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Benefits of resilient design approaches in urban waterfront spaces affected by flooding events: a possible proposal for Xiangjiang River, Xiangtan, China

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ABSTRACT

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a possible proposal for Xiangjiang River, Xiangtan, China

The value of landscape is often reflected in how it serves people, not only by ensuring a better quality of life and sensory experience to them, but also creating more significant values for the society. Due to climate change, natural disasters and flooding events are becoming more frequent and intense, and only by constantly reinventing and innovating can communities reduce crises and bring stability, health, wealth, and development to people. Landscape architects have come to realize that only built infrastructures will not solve the immediate crisis of communities. Walls against floods and concrete levees will only solve the need for temporary flood control, but they will not work in harmony with nature. However, resilient landscape design approaches present opportunities and benefits for communities. Taking Xiangtan section of Xiangjiang River in Hunan Province, China, as an example, this work describes how to use highly resistant vegetation species and related artificial equipment to reduce the impact of unstable water levels on the ecology of the site and create a multi-dimensional landscape corridor as a 'resilient' strategy against floods in such a lack of safety and vitality. The strategy of living in harmony with nature and building multiple layers of defense will bring more efficient benefits to the community.

Key word: Waterfront landscape, Landscape ecology, ecosystem services, resilient design, urban space.

Abstract in lingua italiana

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Il valore del paesaggio si riflette spesso nel modo in cui fornisce delle utilità (anche in senso estimale) alle persone, non solo garantendo loro una migliore qualità della vita e delle esperienze sensoriali, ma anche creando valori più significativi per la società. A causa dei cambiamenti climatici, i disastri naturali e gli eventi alluvionali stanno diventando sempre più frequenti e intensi: solo reinventando e innovando costantemente i propri territori, le comunità possono provare a ridurre gli effetti critici e garantire stabilità, benessere e sviluppo alle persone. Gli architetti del paesaggio si sono resi conto che le sole infrastrutture costruite non possono risolvere queste crisi nell'immediato. Innalzare muri di contenimento e argini di cemento può servire a gestire solo le strategie di controllo temporaneo delle inondazioni, ma non propone soluzioni in armonia con il sistema naturale. Tuttavia, gli approcci resilienti alla progettazione del paesaggio propongono opportunità e benefici per le comunità. Prendendo come esempio la sezione di Xiangtan del fiume Xiangjiang, nella provincia di Hunan, in Cina, questo lavoro descrive come utilizzare specie vegetali altamente resilienti e alcune dotazioni artificiali per ridurre l'impatto dell'instabilità dei livelli idrici sull'ecologia del sito e creare un corridoio paesaggistico multidimensionale come strategia "resiliente" contro le inondazioni in situazioni di mancanza di sicurezza e vivibilità. La strategia di vivere in armonia con la natura e costruire più livelli di difesa porta, in genere, benefici e maggior efficienza alla comunità.

Parole chiave: paesaggio fluviale urbano, ecologia del paesaggio, servizi ecosistemici, progettazione resiliente, spazio urbano.

SUMMARY

The research content of this thesis is as follows:

Chapter 1: Introduces what is resilient design, identifies the problems to be solved and the design objectives, and discusses the feasibility of the scheme.

The second chapter introduces the knowledge of landscape ecology, ecological service function and hydrology, which provides scientific theoretical basis for the design.

The third chapter introduces the data and literature of the current research on landscape ecology in Xiangjiang River Basin and evaluates the research in this field.

Chapter 4: Investigate and analyze the site from micro and macro perspectives, including traffic, climate, culture, hydrology, etc., to control the site conditions more deeply.

Chapter 5: Complete design plan, including workflow, background introduction, strategy, floor plan and detailed design.

Chapter 6: The cost-benefit analysis of the project.

Chapter 7: Project conclusion

In this project, the principle of landscape ecology should be taken into account first, and the landscape should be upgraded without destroying the original ecological appearance as much as possible. Since the Xiangjiang Riverbank is a narrow strip with a height difference, it is difficult for conventional landscape ecological design to meet the design objectives. Therefore, the form of green corridor should be adopted in the spatial layout to form a linear waterfront green space ecosystem extending 15 kilometers, and the diversity of landscapes should be considered. The diversity of landscape is the result of the cooperation of biological diversity and geological diversity.

Local plant species with strong stress resistance were selected and planted along the river, and ecological greenways were used to connect several waterfront wetland parks to become habitats for fish and birds, which contributed to the stability and species richness of the ecosystem. In addition, relevant artificial devices are placed on the green space, three roads of different elevations provide people with activities and viewing requirements of different water levels, swamp walk, fishing platform, wooden plank road, observation platform, and beach further deepen the connection between people and the water.

When the rainy season comes, excess flood water will be discharged to the nearby constructed wetland through the newly built ecological channel on both sides of the riverbank and stored, which will relieve the pressure on the riverbanks to a certain extent. Meanwhile,

the small dam designed by Yangmei Island will also play an important role at this time, which will use the difference between the internal and external water levels to generate electricity until the end of the rainy season, and the power generation time will last for three months. Finally, water stored in constructed wetlands and dams will provide water during the dry season.

In addition, in order to cope with the once-in-a-century flood, different types of landscape squares are distributed along this corridor, providing temporary relief camps for emergency situations, providing tents and storing disaster relief materials; In the upper reaches of the river, we also used a new wind power device, a bladeless turbine, to provide clean energy, and at the same time, it is equipped with a water level alarm can flash red light in danger to remind people to pay attention to safety. These interventions maximize the value of urban open space, creating potential ecological value and economic benefits.

CONTENTS

1. INTRODUCTION

1.1 Concept of ecological resilience

In the definition of ecology [1], ecological resilience [2] is the ability of an ecosystem to resist damage and recover quickly in response to external disturbances, which may be man-made or natural random disturbances, such as floods, volcanic eruptions, storms, fires, deforestation, etc. When these disturbances exceed the tolerance of the land, it is likely to force the area into another less desirable ecological situation or even degradation.

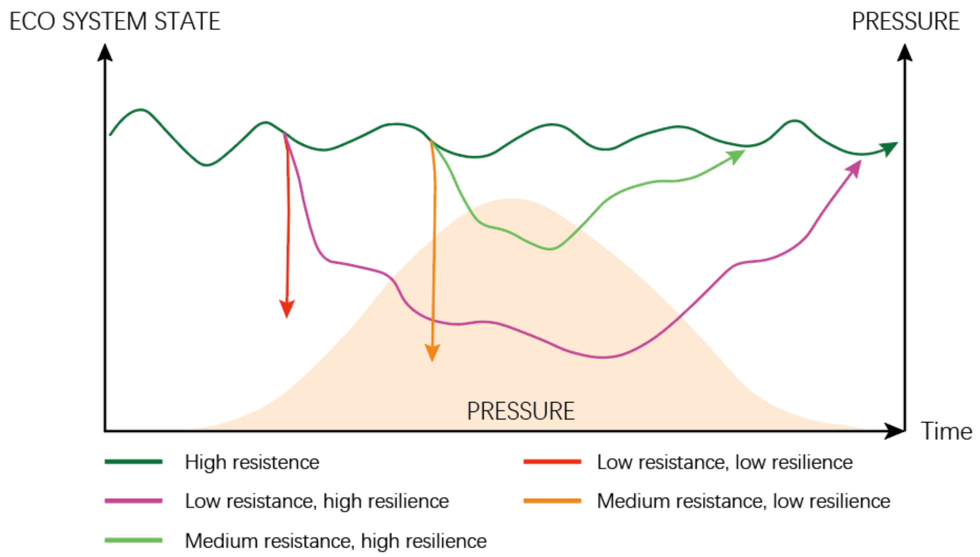

Figure 1.1. Schematic plot of the (eco)system response to a temporal change in environmental conditions that exert a pressure (red) on the system. (Drawn by author)

1.2 Concept of ecological resilient design

The concept of resilience first originated in the field of physics, meaning the property of an object to recover its original size and shape after deformation [3]. Later, Alfred Marshall introduced the concept of resilience in the field of economics, referring to the property of a variable that changes in a certain proportion to another variable. However, In the field of architecture, resilient design is the process of designing buildings, landscapes, and entire communities to mitigate the effects of extreme weather and other external threats in a flexible way. Ecological resilient design is the process of repairing and redesigning the weak links in the ecosystem to make it more complete and richer and resistant to external interference to a greater extent. Ecologically resilient design focuses on ecological and sustainable solutions and has been widely used in many fields such as ecology and urban planning.

Figure 1.2. Flood Resilience Design for Mill River Park in Downtown Stamford, Connecticut.
https://www.asla.org/2015awards/95842.html

1.3 Problem statement and assumption

The process of urbanization has made Xiangtan a more modern and richer city, but in this process, people often ignore the protection of ecological environment. As the mother river of Xiangjiang, its banks have maintained a very primitive and natural state for decades. Although the government has taken measures to strengthen and guard against it, due to soil erosion in the upper reaches, the water level of the riverbed has gradually risen, the frequency of floods has become higher and higher, and the phenomenon of embankment failure has occurred from time to time. From 2011 to 2020 alone, there have been five floods. Therefore, it is necessary to take strong measures to alleviate this phenomenon.

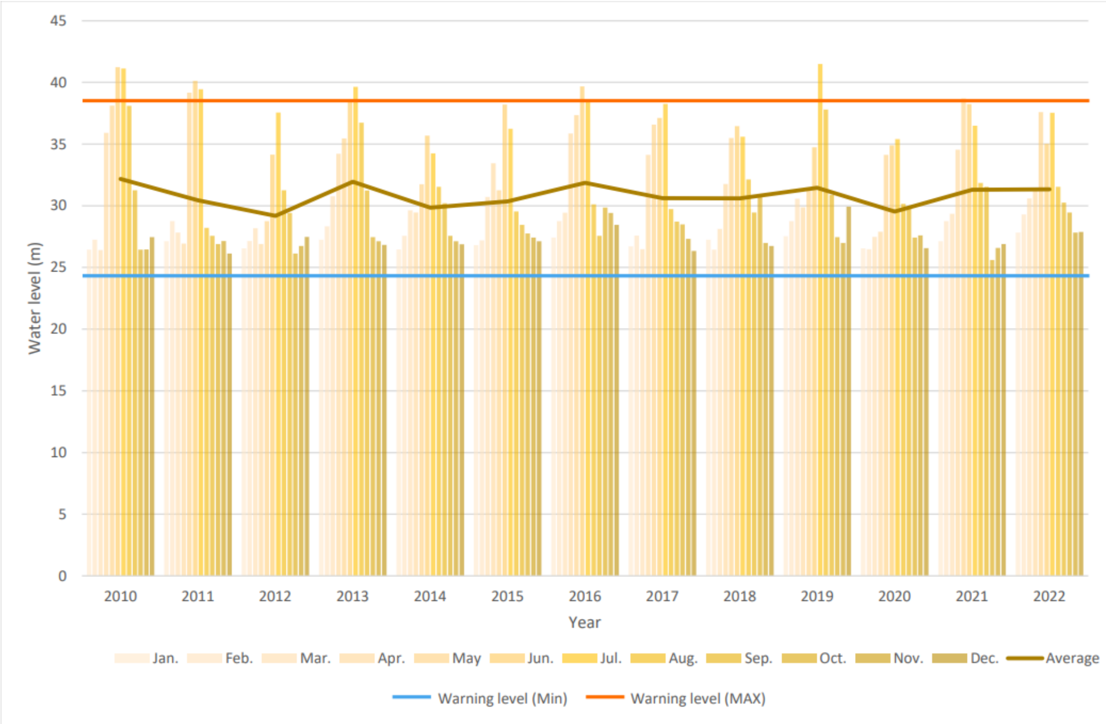

Figure 1.3. Variation of water level of Xiangjiang River in Xiangtan (Author drawing). Atlas of Hunan water resources bulletin, 2010-2022. Data collected from: https://slt.hunan.gov.cn/slt/xxgk/tjgb/

1.4 Objectives of the research

- Discuss how to improve the ecological resilience of Xiangjiang River channel landscape from the perspective of landscape ecology and ecological services.
- Explore strategies to combat Xiangjiang flood at different scales.
- Provide a riverbank landscape ecological improvement scheme for the whole Xiangjiang River basin.
- Make full use of urban waterfront space, provide more landscape services and economic benefits for people, and reduce economic losses caused by floods in at least 30 years in the future.

Figure 1.4 shows the annual economic losses caused by floods in Xiangtan area.

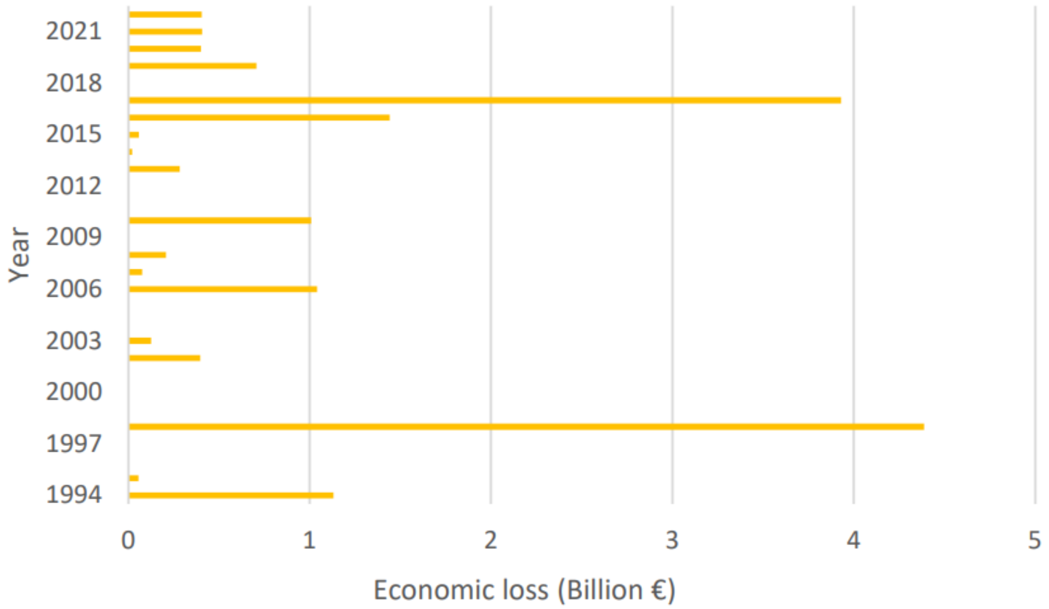

Figure 1.4. Annual economic losses caused by floods in Xiangtan area. (Author drawing)
Data collected from: https://sdaj.hunan.gov.cn/sdaj/dayw_78261/index.html.

1.5 Research and design question

According to the current situation of the site, this work holds that the main problem is how to solve the problem of landscape ecological improvement in such a narrow and long site extending 15 kilometers and under the condition of variable water level. Therefore, I have divided the following sub-problems:

First, how to effectively relieve the pressure of flood on the embankments on both sides of the river in such a large scale.

Second, how to arrange the installation of artificial devices, as low as possible to reduce the damage to the original ecology.

Third, how to achieve a spectacular view in the four seasons and public space activities in such a site with variable water levels.

Fourth, how to organically combine artificial devices with plants to provide more living space for plant growth.

Finally, and most importantly, how can the scattered urban area relate to the natural riparian landscape to strengthen the community and cultural identity of Xiangtan?

The design problem is how to balance the above issues and propose an integrated solution to improve the stress resistance of the riverbank.

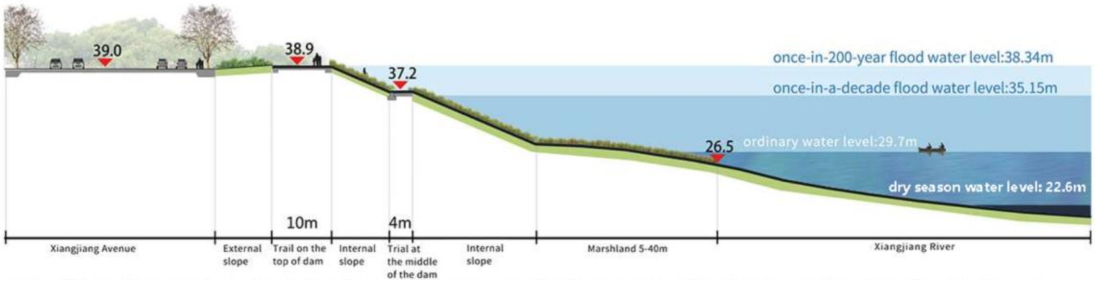

Figure 1.5. Variation of water level of Xiangjiang River. Retrieved from: https://landscape.coac.net/en/node/3880

1.6 Introduction of case studies

1.6.1. Case 1: The Afsluitdijk dam

Windmills, polders, sluices, and pumping stations. Holland has a unique history when it comes to water management. But the most impressive example is probably the Afsluitdijk. Avludijk Embankment. The Afsluitdijk is a sluitdijk in the Netherlands, belonging to the Zuder Sea project, a total length of 32 kilometers, 90 meters wide, an average height of 7.25 meters above sea level, the construction of a two-way four-lane highway, is the world's longest flood embankment, to a considerable extent to solve the serious water problems that have plagued the Netherlands for generations. It was completed in 1932 and designed by Cornelis Lely, a famous Dutch hydraulic engineer.

Figure 1.6. The plan of Afsluitdijk dam.
Retrieved from: https://mvdirona.com/2018/05/afsluitdijk-dam/.

The locks at Den Oever and Kornwerderzand will be reinforced, and flood gates will be built in front of the navigable locks on the Wadden side. These storm surge barriers can be closed during extreme weather conditions to protect the navigation locks from the effects of waterpower.
Additional locks and pumping stations will be built at Den Wouver to allow more water to drain from Loch Ethel into the Wadden Sea. These fish-friendly pumps have low energy consumption and are powered by renewable energy from solar panels on the Avludike Dyke levee.

Figure 1.7. The bird view of Afsluitdijk dam.
Retrieved from: https://www.holland.com/global/tourism/discover-the-netherlands/provinces/friesland/the-afsluitdijk.htm.

Figure 1.8. The sluices at Den Oever. Retrieved from: https://www.rijkswaterstaat.nl/en/about-us/gems-of-rijkswaterstaat/afsluitdijk#&gid=1&pid=2.

Improved over the years, the Afsluitdijk is now more than just a dam; it is a highly efficient high-tech testing ground for highly innovative and sustainable energy mining from wind, hydro and solar.
In Afsluitdijk it is seawater and river water separated by the ion selective membranes. They theoretically can produce 1 Megawatt of electricity from water flows of both fresh and salt water at the rate of 1 cubic meter per second. The company estimates that The Netherlands has the capacity to produce 3 Gigawatts of power from blue energy, enough to power 500,000 Dutch homes.

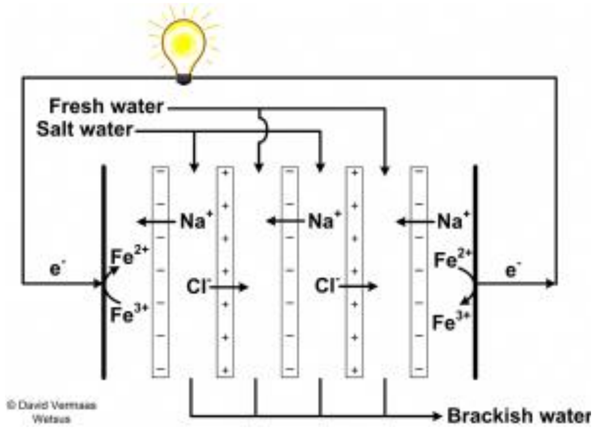

Figure 1.9. The Blue Energy Power Station and workflow.
Retrieved from: https://www.jianshu.com/p/4a5e6c7cb4fb.

However, we know that any project to change the environment is a double-edged sword, the reclamation area that completed the construction first, the Marine food chain and fisheries have been hit hard, and Marine life has died or even become extinct. This is like the water conservancy project we are familiar with, changing the nature will bring about the overall destruction of the ecological balance system. In recent years, in addition to the maintenance of the dam, the Dutch government has not continued to promote the reclamation project, but let the land become wetlands again to solve the problem of the huge ecosystem.
This project provides a reference for solving floods in the Xiangjiang River. Water conservancy projects such as dams, canals, and sluices can relieve the pressure on the riverbank to a certain extent. At the same time, the use of clean energy and innovative projects also increase the local attractiveness, such as tidal power generation, wind energy and so on.

