Figure 7. Plan of the Water System Circulation

Using the undulating change of the bottom topography, the height difference of 1.5m is presented. The whole area is high in the northwest, low in the southeast, as well as high in the south and low in the north. The water circulation is realized by combining the power pump with the natural flow.

5.2 Construction of the subsurface wetland and the biological buffer zone

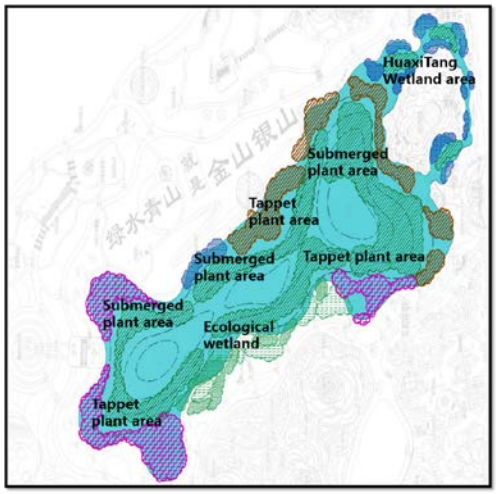

Figure 8. General Layout of the Water Ecological Design

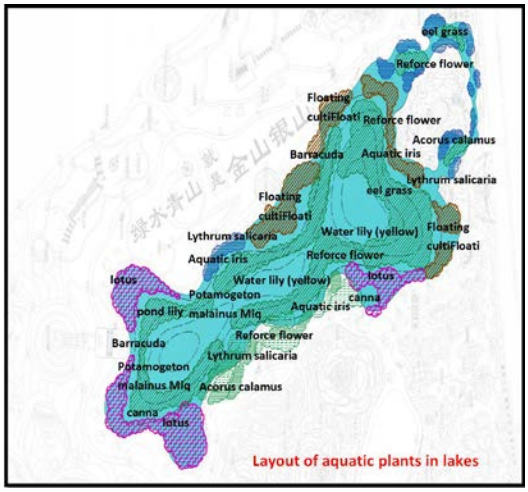

Figure 9. Layout of Aquatic Plants

The survival zone of emergent plants is the area within the water depth of 0.8m around the lake, in which the area with water depth of 0-0.8m is for emergent aquatic plants while the area with water depth of 1-2.5m is for submerged plants.

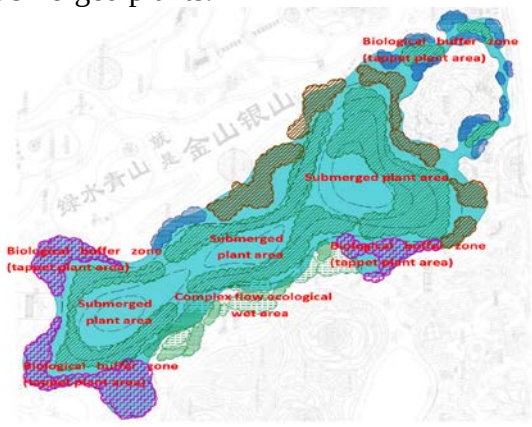

Figure 10. The Biological Buffer Zone

5.3 Design of the combined-flow wetland planting bed

Water dynamic pipeline replenishment and reflux water body pass through the combined-flow ecological wetland and biological filter pond. Each layer is paved with pebbles with the thick of 500 as the biological filler; emergent aquatic plants are planted. Wetland bed packing consists of three

layers: pebbles on the surface, bean stones and the soil layer in the middle and gravel stones below. The calcium content of surface soil is 2-2.5 kg/100 kg. The hydraulic conductivity is good; the permeability coefficient is about 500-1000 m/d.

