

Designing Urban Wetland Parks in China

Towards Guidelines for
Integrating Ecological
Concerns and Open Space
Use



Ph.D. Thesis



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Abstract

Urban wetlands can provide important contributions to the city population, including local climate regulation, recreation, and habitat protection. Along these lines, the Chinese Urban Wetland Park (UWP) initiative of the Sponge City Program aims to address urban environmental challenges and enhance living conditions. While the UWP initiative has been in place since 2005, little scientific understanding exists so far regarding currently employed design guidelines and their effectiveness to address concerns of ecology and open space use.

The objective of this thesis is to develop a framework of integrated design guidelines for UWPs in China, which combine concerns of ecology and open space use. The thesis focuses on three issues: (1) What are the key characteristics and design challenges of UWPs in different urban contexts? (2) What integrated design guidelines can be proposed that combine concerns of ecology and open space use in UWPs? (3) Which benefits do selected UWP design guidelines yield on concerns of ecology and open space use in practice, exemplified in six Chinese case studies?

The research design follows a three-step approach: first, a literature review to identify key design challenges for UWP; second, a development of a framework of design strategies and measures, based on document analyses and a review of 22 illustrative case studies of integrated UWP designs from Germany, the US, and China; third, an in-depth analysis of six Chinese case studies to investigate the benefits of design measures which address concerns of ecology and open space use.

Thirteen key design challenges for UWPs in China were identified, such as increasing habitat connectivity, controlling water pollution, and maintaining biodiversity. The developed framework of design strategies includes 17 design strategies and 57 individual design measures. The in-depth case study analysis revealed key benefits of selected design strategies, for example some of the benefits of open space use, including increasing the number of natural features, supporting recreational activities and events and improving access to open space, and some of the ecological benefits of increasing biodiversity and stormwater retention.

These findings enhance the knowledge of Chinese UWP functioning and design options, but more case study research is needed to test the applicability of our findings. A few recommendations can be made for design practitioners: Existing UWPs should be continuously monitored using a standard evaluation scheme like the one proposed in this research to identify shortcomings and opportunities for management improvement. Future UWP design could benefit from the successful design strategies and measures proposed here, for example connecting biotopes with open space systems to enhance UWPs' design quality and capacities to provide benefits for both people and nature, simultaneously.

Keywords: design guidelines, open space use, ecological concerns, urban wetland parks, China

Zusammenfassung

Urbane Feuchtgebiete können erheblich zur Verbesserung der Lebensqualität der Stadtbevölkerung beitragen, unter anderem durch die lokale Klimaregulierung, den Erholungswert und den Schutz von Lebensräumen. In diesem Sinne zielt die Initiative Chinese Urban Wetland Park (UWP) des Sponge City Programms darauf ab, die Herausforderungen der städtischen Umwelt anzugehen und die Lebensbedingungen zu verbessern. Während die UWP-Initiative bereits seit 2005 umgesetzt wird, fehlen bislang wissenschaftliche Auswertungen der derzeit angewandten Gestaltungsstrategien und deren Wirksamkeit in Hinblick auf die Berücksichtigung von Belangen der Ökologie und Freiraumnutzung.

Das Ziel dieser Arbeit ist es, einen Rahmen für integrierte Gestaltungsstrategien für UWPs in China zu entwickeln und die Belange der Ökologie mit solchen der Freiraumnutzung zu verbinden. Diese Studie konzentriert sich auf drei Fragen: Was sind die wichtigsten Merkmale und gestalterischen Herausforderungen von UWPs in verschiedenen städtischen Kontexten? Welche integrierten Gestaltungsstrategien können vorgeschlagen werden, die die Belange von Ökologie und Freiraumnutzung in UWPs kombinieren? Welchen Nutzen haben ausgewählte UWP-Gestaltungsstrategien in Bezug auf Ökologie und Freiraumnutzung in der Praxis, die an sechs chinesischen Fallstudien untersucht werden?

Das Forschungsdesign verfolgt einen dreistufigen Ansatz: erstens, die Literaturrecherche zur Identifizierung der wichtigsten Gestaltungsherausforderungen für UWPs. Zweitens, die Entwicklung eines Rahmens für Gestaltungsstrategien und-maßnahmen, basierend auf der Analyse von Dokumenten und einer Bewertung von 22 illustrativen Fallstudien zu integrierten UWP-Gestaltungen in Deutschland, den USA und China. Drittens, eine eingehende Analyse von sechs chinesischen Fallstudien, um die Vorteile von solchen Gestaltungsstrategien zu untersuchen, die sich mit Fragen der Ökologie und der Freiraumnutzung befassen.

Es werden 13 zentrale Gestaltungsherausforderungen für UWPs in China identifiziert, wie z. B. die Verbesserung der Biotopvernetzung, die Kontrolle der Wasserverschmutzung und die Erhaltung der Biodiversität. Anschließend

wird ein strategischer Rahmen entwickelt, der 17 Gestaltungsstrategien und 57 Gestaltungsmaßnahmen umfasst. Abschließend werden die Vorteile ausgewählter Gestaltungsstrategien in Bezug auf ökologische und Freiraumnutzungsfragen untersucht.

Die Ergebnisse erweitern die Wissensbasis über die Funktionsweise und Gestaltungsmöglichkeiten der chinesischen UWP erfolgreich, aber es sind weitere Fallstudien erforderlich, um die Anwendbarkeit der Resultate zu testen.

Es können folgende Empfehlungen für die Gestaltungspraxis gegeben werden: Bestehende UWPs sollten kontinuierlich anhand eines Standardbewertungsschemas wie dem in dieser Studie vorgeschlagenen überwacht werden, um Mängel und Verbesserungsmöglichkeiten für das Management zu identifizieren. Eine künftige UWP-Gestaltung kann aus den hier vorgeschlagenen erfolgreichen Gestaltungsstrategien und-maßnahmen lernen, z. B. ein Biotop mit Freiraumsystemen zu verbinden, um die Gestaltungsqualität der UWPs und ihre Fähigkeit, gleichzeitig Nutzen für Mensch und Natur zu bringen, zu verbessern.

Schlagworte: Gestaltungsstrategien, Freiraumnutzung, ökologische Belange, Urban Wetland Parks, China

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List of Abbreviations

| | |
|--------|--|
| IPBES | Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services |
| MEA | Millennium Ecosystem Assessment |
| MOHURD | Ministry of Housing and Urban-Rural Development |
| NBSA | National Bureau of Statistics of China |
| NWI | National Wetland Inventory |
| RS | Ramsar Secretariat |
| SC | State Council |
| SFA | State Forestry Administration |
| USFWS | the United States Fish and Wildlife Service |
| UWP | Urban Wetland Park |

Chapter 1 Introduction

This chapter introduces the concept of urban wetland parks and describes the context of existing UWP research by introducing the research background, problem statements, research aims, and research questions. It also gives a brief outline of the main structure of this dissertation.

1.1 Research background

1.1.1 General issue addressed

Urban wetlands have received increasing attention around the world due to their ability to deliver a range of ecosystem services for people and nature (Gardner & Finlayson, 2018; IPBES, 2018; Ramsar Secretariat, 2012b; Russi et al., 2013), such as reducing floods, replenishing drinking water, improving water quality, improving urban air quality, and promoting human well-being. Nevertheless, the benefits of urban wetlands to nature and to people remain underestimated (Gardner & Finlayson, 2018). It is a global challenge to scientifically plan and design urban wetlands to achieve an eco-systematic development that balances urban needs and ecological concerns.

As China's urbanisation process is taking place at an unprecedented rate, the above challenge is particularly intense in this country. China's urban wetland conservation and sustainable use have met many challenges in the context of rapid urbanization and industrialization. Among these challenges, one prominent problem regards the transition from wetlands to urban areas (He et al., 2014; Millennium Ecosystem Assessment, 2005; Niu et al., 2009). For example, from 1990 to 2010, China lost 2,883 km² of wetlands due to urban expansion (Mao et al., 2018). The transition from wetlands to urban areas is absolutely irreversible compared to the development of agricultural and aquatic land. Although China has made efforts to protect wetlands and to deal with ecological problems caused by urbanization, the rate of wetland loss caused by urbanization continues to increase. In addition, considering the unparalleled growth of China's urbanization rate, from 19.36% in 1980 (World Bank Group, 2019) to 58.52% in 2017 (National Bureau of Statistics of China, 2018), and given the country's plans for future economic development and population growth, the scientific design of urban wetland ecosystems is critical to the sustainable use of urban wetlands in China.

Nationwide design practices in China constitute the development of urban wetland parks (UWPs), which form part of the Sponge City programme (State Council[SC], 2015a) and are being utilised within the context of an urban water crisis and rapid urbanisation. They have been proposed in response to calls to strengthen the construction of an ecological civilization proposed by the 18th National Congress of the Communist Party of China in 2012 (SC, 2015b). In addition to ecological aspects, a strong top-down decision-making process and the collective ownership of land have enabled urban park strategies such as UWPs to be intentionally promoted to increase local governments' land sales

revenue across China (Wang, 2018). Therefore, although the idea of UWPs has only recently surfaced in Chinese urban design discourse, the number of implemented UWPs has increased rapidly, engendering new opportunities and challenges in the field of landscape planning and design. The study of UWPs may provide reference and inspiration not only for China's future UWP design, but also for countries and regions that want to emulate China's achievements, given its growing international influence.

1.1.2 Problem statement

Recent work pertaining to UWPs has shown that they are gradually attracting attention in examination of spatial distribution characteristics (Fan & Wang, 2016; Guo et al., 2018; Pan & Zhang, 2014), case-study design analysis, post-construction assessment (Bai, Yu, Zhang, Dong, & Lin, 2018), and ecosystem services evaluation (Duan et al., 2011; Sun, Xiang, Tao, Tong, & Che, 2019; Wang et al., 2019). From a broader perspective, scholars from various disciplines have examined ecology and open space use in urban wetland areas. Researchers of ecological issues in wetland systems focus on the ecological structure and functions of wetlands (Ávila, Garfí, & García, 2013; Jenkins, Greenway, & Polson, 2012; Juang & Chen, 2007; Krompart, Cockburn, & Villard, 2018; Merriman & Hunt III, 2014; White, 2013; Wiseman, Rutt, & Edwards, 2004; Yan et al., 2018), while researchers of open space use emphasise users' preferences and activities (Faccioli, Font, & Figuerola, 2015; Nassauer, 2004; Pueyo-Ros, Ribas, & Fraguell, 2016; Rooney et al., 2015; Syme, Fenton, & Coakes, 2001; Wang, Nassauer, Marans, & Brown, 2012; Westerberg, Lifran, & Olsen, 2010). However, research combining the study of both these two important aspects of urban areas is still lacking. Unlike that of natural wetland reserves, the ecological value possible for UWPs may be limited. Due to the increasing influence of urban development and population growth, urban wetlands may never return to the state of natural wetlands (Ravit et al., 2017; Rooney et al., 2015). However, we must note the great potential of urban wetlands to achieve public open space use. Providing better access and understanding of nature for urban residents, especially children, will better promote future wetland conservation and education.

Although the UWP initiative by the Chinese government was first implemented in 2005, little scientific understanding exists regarding contemporary design strategies and their effectiveness in addressing the concerns of ecology and open space use. Certain basic problems remain, such as the rich findings of ecological science that have still not been fully applied in landscape practice (Musacchio, 2009; Nassauer & Opdam, 2008; Wang, 2018). In a Chinese context, this gap is particularly serious because the country's pace of urbanisation is unprecedented. In particular, some commentators on UWPs have identified a

common shortcoming: “no ecological planning/design” (Wang, 2018, p.31; Wu, Xiang, & Zhao, 2014, p.231).

Additionally, existing UWP research often emphasises the use and effectiveness of a park after it has been completed (Bai, Yu, Zhang, Dong, & Lin, 2018), but research on specific design methods and strategies for building better UWPs in the future is lacking. Therefore, existing theory is not sufficiently comprehensive to summarise the relevant experiences and lessons of wetland park practice, and thus cannot effectively guide urban wetland design.

1.2 Research aims and questions

This study aims to develop a framework of integrated design guidelines for UWPs in China, combining concerns of ecology and open space use. From a research perspective, this study is important because it helps to enhance the knowledge base regarding Chinese UWP functions and design choices. Second, from a design perspective, such research is necessary because the knowledge and tools developed by the academic community can help designers to better protect and develop urban wetlands under urban conditions. Third, empirical knowledge about the application of UWP in design can help to determine which strategies or measures can help to promote multi-purpose urban wetlands. This knowledge is instructive for designers in different cities.

According to the problem statement and aim above, three research questions are formulated:

- (1) What are the key characteristics and design challenges of UWPs in different urban contexts?
- (2) What integrated design guidelines can be proposed that combine the concerns of ecology and open space use in UWPs?
- (3) What benefits do selected UWP design guidelines yield on concerns of ecology and open space use in practice, as exemplified in six Chinese case studies?

1.3 Outline of thesis

This dissertation is divided into three main parts (see Figure 1.1).