1.6.2. Case 2: Yanwei Zhou Park, Jinhua

An experimental project, completed in 2014 and designed by renowned Chinese landscape architect Yu Kongjian and his design team Turen Landscape, the project focuses on exploring how to make friends with the flood, creating adaptive levees, adaptive vegetation, and 100 percent permeable paving design to achieve ecological resilience of the landscape, as well as flood-compatible structure design. The experiment tested the sponge city's extreme measure: the city befriends the flood[4].

Figure 1.10. Jinhua Yanweizhou Park. Retrieved from:
https://www.turenscape.com/project/detail/4629.html.

In downtown Jinhua, home to more than 1 million people, the last natural riparian wetland of more than 64 acres (26 hectares) remains undeveloped. Located where the Wuyi and Yiwu rivers converge to form the Jinhua River, this wetland is called Yanwei Zhou, which literally means 'sparrow's tail'. Before the Yanwei Chau Park project was implemented, three rivers more than 100 meters wide separated the densely populated communities in the area. Cultural facilities, including the Opera House and green Spaces near Yeonmei Chau, are underutilized due to poor transportation. The remaining 50 acres (20 ha) of riparian wetlands were fragmented or destroyed by sand mining.

To meet these challenges, the strategy they have adopted is resilient landscape.

The first adaptive strategy is to make full use of existing riparian sand quarries with minimal intervention. In this way, existing micro-topography and natural vegetation are preserved, allowing diverse habitats to evolve over time. By adding native wetland species, the biodiversity of the area is adjusted and enhanced. This abundance, especially of species that provide food for birds and other wildlife, increases biodiversity.

Figure 1.11. Rich plant landscape. Retrieved from: https://www.turenscape.com/project/detail/4629.html.

Waterproof terrain and planting design. The landscape architect designed a contrasting solution and convinced the city to stop building the concrete flood wall and tear down the others. Instead, the Yan Wei Chau project "befriends" the flood by using a fill and dig strategy to balance the earthworks and create a watertight terraced riverbank and cover it with flood-adapted native vegetation. Flood control walkways and gazebos are integrated with planted terraces and will be closed to the public during short flood periods. The flood brought fertile silt, which deposited on the terraces, enriching the growth conditions of the native tall grass in the riparian habitat. Therefore, there is no need for irrigation or fertilization at any time of the year. The terraced embankment will also repair and filter rainwater from the pavement above.

Figure 1.12. The park's terraced system. Retrieved from:
https://www.turenscape.com/project/detail/4629.html.

A flexible footbridge connecting the city with nature, the future with the past. A pedestrian bridge winds across the two rivers, connecting the riverbank parks in the north and south urban areas, and connecting the urban areas with the newly built Yanwei Zhou Park in the river. The design of the bridge was inspired by the local tradition of dragon dancing during the Spring Festival. To celebrate the festival, many families tie wooden stools together to create a long, colorful line those winds through fields and narrow dirt roads.

Figure 1.13. The pedestrian bridge in the park. Retrieved from:
https://www.turenscape.com/project/detail/4629.html.

The project has proved successful. Since the park opened in May 2014, an average of 40,000 visitors have used the park and bridge every day. Local media exclaimed: "The whole city is going crazy for a bridge!" Today, Yanwei Zhou Park has created a new image for Jinhua city. Meanwhile, it explores the design approach of resilient landscape.
Through the design of ecological flood protection levees that are friendly to floods, the vegetation design that is suitable for drought and flood, and the design of 100% permeable pavement, the ecological resilient function of the landscape is realized. The trail system and pedestrian bridge are designed to connect the divided cities into one and promote community communication. This is where the inspiration for the design of the Xiangjiang River flood control system and the artificial device comes from.

1.6.3. Case 3: Waterfront Landscape Design of Jing River in Xi'an, China

This is a 19-kilometer-long waterfront design scheme located along the Jing River in Xi'an, China. This scheme is one of the finalists of the international competition. Through a series of strategies, traditional architecture, commercial trade, and agricultural innovation are used to deal with major climate and Environmental challenges.

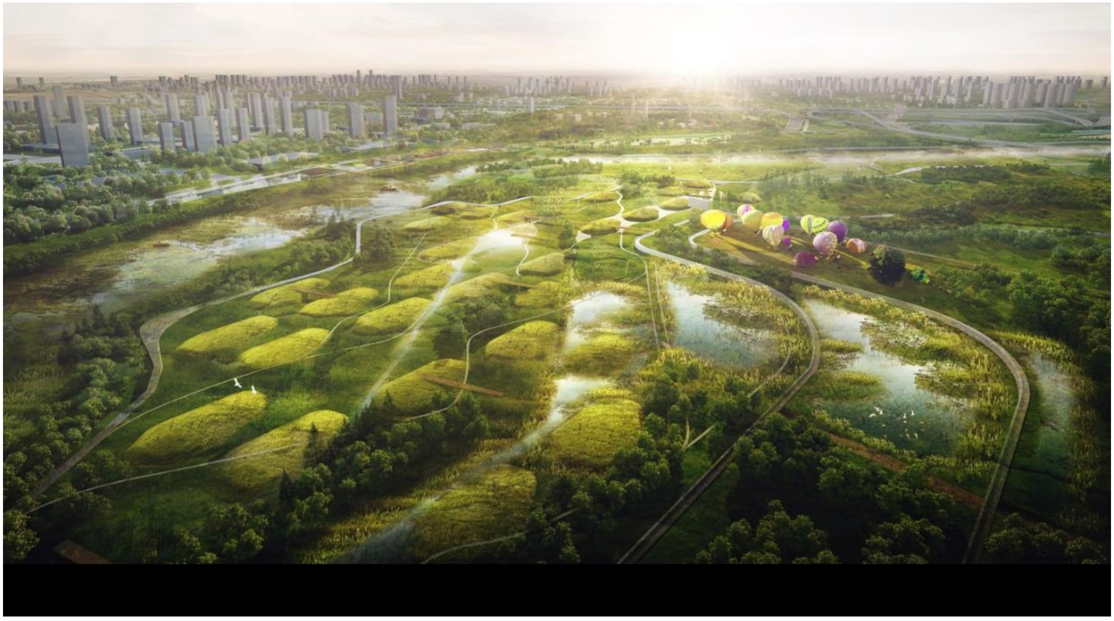

Figure 1.14. Aerial view of the riverbanks of the Jing River. Retrieved from: https://www.archdaily.com/921203/glv-gossamer-merge-resilience-and-urbanism-in-xian-china.

The design proposes a triple design strategy (Three Skin): ‘Guardian Skin’ is a response to climate change and stormwater storage; ‘Ecological Skin’ is used to support site water treatment and biodiversity ‘Cultural Skin’ aims to reflect Xi'an's rich historical traditions and cultural background.

Figure 1.15. Plan of the riverbank of the Jing River. Retrieved from: https://www.archdaily.com/921203/glv-gossamer-merge-resilience-and-urbanism-in-xian-china.

'Guardian Skin' responds to the challenges posed by flood seasons, increased soil erosion, and reduced biodiversity. Three elevated walkways, 'Guardians', 'Dreamers' and 'Sleepers', distinguish four distinct landscaped areas that meander along the river corridor. Planting and activity areas are designed for climate adaptation, biodiversity, and recreation.

Figure 1.16. Riverbank Resilience Design Rendering. Retrieved from: https://www.archdaily.com/921203/glv-gossamer-merge-resilience-and-urbanism-in-xian-china.

'Ecological Skin' uses a range of biodiversity regeneration strategies to restore local natural habitats and clean up riverine pollutants. A watery network of ponds, swales and streams captures, stores, and purifies stormwater in the sponge city system. The proposed Yanhu Lake uses this strategy to carry out lakeside and water sports activities, and the terraced lakeside water sports center of ‘Shui Jing Ming Chi’ provides visitors with water-friendly experiences such as saunas, hot springs, and swimming pools. Regenerated wetlands and farms correspond to the planned main agricultural corridors, including fishponds, orchards, and farm landscapes.

Figure 1.17. Riverbank Resilience Design Rendering. Retrieved from: https://www.archdaily.com/921203/glv-gossamer-merge-resilience-and-urbanism-in-xian-china.

‘Cultural Skin’ revitalizes the landscape and architecture on the edge of the river. A series of unique cultural strongholds integrate the existing urban fabric and waterfront. The flood defense district and the Museum of Rammed Earth Architecture are integrated through a series of landscape buildings; further west, the commercial town creates a center for celebrations and events for the city. The township responds to traditional massing and brick materials, creating a characteristic landscape of arches, laneways, sunken courtyards and plazas, while a modern vaulted brick aesthetic is achieved between a series of soaring ecological lookouts and bridges. continuous.

Inspired by the ecological project of the Jing River, in the design of the banks of the Xiangjiang River, the concept of integrating culture into the design is highlighted. It is proposed to build riverside cultural squares, landscape towers, watchtowers, red buildings, etc. And use continuous red trails to connect these elements in series, reflecting the unique local 'red culture'(Communism).

1.6.4. Case 4: Guaiba Waterfront Urban Park, Porto Alegre, Brazil

Guaíba Waterfront Urban Park is 1.5 kilometers long and covers an area of 5.7 hectares. It is located in Porto Alegre, the largest city in southern Brazil with a population of 1.5 million. The park is an initiative by the local government to reconnect the city and its residents with its most treasured landscape - the Guaíba waterfront.

Figure 1.18. Aerial view of Guaíba waterfront urban park. (Arthur Cordeiro)

This project brings life to an infill area that was created to be part of the flood control system of Porto Alegre. In building this infill, the riparian environment was adversely affected. Also, as prior to the project it had no use and was disconnected from the surrounding city life, creating a somewhat hostile area with serious security, degradation and abandonment problems. Those are some of the issues that the Park seeks to mitigate.

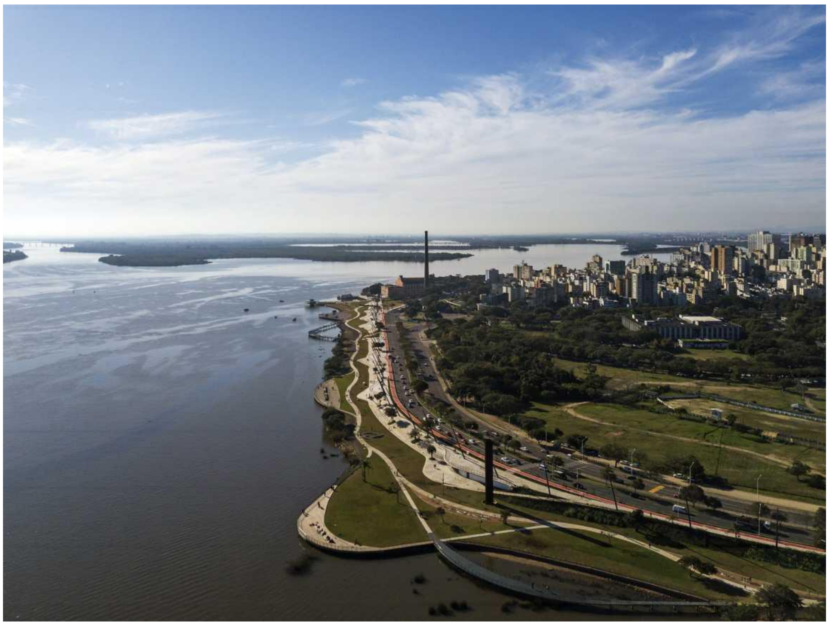

Figure 1.19. Aerial view of Guaíba waterfront urban park. (Leonardo Finotti)

The architectural qualities of the project are connected to the natural way by which it inserts itself in the landscape, taking advantage of the area's topography to accommodate the necessary infrastructures and to create belvederes to contemplate the surrounding scenery. The materials are concrete, steel, wood and glass in natural colors, so to gain lightness. The curved shapes relate to the movement of the waters, unfolding gently along the terrain. They take advantage of the plasticity of the concrete to generate only essential forms.

Figure 1.20. Riverside landscape platform and corridor design (Leonardo Finotti, Arthur Cordeiro)

The scenic dimension of the estuary will be enhanced by the provision of a qualified stage for its appreciation. The stairways that run along the project provide the perfect seating area for the glorious sunset, "the most beautiful one in the world".

Figure 1.21. Landscape platform details (Leonardo Finotti)

The landscape project is mindful of the ecological aspects of the riparian habitat and seeks to reintroduce the native species of this environment, conducing to its regeneration. The native remaining vegetation was left undisturbed and the architectural features accommodated themselves around it. To each "microclimate" (for example, the areas subject to natural floods, and drier areas higher up), specific species were selected, including the creation of an indigenous aquatic plants garden. Overall, it works not only as an environment regeneration project, but also as a permanent, live and open environmental education class.

Figure 1.22. Green design in the park (Leonardo Finotti)

An important element of the project is the light. During the day, the sunlight and its reflections in the Guaíba waters guide the spectacle; after the sunset, architecture starts its own show, with a lightning project that creates, on the pavements of the park, a semblance of the night starry sky.

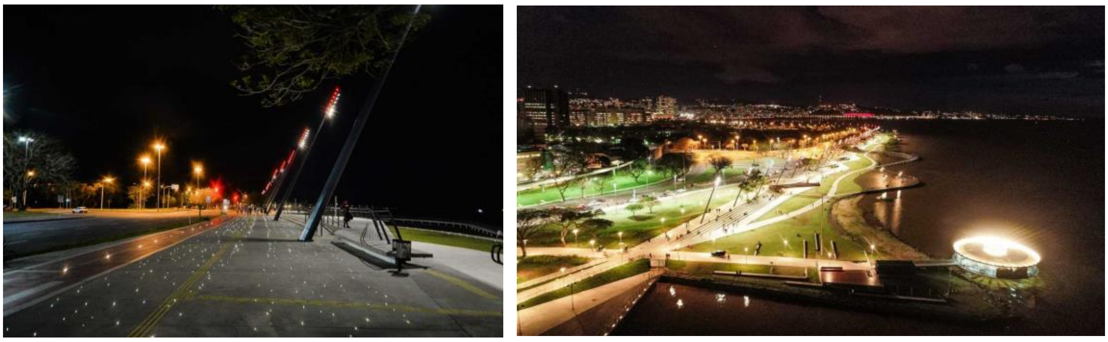

Figure 1.23. Lighting design in the park (Arthur Cordeiro)

Starting from the restoration of the natural environment and the creation of a new, dynamic urban address, through the intelligent use of architecture, landscape and lighting design, combined with a wide range of activities, Porto Alegre will gain a sustainable, vibrant place to demonstrate how the "combination" of human intervention and nature can have a positive impact on both.

It provides reference for the flexible design of the Xiangjiang Riverside space in many aspects, such as the construction method of landscape platforms, the art form of water trails that imitate water flow, how trails at different elevations meet the traffic needs of the site, and the introduction of native species for ecological restoration. At the same time, it It is also a successful business case, such as linking the buildings of the surrounding area (bars, cafes, sports facilities, etc.) with several elements of the natural environment, increasing the number of visitors and turning a previously useless site into a sustainable part of the city An important asset for development, reducing costs and increasing urban value.

1.6.5. Case 5: Stadium Park on the Burswood Peninsula

Stadium Park on the Burswood Peninsula in Perth, Western Australia is home to the city's new Optus Stadium. The 41-hectare precinct, designed by HASSELL, provides a stunning parkland setting for the world-class sports and entertainment venue, as well as an impressive array of casual recreational facilities for Perth's community, and visitors, to enjoy year-round.

Figure 1.24. Stadium Park aerial view. Retrieved from:
https://www.gooood.cn/stadium-park-chevron-parkland-australia-by-hassell.htm

The Stadium Park site had endured significant environmental degradation over many years, due to its past uses as a sewerage treatment facility, cement works and rubbish tip. The Chevron Parkland site presented its own challenges, with its location between the river and the lake making it prone to geological instability and flooding. Intervention rehabilitated the entire site, making it safe for the community and local wildlife. The capping of contaminants in latent soils, reduction of fertiliser use, and bio-filtering of surface water has improved the micro-organisms found in both the soil and the water. Site flooding has been mitigated through the creation of a series of mounds and undulations; with key play structures situated above the 1-in-100-year flood level and incorporating deep pile footings (Figure 1.25).

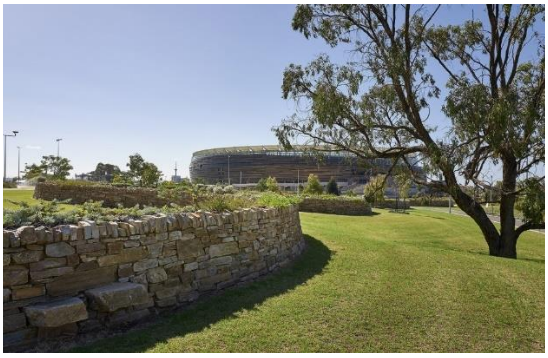

Figure 1.25. Ecological restoration Figure 1.26. Native plants and native setting
Retrieved from: https://www.gooood.cn/stadium-park-chevron-parkland-australia-by-hassell.htm.

The design has introduced thousands of native plants creating a beautiful native setting with spectacular vistas across the river to the city (Figure 1.26). This naturalization of the parkland and its lake and river edges, provides habitat and food for endemic insects, fish and bird life – including species suitable for foraging by the endangered Black Cockatoo. Native wildflower planting for endemic fauna also supports the cross pollination of plant life throughout the area. Risk consultants and the Royal Life Saving Society assessed the waterside play area – informing our positioning of pathways, bioengineering to water edges, benching of banks, sightlines, signage and CCTV.

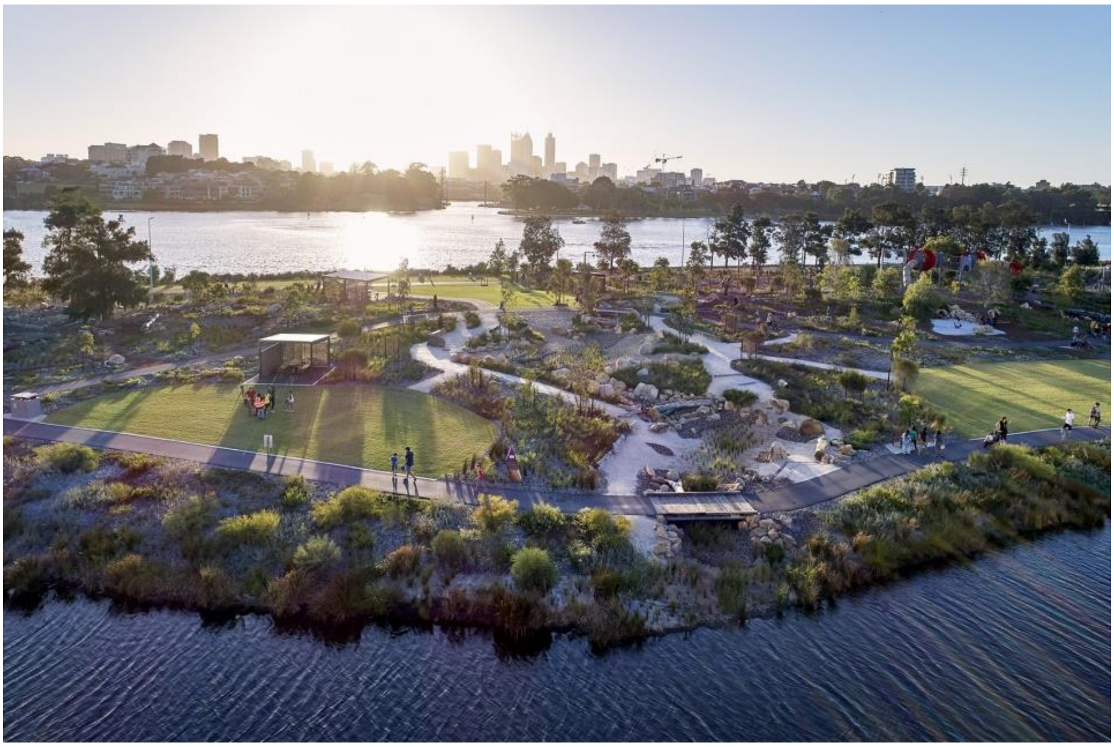

Figure 1.27. Chevron Parkland overview. Retrieved from: https://www.gooood.cn/stadium-park-chevron-parkland-australia-by-hassell.htm

A major attraction within the precinct is Chevron Parkland, a 2.6-hectare nature-play space that's designed to engage children and families with the natural environment and connect them with the indigenous cultural heritage of this land known to the Aboriginal community as 'Whadjuk Noongar' country. Significantly, the Stadium Park development has rehabilitated this prominent site on the eastern foreshore of the Swan River – once a waste ground of the city – to provide a collection of scenic promenades, cycle paths, and flexible event and play spaces, filled with landmark public artworks.