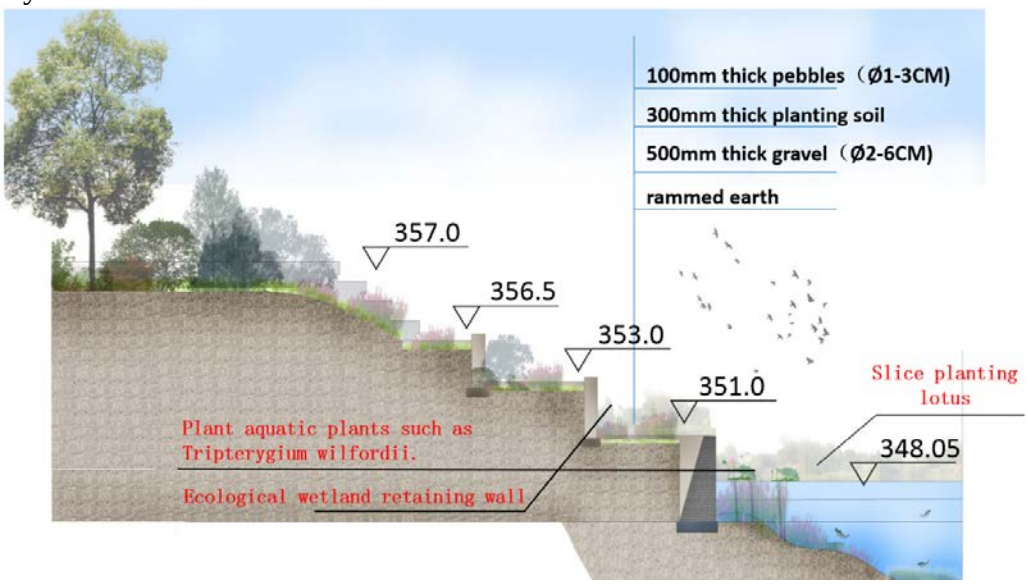

Figure 11. Section of the Wetland Planting Bed

Relevant parameters of the constructed combined-flow wetland system are as follows. The wetland area is 4200 square meters; the optimal treatment water is 600 m3/d, which should not exceed 1000m3/d; pollutant removal capacity of the system is Ce = C0A exp [(-C Kt Av 1.75 L W dn) /Q]; wetland system nitrogen reduction quantity is about 7.5 kg/d; phosphorus reduction quantity is about 1.1 kg/d; total annual nitrogen reduction of wetland system is about 500 kg; total annual phosphorus reduction is about 60 kg.

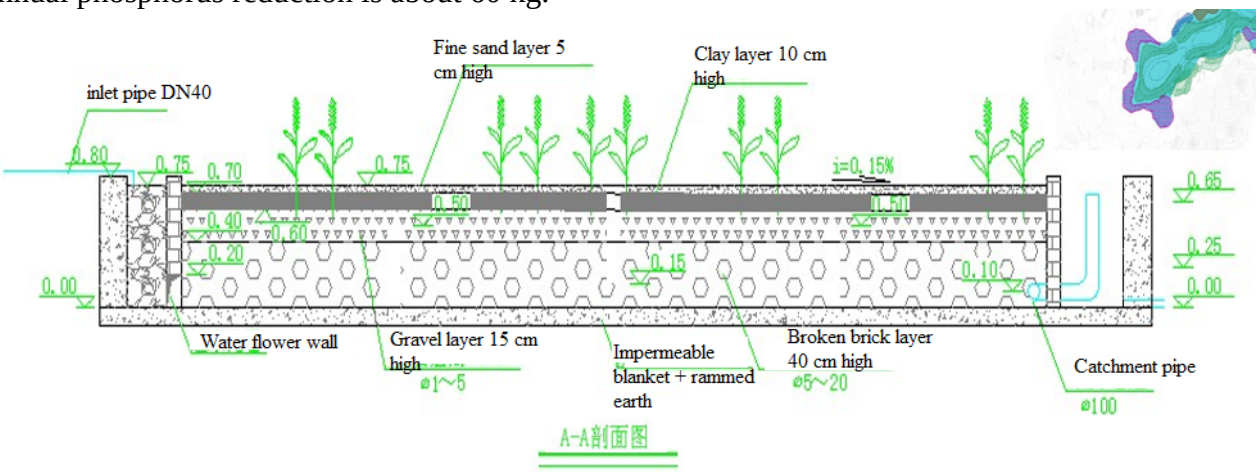

Figure 12-1. Section of the Biological Buffer Filtration and Purification Belt

The ecological buffer and filter purification zone is constructed along the lake; the emergent aquatic plants such as lotus, thalia dealbata, pickerelweed and willow herb are planted around the lake to construct the aquatic habitat. The underwater plant communities are constructed by planting submerged plants such as hydrilla and eel grass under the water, so as to rapidly solve the problem of eutrophication of the water quality.