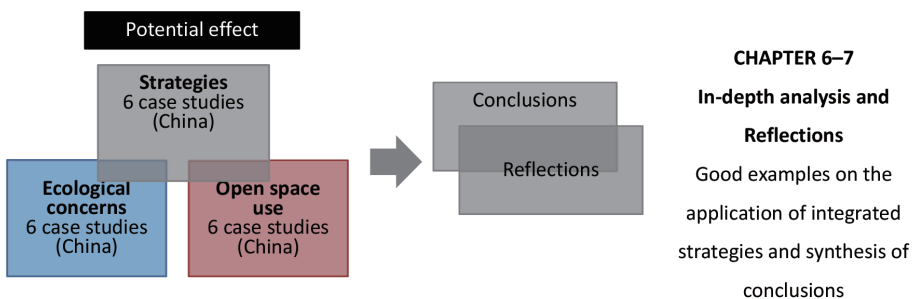
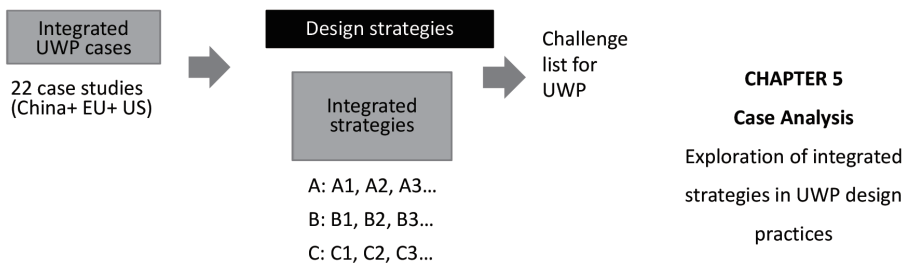
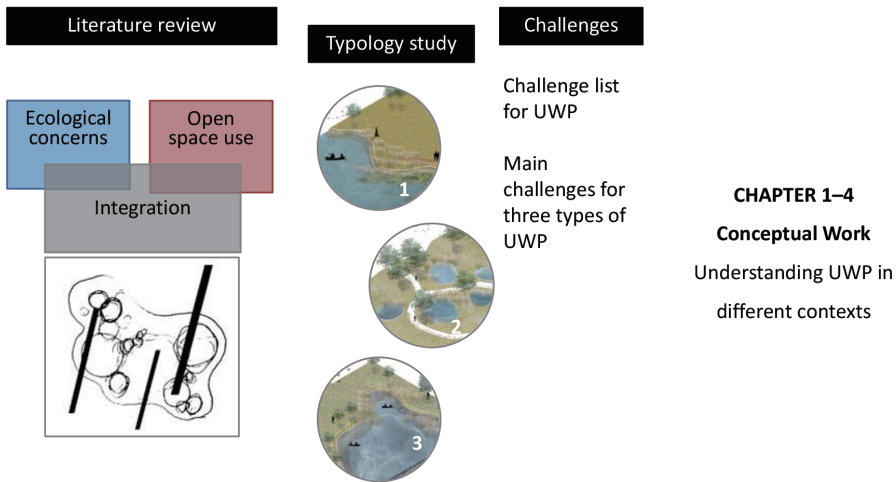


Figure 1.1 Structure of the dissertation.

The first part consists of the first four chapters, used to understand UWP in different environments through literature review. Chapter 2 explains the relevant definitions and key aspects related to UWPs. Chapter 3 presents an account of the research methodology. Chapter 4 addresses the first research question, giving an overview of the characteristics of the three UWP types and the challenges of UWPs in different contexts.

Beginning the second part, Chapter 5 addresses the second research question, focusing on the design strategies and measures used in exemplary cases. From the 22 integrated cases selected, it summarizes a framework of design guidelines that includes design strategies and measures. This framework is then linked to the UWP challenges listed in Chapter 4 to analyse the possibilities of the selected design strategies in addressing those challenges.

The third part includes Chapters 6 and 7, comprising an in-depth analysis and reflection on the application of the selected design measures in six Chinese case studies. Chapter 6 analyses these six cases through field research combined with secondary data. First, it evaluates the benefits of parks in terms of concerns of ecology and open space use, and then it evaluates the relationship between the benefits and the design measures used. Chapter 7 details and discusses the study's conclusions, and it explains the limitations of the study and its future prospects.

Chapter 2 Overview of urban wetland parks design and research

This chapter expands on a review of the theoretical framework of UWP-related ecological considerations and the use of public space. It explains the relevant definitions and key aspects related to UWPs and explores UWP-related key ecological considerations and open space use.

2.1 Concepts related to UWPs

2.1.1 Wetlands and urban wetlands

As defined by the Ramsar Secretariat (RS),

Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six meters. (Ramsar Secretariat, 2016, p.9)

Urban wetlands are those wetlands lying within the boundaries of cities, towns and other conurbations and that 'peri-urban wetlands' are those wetlands located adjacent to an urban area between the suburbs and rural areas; they include rivers and their floodplains, lakes, swamps as well as salt marshes, mangroves, and coral reefs. (Ramsar Secretariat, 2008, p.1, 2018b, p.1)

According to these definitions, urban wetlands are natural, semi-natural, or artificial land-sea transitional ecosystems that are distributed within the urban planning area and are part of the urban ecosystem.

2.1.2 Wetland parks and urban wetland parks

Among the various definitions proposed for wetland parks and urban wetland parks, the two most prominent ones are from the State Forestry Administration of China (SFA) and Ministry of Housing and Urban-Rural Development of China (MOHURD). According to the SFA,

A wetland park is a specific area for the purpose of protecting wetland ecosystems and rationally utilizing wetland resources, as well as for wetland protection and restoration, publicity, education, scientific research, wetland monitoring, and ecotourism. (State Forestry Administration [SFA], 2010, No.2)

A national-level wetland park refers to a specific area approved by the State Forestry Administration of China and managed in accordance with relevant regulations to protect wetland ecosystems, rational use wetland resources, and conduct wetland publicity and education, and scientific research. (SFA, 2017, No.2)

According to the MOHURD,

An urban wetland park is a park within the urban green space planning area for the purpose of protecting urban wetlands, with the functions of science education, scientific research and leisure tourism. (MOHURD, 2017a, No.2)

A national-level urban wetland park refers to a wetland park that meets the following three requirements: (1) It is located within the scope of urban planning and conforms to the urban wetland resource protection development plan. The land use rights are not disputed, and the scope of the green line has been delineated and disclosed as required. (2) It has a typical wetland ecosystem or main ecological function; or the wetland biodiversity is rich; or the wetland biological species are unique; or the wetland faces threats such as shrinking area, functional degradation, and biodiversity loss, and requires the urgency of protection. (3) The wetland area accounts for more than 50% of the total park area. (MOHURD, 2017a, No.6)

Both definitions share the notions that wetland parks address multifunctional use by reasonably protecting and utilizing wetland resources. However, the SFA definition employs a broader notion of the protection, management, and restoration of wetland resource, while the MOHURD definition focuses more on the wetland protection, management, and restoration in urban green spaces. In addition, the MOHURD seems to connect more ambitious social innovation goals with UWP, such as their potential applications in ‘fully meeting the social benefits of wetlands, fostering citizen well-being such as their leisure and recreation needs’ (MOHURD, 2017a).

In defining wetland parks, adding to the government guidelines, many scholars have mentioned that wetland landscapes occupy the main portion of these parklands (Cheng, Zhang, Zhang, & Dai, 2012; Cui & Qian, 2003) and significantly exhibit the characteristics of wetland ecology (Cheng et al., 2012; Wang, Lu, Tang, & Wang, 2010). Based on these definitions, for application in landscape architecture and design research, we define a UWP in this thesis as a multifunctional park within an urban area that has natural or constructed wetlands as its dominant landscape.

2.2 Key ecological aspects for UWPs

The previous section discussed concepts and definitions related to UWPs. Now, we turn to synthesize attributes related to the ecological aspects of UWPs.

Based on the key ecological attributes of success in the literature reviews provided by Ruiz-Jaen and Aide (2005) and by Wortley, Hero and Howes (2013), this section also adds research on ecological contribution of constructed wetlands (Ghermandi, Van Den Bergh, Brander, de Groot, & Nunes, 2010). Finally, the important criteria for the ecological characteristics and ecological functions of urban wetland parks are summarized across four aspects (see Table 2.1): biodiversity considerations, improving water quality or soil quality, storm water retention, and provision of natural habitat.

Biodiversity considerations

Understanding the characteristics of wetland habitats can play an important role in wetland restoration and planning to promote biodiversity (Platteeuw, Foppen, & van Eerden, 2010; Ruiz Bruce Taylor, Rangel Salazar, Enriquez, Leon-Cortes, & Garcia-Estrada, 2017). For example, studies have found that, regardless of type, larger wetlands with shallower waters tend to exhibit more biodiversity (Giosa, Mammides, & Zotos, 2018), and larger restoration wetlands projects or restoration projects located between existing wetlands are often more successful than smaller ones (Breux et al., 2005). Consequently, facilities exist that can be used to enhance biodiversity: restore or create at least larger ponds to protect a wide range of open waters in wetlands (Paracuellos, 2006), and protect appropriate arboreal microhabitats for specific amphibians (do Vale, Torres, Gomes, Fonseca, & Ferreira, 2018). In addition, appropriate management can reduce the negative impact of human activities on water bird habitats (Lehikoinen, Lehikoinen, Mikkola-Roos, & Jaatinen, 2017).

Improving water quality or soil quality & storm water retention

The value of wetlands, especially constructed wetlands, in improving water quality and flood storage has received wide attention. For example, many scholars have studied the functions of pollutant removal by wetlands (Wiseman, Rutt, & Edwards, 2004), purifying water (Juang & Chen, 2007; Mitchell, Chick, & Raisin, 1995; Smith, 2009; White, 2013), reusing sewage (Ávila, Garfí, & García, 2013), and reusing rainwater and controlling flooding (Ghermandi et al., 2010; Jenkins, Greenway, & Polson, 2012).

Provision of natural habitat

Urban wetlands connect other green spaces and act as 'stepping stones' to promote the movement of species in the landscape (Hassall, 2014). Scientists have found that well-managed reservoirs may provide an important breeding ground for maintaining certain waterfowl populations (Breininger & Smith, 1990), with dabbling and diving water birds being more widely distributed in large ponds and open waters (Paracuellos, 2006). In addition, insects in wetlands concentrate in and along stands of emergent macrophytes during the day, while at night

they are mainly in open water near the surface (King & Wrubleski, 1998). Fish populations are also found to use the wetlands of various waters, and reduction in flooding frequency reduces fish diversity (King & Wrubleski, 1998).

Table 2.1 Key ecological attributes related to UWPs

| Key ecological attributes | Related ecological attributes | Source |
|---|---|---|
| Consideration of biodiversity | • Diversity and abundance | Breaux et al., 2005; do Vale, Torres, Gomes, Fonseca, & Ferreira, 2018; Giosa, Mammides, & Zotos, 2018; Lehtikoinen, Lehtikoinen, Mikkola-Roos, & Jaatinen, 2017; Paracuellos, 2006; Platteeuw, Foppen, & van Eerden, 2010; Ruiz Bruce Taylor, Rangel Salazar, Enriquez, Leon-Cortes, & Garcia-Estrada, 2017. |
| Improving water quality or soil quality storm water retention | • Ecological functioning | Ávila, Garfí, & García, 2013; Ghermandi et al., 2010; Jenkins, Greenway, & Polson, 2012; Juang & Chen, 2007; Mitchell, Chick, & Raisin, 1995; Smith, 2009; White, 2013; Wiseman, Rutt, & Edwards, 2004. |
| Provision of natural habitat | • Vegetation structure and reservoir size | Breiningger & Smith, 1990; Hassall, 2014; King & Wrubleski, 1998; Paracuellos, 2006. |

2.3 Key aspects of open space use for UWPs

The previous section in this chapter has discussed the ecological concerns related to UWPs. In this section, we look at urban parks and open space use issues, and we synthesize the physical attributes of urban parks associated with open space use.

This section conducts a literature analysis investigating the characteristics of urban parks that affect open space use. The reviewed literature mostly relates to open space use and park use (recent reviews are provided by McCormack, Rock, Toohey, & Hignell, 2010; Van Hecke, Ghekiere, Veitch, et al., 2018), but we also included studies rooted in factors related to park attributes and park visitation or park-based physical activities. Furthermore, relevant works from the fields of environmental psychology and health research were considered.

The review started with a systematic search of relevant key terms in peer-reviewed papers referenced in the Web of Science, Scopus, and was subsequently further expanded. Search key terms were 'Open space use' OR 'Urban park use' AND 'Urban park' OR 'wetland' AND 'benefits' OR 'effect'. The selection criteria for empirical studies were the following: studies had to (1) address open space use issue; (2) be written in English; and (3) be published since the year 2000.

The relevant public-open-space characteristics from the included articles were extracted and categorized, according to a conceptual framework given by Bedimo-Rung, Mowen, and Cohen, 2005 (p. 163), into five groups: features (facilities or amenities, nature features, and programs), conditions (maintenance and upkeep), aesthetics (attractiveness and appeal), safety (personal security and fear), and access (accessibility). These categories (see Table 2.2) are also used in reviews by McCormack et al. (2010), on the characteristics of urban parks associated with park use and physical activity, and by Van Hecke et al., on open space characteristics influencing adolescents' use and physical activity (Van Hecke, Ghekiere, Veitch, et al., 2018).

Features (facilities and amenities, nature features, programs)

Park features that affect the open space use consist of facilities, nature features, and programs. Among them, facilities refer to physical facilities that visitors can use, such as sports fields, picnic tables, or lighting. The provision and distribution of adequate and varied facilities has an important role in promoting the use of public spaces (Chen, Liu, & Liu, 2016; Wan and Shen, 2015). In addition to the sport fields (Mertens, Van Cauwenberg, Veitch, Deforche, & Van Dyck, 2019; Van Hecke, Ghekiere, Van Cauwenberg, et al., 2018), facilities that support open space use also include playgrounds (Mertens et al., 2019; Van Hecke, Ghekiere, Van Cauwenberg, et al., 2018); walking paths and trails (Reed and Hooker, 2012; Van Hecke et al., 2017; Veitch et al., 2017); supporting amenities (e.g., swings, barbecue equipment) (Baran et al., 2014; Holman, Donovan, & Corti, 1996); and universal design with barrier-free concepts (Subramanian and Jana, 2018). Nature features (such as trees, plants, water features) are identified as supporting open space use. For example, tree presence and water features have been discussed in their relation to the popularity of open spaces (Baran et al., 2014; Reed and Hooker, 2012). Programs in this category include recreational programs or organized events in a park environment. They can be regular educational courses, such as children's educational visits organized by schools, or one-off activities, such as concerts and competitions (Bedimo-Rung et al., 2005).