Figure 1.28. Recreational facilities in the park. Retrieved from: https://www.gooood.cn/stadium-park-chevron-parkland-australia-by-hassell.htm

The park has introduced thousands of native plants to create a beautiful natural landscape, and the parks, riverways, and riverbanks provide habitats for local endemic species. At the same time, it takes care of people of all ages. There are spaces and places for community sports, leisure and entertainment, and activities, so that they can fully contact the waterside and nature. Water bodies are everywhere here, and the community is friends with water, embodying the principle of sustainable development. These interventions have brought a lot of inspiration to the design of the Xiangjiang waterfront resilient space.

Figure 1.29. Riverside space design in the park. Retrieved from: https://www.gooood.cn/stadium-park-chevron-parkland-australia-by-hassell.htm

Figure 1.30. Plan for the park. Retrieved from: https://www.gooood.cn/stadium-park-chevron-parkland-australia-by-hassell.htm

2. THEORETICAL FRAMEWORK

2.1 Landscape Ecology

The theory of landscape ecology emphasizes the influence of human beings on landscape structure and function and proposes the restoration methods and strategies to cope with ecological degradation. The theory of Landscape Ecology includes the principle of landscape stability, which emphasizes the important role of landscape structural heterogeneity in improving anti-interference, recovering from disturbance, and improving overall system stability [5]. This principle is an important contribution to general ecological theory, which emphasizes the importance of the relationships between the various components of a Landscape [6]. The integrity of landscape elements is conducive to enhancing the resistance and resilience against external disturbances.

In addition, corridor, one of the basic elements of landscape structure, is also the focus of this paper. corridor has an important function as a narrow landscape belt different from the adjacent land on both sides. The main goal of the eco-corridor is to increase biodiversity. When land is destroyed by human disturbance, population variability increases, and many plant and animal species are endangered. Reconnecting fragmented areas can significantly reduce population fluctuations.

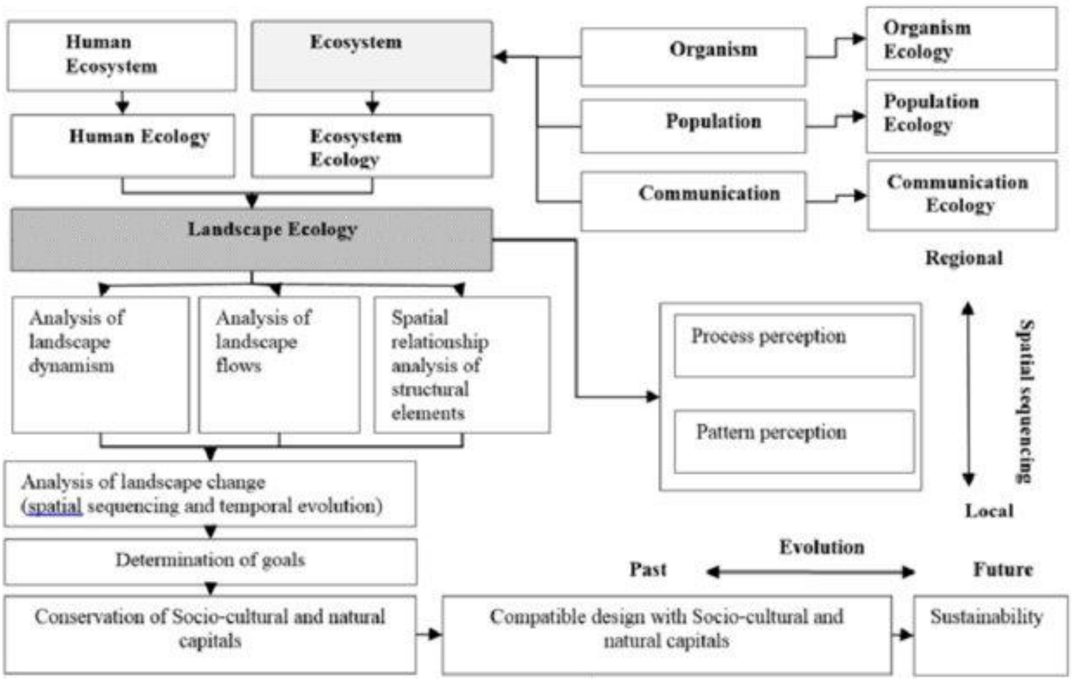

Figure 2.31. Framework of Landscape Ecology. (Ferial Ahmadi, 2018[7])

2.2 Ecosystem Services

Ecosystem services refer to the various benefits that natural environments and healthy ecosystems provide for human beings. Among them, ecosystem services are divided into four categories: supply, regulation, support and culture [8], and regulation services are the important content we need to discuss in this project, because the ecosystem along the Xiangjiang River most directly provides people with flood control and climate regulation, and indirectly brings ecological benefits and cultural benefits.

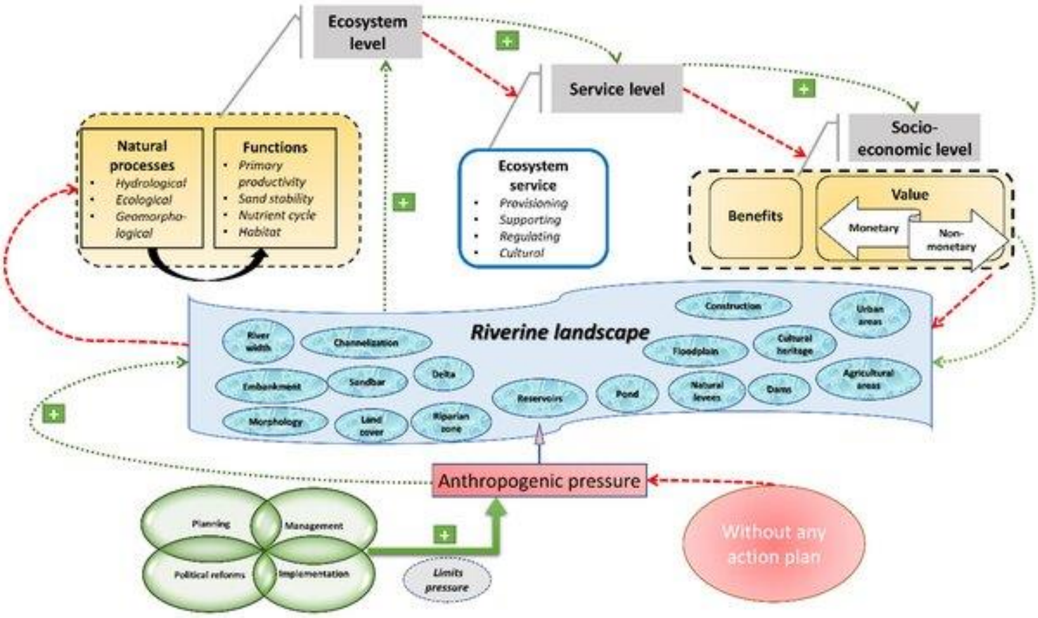

Figure 2.32. Ecosystem Services in the Riverine Landscapes. (Amit Kumar Tiwari. 2023 [8])

2.3 River Hydrology

River hydrology is a discipline that studies river hydrological phenomena, processes, and basic laws, and provides basic basis for flood control, drought relief and river management and development [9]. It is a branch of terrestrial hydrology. Understanding the system characteristics, runoff formation and river movement of Xiangjiang River Basin is an important topic in this paper, especially analyzing the annual and interannual changes of river hydrological regime, which plays a crucial role in proposing the coping strategies in the following paper.

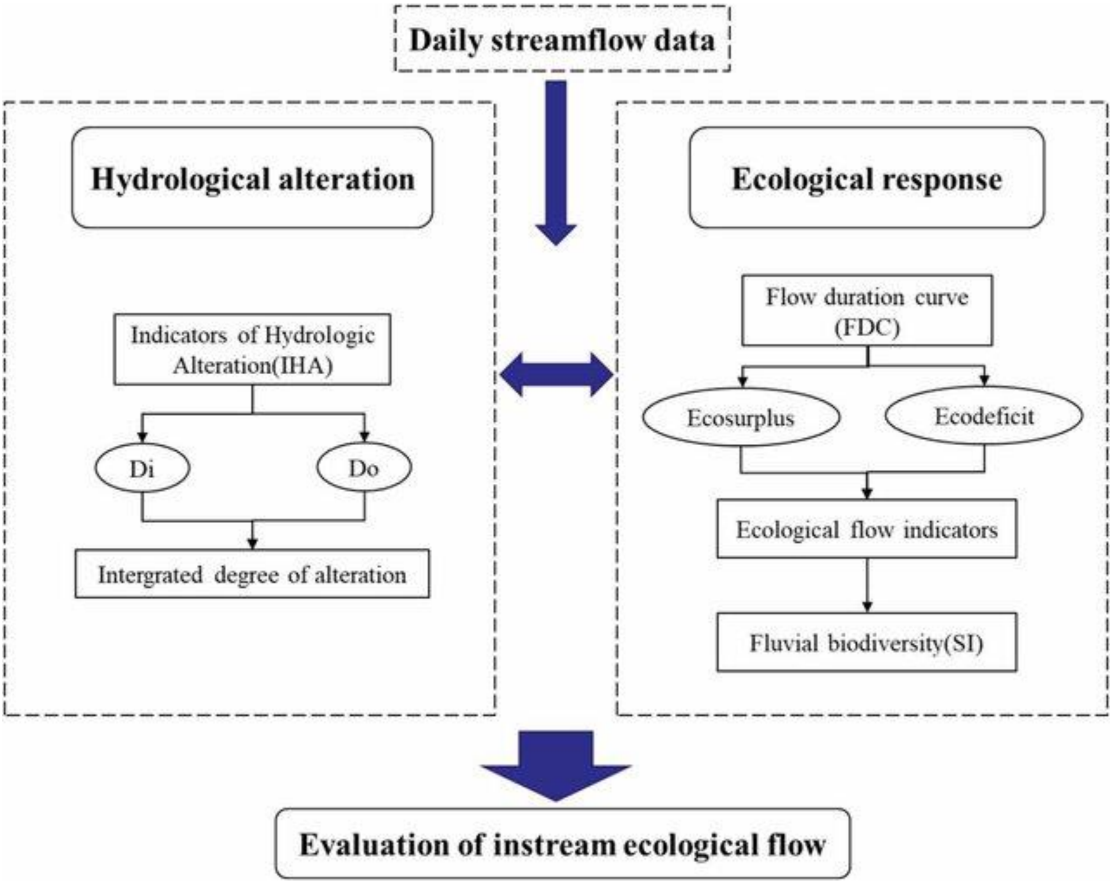

Figure 2.33. Flowchart for working procedures and employed methods in river hydrology. (Hao Chen, 2023[10]).

2.4 Urban waterfront landscape design

Urban waterfront landscape design refers to the comprehensive design of artificial landscape or natural landscape in the area where water and land meet in the urban area. It is worth noting that in the process of making the waterfront area more comfortable and reasonable, we usually need to follow the following principles:

2.4.1. The principle of integrity

In other words, we need to take into account the overall layout of the city plan, understand the nature of land use, where is divided into water front areas, where is divided into conservation areas, whether the site can be constructed and so on[11]; In addition, the analysis of urban traffic lines and the distribution of urban population are also the major premise of the entire project design, which is used to estimate the flow of people and the feasibility of the program.

2.4.2. The principle of sustainability

Sustainable development is defined as "development that meets the needs of the present without compromising the ability of future generations to meet their needs [12], which is mainly reflected in the following three aspects in this project:

First, the sustainable development of biodiversity ensures the balance between the survival of organisms in the ecosystem, human activities, and the natural environment, and optimizes the local ecosystem.

Secondly, the sustainable development of social culture should pay attention to the absorption and development of local culture in the process of updating the waterfront, to enhance people's cultural identity and sense of belonging.

Third, the sustainable development of science and technology, make full use of scientific and technological innovation to enhance the attraction of the site, such as clean energy utilization, engineering, and transportation innovation, to further promote the development of local economy and environmental protection.

2.4.3. Diversity principle

The diversity principle includes many aspects, including species diversity, landscape diversity, functional diversity, spatial diversity, service diversity, and audience diversity. On the one hand, local plants with strong stress resistance should be selected as much as possible in terms of species to enrich plant populations and communities. On the other hand, waterfront space is a "blank" site that is rarely used by people, especially the elderly and children, so the public space design should meet the needs of different groups as much as possible [11].

3. METHODOLOGY

3.1 Data gathering and evaluation

By consulting, combing, and integrating relevant literature of the local official website and hydrological observation station, the climate, ecological and hydrological characteristics of the site are analyzed, and the required data is obtained to propose suitable strategies.

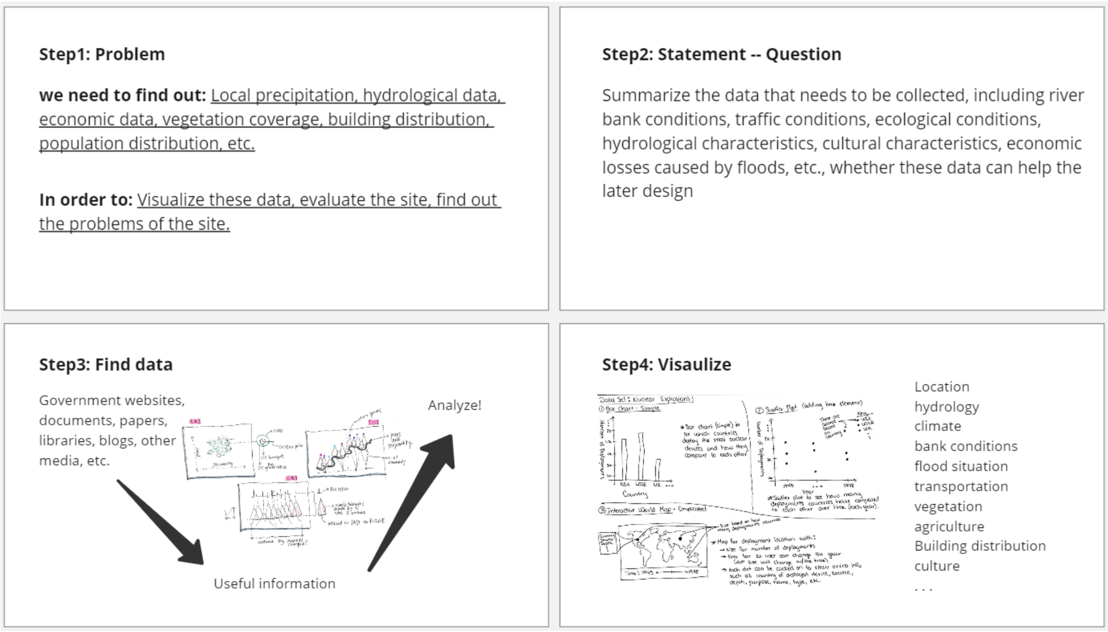

Figure 3.34. Framework for data collection. (Drawn by author)

3.2 Field survey

This design uses seasonal field research on wetlands, records the terrain, surrounding environment, hydrological information, humanistic characteristics of the site, multi-directional statistics, analysis, and comparison, to make the design more practical. The sites of the field investigation include the banks of the Xiangjiang River, small islands in the river, hydrological stations, and wharves, mainly recording the local ecological conditions and hydrological conditions, and at the same time interviewing residents. The interview questions include but are not limited to:

1. The impact of floods on life
2. Evaluate the traffic situation on the riverbank
3. Assessing the ecological level of the riverbank
4. Evaluation of riverbank landscape
5. What are the local customs?

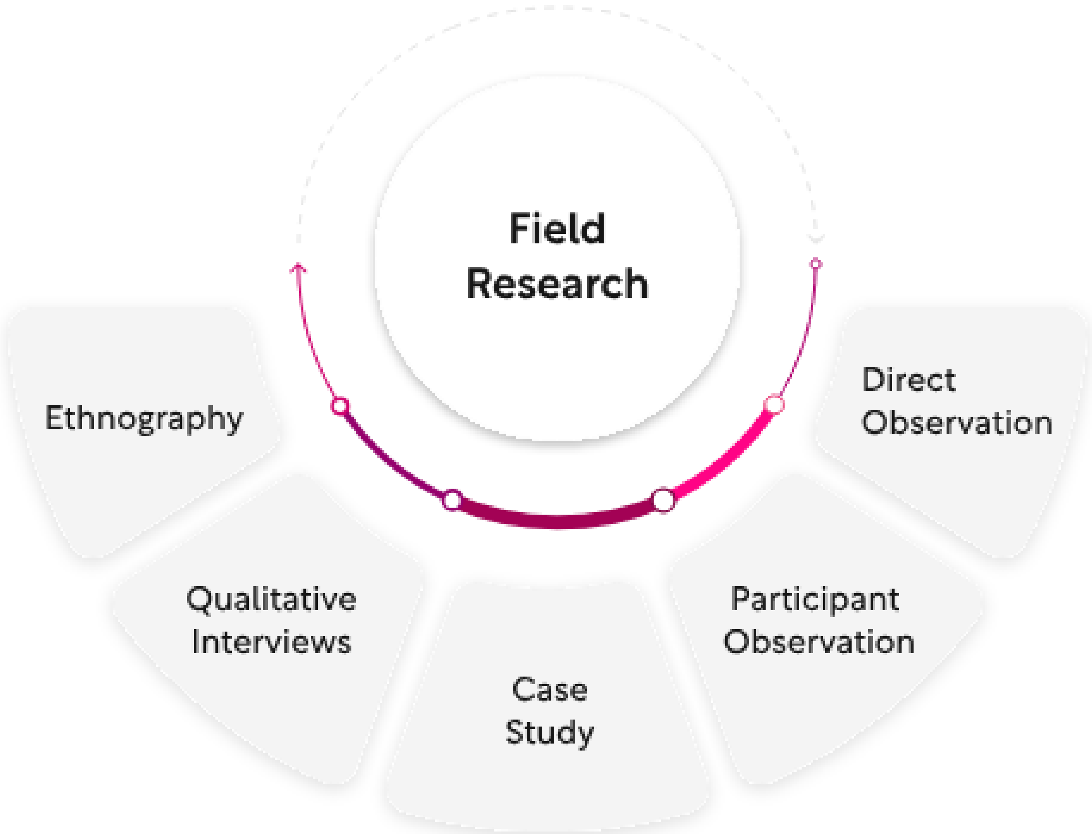

Figure 3.35. Framework for Fieldwork. Retrieved from: https://www.wishwork.org/images/field-research-light.svg.

3.3 Case study

Through consulting the relevant cases of major domestic and foreign wetland parks, landscape design planning overview, landscape ecology and other related content, the historical and cultural background of the site is analyzed, and the design methods and principles of waterfront wetland parks are understood, to better serve the design of urban waterfront parks.

The previous three case studies provide good inspiration for this program, mainly in the following three aspects:

1. 1. The application of water conservancy projects and clean energy helps to alleviate floods and improve the comprehensive benefits of projects
2. 2. Protection of nature, restoration of ecology, resilient design of flood embankments that are friends with water, and resilient bridges that connect the city with natural history and the future. These measures realize the ecological, social, and cultural resilience of the landscape.
3. Integrating culture into the design is highlighted. It is proposed to build riverside cultural squares, landscape towers, watchtowers, red buildings, etc. And use continuous red trails to connect these elements in series, reflecting the unique local 'red culture'(Communism).

4. PRELIMINARY ANALYSIS

4.1 Macro analysis of Xiangjiang River

4.1.1 Location

The Xiangjiang River in southern China's Hunan Province, bounded by Dongting Lake to the north and surrounded by mountains on three sides, resembles a giant horseshoe. It is one of the main tributaries of the Yangtze River. The project site is in Xiangtan City in the middle reaches of Xiangjiang River, which is one of the important industrial and economic cities in Hunan.

Figure 4.36. Xiangjiang location map. (Drawn by author)

Figure 4.37. The location of Xiangtan (Drawn by author)

4.1.2 Hydrogeomorphology

The Xiangjiang River is the largest river in Hunan province and the largest tributary of the Dongting Lake system. Xiangjiang River flows from south to north through Yongzhou, Hengyang, Xiangtan, Zhuzhou, Changsha, Xiangyin, Haohekou in two branches into Dongting Lake. It has a total length of 948 kilometers, a watershed area of 94,721 square kilometers and an average annual runoff of 79.16 billion cubic meters. The average annual passenger volume of Xiangtan section of Xiangjiang River is 54.949 billion cubic meters, and the water surface width is 460~750 meters. Xiangtan section of Xiangjiang River is in the "S" shaped channel, the river flow rate is slow, easy to silt. As a result, there are many sandbanks, such as Arbutus Island and Gusang Island.