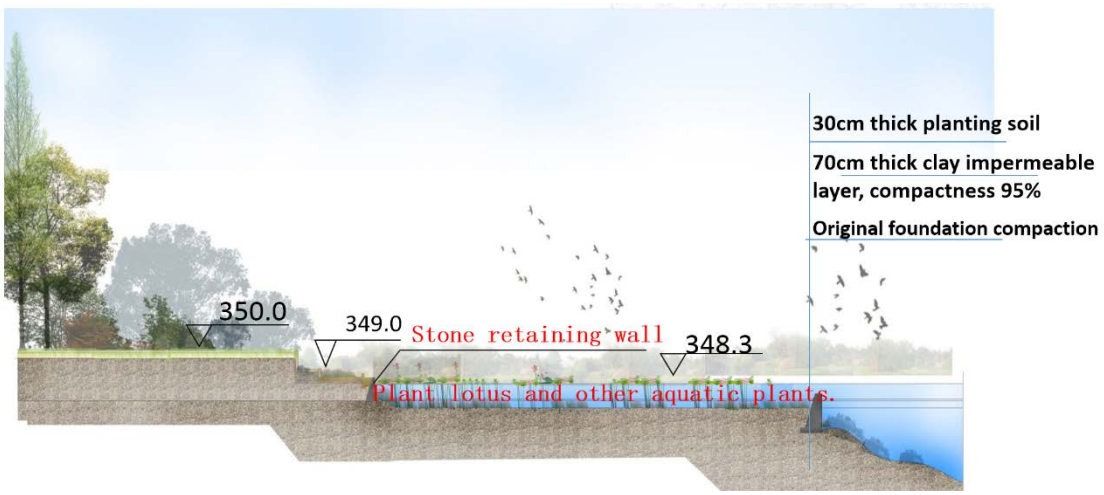

Figure 12-2. Section of the Biological Buffer Filtration and Purification Belt

6. Conclusion

This paper analyzes the current situations of the water body in the Jasmine Capital of Qianwei, including the water quality, as well as its spatial distribution and changing trend. The design combines the functions of sightseeing and ecosystem construction with water quality maintenance, and integrates ecological construction with combined-flow ecological wetland and water system circulation, in order to achieve the goal of the ecological landscape design of the scenic spot. The scientific practice has proved that the water quality targets we designed can be achieved.

The artificial established ecosystem can purify the water body, create a stable and abundant ecological plant community, enrich the landscape diversity, and meet visitors' requirements on leisure, entertainment and experience; it can enhance the sustainable self-purification ability of the water body and make the waterscape become the most important scene of the park. [8-10] Biological, physical and chemical methods, such as building the artificial wetland pond bed, creating the water circulation system and constructing the ecological environment are adopted to carry out the comprehensive treatment and achieve the purposes of purifying the water quality, creating the water scenery and carrying out aquatic sports in the park. [11-18]

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References

[1] Zhang L. The Method of Creating Waterscape in Landscape Design under the New Normal Condition [J]. Shanxi Architecture. 2016 (18): 55-58.

[2] Liu H. Purification of Aquatic Plants and their Application in Waterscape Ecological Design [D]. Zhejiang University. 2003.

[3] Liu Y, Lu J S, B J. Characterization and Driving Force of Water Purification in Terrestrial Ecosystem of Watershed [J]. Progress in Geography. 2019 (04): 96-99.

[4] Fan X X, Song G, Song F Q, Liu C G, Wu G G, Zhao D D, Zhang J. Atrazine Polluted Water Purification Technology and Degradation Mechanism [J]. Environmental Engineering. 2015 (09): 12-15.

[5] Zeng S. Ecological Design of Urban Waterscape in Xinjiang [J]. Xiandai Horticulture. 2013 (12): 63-65.

[6] Han Y J, Yang L, Zhao L, Wu D, Wei Y, Li H Y, X B B, Wu F J, Wang Y. Research and Prospect of Duckweed Plants in Water Purification [J]. Bulletin of Biology. 2016 (06): 71-72.

[7] Li Y Liu J F, Liu J Z, Zhang H, Liao D X. Advances in Aquatic Plant Allocation and Water Purification [J]. Chinese Agricultural Science Bulletin. 2015 (15): 60-62.

[8] Zhang S G. Symposium on Water Purification and Treatment Equipment [J]. Agriculture Machinery Technology.2009 (01): 45-48.

[9] Wu D, Ling H, Zhou X, Huang X Y, Tan D X. Study on Long-term Transport and Management of the Black and Odor Water Treatment Project in Taihu Lake Basin [J]. Anhui Agricultural Science Bulletin. 2018 (21): 93-95

[10] He Y T. Comparative Analysis and Design of Different Types of Modern Urban Waterscape [D]. Jiangnan University. 2008

[11] Yang Y S. Application of Constructed Wetlands in the Purification of Urban Waterscape System: A Case Study of Xipu River in Liupanshui, Guizhou Province [J]. Wetland Science and Management. 2015 (01): 45-46.

[12] Liu Y. The Role of Aquatic Plants in River Ecological Governance: A Case Study Wusha River Project in Nanchang, Jiangxi Province [J]. Chinese Horticulture Abstracts. 2017 (05): 49-53.

[13] Chen S. Study on the Construction of Small-scale Wastewater Purification Constructed Wetland Waterscape [D]. Southwest Jiaotong University, 2015.

[14] Li J. Study on Plant Landscape Design of Constructed Wetlands in Northern China with Purification Functions [D]. Chinese Academy of Forestry. 2013.

[15] Cheng W, Cheng D, Li Q. Purification Mechanism and Application of Aquatic Plants in Water Pollution Control [J]. Industrial Safety and Environmental Protection. 2005 (01): 145-147.

[16] Hu Z M. Design and Application of Aquatic Plants in Landscape Architecture [J]. Chinese Horticulture Abstracts. 2018 (04): 98-101.

[17] Zhang X, Zhang L, Zeng F Y. Selection of Aquatic Plants for Waterscape with Different Functions [J]. Journal of Green Science and Technology. 2018 (13): 56-58.

[18] Xing W M, Xue T. Application of Aquatic Plants in Aquatic Ecological Restoration: A Case Study of Jialu River [J]. Agriculture of Henan. 2017 (06): 33-36.