Condition (maintenance and upkeep)

Park upkeep is considered to be the most important prerequisite for park visitation in two studies (Mertens et al., 2019; Van Hecke, Ghekiere, Van Cauwenberg, et al., 2018). Park users are more likely to visit parks where the features are regularly maintained and avoid places that contain disrepair elements. For example, parks with well-maintained and clean environments and high-quality equipment were perceived positively by the adolescents for park visitation (Henderson et al., 2001; Rehrer et al., 2011). Consequently, lack of maintenance is often considered a problem that affects the use of parks, such as uneven ground or play-

ing fields, lack of grass, and low-quality sidewalks (McCormack et al., 2010).

Aesthetics (attractiveness and appeal)

Many studies have mentioned that the aesthetics category is important for open space use. This category combines perceived attractiveness with appealing design elements. When visiting the park, having some beautiful or attractive things to look at can be an impetus for physical activity (Bedimo-Rung et al., 2005). For example, beautiful scenes with nature and green space (i.e. lots of trees, river, attractive plants) and diverse habitats around trails encourages public open space visitation (Derr, Rupp, & Wagner, 2016; Derr & Tarantini, 2016; Rehrer et al., 2011; Van Hecke et al., 2016).

Additionally, open space characteristics such as historical elements (e.g., old buildings or traditional status) which can illustrate the historical background of the city (Van Hecke et al., 2016), or water features (such as ponds, fountains or rivers), which provide opportunities to interact with water were also perceived positively by adolescents for public open space visits (Derr & Tarantini, 2016).

Safety (personal security and fear)

Safety here refers to the personal safety of park users and is an important condition for the use of parks (Bedimo-Rung et al., 2005). Many studies have shown that the physical space characteristics of parks or other public spaces can affect people's perceptions of public space security. Specific park attributes related to safety from crime and injury include the presence of lighting (Cutt, Giles-Corti, Wood, Knuiman, & Burke, 2008; Tucker, Gilliland, & Irwin, 2007), safe facilities, soft or grassy ground, the presence of law enforcement (Yen, Scherzer, Cubbin, Gonzalez, & Winkleby, 2007), and increased surveillance (Henderson et al., 2001). However, attributes such as insufficient lighting, poor maintenance of facilities, excessive traffic near the open space, and the presence of hidden areas or paths have a negative impact on people's sense of security (McCormack et al., 2010; Van Hecke et al., 2016). In addition, certain features of the adjacent environment (such as well-tended lawns or gardens) are interpreted as a sign of care, making the area appear safer and encouraging visitation (Bedimo-Rung et al., 2005). Careful design and management for urban woodland vegetation is perceived as both safe and attractive; low density in the vegetation or undergrowth, in particular, is seen as a key component for increased perceived personal safety (Jansson, Fors, Lindgren, & Wiström, 2013).

Access (accessibility)

Access denotes the ability of people to get to and navigate a park (Bedimo-Rung et al., 2005). Most of the findings related to access and park use are related to park proximity. For example, studies have shown that park proximity and travel

time to the park are important factors influencing users' access (Wang, Brown, Zhong, Liu, & Mateo-Babiano, 2015). In general, having more local parks within walking distance is positively correlated with park use and the necessity of driving to parks discourages park use (Griffin, Wilson, Wilcox, Buck, & Ainsworth, 2008; Henderson et al., 2001).

In addition, good access to public transportation, with parks located near other destinations (such as schools, shops, downtown, or friends) or located along daily walking routes, is also considered to be a promoter of open space use. For example, scholars have found that park playgrounds on regularly walked routes (i.e., on the route to and from schools) are used more frequently than those located elsewhere (Ferré, Guitart, & Ferret, 2006).

Table 2.2 Evidence of park characteristics that support open space use

| Park characteristics categories | Park characteristic that supports open space use | Source | | |
|---------------------------------|--|--|---|--|
| Features | • Facilities | • Sport activity zones or exercise facilities | Mertens et al., 2019; Van Hecke, Ghekiere, Van Cauwenberg, et al., 2018 | |
| | | • Playgrounds | | |
| | | • Walking paths and trails | | Reed and Hooker, 2012; Van Hecke et al., 2017; Veitch et al., 2017 |
| | | • Provision and distribution of a sufficient number and variety of facilities. | | Chen et al., 2016; Wan & Shen, 2015 |
| | | • Supporting amenities (e.g., swings, barbecue equipment, shade) | | Baran et al., 2014; Holman et al., 1996; Tucker et al., 2007 |
| | • Natural features | • Universal design with barrier-free | Subramanian & Jana, 2018 | |
| | | • Presence of trees | Fermino, Reis, Hallal, & de Farias Júnior, 2013 | |
| | | • Naturalness | Wan & Shen, 2015 | |
| | | • Trees (attributes such as creating shade, with canopy and large leaves) | Hami & Maruthaveeran, 2018 | |
| | | • Water features and attractions | Baran et al., 2014; Reed & Hooker, 2012; Tucker et al., 2007 | |
| Programs | • Educational visits | Bedimo-Rung et al., 2005 | | |
| | • Events | | | |
| | • Park upkeep was the most important park characteristic for park visitation | | | |
| Condition | • Regular park upkeep | Mertens et al., 2019; Van Hecke, Ghekiere, Veitch, et al., 2018 | | |
| | • Good and up-graded equipment | Henderson et al., 2001; Rehrer et al., 2011 | | |
| | • Cleanliness | Rehrer et al., 2011; Tucker et al., 2007 | | |

| | | | |
|------------|---|--|--|
| Aesthetics | <ul style="list-style-type: none"> Beautiful scenery | <ul style="list-style-type: none"> Beautiful scenery with nature and greenery (i.e., many trees, river, attractive plants) and diverse habitat around trails | Derr et al., 2016; Derr & Tarantini, 2016; Rehner et al., 2011; Van Hecke et al., 2016 |
| | <ul style="list-style-type: none"> Historical elements | <ul style="list-style-type: none"> Historical elements and statues were perceived as attractive | Derr & Tarantini, 2016; Van Hecke et al., 2016 |
| Safety | <ul style="list-style-type: none"> Existence of safety supervision | <ul style="list-style-type: none"> More police presence might enhance use, as the parks would be safer | Yen et al., 2007) (Henderson et al., 2001 |
| | <ul style="list-style-type: none"> Presence of lighting | <ul style="list-style-type: none"> Sufficient lighting in the parks would help prevent the behaviours resulting in unsanitary and dangerous debris | Cutt et al., 2008; Tucker et al., 2007 |
| | <ul style="list-style-type: none"> Well maintained plants | <ul style="list-style-type: none"> Careful design and management of urban woodland vegetation | Bedimo-Rung et al., 2005; Jansson et al., 2013 |
| | <ul style="list-style-type: none"> Low density undergrowth | <ul style="list-style-type: none"> Possibilities for overview and control | Jansson et al., 2013 |
| Access | <ul style="list-style-type: none"> Park proximity | <ul style="list-style-type: none"> Having more local parks within walking distance Accessibility by foot or bike and public transport Accessibility by public transport | McCormack et al., 2010; Van Hecke et al., 2016 |
| | <ul style="list-style-type: none"> Conveniently located | <ul style="list-style-type: none"> Located along daily walking routes Located close to other destinations such as schools, shops, and the city centre | Ferré et al., 2006 Van Hecke et al., 2016 |

2.4 Summary

As important parts of urban ecosystems and public spaces, UWPs perform a special role and have immense value, as compared with other landscape types. Compared with general urban parks or waterscape parks in public open space systems, UWPs highlight ecological values: supporting biodiversity, providing large-scale wet ecosystem habitats, and linking other urban ecological patches; compared with natural wetlands and wetland reserves, UWPs have limited ecological value, but they have great potential to provide social and cultural value in addition to a certain degree of ecological function: for example, providing large areas of open space for local residents and tourists supporting exercise, recreation and science education. In short, UWPs have both the wetland system and the park system, and they are limited to urban areas. This chapter reviews these two dimensions of research and explores UWP-related key ecological considerations and the use of public space. The information in this section provides a basis for the assessment of selected design guidelines in the case studies of Chapter 6.

Chapter 3 Research methods

This chapter presents an account of the research methodology. It begins by looking briefly at the three-step research design of this dissertation. It then goes on to the methods for each research question, which include literature and document analysis, case studies and in-depth case studies.

3.1 Research design

To address our research question, we developed a mixed-methods research design consisting of three steps: identifying key UWP design challenges, developing a framework of integrated design guidelines, and assessing the effects of selected UWP design measures and measures on concerns of ecology and open space use in six Chinese case studies (see Figure 3.1).

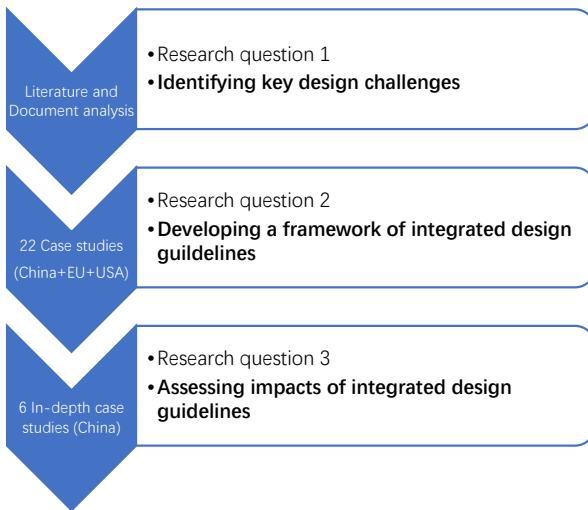


Figure 3.1 Three-step research design.

3.2 Methods for Chapter 4: Literature and document analysis

Chapter 4 begins by looking briefly at typology research concerning wetlands and criteria for UWP classification, identifying and focusing on three types of UWP. It then goes on to consider the challenges of UWP design in China. The identification of key UWP characteristics and design challenges is based on literature and document analysis.

3.2.1 Identifying key characteristics

First, we develop a typology of UWPs in China, primarily based on their respective wetland characteristics and landscape elements. Our typology draws on the classification process of the National Wetlands Inventory (NWI) (Cowardin,

Carter, Golet, & LaRoe, 1979) and the approach proposed by Semeniuk and Semeniuk (1995).

3.2.2 Identifying key design challenges

For each of the types of UWPs identified, we explored specific challenges by drawing on relevant literature concerning challenges and recommendations for urban wetland design. Key publications considered include the seminal Urban Planet study (Elmqvist et al., 2018) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) Global Assessment on Biodiversity and Ecosystem Services (IPBES, 2019). Further design challenges are synthesised from a series of studies related to the Ramsar Convention, such as the Global Wetland Outlook (Gardner & Finlayson, 2018), Wetland and Sustainable Development Goals (Ramsar Secretariat, 2018a), and Principles for the Planning and Management of Urban and Peri-urban Wetlands (Ramsar Secretariat, 2012b), as well as the latest Chinese government policy documents on UWPs formulated by the Ministry of Housing and Urban–Rural Development (MOHURD, 2017a, 2017b).

3.3 Methods for Chapter 5: Case studies

This chapter begins by investigating the examples of best practices of urban wetland parks in China, Germany, and the United States. It then considers their design strategies and measures based on three types that are presented in the previous chapter. Finally, a collection of various design strategies is identified and presented in a systematic structure. This structure categorizes the design strategies and measures into three UWP types in which they are applied. Within each type, the measures are subordinated in groups of design strategies. This summary may inspire new design ideas in future research.

3.3.1 Project selection

The development of integrated design guidelines was based on an identification and exploration of 22 examples of good practices of UWPs designs from China, Germany, and the United States. The sample projects were selected on the basis of extensive research derived from relevant journals, books, and online databases. Three criteria were used to select suitable case studies:

- The cases represent UWPs, understood as open spaces of green and blue infrastructure embedded within an urban fabric.
- The cases include restored or created wetland areas. Projects exclusively intended for human uses were omitted.
- The cases allow for open space use by people. Urban wetland parks de-

signed exclusively for ecological functions without access for people were excluded.

Based on the classification of UWPs in Section 3.2, our 22 examples of good practices (see Table 3.1) were divided into three groups. Each group of UWPs is based on similar hydrological cycles and geomorphological types.