Figure 4.38. DongTing Lake water system. (Drawn by author)

Figure 4.39. Live photos of the riverbank (Photographed by the author)

4.1.3 Climate analysis

Xiangtan is a subtropical monsoon humid climate area, which is dry in summer and autumn, and susceptible to cold waves and strong winds in winter and spring. Light energy resources are relatively rich, the average sunshine hours over the years 1640-1700 hours. Abundant heat resources, the average temperature 16.7-17.4℃. Precipitation is abundant, but the seasonal distribution is uneven, the annual change is large, the annual precipitation is 1200-1500 mm.

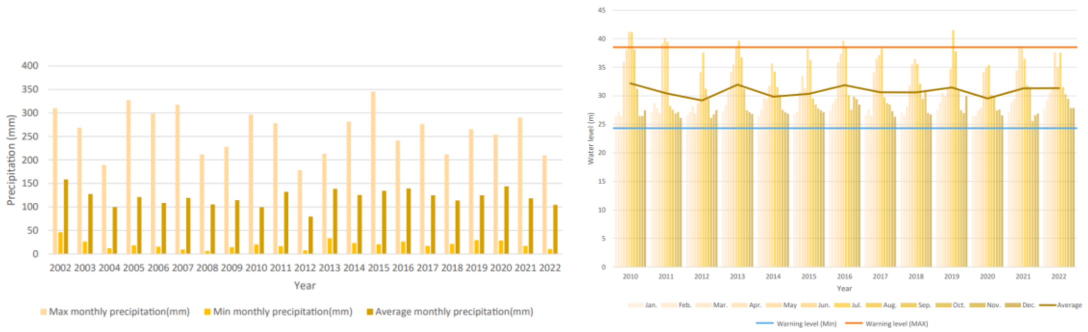

Figure 4.40. Average annual precipitation and variation of water level. (Drawn by author). Retrieved from: https://slt.hunan.gov.cn/slt/xxgk/tjgb/

4.1.4 Evolution of river channels

The Xiangjiang River flows from south to north through Xiangtan City, with an average width of 500-700 meters, a depth of 10-20 meters, and a maximum depth of 30 meters. The surface water system in the area is developed, with Juanshui and Lianshui rivers as the main tributaries. In the past 20 years, affected by sediment deposition, the area of Yangmei Island in the channel is increasing day by day, and the highest water level is also increasing. Riverbanks have long been underdeveloped or semi-developed, especially in rural areas, and are generally in a natural state, so their resistance to flooding is very low.

Figure 4.41. Current situation of Riverbank. (Drawn by author)

Figure 4.42. The process of sediment deposition (Drawn by author). Retrieved from: https://earth.google.com/web/.

4.1.5 Flood zone analysis

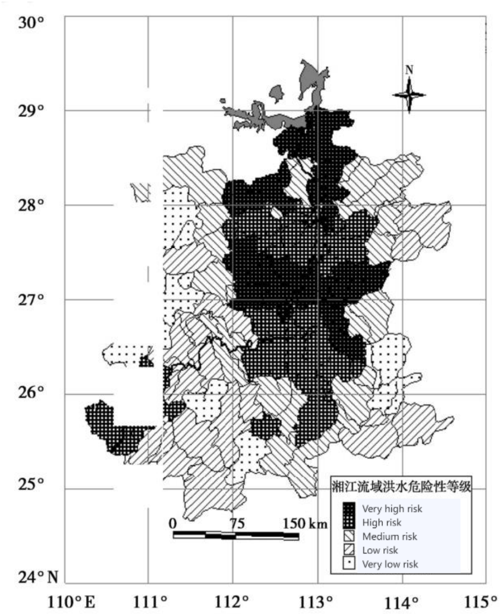

Figure 4.43. Assessment map of flood hazard in Xiangjiang River Basin (Du Juan, 2006)

As the Xiangtan section of the Xiangjiang River is in the "S" shaped channel, the flow rate of the river slows down, it is easy to accumulate sediment, resulting in the continuous rise of the riverbed, so this area is extremely prone to the danger of breaking the bank. As can be seen from the software simulation chart below, in the rainy season, the western and southern parts of the river are the worst-hit areas.

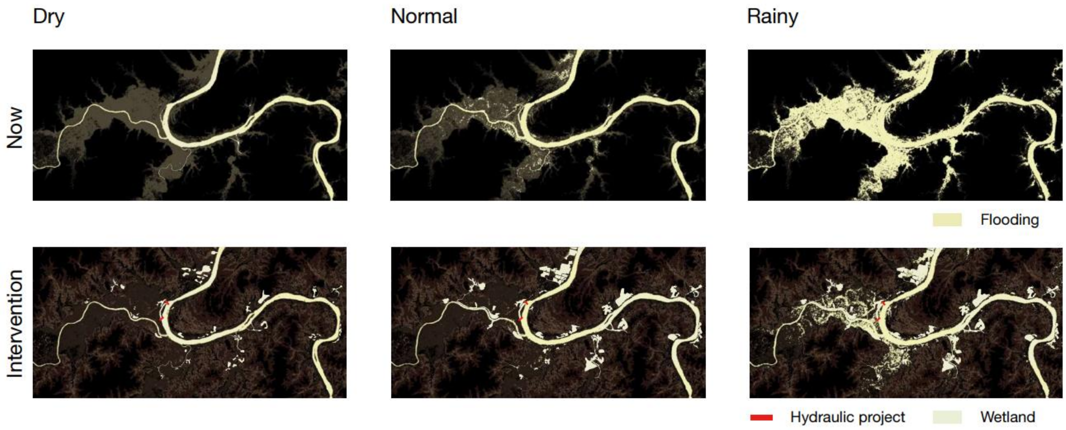

Figure 4.44. Software simulates flooded areas (Drawn by author). Data resource from: https://www.openstreetmap.org/

4.2 Conclusion of the macro scale analysis

The Xiangtan River passes through Xiangtan City from south to north, and the terrain of Xiangtan section is generally low in the north and high in the south. Affected by the subtropical monsoon, there are distinct dry and rainy seasons, which are often disturbed by floods. The average water level in the dry season is 26.3 meters, and that in the rainy season is 35.6. The river channel of Xiangtan section of Xiangjiang River shows an "S" shape, with relatively flat terrain and slow flow rate. Therefore, the river channel near Yangmei Island is easy to deposit sediment, and the highest water level is getting higher and higher, so the nearby area is in the frequent flood area. It is worth noting that most of the riverbanks in this region are in an undeveloped or semi-developed state, especially in rural areas, most of the riverbanks are in a natural state, no matter from the perspective of landscape or safety, the development potential of the riverbanks is huge.

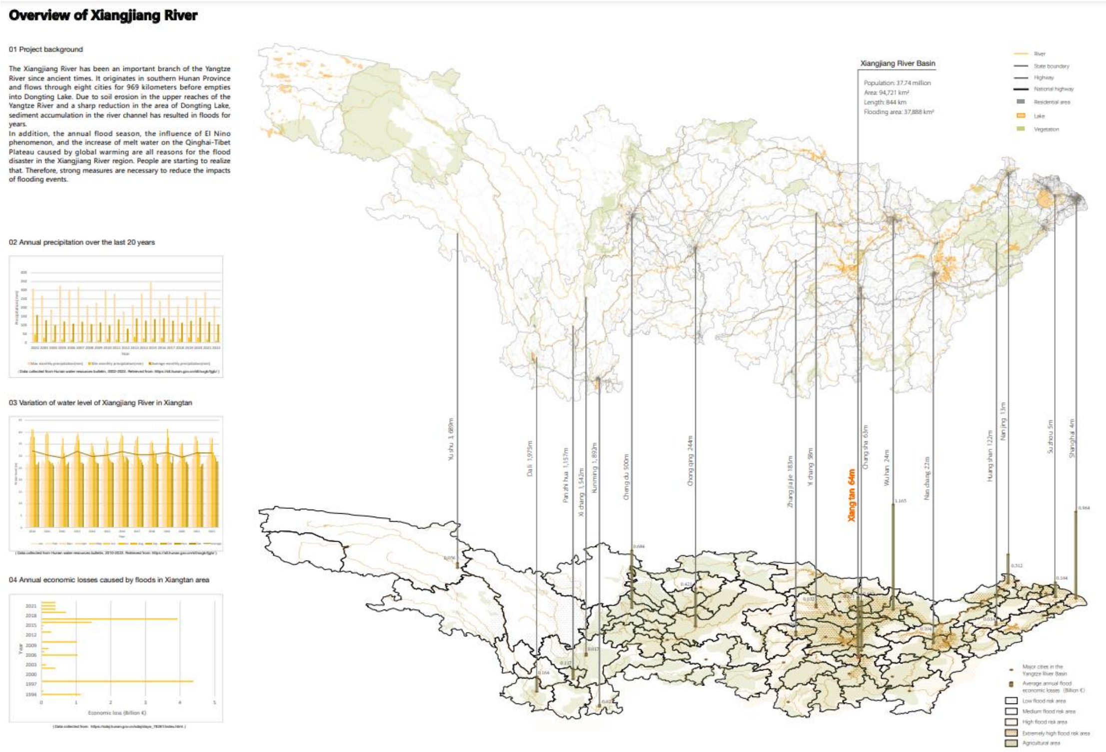

Figure 4.45. Macroscopic Analysis of Xiangjiang River Basin. (Drawn by author)

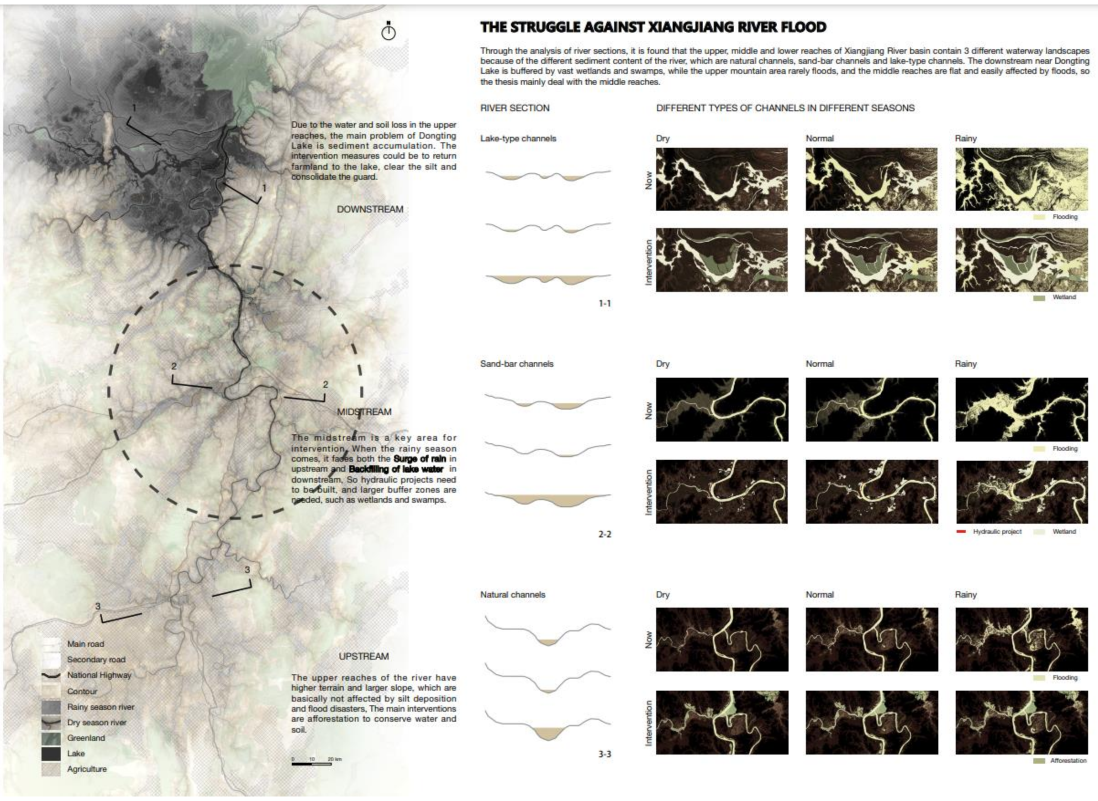

Figure 4.46. Analysis of the upper, middle, and downstream of the Xiangjiang River and the causes of floods. (Drawn by author)

4.3 Microscopic scale analysis: Xiangtan Section of Xiangjiang River

4.3.1 Composition of water system

Xiangjiang River flows through the main urban area of Xiangtan in a "U" shape from south to north, with a total length of 42 kilometers, a water surface width of about 450-750 meters, and a project area length of about 15 kilometers. The Xiangjiang River is a rain-source river and a channel for flood discharge. The water level drop in the dry and rainy season is more than 10 meters, so the flood control pressure is great, which also has a great impact on the waterfront landscape construction. Xiangjiang River has two tributaries in Xiangtan, both of which are located on the left bank, namely Lianshui River and Juanshui River. Meanwhile, there are many connected channels along the Xiangjiang River, mainly urban flood discharge channels and sewage discharge outlets.

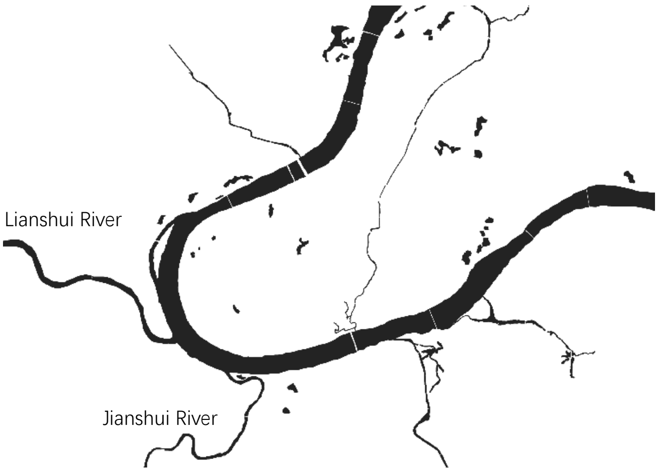

Figure 4.47. The waterway distribution in Xiangtan (Drawn by author). Data resource from: https://www.openstreetmap.org/

4.3.2 Traffic analysis

Xiangtan's transportation is very developed, with four Bridges connecting the north and south, the city is located at the intersection of two national highways and three national expressways, in addition to four other provincial expressways and a railway, with two railway stations and one light rail station, and no airport. The density of highway network is 0.45km/km2, with an average of 8.3 km per 10,000 people, which is much higher than the national average and ranks first in Hunan Province. Xiangtan, together with Changsha and Zhuzhou, forms the most convenient highway network in the province and is a national highway transport hub. It has an intercity railway station, which is convenient for tourists from the provincial capital Changsha. Xiangjiang River water transport conditions have the capacity of thousand-ton cargo passage, with nine ports. There is a big difference in the road conditions of Xiangjiang

River, the riverside section of the city is concrete asphalt pavement, the bank has a sand road stretching ten kilometers, can pass people and bicycles, some village sections are concrete pavement, people and vehicles shared.

Figure 4.48. Xiangtan urban traffic (Drawn by author).
Data resource from: https://www.openstreetmap.org/

4.3.3 Vegetation and agriculture structure

The natural scenery of Xiangtan is mainly characterized by hills with high vegetation coverage and rich waters, among which the forest coverage rate is 42.51%, mainly concentrated in the northeast and southwest of Xiangjiang River, and the urban green coverage rate is 45.81%. The main tree species are camphor, Guangyulan, mulberry, ginkgo, masotaxia, chiyama and so on. The proportion of agricultural land is 23.6%, mainly concentrated in the west and south of Xiangjiang River, where rice is the main food crop.

Figure 4.49. Distribution of green space and farmland in Xiangtan (Drawn by author). Data resource from: https://www.openstreetmap.org/

4.3.4 Distribution of buildings

Xiangtan has a long history. Yuhu Street has been the town center for 1000 years. After 2000, Xiangtan Municipal government established a large administrative district in the central area, and the population gradually migrated to the center, mainly in the red line area. In the last century, the urban landscape of Xiangtan is not modern, and there are not many high-rise buildings. The urban buildings are mainly industrial and living buildings, and there are still a few old residential areas more than 50 years old. After the 21st century, the administrative center area is a new type of urban landscape area where the new commercial and residential high-rise buildings are concentrated（Figure 4.23）.

Figure 4.50. Residential and riverbank buildings. Collected from: https://cn.chinadaily.com.cn/a/202306/13/WS648844bba310dbde06d2339f.html.

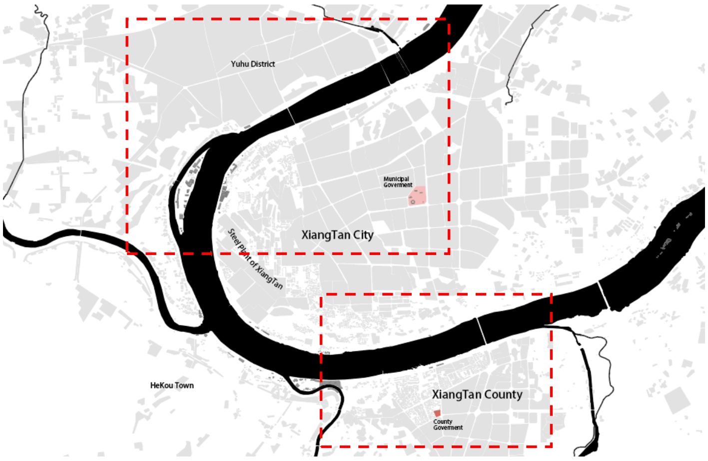

Figure 4.51. Xiangtan architecture distribution. (Drawn by author). Data resource from: https://www.openstreetmap.org/

4.4 Survey of customs and living habits

Xiangtan is the hometown of great men and the hometown of Mao Zedong, the first chairman of China, so the "red" culture (Communism) is the main theme of Xiangtan. Many landmark buildings in Xiangtan are in red, such as the 'Wanlou' tower on the bank of the Xiangjiang River (Figure 4.39), and there are also many red sculptures in the cultural square on the bank (Figure 4.40). These red elements represent the revolutionary fighting spirit and their patriotism of the people in Xiangtan. In addition, Xiangtan is also a famous place for producing lotus seeds, so it is called 'Lotus village', and even the sculptures in the city center are in the shape of lotus flowers (Figure 4.41).

Figure 4.52. 'Wanlou' Tower

Figure 4.53. Riverside Square

Figure 4.54. City Sculpture

Retrieved from: https://en.wikipedia.org/wiki/Xiangtan.

The older generation in Xiangtan likes to listen to opera, play mahjong and poker, while the young people prefer to go to entertainment venues and shopping, such as KTV, skating rink, Internet cafes, commercial centers, night markets and so on. The staple food of Xiangtan people is mainly rice and noodles, and the taste is spicy. Residents of Xiangtan have the habit of taking a walk after dinner. With the development of real estate, the banks of the Xiangjiang River have gradually become a gathering place for many merchants. Therefore, the banks of the Xiangjiang River are a good place for them to take a walk. There are also many elderly people dancing ballroom dances together and holding beer. In the cultural festival, many online celebrity bloggers and street artists perform there. Every summer, people like to go swimming or fishing in the Xiangjiang River. People mainly believe in Buddhism, and a small number of people believe in Christianity and Islam.

Figure 4.55. Chairman statue, opera, beer festival and river night market. Retrieved from: https://en.wikipedia.org/wiki/Xiangtan.

4.5 Conclusions of Xiangtan Section of Xiangjiang River

Xiangtan has developed land transportation, and there are convenient ways to get here from surrounding cities, but the condition of the road along the river is not good, so it needs to be constructed and separated from vehicles. Crowd gathering places are mainly concentrated in the north and south of Xiangjiang River, so landscape centers can be arranged in these areas as much as possible. Along the Xiangjiang River are connected buildings of different ages, including old towns, new towns, heavy industry areas and rural areas. Therefore, the design should be tailored to local conditions, protect the architectural ruins of the old city, and carry out renovation and upgrading without destroying the original landscape. In terms of greening, the natural form along the Xiangjiang River has been maintained for a long time, and the artificial traces are not obvious. The native aquatic plants can be used. There are many wetlands near the riverbank. Fishponds, artificial lakes, and channels can be preserved and utilized. At the same time, there are many docks on the riverbank, the design content needs to consider the impact on ship berthing and cargo.

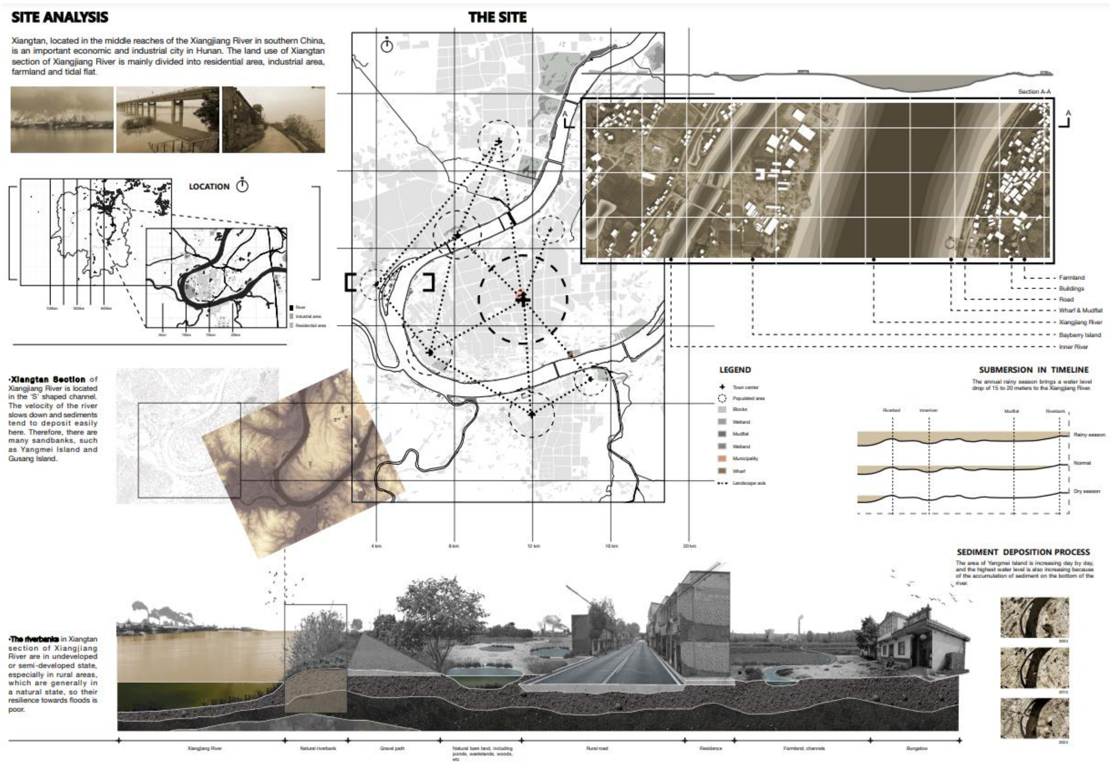

Figure 4.56. Site Analysis in Xiangtan. (Drawn by author)

5. DESIGN

5.1 Introduction to design

5.1.1 Framework model

As events become more frequent and intense due to climate change, communities must adapt and redevelop to reduce risk and improve ecological and human health. Now is also the time to stop placing communities and infrastructure in high-risk areas. We need to reduce sprawl, which further exacerbates risks.

Resilient landscape planning and design offers a way forward for communities. We can now use multi-layered protection systems with diverse, scalable elements, any of which can fail safely in the event of a disaster. The guidelines released by the American Society of Landscape Architects (ASLA) explain how to better protect cities and reduce natural disasters through resilient landscape planning and design. According to the guidelines, the goal of resilient landscape planning and design is to transform neighborhoods so that cities can more quickly recover from extreme climate events today and in the future.

Working with nature, rather than against it, which can help communities become more resilient and stronger in the aftermath of disruptive natural events [14]. Next, in addition, working with nature to create multi-layered defenses can bring some co-benefits. In this project, buffer zones along rivers can provide wildlife habitat and recreational opportunities; urban forests composed of different species can clean the air while reduces the urban heat island effect; green infrastructure designed to control flooding also provides needed community space and creates jobs.

5.1.2 Approach and principles

Work with nature. It turns out that to deal with the Xiangjiang flood, the community tried to use hard infrastructure projects as a single solution, such as building flood walls and building higher dams. Today, with rising water levels and temperatures and reduced budgets, the best defense method should be adaptive. Green infrastructure and adaptive multi-layer systems for flood control can maintain the vital functions of riverbanks and are a cost-effective and practical solution.

Multiple combinations. This project plans to unify the three elements of the riverside cultural landscape, natural landscape, and biological landscape. Ecosystems serve as natural channels and buffer zones; parks and open spaces allow water to travel safely or store stormwater for future use; strong green infrastructure systems, such as those used in transportation networks, purify, and absorb floodwater, making cities more resilient. Manage water resources effectively. Adapt measures to local conditions. Flooding is a local problem and must be designed for specific conditions. Landscape architects use their knowledge of topography, hydrology, and ecology to work with planners, ecologists, engineers, architects, and others to design a multifunctional system that is both a public space and stormwater management.

Improve the attractiveness of waterfront space. It is planned to build a style street on the riverbank to attract investment, carry out appropriate economic activities, and drive the development of local tourism; actively promote the spread of park culture, vigorously develop cultural peripheral industries, do a good job in logistics management of the park, and improve the experience of tourists visiting the park.

Technological innovation. Maximize the value of urban open space and create potential ecological value and economic benefits.

Landscape value definitions

Landscape value	**Definition**
Esthetic	I value this place for the scenery, sights, smells or sounds.
Economic	I value this place because it provides income and employment opportunities through industries such as forest products, mining, tourism, agriculture, shellfish, or other commercial activity.
Environmental quality	I value this place because it helps produce, preserve, and renew air, soil and water or it contributes to healthy habitats for plants and animals.
Future	I value this place because it allows future generations to know and experience as it is now
Health	I value this place because it provides a place where I or others can feel better physically and/or mentally
Heritage	I value this place because it has natural and human history that matters to me and it allows me to pass down the wisdom, knowledge, traditions, or way of life of my ancestors
Home	I value this place because it is my home and/or I live here
Intrinsic	I value this place because it exists, no matter what I or others think about it or how it is used
Learning	I value this place because it provides a place to learn about, teach, or research the natural environment
Recreation	I value this place because it provides outdoor recreation opportunities or a place for my favorite recreation activities
Social	I value this place because it provides opportunities for getting together with my friends and family or is part of my family's traditional activities
Spiritual	I value this place because it is sacred, religious, or spiritually special to me
Subsistence	I value this place because it provides food and other products to sustain my life and that of my family
Wilderness	I value this place because it is wild

Figure 5.57. Landscape value and definition. (Lee Karol, 2017[15])

5.2 Overall River landscape transformation strategy

How to improve the resilience of the site is the main goal of this project, so recurring landscape units and multi-dimensional system design have become strategies. This project will be carried out from three aspects: riverbank resilient design, flood drainage and storage, early warning and safety zone setting.

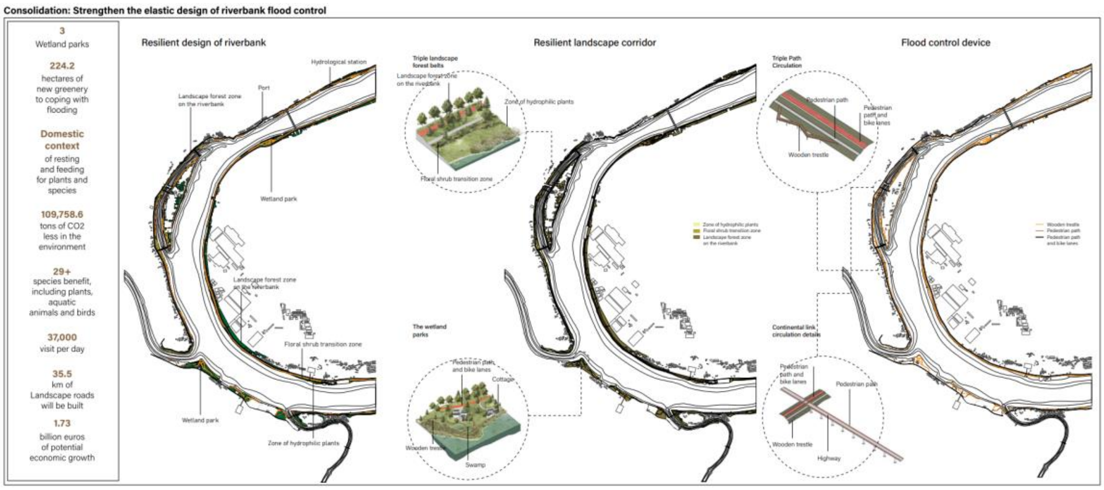

Figure 5.58. Framework for riverbank resilient design. (Drawn by author)

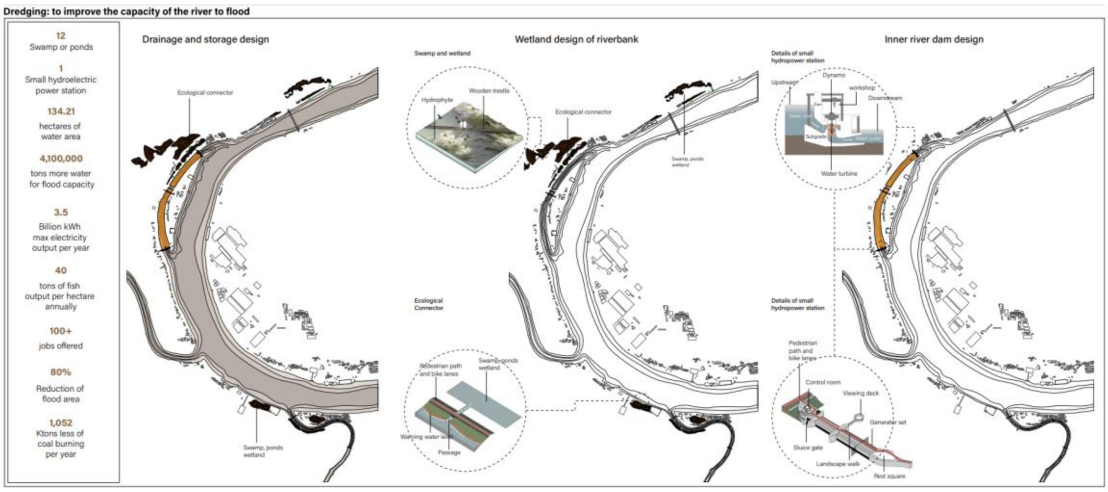

Figure 5.59. Framework for flood drainage and storage. (Drawn by author)

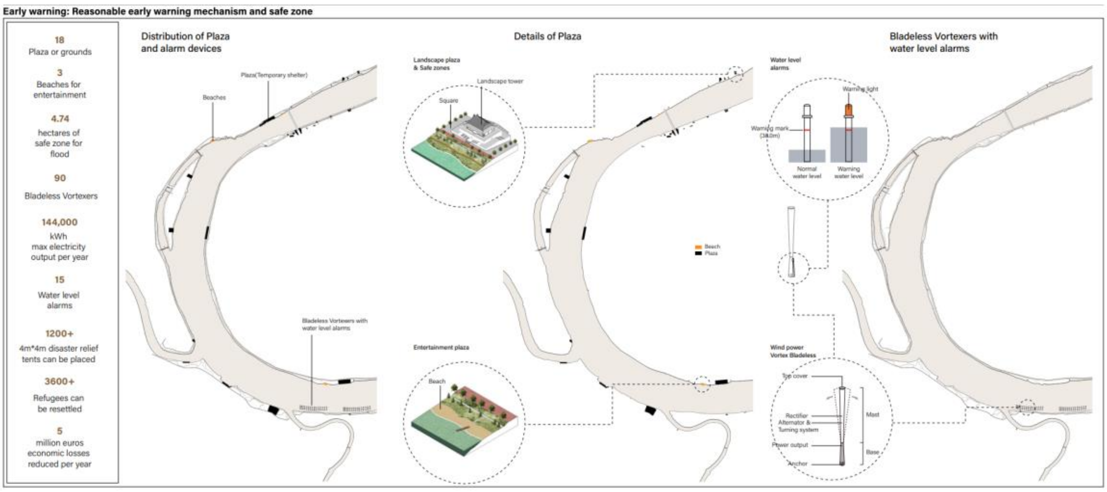

Figure 5.60. Framework of early warning and safety zone setting. (Drawn by author)

5.2.1 Resilient design of the riverbank

Choose plants with strong stress resistance and related artificial devices to reduce the ecological impact of the perennial water level instability on the site. A variety of plants are planted in different areas divided by the waterline, and a series of public spaces are designed with the waterline as a multi-dimensional design to minimize interference with the daily leisure activities of citizens. The natural ecology is emphasized below the water level in the flood season, and the public space construction is emphasized above the water level. Below the water level in the flood season, the marsh trails are constructed with waterproof materials such as concrete and steel mesh to resist the impact of the river water; elevated grid panels and viewing platforms are also built in the site to provide sufficient space for plant growth and form a natural flood discharge channel, further shortening the site immersion time.

Figure 5.61. Triple landscape forest belt
(Drawn by author)

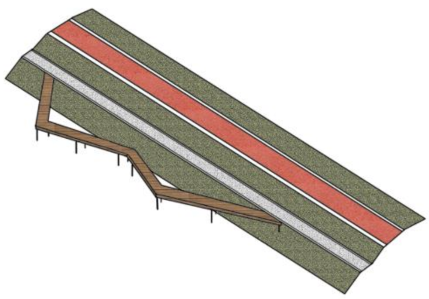

Figure 5.62. Flood control devices
(Drawn by author)

Figure 5.63. Landscape platform diagram. Retrieved from: https://landscape.coac.net/en/node/3880.

5.2.2 Flood diversion and storage design

The Xiangjiang River is divided into the inner river and the outer river by Yangmei Island in the 'U' bend. The average water surface width of the inner river is 180 meters, the average water depth in the rainy season is about 8.5 meters, and the average water depth in the dry season is about 1.5 meters. Therefore, the inner river may become a natural small river. The reservoir is planned to build a small dam at the north and south ends of Yangmei Island, that is, the upper and lower reaches of the inland river. The rainy season is the water abandonment period. and the dry season is the non-water abandonment period. It is used to regulate the flood in the dry and rainy seasons. hydroelectric power. Landscape corridors and landscape trails are paved on the surface of the dam for tourists to enter the island and view the scenery, forming a closed loop with the ecological corridor on the riverbank. In addition, there are dozens of large and small lakes, ponds, or wetlands on the left bank of the Xiangjiang River. These spaces with a certain water storage capacity form a potential "sponge" system that can be used to store excess flood water. These water bodies are connected to the inland river through newly built ecological channels. These ecological channels are at the warning water level of the riverbank. Each channel has its own gate, so its water inflow and outflow are controllable, to adjust the water level of the inland river and prevent it from being too low or too high.

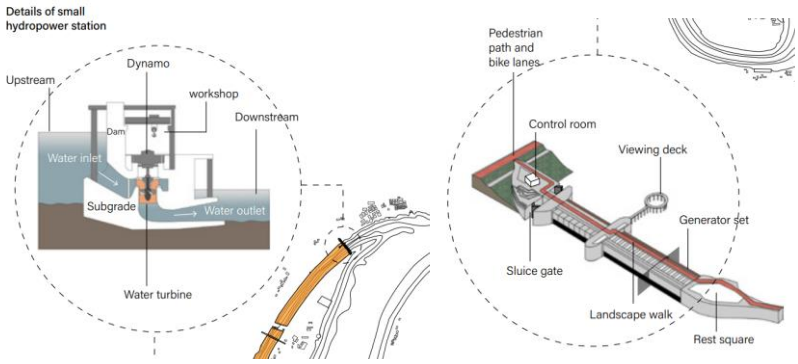

Figure 5.64. Diagram of small hydropower station. (Drawn by author)

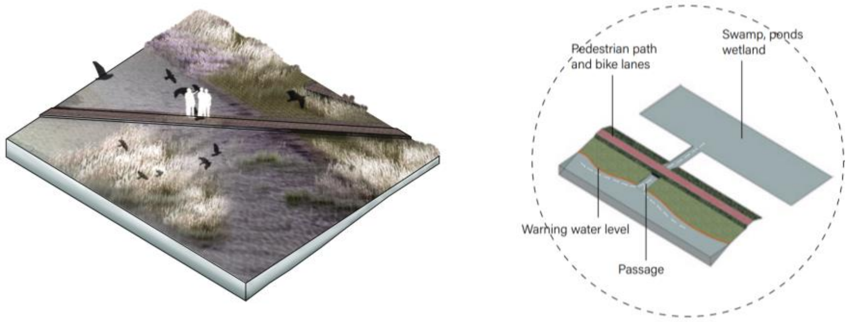

Figure 5.65. Diagram of wetland and ecological connector. (Drawn by author)

5.2.3 Warning and safety zone settings

Although we want to be friends with floods, we must also be aware that floods are not 100% controllable. During the period from 2010 to 2020 alone, four large-scale floods occurred in the Xiangjiang River, which caused serious damage to the lives and property of residents near the riverbank. It is a great threat, so reasonable early warning devices and adequate safety zone settings are necessary.

It is planned to design and construct landscape plazas of different sizes and specifications along the Xiangjiang River according to the density of people. These plazas are distributed along the river and arranged reasonably according to the population density. Generally, one is built at about 300-500 meters, mainly to provide leisure and entertainment places for residents. During the flood season It can also provide emergency shelters for residents along the coast, such as 'Guanxiangge Plaza', 'Wanlou Plaza', 'Bund Square', (Figure 5.30, Figure 5.32) etc., or will become a landmark building in Xiangtan area.



Figure 5.67. Wanlou plaza   Figure 5.66. Waitan plaza   Figure 5.68. Guanxiang plaza

Retrieved from: https://cn.chinadaily.com.cn/a/202306/13/WS648844bba310dbde06d2339f.html.

In addition, it is planned to use the upper reaches of the Xiangjiang River monsoon for wind power generation. The power generation device is trying to introduce the Vortex Bladeless S.L. wind power device of the Spanish team. Since this invention is based on a brand-new technology, it requires innovative research routes and extensive tests, so it is a good idea Opportunity to reach cooperation between the two parties. Such devices are low-maintenance and harmless to wildlife (like solar panels), so they open new horizons for wind energy in urban areas and protected areas. Likewise, they can also be adapted to the installation area of conventional wind power, so the technology can be scaled up, bringing its own characteristics to mass production on classic wind farms or on large waters[13]. The water level warning light on the base of the device monitors the water level always changes. Once the water level exceeds the warning light, the red light will flash to remind people to pay attention to safety.

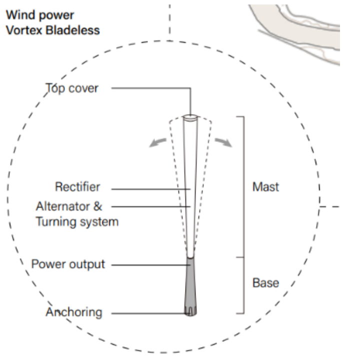

Figure 5.69. Power generation principle.

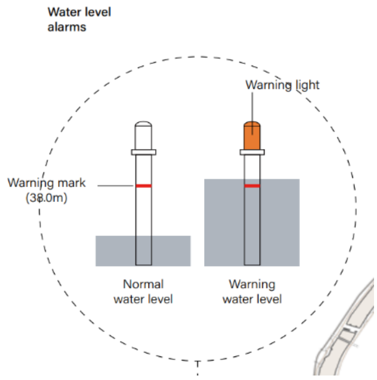

Figure 5.70. Water level warning light

(Drawn by author)

5.3 Waterfront space design of Xiangtan section

5.3.1 Guide for the design

Landscape elements (of the architectural framework) detailed in this chapter include:
- Ecological corridor and road design
- Constructed wetland and inland river dam design
- Landscape square and warning device design

Each part includes their axonometric drawing, section drawing, detailed design drawing, plan view or effect drawing, and certain text description.

5.3.2 Ecological corridors

The ecological corridor is divided into three layers. Above the normal water level, weeping willows, poplars, cypresses, tallow, and other drought-tolerant plants are planted to form landscape forest belts. Ground plants such as miscanthus, pasha, palm bamboo, and canna are often planted below the water level to form a large area of thatch landscape. Drought-resistant plants, such as miscanthus, pampas grass (Cortaderia selloana), Chinese fountaingrass (Pennisetum alopecuroides), flabelliformis, Canna generalis, Water-garden Iris, purple loosestrife (Lythrum salicaria), roof iris (Iris tectorum) and orange daylily (Hemerocallis fulva), are planted in the transitional zone in between with the changing water level. In addition, plants such as verbena, cosmos, and cacao chrysanthemum are planted on the riverbank, forming a rich multi-dimensional landscape, high-density flowering planting landscape.