Table 3.1 Key characteristics of 22 cases from Europe, China, and the United States

| Nr. | Name | Location | Size (ha) | Completion date |
|------------------------|--|--------------------|-----------|-----------------|
| Type A: Riverine UWP | | | | |
| 1 | Yanwweizhou Park | Jinhua, China | 26 | 2014 |
| 2 | Harbin Culture Center Wetland Park | Harbin, China | 118 | 2013 |
| 3 | Yanxiu Park | Liaoyang, China | 28 | 2012 |
| 4 | Milliken State Park | Detroit, USA | 2.5 | 2010 |
| 5 | Renaissance Park | Chattanooga, USA | 8.9 | 2006 |
| 6 | Black Rock Sanctuary | Phoenixville, USA | 48.6 | 2010 |
| 7 | Shanghai Houtan Park | Shanghai, China | 14.0 | 2010 |
| 8 | Yuma East Wetlands | Yuma, USA | 141.6 | 2010 |
| 9 | Zaragoza Water Park | Zaragoza, Spain | 120 | 2006 |
| Type B: Lacustrine UWP | | | | |
| 10 | Xixi Wetland Park | Hangzhou, China | 1150 | 2011 |
| 11 | Beijing Olympic Forest Park | Beijing, China | 680 | 2008 |
| 12 | Railroad Park | Birmingham, USA | 7.7 | 2010 |
| 13 | The Morton Arboretum Meadow Lake | Lisle, USA | 10.9 | 2005 |
| 14 | Carmel Clay Central Park | Carmel, USA | 65.2 | 2007 |
| 15 | Tangshan Nanhu Eco-City Central Park | Tangshan, China | 630.1 | 2009 |
| Type C: Palustrine UWP | | | | |
| 16 | Qunli Wetland Park | Harbin, China | 30 | 2011 |
| 17 | Qiaoyuan Park | Tianjin, China | 22 | 2008 |
| 18 | Palmisano Park | Chicago, USA | 10.9 | 2010 |
| 19 | South Los Angeles Wetland Park | Los Angeles, USA | 3.6 | 2011 |
| 20 | Magnuson Park | Seattle, USA | 62.3 | 2012 |
| 21 | Rudow Park | Berlin, Germany | 10.2 | 2009 |
| 22 | Maurice Rose Airfield, Frankfurt Bonames | Frankfurt, Germany | 7.7 | 2004 |

3.3.2 Developing a framework of integrated design guidelines

For the selected 22 UWPs, the design strategies and measures applied in their creation were identified based on a systematic analysis and reflection (cf. Klemm, Lenzholzer, & van den Brink, 2017; Prominski, 2016; Prominski, Maass, & Funke, 2014; Prominski et al., 2017). Each design strategy originated from the designer's attitude towards ecological elements and public open spaces in the construction of wetland parks (for example, to endure them, connect with them,

create them, or change them). For each design strategy, we identify several design measures that can be used to implement it. Each individual design measure is identified using document and literature analyses as well as field visits. Design measures may range from small-scale interventions, such as setting a stepping stone, to large-scale actions such as the design of a pond system. In order to describe how each strategy or measure can contribute to the challenges faced by UWPs, we linked all of the identified strategies and measures to the challenges summarised in the previous section.

3.4 Methods for Chapter 6: In-depth case studies

This chapter focuses on six case studies in China. Each case is analysed by the same structure, describing implemented design measures and estimating aspects of open space use and ecological concerns.

3.4.1 Project selection

Case selection was based on field surveys in May–June, 2015 and in May 2016. In the first pre-selection, 12 projects were visited throughout China. Based on the criteria in Section 3.3.1, we finally selected the six integrated cases (see Figure 3.2 for my subsequent investigation and study in this chapter).



According to the distribution from north to south, they are as follows:

- Harbin Cultural Center Wetland Park
- Qunli Wetland Park,
- Olympic Park,
- Qiaoyuan Park,
- Xixi Wetland Park, and
- Yanweizhou Park.

Figure 3.2 Location of the six projects for in-depth case studies.

3.4.2 Mapping human use in the park

The open space use characteristics of these parks are documented based on the method of observation and human behaviour mapping (Goličnik & Thompson, 2010).

This study uses non-participating observations taken on sunny days in May (2015, 2016) from 10:00–12:00 or 15:00–17:00 in each park. The data are recorded in the matrix and drawn on the maps. The matrix notes the observing and recording of the number of visiting people, along with their age and gender. The maps highlight the particular activity location and certain uses. Tables 3.2–3.4 show the categories for these variables.

Table 3.2 Age types

| AGE CATEGORY | VALUE | NOTES |
|--------------|-------|------------------------------|
| 1 | <16 | Children up to the age of 16 |
| 2 | 16–40 | Adults between 16–40 |
| 3 | 40–60 | Adults between 40–60 |
| 4 | >60 | Seniors |

Table 3.3 Gender types

| GENDER CATEGORY | VALUE | NOTES |
|-----------------|--------|------------------|
| 1 | Male | Male observees |
| 2 | Female | Female observees |

Table 3.4 Activity types

| ACTIVITY CATEGORY | VALUE | NOTES |
|-------------------|-------------------------|---|
| Dynamic movement | Boating | Boating on the lakes or rivers, usually in groups |
| Static movement | Camping | Activities that around the camping tent. E.g. sleeping, reading, sunbathing, eating |
| Static movement | Childcare | Watching over children |
| Dynamic movement | Doing exercise | E.g. jogging, yoga, running, Tai Chi |
| Static movement | Digging wild vegetables | A short stay at a certain location |
| Static movement | Fishing | Usually staying in a place for a long time |
| Static movement | Photographing | Usually 2 or more people a short stay at a certain location |
| Dynamic movement | Playing | E.g. playing water, playing football |
| Static movement | Sitting | Sitting in the shade, resting, sitting and watching, sitting and talking |
| Static movement | Standing | Standing and watching, standing and talking |
| Dynamic movement | Walking | Walking slowly, walking through, strolling |
| Dynamic movement | Walking dog | Usually appearing on an uncertain route |

3.4.3 Assessing impacts of integrated design guidelines

The potential effects of the design guidelines in terms of open space use and ecological aspects are evaluated by criteria identified through a focused literature analysis (see Chapter 2). We used relevant key terms in a query of the Web of Science and Scopus databases and included additional references and books.

Five criteria for the evaluation of open space use are selected, primarily relating to the work of Bedimo-Rung, Mowen, and Cohen (2005): features, conditions, aesthetics, safety, and access. Similar criteria were applied by McCormack, Rock, Toohey, and Hignell (2010), to study the use of urban parks, and by Van Hecke et al. (2018), on the open space characteristics influencing adolescents' physical activity and use of the space.

The ecological evaluation was based on the following key criteria: biodiversity considerations, improvement of water quality or soil quality, storm water retention, and provision of natural habitat. It was specifically based on the key ecological attributes utilised by Ruiz-Jaen and Aide (2005), a literature review by Wortley, Hero and Howes (2013), and research on the ecological contribution of constructed wetlands in urban areas (Ghermandi et al., 2010).

Data for our evaluation include primary data, such as on-site observations, field research, and secondary data, including published papers and publicly available government data.

3.4.4 Analysis structure of case study

Using recorded information and data from field surveys, observation, photos, plans, and literature, we first describe the project background and implemented design measures. For the second step, in order to analyse the typical patterns of open space use in each UWP, the results of behaviour mapping are firstly listed and discussed. In order to estimate the potential impact of open space use, important benefits and effects are summarized according to the five criteria presented in Section 3.4.3. The third step is to estimate the potential impact of the ecological aspect based on the four criteria in Section 3.4.3. Finally, the potential impacts of specific measures within the park on open space utilization and ecological issues are summarized.

Chapter 4 Characteristics of urban wetland parks in different contexts

In seeking to analyse the characteristics of UWP in China and identify design strategies for these UWPs, it is useful to first consider the characteristics of different types of UWPs, meanwhile, it needs to consider the related problems and challenges in China. This chapter concerns these two issues and addresses the first research question: what are the key characteristics and design challenges of UWPs in different urban contexts? It begins with looking at typology studies of wetlands and criteria for UWP classification, identifying and focusing on three types of UWP: riverine type, lacustrine type, and palustrine type. It then goes on to design challenges faced by UWPs in China.

4.1 Typology study of urban wetland parks

In order to analyse the characteristics of UWP in China in the study, it is useful first to consider the types of wetlands and the potential criteria for UWP classification. This section addresses this issue and briefly discusses issues surrounding wetland classification, potential classification criteria, and UWP types. For each type, the formation and spatial characteristics are analysed.

4.1.1 Wetland classification

Wetland classification helps us better to understand and manage wetland resources. One challenge for wetland classification is how to use a simple, universal classification framework to combine diverse wetland classification schemes (based on different criteria). Wetland classification schemes vary according to, for example, geographic area, wetland structure, function and use, and the proportion of classification (Keddy, 2010, p. 5; Brinson, 2011, p. 97).

A variety of classification systems exist (see Table 4.1). For example, the widely used National Wetland Inventory (NWI) approach of the United States Fish and Wildlife Service (USFWS), also known as the Cowardin classification system, divides wetlands into five major systems: marine, estuarine, riverine, lacustrine, palustrine, which share similar hydrologic, geomorphologic, chemical, and biological factors (Cowardin, Carter, Golet, & LaRoe, 1979). The Ramsar classification system, formed on the basis of the NWI, divides wetlands into three simple categories: marine or coastal Wetlands, inland wetlands, and human-made wetlands (Secretariat, 2012a). The Canadian system—which divides wetlands into bog wetlands, fen wetlands, swamp wetlands, marsh wetlands, and shallow water wetlands (Warner and Rubec, 1997), mainly based on plant type; Gopal et al. (1990) classify wetlands into bogs, fens, swamps, temporary lakes, marshes, and permanent lakes, based on water regime and nutrient supply (Gopal, Kvet, Loffler, Masing, & Patten, 1990). The classification of Keddy (2010, pp. 5–8) proposes a simple classification system that distinguishes six types of wetlands based on location and hydrology: swamp, marsh, bog, and fen, shallow water and wet meadow; Semeniuk and Semeniuk (1995, p. 108) introduced a simple classification based on potential non-genetic features in a special issue of Veg-

etatio (now Plant Ecology), which combines topographical settings with various types of hydrological periods to form 13 major wetland types.

Table 4.1 Wetland classification systems according to six approaches

| Classification system | Factors and criteria | Wetland types |
|---------------------------|--|---|
| NWI | Hydrologic, geomorphologic, chemical or biological factors | Marine, estuarine, riverine, lacustrine, palustrine |
| Ramsar | Same as above | Marine and coastal Wetlands, inland wetlands, and human-made wetlands |
| The Canadian system | Mainly based on plant type | Bog wetlands, fen wetlands, swamp wetland, marsh wetlands, shallow water Wetlands |
| Gopal et al. (1990) | Water regime and nutrient supply | Bogs, fens, swamps, temporary lakes, marshes, and permanent lakes |
| Keddy (2010) | Location and hydrology | Swamp, marsh, bog, and fen, shallow water and wet meadow |
| Semeniuk & Semeniuk(1995) | Geomorphology and hydrology | 13 types (see more in Table4.2) |

As can be seen from Table 4.1, the hydrological and geomorphological factors are the most attractive of these classification systems. As the three most basic attributes in a wetland environment, these two components (geological or geomorphological and hydrological) are relatively stable, compared to other plant types (Semeniuk and Semeniuk, 2011). Take Semeniuk’s approach, for example:

There are at least 5 basic landform types that determine the occurrence of wetlands. These are listed below in geometrically gradational series from concave basins to convex hills: 1. Basins 2. Channels 3. Flats 4. Slopes 5. Highlands, or hills. Four types of permanence are distinguished: 1. Permanently inundated 2. Seasonally inundated 3. Intermittently inundated 4. Seasonally waterlogged. (Semeniuk and Semeniuk, 1995, p. 108)

Figure 4.1 shows an example of focusing on topography and hydrology at the primary level of classification. When the basic classification is enhanced by only four descriptors (scale, salinity, matrix, and vegetation), hundreds of different kinds of woodlands can be distinguished, which will support different types of ecological features. Wetland geomorphology and water and humidity attributes are non-genetic standards. This wetland classification method is basically based on two major factors that determine the existence of all wetlands (i.e., landform and water), helping to reveal the underlying and unified characteristics of wetlands that occur under different topographic and climatic conditions.

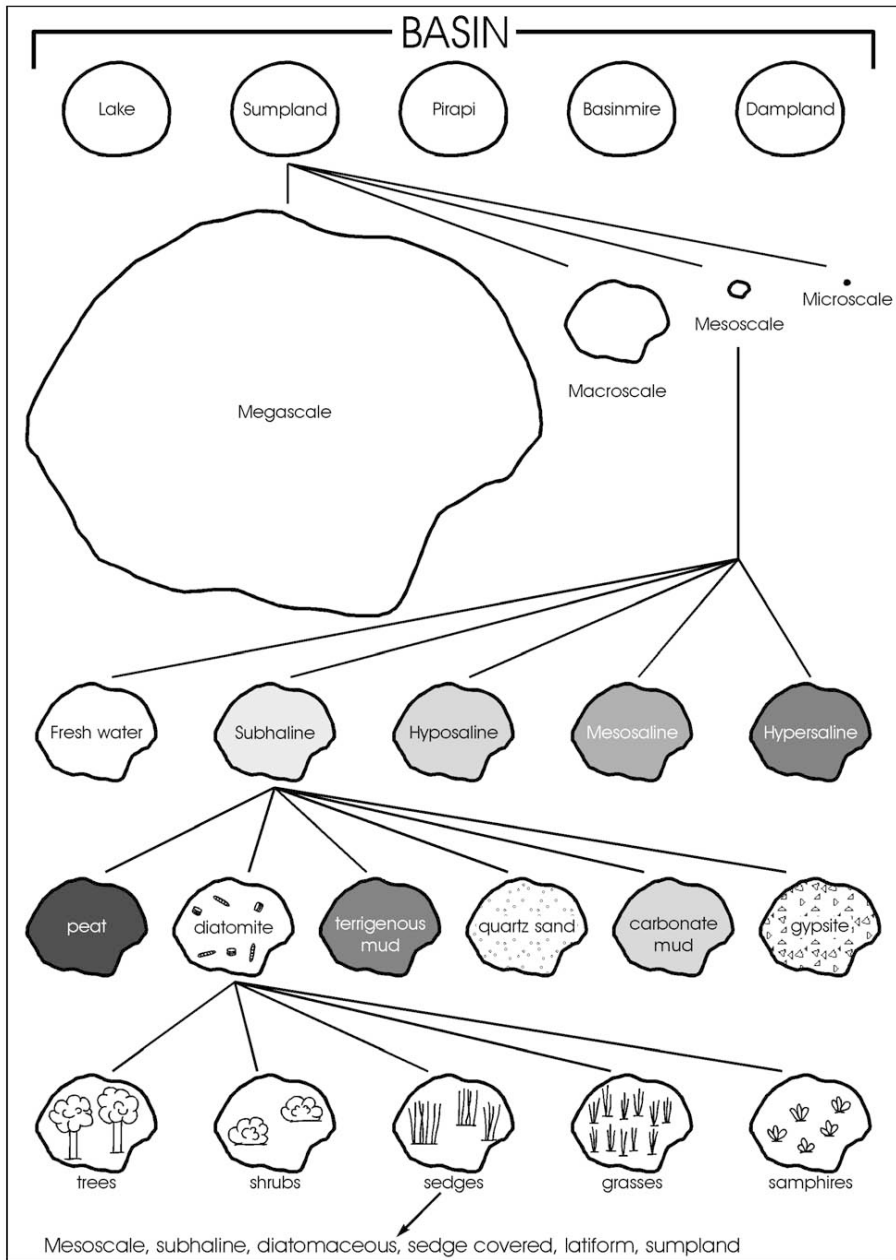


Figure 4.1 Classification diagram of the example of basin. This figure shows an example of landform category to illustrate the geomorphology of the wetland or hydrological classification. The progressive levels use descriptors for scale, water salinity, wetland fill, and vegetation cover types. Adapted from Semeniuk & Semeniuk, 2011 p. 459.

Table 4.2 Combining the land and water attributes for wetland classification

| Water longevity | Landform | | | | |
|--------------------------------------|-----------------------|---------------------|-------------------------|-----------------------|------------------------|
| | Basin | Channel | Flat | Slop | Highland |
| Permanent inundation | Lake ¹ | River ¹ | - | - | - |
| Seasonal inundation | Sumpland ² | Creek ¹ | Floodplain ¹ | - | - |
| Intermittent Inundation ⁴ | Playa ³ | Wadi ¹ | Barkarra ³ | | |
| Seasonal waterlogging ⁵ | Dampland ² | Trough ¹ | Palusplain ² | Paluslop ³ | Palusmont ³ |

Note:

¹ Existing terminology;

² Term coined by (Semeniuk, 1987);

³ Term coined by (Semeniuk & Semeniuk, 1995);

⁴ Those soils that are covered with free standing water; the soil below the surface in these situations is also saturated (waterlogged);

⁵ Those soils that are saturated with water, but where the water does not inundate the soil surface.

Reprinted by permission from Springer Nature Customer Service Centre GmbH: Springer Nature. Vegetatio, A geomorphic approach to global classification for inland wetlands, Semeniuk & Semeniuk, p.110, © Kluwer Academic Publishers 1995.

4.1.2 UWP types

In terms of generality and consistency, wetland classification methods based on geomorphic factors and hydrological factors are more attractive. It is because these two factors are relatively stable, compared to plant factors, meanwhile, the three factors are the most basic attributes in a wetland environment (Semeniuk and Semeniuk, 2011). The UWP classification of this study divides UWP groups by identifying and summarizing the dominant wetland types. This study refers to the classification process of the NWI (Cowardin, et al., 1979) and Semeniuk (Semeniuk and Semeniuk, 1995), combined with on-site wetland survey and plan analysis, and finally, it summarizes three types of wetland parks (see Table 4.3).

Table 4.3 Three types of UWPs according to dominant wetland types

| UWP types | Dominant wetland types | Landform | Water longevity | Group characteristic |
|----------------|---|--------------------|---|---|
| Riverine UWP | River Creek Floodplain | Channel or flat | Permanent inundation Seasonal inundation | Related to river movement |
| Lacustrine UWP | Lake Farm pond Fish and shrimp pond | Basin | Permanent inundation | Related to lake wetlands (Permanent inundated basins) |
| Palustrine UWP | Dampland ¹ Sumpland ² Swamp Bog Seasonal pond | Basin | Seasonal waterlogging Seasonal inundation Permanent inundation Intermittent inundation | Related to small, shallow, permanent or intermittent inundated basins |

Note. 1 Seasonally waterlogged basin of variable sizes and shapes; defined by Semeniuk (1987, p. 105). 2 Seasonally inundated basins of variable sizes and shapes; defined by Semeniuk (1987, p. 105).

Firstly, if a UWP's dominant wetland type is related to river movement (e.g., rivers, creeks, floodplains, etc.), it is classified as a Riverine UWP group; sec-

only, if a UWP's dominant wetland type is related to lake wetlands (e.g., lakes, ponds, artificial lakes, etc.), it is classified as a lacustrine UWP group; thirdly, if a UWP's dominant wetland type is a permanent or intermittent inundated basin, including small shallow ponds or swamps of various variable sizes and shapes, it is classified as a palustrine UWP group.

Wetland types in UWPs represent only a small fraction of the general classifications of wetlands. Among them, rivers and lakes are included in Semeniuk's and the NWI's classification systems. 'damland' and 'sumpland', which Semeniuk defines as similar to swamps, are included in 'palustrine' system of the NWI. By adopting a generalized and unified classification method, the three UWPs selected in this study contain as many as possible of the main wetland types of UWP. Other categories, such as marine wetlands, are not discussed in this study because they are beyond the scope of urban wetland park research.

Riverine UWP

The riverine UWP is a type of park in which river-type wetlands occupy a dominant landscape, usually established at the floodplain. China has abundant river resources. According to official statistics,¹ there are 22,909 rivers with a basin area of more than 100 km², most of which are distributed in the eastern region.

Formation of river wetlands

Erosion and sedimentation processes dominated by water flow cause changes in river wetlands. In these processes, on the one hand, due to the regular erosion by floods, the surface water catchment area forms the floodplain wetland. On the other hand, in the flat terrain, due to the sedimentation of the river water, the sediment is largely deposited, forming the estuary wetland.

Spatial characteristics

Natural rivers usually meander, and their floodplains are generally wide and large. River wetlands prolong the shape and trend of the rivers, with linear spatial characteristics. Due to the fluidity and linear characteristics of the water body, the area where the river wetland contacts the surrounding environment is larger, and accordingly it is more often subject to human disturbance. This kind of interference is more intense in urban areas. For example, in order to improve land use, traditional artificial hydraulic engineering projects usually reduce the area of floodplains and set up flood levees.

Riverine wetlands in urban areas are mostly linear and strip-shaped spatial

1 Ministry of water resources of P. R. China, 2013. Bulletin of first national census for water. Data retrieved from http://www.mwr.gov.cn/sj/tjgb/dycqgslpcgb/201701/t20170122_790650.html.

forms. Three types of areas usually appear in this wetland park construction. The first is a sandbank along one side of the river. This type of wetland space is the most common. A typical example is the Harbin Cultural Center Wetland Park, located along the riverside of the Songhua River (see Figure 4.2, upper right). The second is built along the shoal areas on both sides of the river, such as the Qian'an Sanlihe Wetland (see Figure 4.2, bottom left). The third one is at the bifurcation of the linear water body or confluence of two rivers. For example, Yanweizhou Park is located at the junction of Yiwu River and Wuyi River (see Figure 4.2, top left). The wetland shoal area in the estuary comes from the accumulation of sediment from the upstream river.

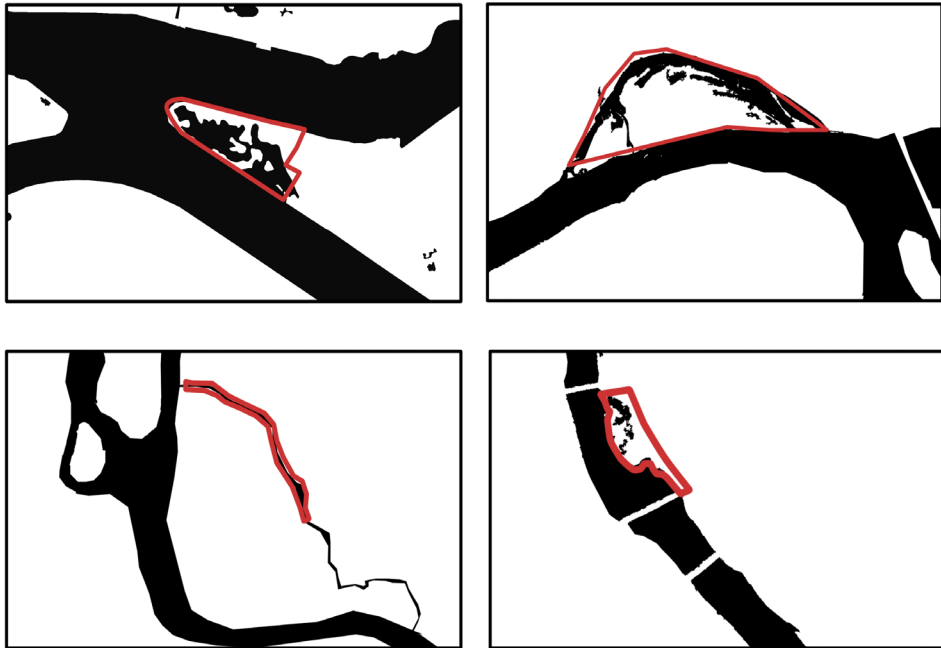


Figure 4.2 Water and land spatial distribution of four riverine UWPs.
 Note. The black area refers to water (River and Wetland). The red frame indicates the scope of the park. Top left: Yanweizhou Park; Upper right: Harbin Cultural Centre Wetland Park; Bottom left: Qian'an Sanlihe Park; Bottom right: Yanxiu Park.
 Adapt from Google Earth. Map data: Google, DigitalGlobe.

Lacustrine UWP

A lacustrine UWP is a wetland park where natural or artificial lakes or reservoirs occupy a dominant landscape. China has a large number of lake resources. According to official statistics,² there are 2,860 lakes with a water surface area of

² Ministry of water resources of P. R. China, 2013. Bulletin of first national census for water. Data retrieved from http://www.mwr.gov.cn/sj/tjgb/dycqslpcgb/201701/t20170122_790650.html.

1 km² or more, in addition to a large number of artificial lakes. Based on these lakes, lake wetlands are distributed throughout China.

Formation of lake wetlands

Lake wetlands usually form at the edges of lakes. The formation processes mainly include decrease of water intake, leading to a decline of lake water level; increase of sediment into the lake, gradually shallowing the lake; and accumulation of biological debris, causing the lake bottom to rise and then wetland plants to appear. Finally, lake wetlands gradually form.

Spatial characteristics

Lake wetlands form due to the long-term impact of lake water on land. Lakes in urban areas are greatly affected by human activities, and there are two general types of spatial structures. Some of them have been affected by historical agricultural activities to form a series of rivers, farmland and fishponds, showing a network-like spatial structure, such as Xixi Wetland Park. The others have been artificially transformed into a central lake surface with a flatter shoreline, shorter perimeter, and smaller curvature change, such as Olympic Forest Park.

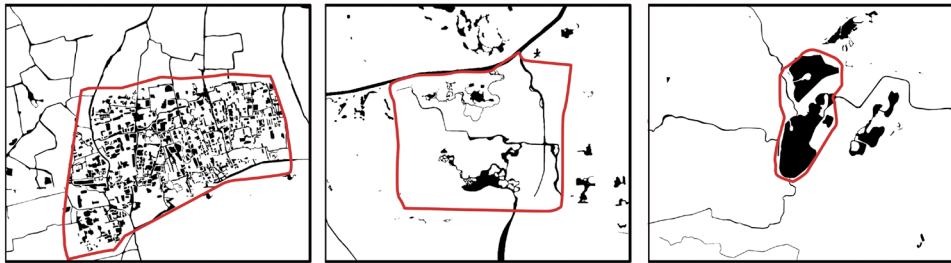


Figure 4.3 Water and land spatial distribution of three lacustrine UWPs.

Note. The black area indicates spatial water (River and Wetland). The red frame indicates the scope of the park. Left: Xixi Wetland Park; Middle: Olympic Park; Right: Tangshan Nanhu Eco-City Central Park. Adapt from Google Earth. Map data: Google, DigitalGlobe.

Palustrine UWP

A palustrine UWP is a type of park where seasonal basin wetlands predominantly occupy the landscape, composed of artificial restoration of ponds and degraded wetlands. In urban areas, it often represents the transformation of former degraded wetlands, landfills, grey fields and brownfields in a populated community into a functional and attractive wetland landscape.

Formation of palustrine wetlands in palustrine UWPs

According to the NWI classification, natural palustrine wetlands are mainly formed in the following cases:

The Palustrine System was developed to group the vegetated wetlands traditionally called by such names as marsh, swamp, bog, fen, and prairie, which are found throughout the United States. It also includes the small, shallow, permanent or intermittent water bodies often called ponds. Palustrine wetlands may be situated shoreward of lakes, river channels, or estuaries; on river flood-plains; in isolated catchments; or on slopes. They may also occur as islands in lakes or rivers. (Cowardin, et al., 1979, p. 10)

In addition, there are two common situations in the formation of palustrine wetlands in palustrine UWPs. One stems from quarrying or coal mining in the subsidence area. After being abandoned for many years, the wetland forms due to the fact that the groundwater rises to the collapsed surface combined with natural precipitation, such as Palmisano Park. The other type is due to the excavation of the project, such as military or industrial development, resulting in surface subsidence. The rainwater and groundwater then interact to form palustrine wetlands, such as the Qiaoyuan Park in China and the Maurice Rose Airfield project.