Being resilient, it decreases the risk of obstructions during floodings, because the tree species selected are resilient and they won't be eradicated by light and medium events.

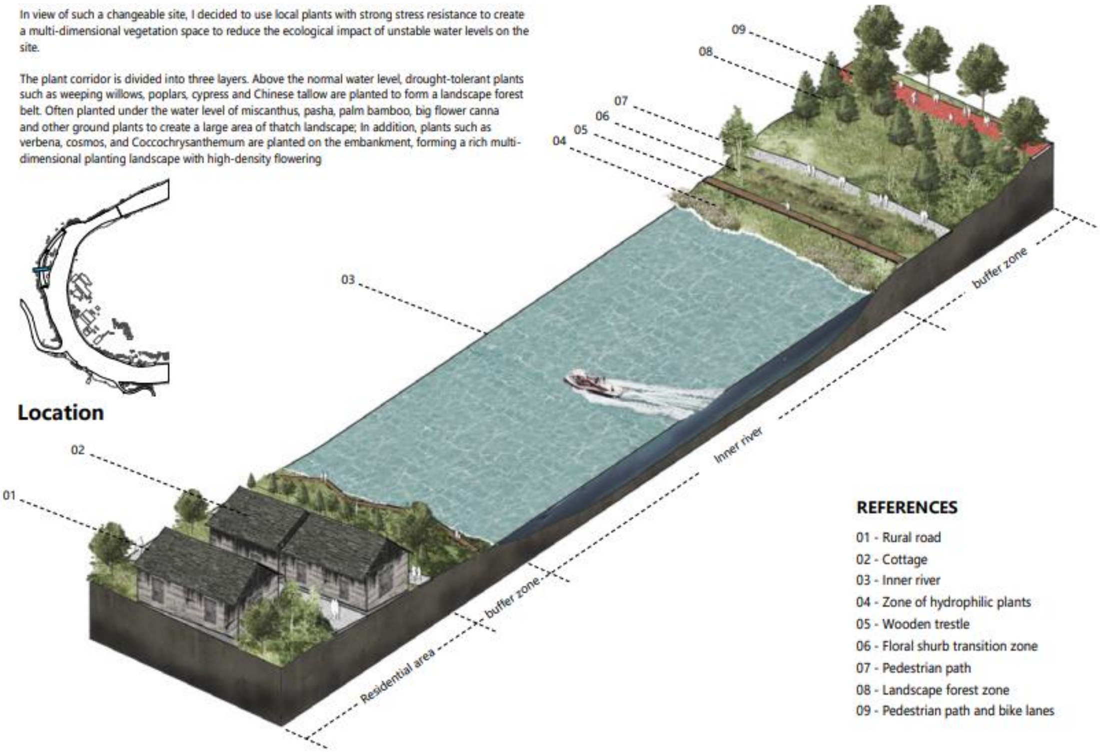

Figure 5.71. Axonometry of Ecological corridors. (Drawn by author)

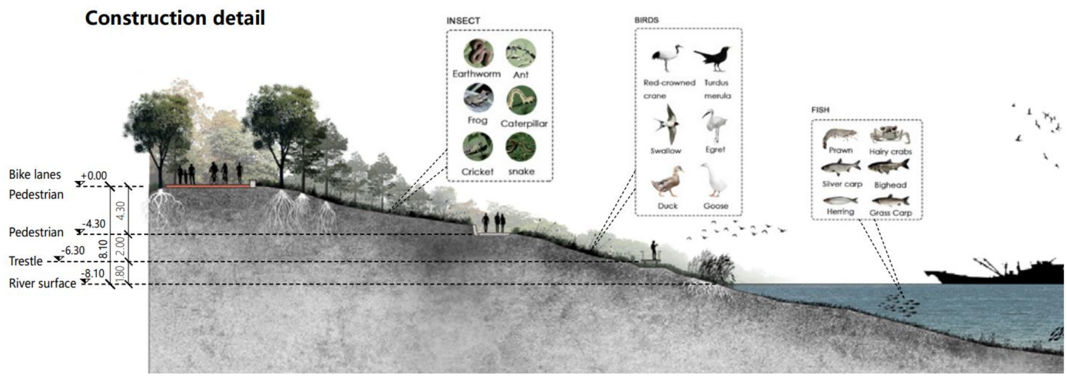

Figure 5.72. Construction detail of Ecological corridors. (Drawn by author)

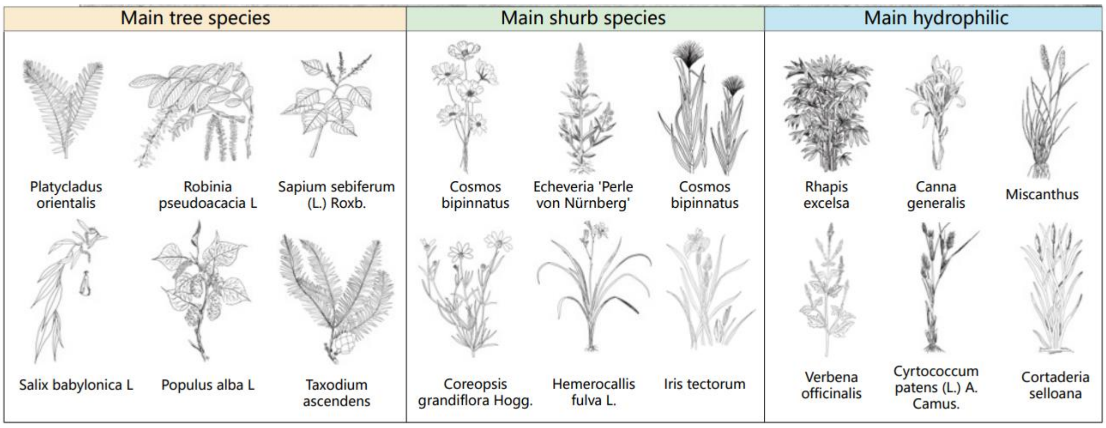

Figure 5.73. Plant collocation. (Drawn by author)

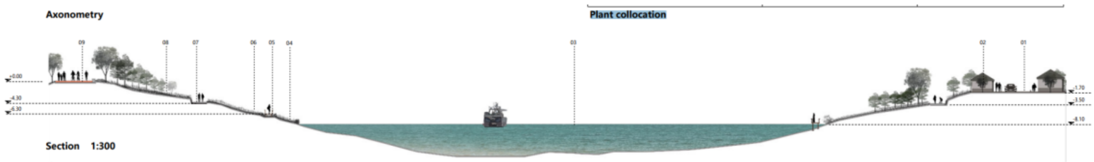

Figure 5.74. Section of Ecological corridors. (Drawn by author)

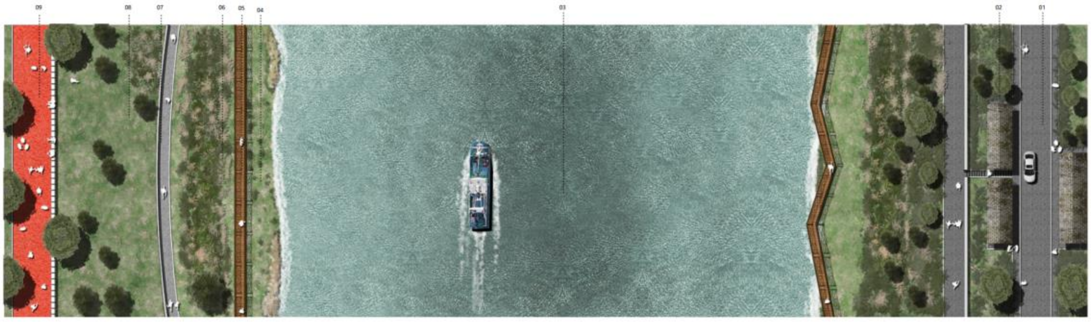

Figure 5.75. Partial masterplan of Ecological corridors. (Drawn by author)

5.3.3 Road design

The artificial installation is designed to enhance the self-reinforcement of the site and minimize its interference. Three footpaths with different elevations have been built to meet the activities and viewing needs of citizens at different water levels. They are the dam top sightseeing trail, the dam multi-functional experimental area and the swamp trail [15]. It is worth noting that Xiangtan is the cradle of red culture (communism), so to increase the cultural attributes of the city, red paint is used for the dam top sightseeing trail. At the same time, the two landscape buildings "Wanlou" and "Guanxiang Pavilion" on the riverbank are also red, so red was chosen to increase their connectivity. The wetland walkway is built with waterproof materials, and the overhead structure provides sufficient growth space for plants, which can also play the value of urban space even in flood season.

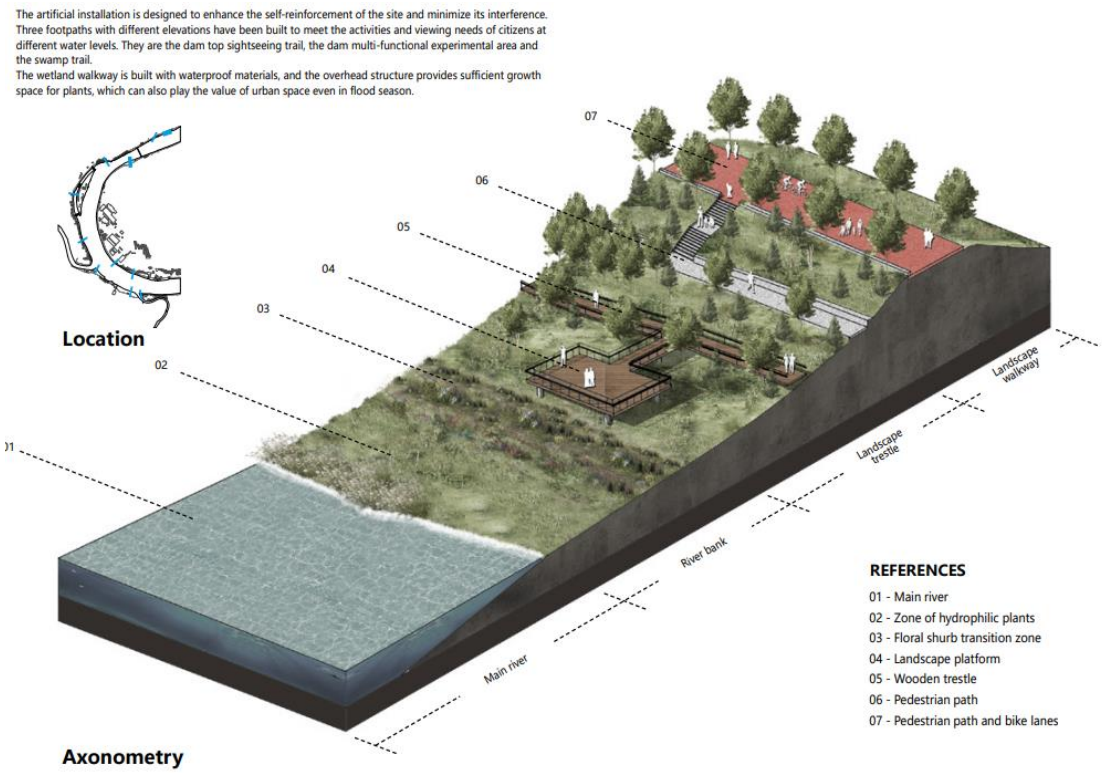

Figure 5.76. Axonometry of Road design. (Drawn by author)

Figure 5.77. Section of Road design. (Drawn by author)

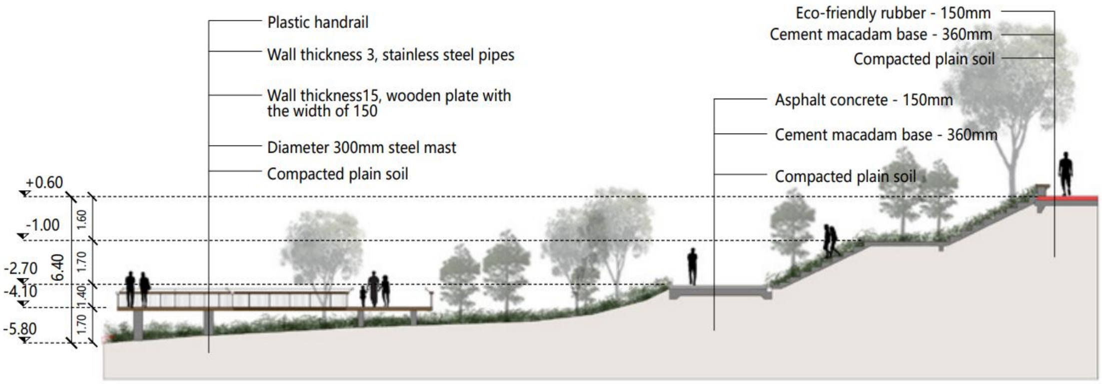

Figure 5.78. Construction detail of Road design. (Drawn by author)

Figure 5.79. Flood control devices rendering. (Drawn by author)

5.3.4 Artificial wetland

The wetland consists of a newly built artificial lake and natural water system connected to the Xiangjiang River by an ecological channel, which is used to regulate the change of water level on both sides of the riverbank, and it stores water during the rainy season to reduce the pressure of floods. Like the ecological design of riverbanks, the purpose of constructing artificial wetlands is to increase the resilience of the site to respond to small or medium-sized events and reduce the risk of flood congestion during flood seasons.

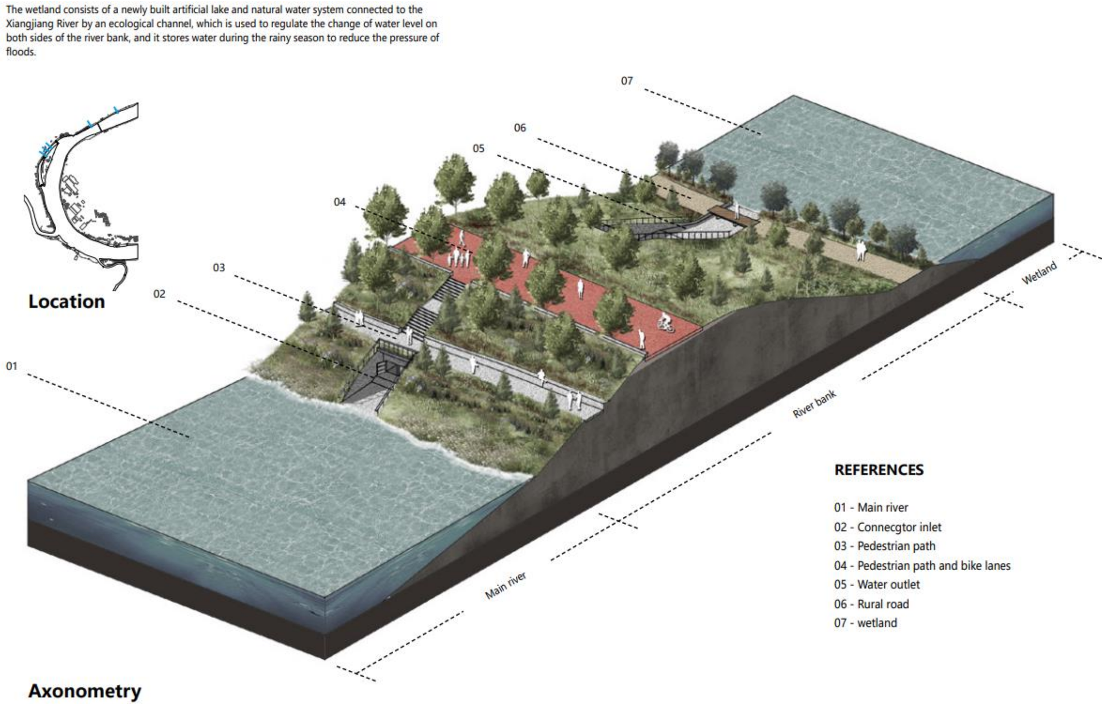

Figure 5.80. Axonometry of Ecological connector. (Drawn by author)

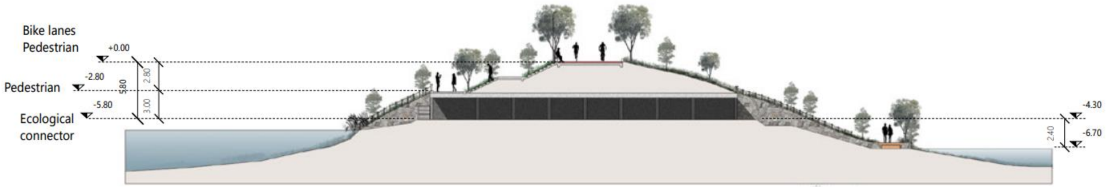

Figure 5.81. Section of Ecological connector. (Drawn by author)

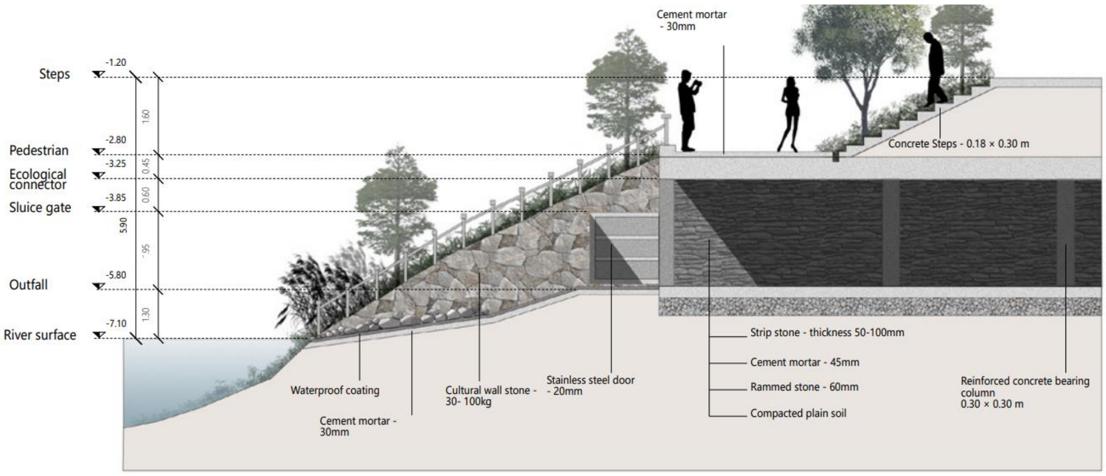

Figure 5.82. Construction detail of Ecological connector. (Drawn by author)

Figure 5.83. Ecological connector rendering. (Drawn by author)

5.3.5 The inner river dam

The main purpose of the dam is to coordinate the water balance between the dry and rain seasons and use the water level to generate electricity. Xiangtan from July to September is the water abandonment period (Rainy season), October to June is the non-abandonment period (Dry season), the annual average power generation is expected to be 3.5 billion KWH. Another important use of the dam is to provide landscape access for visitors, it can connect the riverbank with the Yangmei Island, forming a landscape closed loop. The lotus sculpture references iconic sculptures in the city center, which can leave a deep impression for tourists visit here, at the same time, it gives residents a sense of belonging and cultural identity.

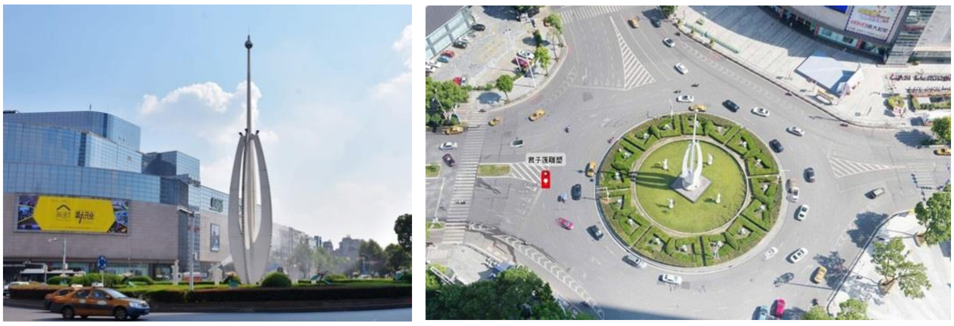

Figure 5.84. The lotus sculpture in the city center. Retrieved from: https://www.sohu.com/a/241464379_100180399.