Spatial characteristics

Due to the serious damage to the base ecosystem and the short time required for natural restoration, the palustrine UWP has relatively poor environmental quality, a single spatial type, and poor landscape diversity. Due to the artificial excavation of multiple water bodies, the spatial structure is scattered, and the degree of landscape fragmentation is relatively high. In addition, this type of wetland park has less isolation and buffer areas from people and is significantly affected by human activity.

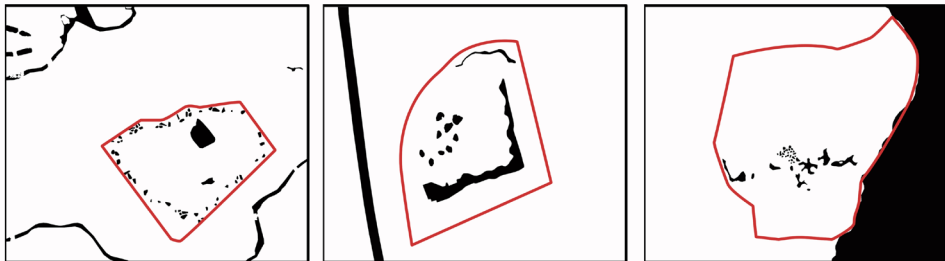


Figure 4.4 Water and land spatial distribution of three palustrine UWPs.

Note. The black area refers to water (river and wetland). The red frame indicates the scope of the park. Left: Qunli Wetland Park; Middle: Qiaoyuan Park; Right: Magnuson Park. Adapt from Google Earth. Map data: Google, DigitalGlobe.

4.2 Challenges for UWP

Rapid urbanisation presents enormous challenges for UWP and other urban wetlands resources. According to the United Nations, by 2030 there will be 43 megacities in the world with a population of more than 10 million, and by 2050, 68% of the world's population is expected to live in urban areas (United Nations, 2018). Achieving scientific urban wetland planning and design is not a challenge unique to China. According to the Urban Planet Report and IPBES Global Assessment on Biodiversity and Ecosystem Services, overdevelopment, changes in wetland habitats, water pollution, invasive species, and climate change are the dominant drivers of wetland loss and degradation (Elmqvist et al., 2018; IPBES, 2019). In order to achieve sustainable use and development of wetlands, it is necessary to control water pollution, maintain habitats and biodiversity in cities, increase habitat linkages, and control species invasion. The Ramsar Convention also offers advice on urban wetland planning and design, such as increasing the resilience of wetlands to disasters, maintaining the integrity of wetland structures, and encouraging full-scale public participation (Ramsar Secretariat, 2012b).

As China's urbanisation process is taking place at an unprecedented rate, the above issues are particularly intense in this country. Wetland shrinkage and degradation have caught the attention of the country's central and local governments. In response to the construction of UWPs, the Chinese government has developed design guidelines that point out key requirements and important challenges for them. In 2005, the MOHURD formulated pilot guidelines for the design of urban wetland parks, pointing out that

Urban wetland park planning and design should follow the principle of combining systematic protection, rational use and coordinated construction. While realizing the environmental benefits of urban wetlands, we must make rational use of resources; give full play to its economic benefits, social benefits, and the role of wetlands in beautifying urban environments. An urban wetland park should have a certain size and generally should not be less than 20 hectares. (MOHURD, 2005, p. 3)

The pilot guidelines thus emphasise goals and aspirations for the rational use of urban wetland resources. However, they are relatively ambiguous, using uncertain phrases such as 'generally should not be' and lacking specific practical guidance. During the period from 2004 to 2012, in the urbanisation stage of real estate development, local governments created a large number of urban green spaces, including urban wetland parks, in order to increase real estate and land prices and to promote regional development. However, the design practices

implemented in these parks have suffered a number of failures (Zhang, Zhou, & Gao, 2012), for example the Huaifang Wetland park and Nanyuan Park in Beijing. Moreover, the phenomenon of ‘planning or design without ecology’ is widespread across China, partly due to a combination of poor ecological knowledge and landscape practice (Wang, 2018; Wu et al., 2014).

Since 2015, the concepts of ‘eco-red lines’ and ‘sponge cities’ were promoted in China (Ministry of Environmental Protection of the People’s Republic of China [MEP], 2015; SC, 2015a). The ecological concept of urban wetland parks has received special attention. In 2017, new guidelines (MOHURD, 2017b) repositioned the urban wetland park as ‘one of the key ecological infrastructures’ and ‘an important component of the urban green space system’ and identified the goal of ‘achieving sustainable park development’. Key challenges and requirements are highlighted, such as ‘controlling water pollution’, ‘maintaining biodiversity’, ‘maintaining wetland structural integrity’, ‘erosion regulation’, ‘reducing flood risks’, and ‘storm water management’ (for further, see Table 4.4). Combining these worldwide and Chinese perspectives, 13 key challenges faced by UWPs are summarised in this study, as shown in Table 4.4.

Table 4.4 Challenge list for UWPs.

| Sources | Key problems, suggestions, or requirements | Challenge list |
|---|--|--|
| Challenges identified by Elmqvist et al. and IPBES (Elmqvist et al., 2018; IPBES, 2019) | <ul style="list-style-type: none"> • Overexploitation • Water pollution • Habitat changes • Invasive species • Climate change | <ol style="list-style-type: none"> 1) Increasing the connectivity of habitats 2) Controlling water pollution 3) Maintaining biodiversity 4) Controlling invasive species |
| Challenges identified by RS (Gardner & Finlayson, 2018; Ramsar Secretariat, 2012b, 2018a) | <ul style="list-style-type: none"> • Enhanced resilience to disasters • Wetland conservation • Full participation | <ol style="list-style-type: none"> 5) Maintaining wetland structural integrity 11) Encouraging full participation |
| Challenges identified by MOHURD (MOHURD, 2017a, 2017b) | <ul style="list-style-type: none"> • Maintenance of biodiversity • Wetland structural integrity • Naturalness • Achieving high social benefit • Meeting public recreational needs • Meeting science education needs • Diversity • Uniqueness • Protecting and restoring natural habitats • Wetland area greater than 50% • Reducing flood risks • Storm water management • Controlling peak runoff • Controlling water pollution • Provisioning water • Retention of soils and sediments • Preserving the cultural resources • Necessary park facilities • Erosion regulation | <ol style="list-style-type: none"> 2) Controlling water pollution 3) Maintaining biodiversity 5) Maintaining wetland structural integrity 6) Erosion regulation 7) Reducing flood risks 8) Storm water management 9) Preserving cultural resources 10) Providing necessary amenities 11) Encouraging full participation 12) Creating spaces for recreational activities 13) Providing opportunities for education |

Note. UWPs = urban wetland parks. IPBES = Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. RS = Ramsar Secretariat. MOHURD = Ministry of Housing and Urban-Rural Development.

Challenges for three types of UWPs

Urban wetland parks with different bases and spatial forms face different challenges (Cheng et al., 2012; Wang, Wang, Wang, & Sun, 2008; Wang, 2008). Cheng et al. (2012, p. 24) identified five types of wetland parks: lake, river, coastal, farmland, and restoration, which is quite similar to our classification in Section 4.1.2 (see Table 4.3). The river type is included in our ‘Riverine UWP’; the lake type and farmland type, in our ‘Lacustrine UWP’; and the restoration type, in our ‘palustrine UWP’. Based on a comparison of the key problems from Cheng et al. and the key challenges (Table 4.4) from this study, Table 4.5 below summarizes the major disturbances and problems faced by the three types of UWPs.

Table 4.5 Top challenges for each type of UWPs

| | Problems and key interferences | Related challenges |
|----------------|---|---|
| Riverine UWP | <ul style="list-style-type: none"> • Water level fluctuates with the seasons (caused by natural disturbances such as floods and precipitation) • Upstream pollution • Floodplain shrinking caused by human intervention such as straightening, hard revetment, etc. • River erosion • Water conservancy projects, which have changed the estuary landform and aggravated the fragmentation of wetland habitats | <ul style="list-style-type: none"> • Reducing flood risks (MOHURD, 2017b) • Controlling water pollution (Elmqvist et al., 2018; IPBES, 2019; MOHURD, 2017b) • Maintaining wetland structural integrity (Gardner & Finlayson, 2018; MOHURD, 2017a, 2017b; Ramsar Secretariat, 2012b, 2018a) • Regulating erosion (MOHURD, 2017b) • Increasing the connectivity of habitats (Elmqvist et al., 2018; IPBES, 2019) |
| Lacustrine UWP | <ul style="list-style-type: none"> • Water pollution caused by past agricultural activities, accelerating the process of eutrophication of water bodies and threaten the growth of wetland vegetation. • The hard roadbed, which splits the flow of lake water and separates the lake from other natural water bodies • Stiff bank and short shoreline, due to by improper renovation | <ul style="list-style-type: none"> • Controlling water pollution (Elmqvist et al., 2018; IPBES, 2019; MOHURD, 2017b) • Increasing the connectivity of habitats (Elmqvist et al., 2018; IPBES, 2019) • Maintaining biodiversity (Elmqvist et al., 2018; IPBES, 2019; MOHURD, 2017a, 2017b) |
| Palustrine UWP | <ul style="list-style-type: none"> • Serious ecosystem damage • Poor environmental quality and lack of diversity • Lack of connection between artificial water bodies • High landscape fragmentation, frustrating the palustrine’s ability to meet habitat requirements • Lack of adequate buffering with the outside world • Affected by human construction and residential activities | <ul style="list-style-type: none"> • Maintaining wetland structural integrity (Gardner & Finlayson, 2018; MOHURD, 2017a, 2017b; Ramsar Secretariat, 2012b, 2018a) • Increasing the connectivity of habitats (Elmqvist et al., 2018; IPBES, 2019) • Maintaining biodiversity (Elmqvist et al., 2018; IPBES, 2019; MOHURD, 2017a, 2017b) • Managing storm water (MOHURD, 2017b) |

Note. Problems and key interferences are adapted from Cheng et al. (2012, pp. 28–35).


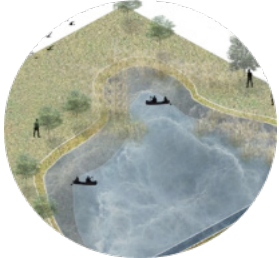

As an example of river-type wetland parks, their disturbances mainly include water level fluctuations caused by floods and rainfall; upstream pollution; shrinking

floodplains, caused by human activities such as straightening and hard re-
 vement; water erosion; and fragmented wetland habitats, caused by water con-
 servancy projects, and so on. Therefore, the main challenge in designing a riv-
 erine urban wetland park is generally to solve these disturbance problems and
 include reducing flood risks, controlling water pollution, maintaining wetlands’
 structural integrity, regulating erosion, and increasing the connectivity of habi-
 tats. Correspondingly, for lacustrine urban wetland parks, the main challenges
 include controlling water pollution, increasing the connectivity of habitats, and
 maintaining biodiversity; for palustrine urban wetland parks, the main challeng-
 es include maintaining wetlands’ structural integrity, increasing the connectivity
 of habitats, maintaining biodiversity, and managing storm water.

4.3 Summary

The results in this chapter consist of the following points: UWP is generally clas-
 sified into three main categories on the basis Semeniuk and Semeniuk’s structur-
 al classification combining with the NWI classification; a checklist of 13 challenge
 types is identified; spatial characteristics and the primary challenges related to
 each UWP type are summarized (see Table 4.6).

Table 4.6 Summary of three UWP types

|  |  |  |
|--|--|---|
| River UWPs | Lacustrine UWPs | Palustrine UWPs |
| Spatial characteristic <ul style="list-style-type: none"> ● Linear and strip-shaped forms | Spatial characteristic <ul style="list-style-type: none"> ● Relatively complete body of water ● Network like structure | Spatial characteristic <ul style="list-style-type: none"> ● Dispersed structure |
| Main challenges <ul style="list-style-type: none"> ● Reducing flood risks ● Controlling water pollution ● Maintaining wetland structural integrity ● Erosion regulation ● Increasing the connectivity of habitats | Main challenges <ul style="list-style-type: none"> ● Controlling water pollution ● Increasing the connectivity of habitats ● Maintaining biodiversity | Main challenges <ul style="list-style-type: none"> ● Maintaining wetland structural integrity ● Increasing the connectivity of habitats ● Maintaining biodiversity ● Storm water management |

These findings contribute in several ways to our understanding of UWPs in China and provide a basis for the analysis of UWPs with different landforms and water longevity conditions. The methods used for this UWP classification may be applied to other wetland-dominated landscapes elsewhere in the world.

The challenges that we have identified in Section 4.2 assist in our understanding of the major related tasks. This overview demonstrates that thirteen main types of design challenges such as increasing the connectivity of habitats, controlling water pollution and maintaining biodiversity need to be addressed in order to achieve the goals of 'sustainable parks', which are required by policies and conventions. New landscape design guidelines need to be developed for these design challenges. The next chapter, therefore, discusses the cases and design guidelines.

Chapter 5 Design strategies and measures

This chapter addresses the second research question: what integrated design guidelines can be proposed that combine the concerns of ecology and open space use in UWPs? Based on three types of UWPs that are presented in Chapter 4, this chapter analyses 22 integrated cases and summarizes a framework of design guidelines, which includes design strategies and measures. It then goes on to look at four to seven superordinate design strategies for each UWP types. Finally, it links the framework with the UWP challenges listed in Chapter 4 to analyse the possibilities of the selected design strategies in addressing those challenges.

5.1 Towards a framework of integrated design guidelines

Based on a review of 22 illustrative case studies of integrated UWP designs, this chapter develops a framework of integrated design guidelines. These 22 cases were selected in accordance with the criteria in Section 3.3.1. They all addressed the ecological aspect and the open space use aspect. A detailed description of sixteen of these cases is listed in the Appendix. The other six cases will be discussed in more detail in Chapter 6.