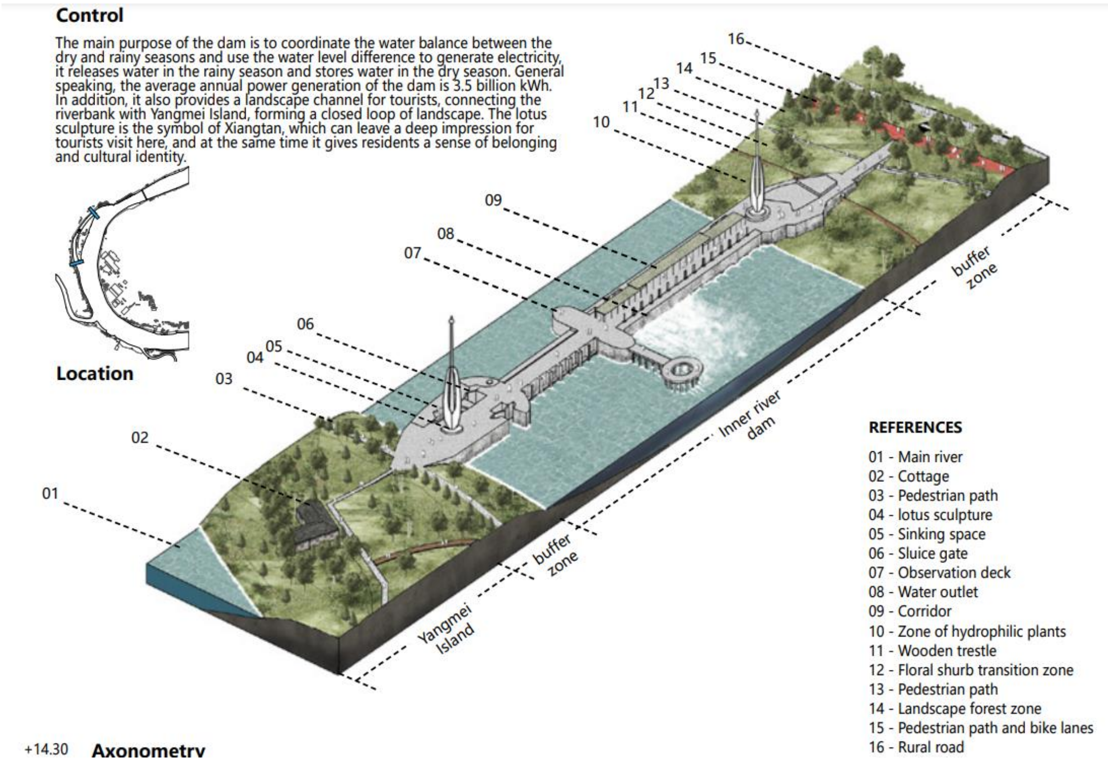

Figure 5.85. Axonometry of the inner river dam. (Drawn by author)

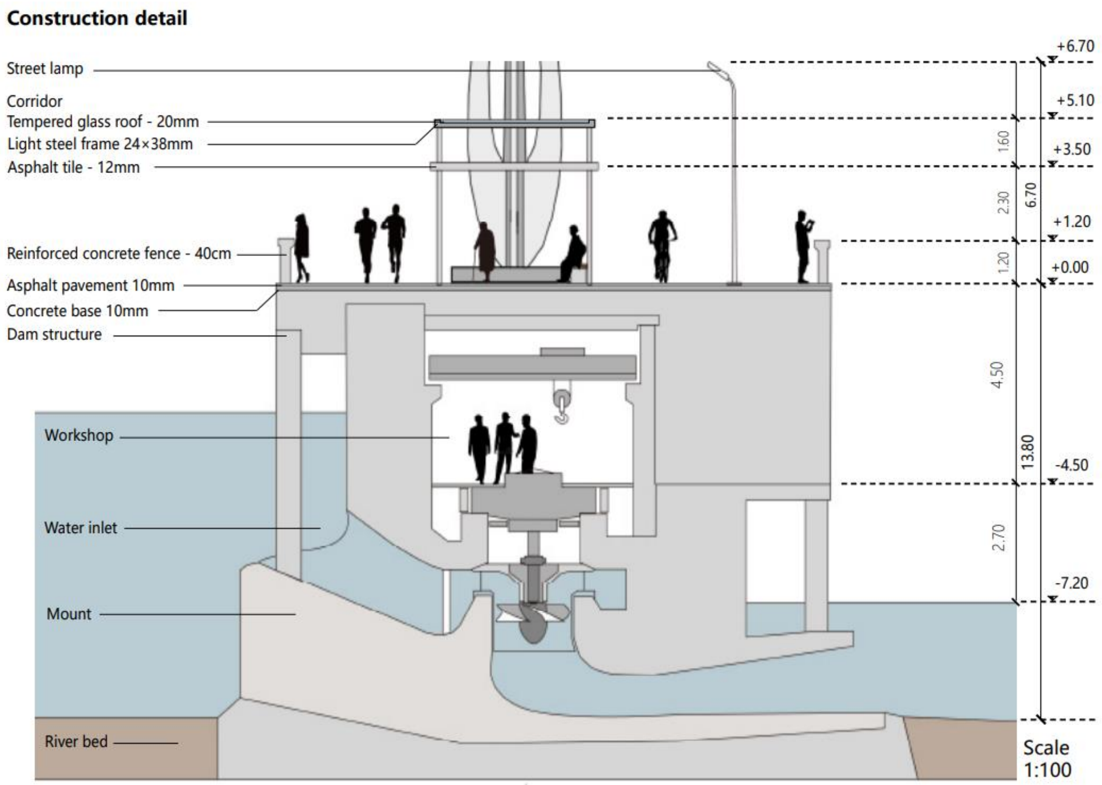

Figure 5.86. Construction detail of the dam. (Drawn by author)

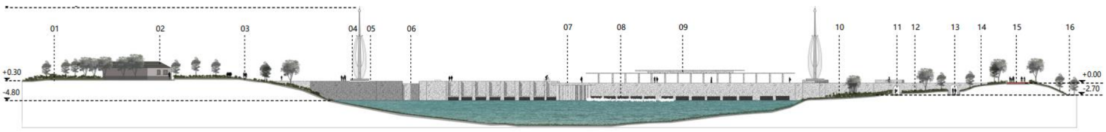

Figure 5.87. Section of inner river dam. (Drawn by author)

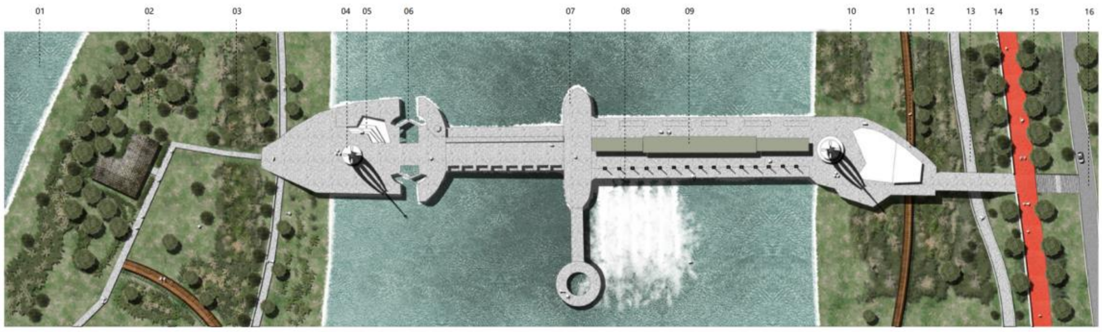

Figure 5.88. Masterplan of inner river dam. (Drawn by author)

5.3.6 Landscape Plazza

The landscape plazas are distributed along the river. According to the population distribution density, it is recommended to build a plaza at intervals of 300-500 meters. Its main purpose is to provide leisure and entertainment for residents. During the flood season, it can also provide emergency refuge for residents near the riverbank. The representative landscape plaza "Guanxiang Pavilion" is selected below, which may become a landmark building in Xiangtan. area.

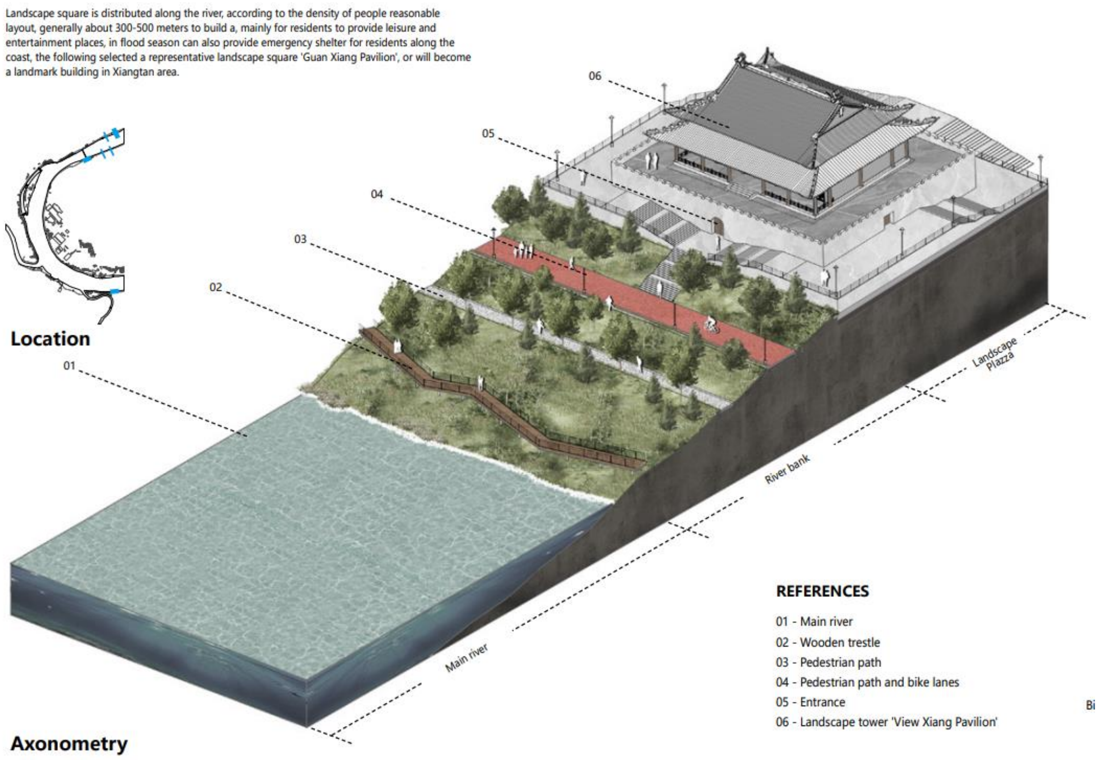

Figure 5.89. Axonometry of landscape plaza. (Drawn by author)

Figure 5.90. Section of landscape plaza. (Drawn by author)

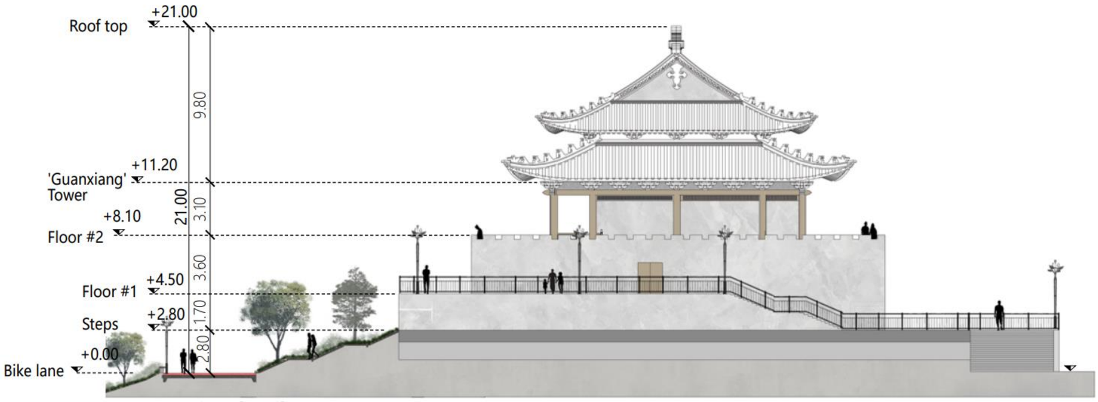

Figure 5.91. Construction detail of landscape plaza. (Drawn by author)

Figure 5.92. Landscape plaza rendering. (Drawn by author)

5.3.7 Wind Energy and Early Warning Devices

The project uses bladeless turbines, a new power generation technology that is low maintenance and harmless to wildlife, so they open new horizons for wind energy in urban areas and protected areas. The blue appearance helps them blend in with the colors of the river and sky.

In addition, the water level warning light located in the base part always monitors the water level change, once the water level exceeds the warning level, the red light reminds people to pay attention to safety.

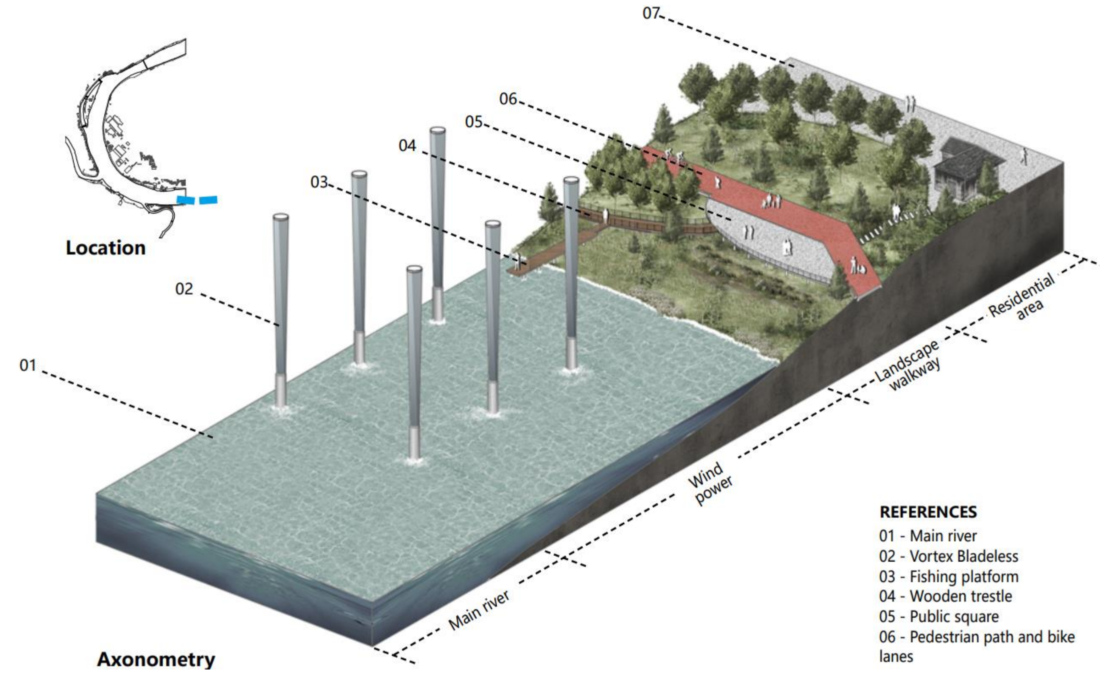

Figure 5.93. Axonometry of Wind Energy and Early Warning Devices. (Drawn by author)

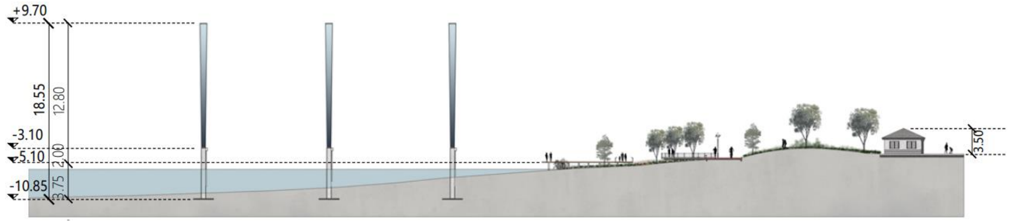

Figure 5.94. Section of Wind Energy and Early Warning Devices. (Drawn by author)

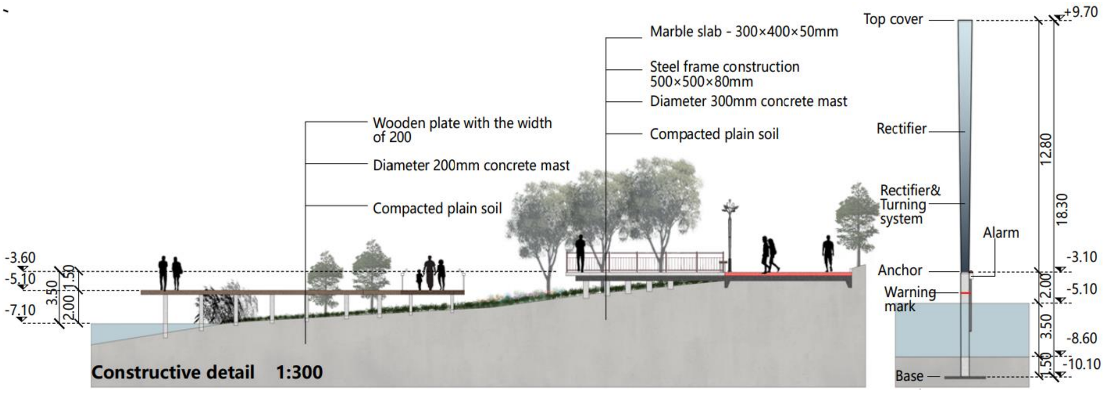

Figure 5.95. Construction detail of devices. (Drawn by author)

Figure 5.96. Wind energy and early warning devices rendering. (Drawn by author)

In this subsection, the proposal considers the importance of combining multiple disciplines. Not only do you need to use knowledge related to energy engineering, mechanical manufacturing, and electrical engineering, but you also need to consider material design, aesthetics, and ecological principles. For example, the size and distribution of bladeless turbines need to consider wind direction, wind speed and wind utilization efficiency, and power generation materials need to be wear-resistant and environmentally friendly. At the same time, the selection and matching of installation colors also affects the harmony of the landscape. The choice of blue is to blend in with the river and sky, minimizing the impact on the surrounding ecology. Therefore, this is a multi-disciplinary technology application result. However, this section only provides an overall vision of the solution. It does not explain too much about the specific device principles and applications, nor does it represent the final effect of the design after it is implemented.

5.4 Masterplan

For such a changeable site, multi-dimensional landscape design is necessary. Highly resistant plants and associated artificial devices help to reduce the impact of unstable water levels on the ecology of the site. The new elements of the plan include two small dams, a total of about 30 kilometers of trails at the top of the dam, 30 kilometers of trails in the middle of the dam, 15 kilometers of swamp trails, 2 landscape buildings, 12 landscape squares, and landscape bridges 2, 12 artificial wetlands, 3 wetland parks, 3 beaches, 19 Diaoyutai, 2 wind farms, 224.2 hectares of new flood control green infrastructure, etc.

The project site is located on the west bank of the Xiangjiang River in Xiangtan. It is about 8 kilometers long from north to south and 5 kilometers wide from east to west. The green corridor along the river is about 15 kilometers long and it is shaped like a 'C' (Figure 5.82). The total construction area is about 224 hectares.

In order to realize the resilient design of the riverside waterfront space, it is proposed to use the diversity of plants to strengthen the stability of the ecosystem. The ground cover plants are divided into three levels with trees, shrubs, and wetland plants to establish a composite ecological green corridor. 3 trails with different elevations, the dam top sightseeing trail, the dam middle sightseeing trail, and the swamp boardwalk are used to meet the citizens' activities and viewing needs at different water levels. The establishment of corridors and artificial devices has become the main part of the proposal. It is estimated that it can reduce 109,758.6 tons of CO2 per year, add 35.5km of sightseeing roads, benefit more than 29 species, and increase the number of tourists to 37,000 people/day, bringing potential revenue of 1.73 billion euros to the local area.

The artificial wetland on the riverbank and the two dams on the inland river not only provide a buffer for floods, but also bring many benefits to the city. These interventions connect 134.21 hectares of water, providing an additional 4.1 million tons of flood carrying capacity. The dams are expected to generate 3.5 billion kilowatt hours of electricity per year, reducing coal use by 1,052 kilotons. The inland reservoirs can create an additional 40 tons of fishing capacity per year. It will create more than 100 jobs. When floods come, it is expected to reduce the affected area by 60%-80%.