Our framework of integrated design guidelines includes a total of 17 strategies and 57 associated measures (see Figure 5.1). Among these 17 strategies (see Figure 5.2) are 7 key design strategies (A1–A7) for riverine UWPs, 6 key design strategies for lacustrine UWPs (B1–B6), and 4 key design strategies for palustrine UWPs (C1–C4).

For Riverine UWPs, design strategies focus on the design of submersible, flood-adaptable landscapes for multiple uses. One strategy is to design elements between the average water level and the high-water level (A1: Tolerant of water-table changes), such as paths, platforms, playgrounds, submersible vegetation, and boardwalks that can withstand high water levels. Another strategy is to extend the floodplain in the cross-sectional direction to expand river water discharge (A2: Increasing floodplain space). This extension can be achieved, for example, by reshaping a steep bank with a gentle natural slope or excavating temporary ponds and pools on the floodplain. Other design strategies include increasing the connections and interactions between water, plants, animals, and people within UWPs (A5: Increasing complexity). In this way, biodiversity and open space use can be synergistically enhanced. Possible design measures include establishing a meandering path for the water and designing terraced wetlands and pond systems.

For lacustrine UWPs, design strategies emphasise the relation of natural habitats and public spaces. One design strategy is to design transition zones (B1): for example, to divide protected areas and public activity areas to adjust the intensity of human use in different areas. In order to better protect biodiversity, certain sensitive areas for wildlife are specifically identified. Another strategy is to connect biotopes with open space systems in those insensitive areas (B2). By combining different needs, biotopes in urban wetland areas can be quite relevant, as their expansion into open space systems will bring direct added value to the people. Possible measures include creating corridors, trail systems to encourage visitors to explore the wood areas or hills and stepped terraces descending

down to the lake.

For palustrine UWPs, design strategies address improving the quality of open spaces and complementing habitat systems in urban areas to provide symbiotic areas. One design strategy is to increase diversity (C1), providing a more attractive space for humans, animals, and plants. For example, creating ponds with different depths, increasing the number of small wetlands, and creating diverse water storage areas. Other strategies include contacting with water (C3) and combining habitat and open space (C4), giving people more opportunities to interact with nature.

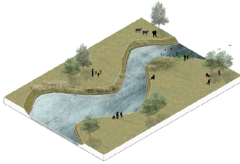
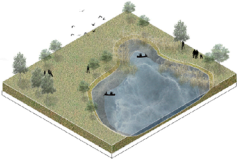

| | LIST OF DESIGN STRATEGIES | LIST OF DESIGN MEASURES |
|---|---|---|
| <p>A Riverine UWP</p>  | <p>A1 Tolerant of water-table changes A2 Increasing floodplain space A3 Varying the bank reinforcement A4 Placing above the water A5 Increasing complexity A6 Contacting with water A7 Integrating the public</p> | <p>A1.1 Paths within the flood plain A1.2 Submersible platforms A1.3 Social event grounds A1.4 Submersible vegetation A2.1 Reshaping with more gently sloping banks A2.2 Vernal pools A3.1 Terraced banks A3.2 Timber revetment A3.3 Stone revetment A3.4 Plants embankment A4.1 Pavilions on piles A4.2 Elevated piers A4.3 Bridges over the water A4.4 Buildings on piles A4.5 Raised boardwalks/platforms A5.1 Establishing water's meandering path A5.2 Terraced wetlands A5.3 Ponds system A6.1 Boardwalks near banks A6.2 Gently sloped open lawn area near the river A6.3 Seating areas with direct views to the Lake A6.4 Waterfalls A7.1 Sports clubs or classes A7.2 Spaces designed specifically for practicing instruments A7.3 Gathering space for social groups</p> |
| <p>B Lacustrine UWP</p>  | <p>B1 Designing Transition Zones B2 Connecting biotope with open space systems B3 Contact with water B4 Varying the lakeshore reinforcement B5 Cultivating characteristics B6 Integrating the public</p> | <p>B1.1 Divide into protected areas and open space B1.2 Certain sensitive areas are designed expressly for wildlife B2.1 Creating corridors B2.2 Trail systems designed to encourage visitors to explore (the wood areas or hills) B2.3 Submersible stepped-terraces descending down to the lake B3.1 Create boardwalks near the water B3.2 Put buildings at the water edge B3.3 Create walking dams B3.4 Create stairs near the water B3.5 Boat docks and extensive boardwalks B3.6 Design waterfalls B4.1 Stone revetment B4.2 Planted edge B4.3 Gabions embankment to stabilize the lakeshore B5.1. Historic landscape structure B5.2 Historical buildings B6.1 Public orchard B6.2 Educating the public to protect wetlands B6.3 Looped running pathway</p> |
| <p>C Palustrine UWP</p>  | <p>C1 Increasing diversity C2 Designing transition zones C3 Contact with water C4 Combining habitat with open space</p> | <p>C1.1 Create ponds with various depths C1.2 Increase number of small wetlands C1.3 Various water storage areas C2.1 Leave the natural core C2.2 Create buffers C2.3 Divide different areas by use intensity C3.1 Create raised platforms C3.2 Create boardwalks near the water C3.3 Bridges C4.1 Recreation trails along the filtration ponds C4.2 Almost every pond has an observation platform</p> |

Figure 5.1 Integrated framework of all design strategies and measures.

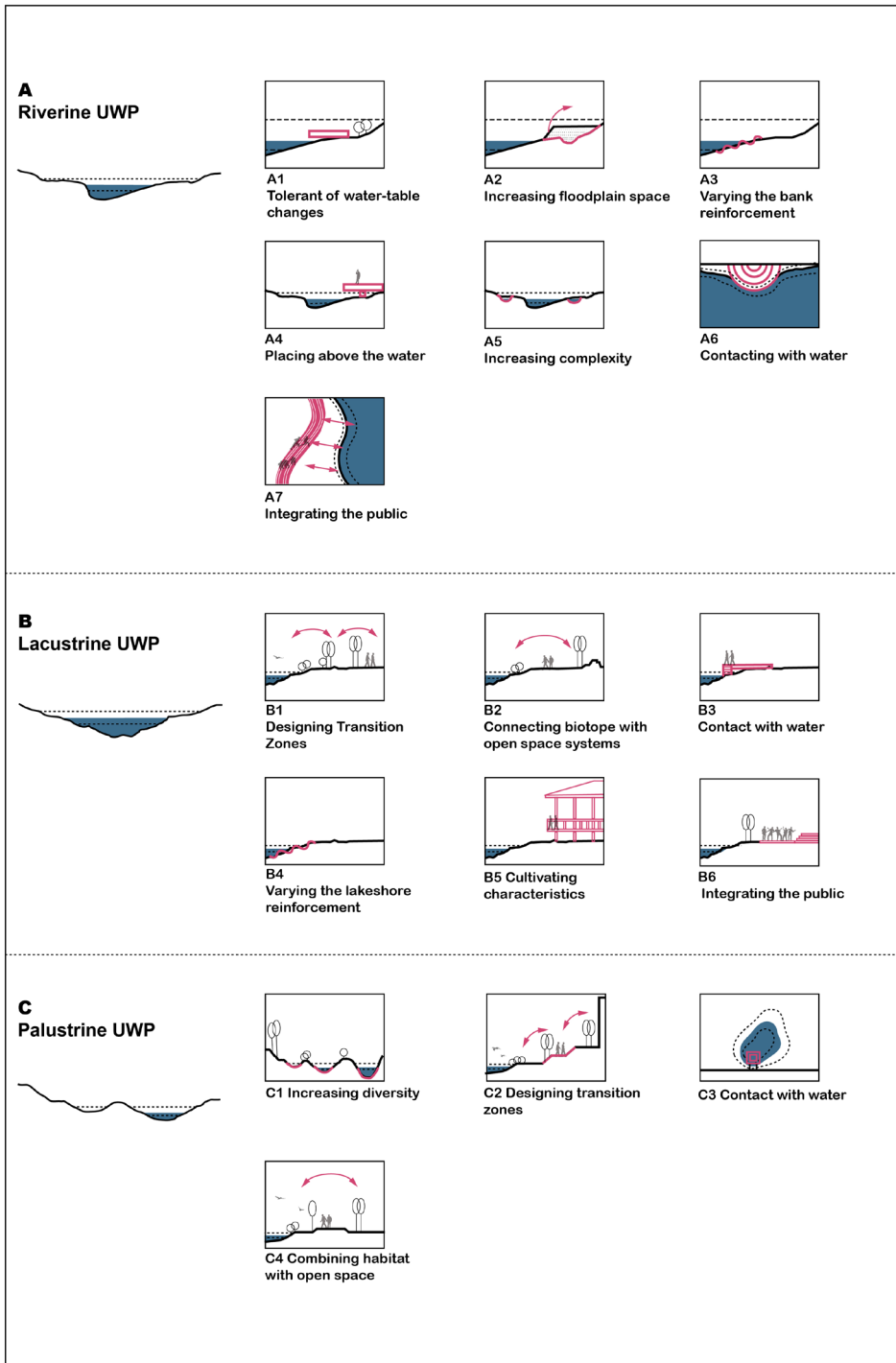


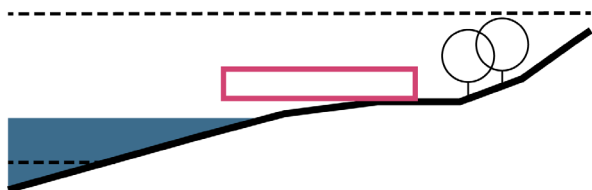
Figure 5.2 Diagrams illustrating the 17 design strategies from the integrated framework.

5.2 Design strategies for riverine UWPs

Riverine UWPs comprise those wetland parks extending across the floodplain next to a river or at the confluence of two rivers. Despite periodic flooding, it can be designed to be a submersible landscape for multiple uses. These reshaped parklands can help control floods, provide natural habitats, and serve as open spaces.

River wetlands usually have a linear spatial shape, and the contact surface with the external environment is large, which is correspondingly subject to more human interference. For example, large-scale river straightening, wetland reclamation, hard revetment, and other activities have greatly damaged the natural attributes of the wetlands and aggravated the fragmentation of river wetlands.

5.2.1 A1: Tolerant of water-table changes



A UWP area in the floodplain should be able to withstand flooding and endure temporary inundation. For most of the year, when the river is at medium or low water levels, the floodplain can be used without restrictions and accommodate

a large number of public uses. At high water levels, these places are no longer accessible or are only partially so. For this reason, it is necessary to design and provide open spaces between the average water level and the high-water level in order for the landscape to survive temporary flooding without significant damage.

These spaces include settings and elements that can tolerate high water levels, such as roads and paths, play facilities, event grounds, submersible vegetation, and boardwalks. These facilities are permanently installed, and the materials selected can withstand longer flood periods.

A1.1
Paths within the flood plain

Yanweizhou Park, Zaragoza Park, and Harbin Cultural Center Wetland Park



Establishing paths and road systems link different areas of the floodplain, which are difficult to access and rarely used. The path network can be constructed as footpaths, wide paved roads, or rough boardwalks. They are developed to adapt different water tables during dry season and flood season. For example, in the Yanweizhou Wetland Park, the paved paths are just above the five-year flood level, affording visitors an intimate naturalistic experience for most of the year, and they are submersible during flood season. Due to the sedimentation of the river, it may be necessary to clear the path of the sediment after the flood.

Yanweizhou Park

A1.2
Submersible platforms

Yanweizhou Park and Yanxiu Park



Platforms are installed in the floodplain and connected by a network of boardwalks. They can provide viewing and resting places that satisfy the needs of recreational use and allow urban residents to come into close contact with nature.

Yanxiu Park

A1.3*Renaissance Park, Yanxiu Park, and Yanweizhou Park***Social event grounds**

The floodplain in the wetland park can provide open space for social events. For example, in the Renaissance Park, the amphitheatre that rises from the wetland bank with the hills beyond and circular clearing in the flooded forest provide gathering spaces for environmental education activities and other social gatherings. These permanently installed elements in the flood area present no obstruction to flood water discharge at a high water level.



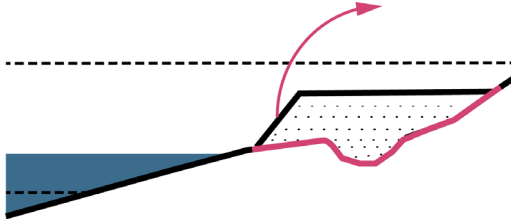
Renaissance Park

A1.4*Yanweizhou Park and Renaissance Park***Submersible vegetation**

Yanweizhou Park

Submersible vegetation has been used in the design to accommodate annual fluctuations of the water table, from native vegetation that tolerates droughts and floods or plants from similar seasonally flooded habitats, such as riverside forests and wetlands. There are many possibilities for such park design. In the lower areas, the original covers and trees are preserved to cope with the natural succession process. On higher lands, native forests are combined with a series of self-generated semi-natural meadows to create colour surprises in different seasons. The Yanweizhou project achieves ‘friends with the floods’ by creating a terraced river embankment that covers flood-adapted native vegetation.

5.2.2 A2: Increasing floodplain space

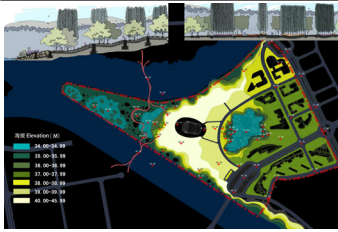


A river's floodplain plays an important role in flood control and the maintenance of the riverfront ecosystem. Expanding the floodplain area is conducive to better achieving these effects. In addition, the extended floodplain provides a wide range of public spaces for use at low water levels.