The landscape square and wind power generation device emphasize the sustainable development, comprehensiveness, and innovation of the project, organically integrating the cultural landscape and natural landscape power generation device. It is proposed to build 18 landscape squares, 3 recreational beaches, provide a 4.74 ha flood control safety area, 2 floating power plants, and a total of 90 bladeless turbines. If the power generation efficiency of the bladeless turbine is calculated as 70% of the efficiency of the traditional rotary alternator [16], then the power of each bladeless turbine is about 420-1000 kWh. Based on 10 hours of working time per day, it is expected that the Xiangjiang Wind Farm It can generate a minimum of 137,970,000 kWh of electricity per year. In addition, the landscape square can provide space for more than 1,200 tents, which can accommodate more than 3,600 refugees. These interventions are expected to reduce economic losses caused by flooding by 5 million€ per year.

MASTERPLAN

Figure 5.97. The masterplan of Xiangjiang River landscape project. (Drawn by author)

5.5 Aerial view

The aerial view here is located at the 'U'-shaped bend of the Xiangjiang River. The overlooking angle is from northwest to southeast. The island is Yangmei Island, an independent site located in the middle of the project, it is not only a 'performance' platform for the two hydroelectric power stations, but also serves as an island, bringing a different tour experience to tourists. Piers, fishing platforms, and trails on dams also bring more fun to people.

Figure 5.98. The Bird view of Xiangjiang River landscape project. (Drawn by author)

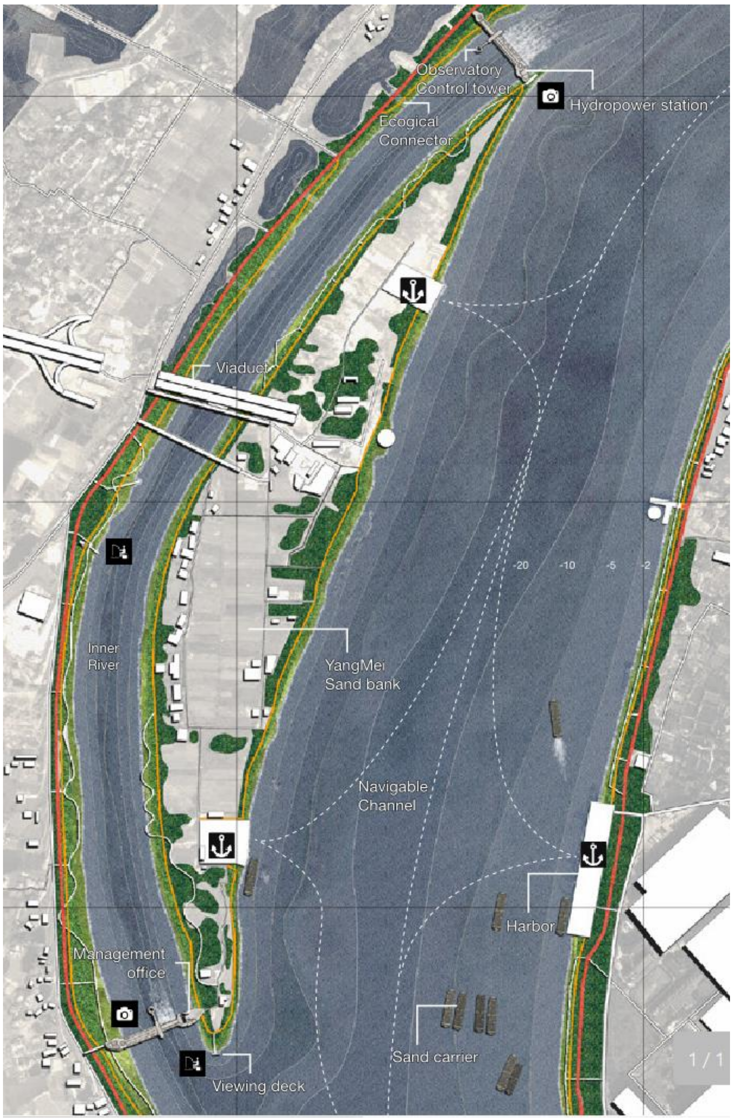

Figure 5.99. Masterplan of Yangmei Island. (Drawn by author)

5.6 Before and after comparison

The Figure 5.38 shows the simulation of normal water level, rainy season water level and flood water level.

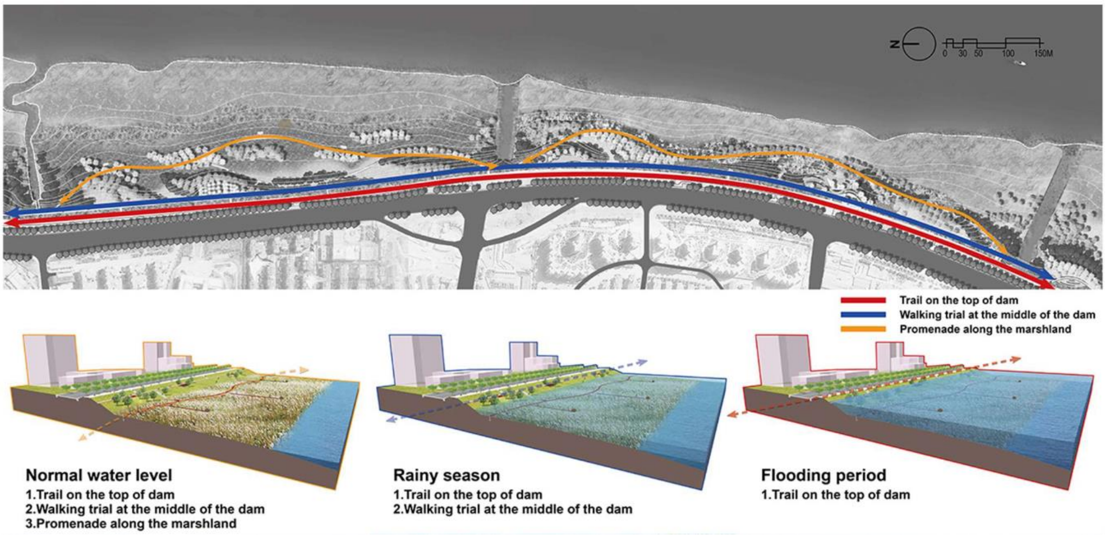

Figure 5.100. The scenarios in different season. Retrieved from: https://landscape.coac.net/en/node/3880.

The completion of this proposal marks the end of the renovation plan for more than 30 kilometers of the Xiangtan City section of the Xiangjiang River Scenic Belt. Compared with the riverbank wasteland before, the riverbank now has become an oasis. Due to the implementation of the intervention, some riverside residents will be resettled into new communities provided by the government, and the population density will be further reduced (Figure 5.85 – Figure 5.88). The proposal reduces the damage caused by floods to the ecological environment, allowing more animals and plants to survive here, so the number and quality of species are greatly improved. The walking trail makes transportation convenient, and people can walk, ride bicycles, and explore leisurely in the park. The marsh trail attracts visitors to stroll on the carefully planted river beach, and they can also enjoy the scenery from the observation deck.

Figure 5.101. The current situation of riverbank. (Drawn by author)

Population density	■■■■□□□□□□	Road condition	■■■□□□□□□□
Biological species	■■□□□□□□□□	Landscape effect	■■■□□□□□□□
Revetment condition	■■□□□□□□□□	Tourist volume	■■□□□□□□□□

Figure 5.102. Comprehensive assessment before intervention. (Drawn by author)

Figure 5.103. After the intervention of the riverbank. (Drawn by author)

Population density	■■■□□□□□□□	Road condition	■■■■■■■□□□
Biological species	■■■■■■□□□□	Landscape effect	■■■■■■□□□□
Revetment condition	■■■■■■■■□□	Tourist volume	■■■■■■■□□□

Figure 5.104. Comprehensive evaluation after intervention. (Drawn by author)

The dam on Yangmei Island and the new wind farm will become new landmark buildings in Xiangtan. Visitors in the park will become potential consumers of the two tourist attractions, bringing some economic benefits to the city. The landscape in the park has been further enhanced and it provides visitors with a healthier way to get closer to nature, allowing the area to be visited by at least 100,000 people every day.

The project also plays an important role in cultural dissemination. The lotus sculptures on dam and the lotus shapes of urban furniture leave a deep impression on tourists here, and at the same time give residents a sense of belonging and cultural identity.

6. COST-BENEFIT BALANCING

Cost–benefit analysis (CBA), sometimes also called benefit–cost analysis, is a systematic approach to estimating the strengths and weaknesses of alternatives. It is used to determine options which provide the best approach to achieving benefits while preserving savings in, for example, transactions, activities, and functional business requirements [17]. This project uses this method to judge the main impact of intervention measures on the environment, such as the improvement of the ecological environment, and at the same time analyze and determine the terminal effects of important environmental impacts, such as reducing CO2 emissions in the air and increasing vegetation coverage, and finally carry out monetary valuation on the above-mentioned terminal effects through the valuation technique[18].
Among them, there are three main methods of cost-benefit analysis, namely the net present value method (NPV), the present value index method, and the internal rate of return method. Since project investment is indivisible, we use the net present value method. For the record, the following is not a complete cost-benefit analysis, but merely a comparison of the proposed costs and potential benefits of preliminary consideration.

6.1 Estimate of direct costs

The chart below shows the roughly estimated cost (direct cost) of each sub-project. The prices of various materials are estimated based on the Chinese market price in 2023(Data collected from: http://www.cnjcw.com/) and they do not represent the final cost.

Number	Sub-projects	Category	Goals	Unit price of construction	Total price (million €)
1	Trail on the top of dam	Traffic	30km×8.0m	16€/m^2	3.84
2	Walking trial at the middle of the dam	Traffic	30km×4.0m	3€/m^2	0.36
3	Promenade along the marshland	Traffic	15km×2.0m	30€/m^2	0.90
4	Hydropower station	Energy	2	7,500,000€	15.00
5	Landscape vegetation	Green	2.24km^2	15€/m^2	336.30
6	Landscape architecture	Landscape	2	50,000€	0.10

7	Landscape square	Landscape	$0.45km^2$	$115€/m^2$	51.75
8	Landscape bridge	Traffic, Landscape	110m×5.5m 20m×4.5m	$720€/m^2$	0.50
9	Constructed wetland	Landscape, Water balance	$1.34km^2$	$18€/m^2$	24.12
10	Wetland Park	Landscape, Water balance	$0.32km^2$	$25€/m^2$	8.00
11	Beach	Entertainment	$8146m^2$	$20€/m^2$	0.16
12	Fishing platform	Entertainment	19	5400€	0.10
13	Wind farm	Energy	2	562,500€	1.13
14	City furniture	Infrastructure	60km	2800€/km	0.17
Total					442.43

Table 6.1. Define the purpose and goals of the action. (Calculated by the author). Retrieved from: http://www.cnjcw.com/

6.2 Estimate of indirect costs

The indirect cost of a construction project refers to the contractor's cost of providing on-site services and facilities, such as site management and security, factory, etc. [19], which is also commonly referred to as overhead costs. The following list is only a rough calculation of the negative impact the proposal will bring to the local environment and the possible economic losses. The data cannot be used as a professional engineering indirect cost case study.

According to an overview of China's construction waste recycling industry in 2019, construction waste generated from building decoration accounts for about 7.1%. Assuming that the average construction thickness is 0.5m, it is estimated that 620,000 cubic meters of construction will be generated (excluding landscape architecture). (Retrieved from: http://pdf.dfcfw.com/pdf/H3_AP202009291418132187_1.pdf)

According to the compensation standards for land expropriation and house demolition in Xiangtan City in 2022, the compensation for natural dry land is 4.3€/m2, the compensation for ponds is 8.6€/m2, the housing compensation is about 500€/m2, and the compensation for agricultural land is about 6.5€/m2. Bare ground compensation is approximately 4.3€/m2. (Retrieved from: https://www.jinglawyer.com/zdbc/zdbcbz/16859.html)

Water pollution is mainly affected by sewage discharge from ships and factories, construction waste and eutrophication of water bodies. Here we mainly consider construction waste pollution and eutrophication of water bodies, which mainly occur in water bodies of inland dams and artificial wetland areas. According to the official website, the non-resident domestic water and sewage treatment fee will be adjusted from 0.14€/ton to 0.2€/ton in 2020. If these water bodies are polluted, the fee will be calculated as 1.4 yuan/ton, and the average water depth will be calculated as 5.0m.

(Retrieved from: https://huanbao.bjx.com.cn/news/20191223/1030556.shtml)

Number	Sub-projects	Category	Goals	Unit price of construction	Total price (million €)
1	Construction waste removal	Clean	440200 m^3	0.5€/m^3	0.22
2	Destruction of natural vegetation	Ecology	0.36km^2	4.3€/m^2	1.55
3	Water pollution	Pollution	1.80 km^2	0.2€/m^3	0.90
4	Demolition of old buildings	Demolition	87900 m^2	500€/m^2	43.95
5	Lake expropriation	Government subsidies	1.34km^2	8.6€/m^2	11.52
6	Farmland expropriation	Government subsidies	0.483km^2	6.5€/m2	3.14
7	Expropriation of bare land	Government subsidies	0.45km^2	4.3€/m^2	51.75
Total					113.03

Table 6.2. Estimate of indirect costs. (Calculated by the author)

6.3 Forecasting Cost and Benefit Outcomes in 5 Years

This step is mainly to estimate the income and expenses brought by the project within a certain period. This proposal is a non-professional cost and benefit estimate, so the short term 5 years is selected in the proposal. Benefit B is: Calculated according to the return on investment (ROI) of each sub-project in the current market, the total income obtained after 5 years. Project return on investment is usually 7%-12%. (ROI collected from: https://www.zhihu.com/)

serial number	Project proposals	Benefit B (million€)	Cost C (million€)	Profit B-C (million€)	Earnings ratio B/C	Net profit ratio (B-C)/C	Ranking
1	Trail on the top of dam	3.24	3.84	-0.60	0.844	-0.156	13
2	Walking trial at the middle of the dam	0.34	0.36	-0.02	0.944	-0.056	9
3	Promenade along the marshland	0.62	0.90	-0.28	0.689	-0.311	14
4	Hydropower station	32.40	15.00	17.40	2.16	1.160	5
5	Landscape vegetation	723.24	336.30	386.94	2.151	1.151	6
6	Landscape architecture	0.23	0.10	0.13	2.300	1.300	3
7	Landscape square	105.45	51.75	53.70	2.038	1.038	7
8	Landscape bridge	0.45	0.50	-0.05	0.900	-0.100	10
9	Constructed wetland	53.47	24.12	29.35	2.217	1.217	4
10	Wetland	18.54	8.00	10.54	2.316	1.318	2

	Park						
11	Beach	0.16	0.16	0	1	0	8
12	Fishing platform	0.09	0.10	-0.01	0.900	-0.100	11
13	Wind farm	7.00	1.13	5.87	6.195	5.195	1
14	City furniture	0.15	0.17	-0.02	0.882	-0.118	12

Table 6.3. Forecasting Cost and Benefit Outcomes in 5 Years. (Calculated by the author). Method comes from: Wu Dan. Cost-benefit analysis of air quality management. (n.d.)

6.4 Select metrics and measure all cost and benefit elements

6.4.1 Discount the incurred future costs and benefits to present value

$$PV_b = \sum_{i=o}^{n} \frac{B_i}{(1+r)^i} \tag{1.1}$$

$$PV_c = \sum_{i=o}^{n} \frac{C_i}{(1+r)^i} \tag{1.2}$$

B_i, C_i: Benefits and expenses incurred in year i
n: Calculation period
r: Social discount rate

Assume that the calculation period is 5 years, r=0.09 (According to the latest policy of Bank of China 2023), Maintenance costs are calculated at 5% of the project in the first year and increase by 9% annually thereafter, and then,

Program number	PV_b (million€)	PV_c (million€)
1	3.150	4.740
2	0.260	0.445
3	0.570	1.104
4	33.150	18.470
5	742.100	475.940
6	0.203	0.120
7	108.400	63.900
8	0.440	0.620
9	47.600	29.620
10	19.200	9.850
11	0.152	0.174
12	0.096	0.125
13	8.200	1.400
14	0.150	0.210

Table 6.4. The incurred future costs and benefits to present value. (Calculated by the author). Method comes from: Wu Dan. Cost-benefit analysis of air quality management. (n.d.)

6.4.2 Comparing Discounted Costs and Benefits

NPV (net present value)

$$NPV = \sum_{i=o}^{n} \frac{B_{Ti} - C_{Ti}}{(1+r)^i} \quad (1.3)$$

B_{Ti}, C_{Ti}: Total benefits and total costs incurred in year i
n: Calculation period
r: Social discount rate

Assume that the calculation period is 5 years, r=0.09 (According to the latest policy of Bank of China 2023), Use the calculation data from the previous step：

Program number	NPV
1	-2.16
2	-0.13
3	-0.55
4	8.85
5	139.46
6	0.07
7	26.21
8	-0.21
9	15.53
10	5.83
11	0.12
12	0.35
13	4.34
14	-0.09
Total	197.62

Table 6.5. The NPV values of different actions. (Calculated by the author). Retrieved from: Wu Dan. Cost-benefit analysis of air quality management. (n.d.)

6.4.3 CBA Evaluation Criteria

To evaluate a single plan, NPV>= 0; for multiple plans, the larger the NPV, the better. In all subprojects, the income situation of roads, landscape bridges and urban furniture is loss-making in the 5-year period, and other incomes are positive, especially hydropower stations, landscape vegetation, landscape plazas, artificial wetlands, and wind farms, and the total NPV. The comprehensive income is 197.62, and the comprehensive income far exceeds the loss. Therefore, the Xiangjiang Riverbank Resilient Improvement Project is feasible within a 5-year period.

7. CONCLUSION

From the perspective of dealing with floods, this project uses landscape ecology and ecological principles to take the Xiangtan section of the Xiangjiang River as the site for this design. From the macro to the micro, its design has undergone roughly three evolutionary processes.

First, the background of the project and the impact of the flood on the Xiangjiang River were analyzed in the super-large-scale Yangtze River Basin. Then, the profile of the upper, middle and lower reaches of the Xiangjiang River and the inundation conditions in the dry and rainy seasons were analyzed in the large-scale Xiangjiang River Basin, and the overall strategy was obtained: The upper reaches need afforestation to maintain water and soil, the lower reaches need to return farmland to lakes, dredging and strengthening dikes, and the middle reaches need new water conservancy projects, adding green infrastructure and buffer zones.

Then, we focused on the midstream, a challenging and changeable venue. In the medium-scale Xiangtan section of the Xiangjiang River, this paper analyzes the hydrology, traffic, climate, vegetation, and other factors of the site, and finds that there are three major challenges facing the site. First, the huge change in water level during the dry and rainy seasons makes the ecology of the riverbank very fragile and cannot form Effective measures to deal with floods. Second, due to the accumulation of sediment, the carrying capacity of the river channel becomes very weak, and the excess flood cannot be diverted to a safe place. Third, the riverbank lacks early warning devices and shelters. When a flood of 100-year level or above comes, riverside residents cannot evacuate safely.

To this end, this paper proposes corresponding interventions to address these challenges. First, the resilient landscape construction of the riverbank is improved, and plants with strong stress resistance and related artificial devices are selected to reduce the ecological impact of the perennial water level instability on the site. A variety of plants are planted in different areas divided by the waterline, and a series of public spaces are designed with the waterline as a multi-dimensional design to minimize interference with the daily leisure activities of citizens. In addition, build a small dam on the upstream and downstream of the 'U'-shaped inland river to regulate the flood in the dry and rainy seasons. There are dozens of lakes, ponds, or wetlands on the left bank of the river. These water bodies pass through the newly built the ecological channel is connected to the inland river to adjust the water level inside and outside the river. During the rainy season, excess floodwater will be discharged into the wetland and irrigation system to reduce the pressure on the river. Finally, landscape plazas of different sizes and specifications are distributed along the river, providing leisure and entertainment places for residents, and serving as emergency shelters during flood seasons. The combination of the brand-new wind power installation and the water level warning light ensures the harmony of the landscape and raises people's vigilance to the coming flood.

Finally, the proposal is made to create spaces that having their own purpose and identity, it can also help to reduce the possible impacts of floodings in those areas. It will not be used for other purposes in the future (such as illegal settlements and high-risk agricultural uses).

In addition, since this design only stays at the theoretical stage and involves many fields like planting design, ecology, engineering practice, mechanical Design and so on, it is inevitable that the proposal is incomplete, and it needs further research. It is hoped that this proposal can provide some reference and guidance for the construction of urban waterfront parks in the future.

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