For river-type urban wetland parks, due to the development of surrounding community and population pressure, there are often limited river floodplain restrictions. The expansion of the floodplain can be realized in the cross-sectional direction to expand the discharge of river water. One measure is to transform the steep bank into a gentle natural slope. When the river's water level rises, the park carries a portion of the water while providing open space at the low water level. In addition, one measure is to excavate temporary pools and ponds on the floodplain, which can store river water at high water levels and may dry up at low water levels. These temporary pools with water level changes can provide important wetland habitats for certain birds and plants.

A2.1
Reshaping with more gently sloping banks

Yanweizhou Park, Yanxiu Park, and Harbin Cultural Center Wetland Park



Yanweizhou park



Harbin Cultural Center park

Reshaping the cross section of the floodplain, creating a lower and sloped embankment by excavation, can provide more drainage space for the flood. For example, the Yanweizhou project expands the flood space by creating a terraced river embankment that covers flood-adapted native vegetation, creating a park that works with floods.

In addition, permeable materials and gentle slopes can help to increase the use of public space in the floodplain space. For example, local people often visit the grassy slopes in Harbin Cultural Wetland Center Park at low water levels.

A2.2
Vernal pools

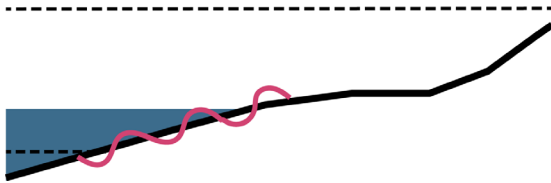
Black Rock Sanctuary, Zaragoza Park, and Harbin Cultural Center Wetland Park



Black Rock Sanctuary

Ponds, temporary pools, and puddles are excavated in the floodplain area, which can expand the floodplain area as well as become habitats for distinctive plants and animals. The size and planting configuration of the pond can be designed for a specific species. For example, in Black Rock Sanctuary, the vernal pool is one of a series of wetlands designed to attract migratory birds.

5.2.3 A3: Varying the bank reinforcement



In the past, interventions such as canalized and straightened watercourses and the establishment of high flood levees were used widely in order to inhibit erosion as much as possible in many urban rivers. These interventions greatly undermine the continuity of river and wetland ecosystems. Accordingly, in order to restore the natural processes of rivers and wetlands, the reconstruction of embankment reinforcement has become an important strategy. Unlike the embankment reconstruction of natural rivers, river-type urban wetland parks, especially in densely built areas, have limited space for natural development within the restricted areas of the original flood control. Thus, a variety of protective measures are designed to achieve diversified use in a limited riverbank area. Important design measures, such as designing permeable terraced banks or using natural elements such as plants, wood, and stones, can provide diverse habitats, create diverse water flow possibilities, and provide accessible open spaces that integrate water while securing banks.

A3.1*Yanweizhou Park and Yanxiu Park***Terraced banks**

Yanweizhou Park

Terraced revetment is a design measure that helps to enlarge the discharge cross-section, slow the speed of water flow, and increase accessibility to adjacent water areas. At the same time, terraces combined with vegetation planting can enhance the ecological function of the riverbank. For example, Yanweizhou Park removed the hard flood levees and turned the riverbank into a terraced bank that could be submerged in various flood conditions. The elevation of the bottom of the terrace 39.43 m above the river bottom marks the location of the flood in 20 years; the top of the terrace is 40.8m, which can withstand the 50-year flood height of 40.71 m. Flooding brings fertile silt and deposits it on terraces, enriching the growth conditions of native grasses in river-side habitats.

A3.2*Renaissance Park and Yanxiu Park***Timber revetment**

Yanxiu Park

One design possibility to protect the embankment is to use timber poles. Timber poles, combined with stones or living vegetation, are often used as embankment materials for river-type wetland parks. For example, in Yanxiu Park, timber poles made from existing trees on site, combined with gabions and cobbles, are used to build new embankments.

A3.3*Shanghai Houtan Park, Yanxiu Park, and Renaissance Park***Stone revetment**

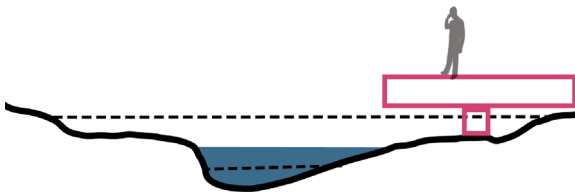
Shanghai Houtan Park

Securing riverbanks from erosion with stones can provide a variety of design possibilities. Depending on the specific circumstances of the site, stone materials for revetment can be consciously selected from a range of sizes, forms, and types. For example, in Shanghai Houtan Park, stacked riprap has been used to replace existing concrete floodwalls. These riprap protect the coastline from erosion and allow native species to develop along the edge of the river. It is also possible to better enhance the ecology of the river bank by combining various revetment forms, such as gabions or piled stones, as well as combining various materials such as logs, stakes, and seeds.

A3.4*Yanweizhou Park and Yuma East Wetlands***Plants embankment**

Yuma east wetlands

Protecting riverbanks with the help of living plants (rather than rock or concrete) can provide ecosystem services while preventing riverbank erosion. For example, in the Yuma East Wetlands, the riverbanks have been lined with buried willow withies and planted with a range of native species. This type of measure is often used, and this rough vegetation embankment also provides a rich habitat for certain fish, insects, and amphibians.

5.2.4 A4: Placing above the water

The inaccessible muddy and dirty water edges created by the annual water level fluctuations pose challenges to the accessibility of riverine wetland parks. The landscape design strategy of placing above the water helps to transform the previously deteriorating wetland habitat and the uninvited urban fringe into a multi-functional wetland park. In addition to realizing the ecological functions of regulating rain and purifying urban surface runoff, it can also become a public open space that would be accessible all year.

One possibility is to create a passage above the surface of the water that separates the pedestrian space from the edge of the wetland. For example, boardwalks and rest places built above the water with minimal interventions enable people to get close to nature without destroying nature. Other measures, including elevated piers, bridges, and buildings on piles, also provide visitors with open space that can be used at high water levels.

A4.1**Pavilions on piles***Yanxiu Park*

Yanxiu Park

At the edge of the river or in floodplains, pavilions on piles are often designed to provide visitors with open and covered spaces. Floods can flow underneath them instead of immersing them. The pavilion in Yanxiu Park offers a place to play and practice music all year round.

A4.2**Elevated piers***Renaissance Park*

Renaissance Park

Piers are placed above the water and open up new viewpoints for visitors. They enter the river space in a specific place and invite people to linger by the wetland. In Renaissance Park, the elevated pier above the constructed wetland offers great environmental education and wildlife viewing opportunities for visitors.

A4.3**Bridges over the water***Yanweizhou Park*

Yanweizhou Park

In Yanweizhou Park, a pedestrian bridge crosses two rivers connecting the banks of the southern and northern urban areas. During high waters, this bridge, elevated above the 200-year flood level, hovers above the riparian wetland and allows visitors an intimate connection to nature within the city.

A4.4**Buildings on piles***Yanweizhou Park*

Yanweizhou Park

Buildings on piles are a common setting for river landscapes. Buildings on the piles can be protected from flooding, and floods can flow underneath. In Yanwaizhou Park, the observation platform is built according to this measure. If the water level is high, the platforms remain accessible.

A4.5**Raised boardwalks/platforms**

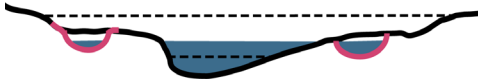
Harbin Cultural Center Wetland Park, Black Rock Sanctuary, and Shanghai Houtan Park



Harbin Culture Center Park

Boardwalks and rest places built above the water with minimal interventions enable people to get close to nature without destroying it. In Harbin Culture Center Wetland Park the raised boardwalks and platforms provide an open space that is accessible year-round for visitors.

5.2.5 A5: Increasing complexity



Increasing complexity means, to a certain extent, increasing the connectivity of each space. At the urban wetland park design level, this means enhancing habitat connectivity and increasing links between the various components of wetlands. Therefore, the strategy presented here is to increase the connections and interactions between water, plants, animals, and people. In this way, biodiversity and public space use can be synergistically enhanced. The design measures proposed in this design strategy include the establishment of a meandering path for the water in wetlands, the design of terraced wetlands, and the design of pond systems within the park.

A5.1
Establishing water's meandering path

Milliken State Park and Renaissance Park



Renaissance Park

In order to increase the interaction of water and plants to achieve maximum filtration and habitat increase, a certain curved path can be established in the wetland. In Renaissance Park, a buffered gabion planted with wetland plants subtly establishes a meandering path through the wetlands.

A5.2
Terraced wetlands

Yanweizhou Park and Shanghai Houtan Park



Shanghai Houtan Park

Inspired by Chinese agricultural terraces, the terraced wetlands were designed as a measure to deal with contaminated rivers. After entering the constructed wetland, the river water is filtered and purified step by step with the height of the terrace and the height difference of the plant. Meanwhile, the design of terraced wetlands can alleviate urban floods, expand habitats and biodiversity, and connect people to rivers. In Shanghai Houtan Park, the terraced wetland design resolves the height change from road to shoreline, creating a quiet valley for visitors and providing shelter for urban life, recreation, education, and research.

A5.3
Pond systems

Yanxiu Park



Yanxiu Park

In order to provide a more intimate human–water interaction and increase riparian habitat, a pond system can be designed inside the park. Ponds that are configured as trapezoidal or gentle slope vegetation embankments provide a more interaction with water and enhance the habitat structure of plants and wildlife. In Yanxiu Park, a side pond access system was established by connecting two existing gravel pits to the new creek to safely move floods into and out of the park.

5.2.6 A6: Contacting with water



Water and water landscapes have an important impact on human cultural development. The water environment in the city not only helps to improve the climate and provide habitat, but also brings huge benefits to the residents, such as education, culture, and recreational value. Contact with the water environment allows people to better understand nature, actively engage with plants and animals, and promote thought and action to better protect nature and resources for future generations.

Therefore, designers create a series of spaces through various design tools to promote people's opportunities to come into contact with water. For example, many wetland parks use multi-level platforms, bridges, boardwalks, adjacent water buildings, steps, and dams to provide open space for residents and visitors.

A6.1 **Boardwalks near banks**

Yanweizhou Park, Harbin Culture Center Wetland Park, Shanghai Houtan Park, Yuma East Wetlands



Harbin Culture Center Wetland Park

Creating boardwalks near the water is a common design measure in the strategies of contacting with water. These boardwalks not only carry people's activities, such as touching or observing water, plants and animals, but also as a walking channel to bring people into or out of this part of the water space.

A6.2
Gently sloped open lawn area near the river

Yanxiu Park



Yanxiu Park

A gentle open lawn area with a dense canopy and open view towards the river provides a closer interaction with the water. In addition, this plant embankment helps to enhance the habitat structure of plants and wildlife. In Yanxiu Park, a lawn slope on the river banks provide visitors with a large space to come into contact with the water. However, it should be noted that in the floodplain, this design is controversial in resisting the erosive river flows.

A6.3
Seating areas with direct views to the Lake

Yanxiu Park



Yanxiu Park

Seating areas with direct views to the lake gives people more opportunities to get in touch with water. At the Yanxiu Park's entrance plaza, a stepped seating area encourages people to directly enjoy Yanxiu Lake, and it provides plenty of open space for social events and other group activities.

A6.4
Waterfalls

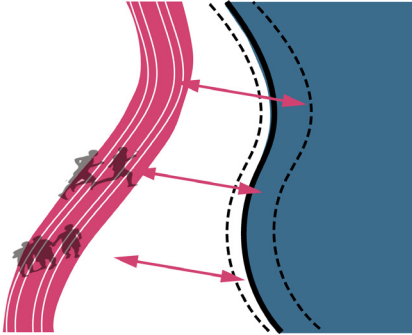
Yanxiu Park



Yanxiu Park

Waterfall design is a common design measure widely used in traditional Chinese gardens. In modern landscape design, for example in Yanxiu Park, the waterfall design combined with the terrain of the site provides the calming sound of water to block undesirable traffic noise from surrounding busy bridges and arterial roads.

5.2.7 A7: Integrating the public



In light of the typical heavy human use of parks within the city, especially in urban centres, many possibilities are available to connect river-type urban wetland parks to the public. The measures to achieve this strategy are mainly to meet basic needs such as providing space for fitness and walking, providing space for social groups, and special needs, such as space designed for practicing music or for fitness classes.

A7.1

Sports clubs or classes

Yanxiu Park



Yanxiu Park

Various spaces can be designed to provide a variety of activities for the public during non-flood periods. In the high-lying areas, sports fields, gym equipment, and looped running pathways are arranged as an important part of the park to provide space for fitness and walking. Yanxiu Park, using this measure, appeals to hundreds of citizens from various walking clubs every day.

Fitness Class

Milliken State Park



Milliken State Park

Urban Wetland Park provides places for the public to enjoy fitness classes. The Peter Stroh Memorial, for example, is located in the heart of Milliken State Park, with water features and 800 sq. ft. of courtyard with seating, providing fields for yoga classes.

A7.2*Yanxiu Park***Spaces designed specifically for practicing instruments**

Yanxiu Park

In addition to general open space use, there are times when special park uses need to be addressed, such as spaces designed to practice music on instruments. This situation is well shown in Yanxiu Park. By setting up a 'musician pavilion', the designer provides space for a practicing saxophonist or traditional Chinese erhu player. By providing open and covered spaces, the park allows nearby retired seniors to enjoy the waterfront while playing their instruments.

A7.3*Renaissance Park and Shanghai Houtan Park***Gathering space for social groups**

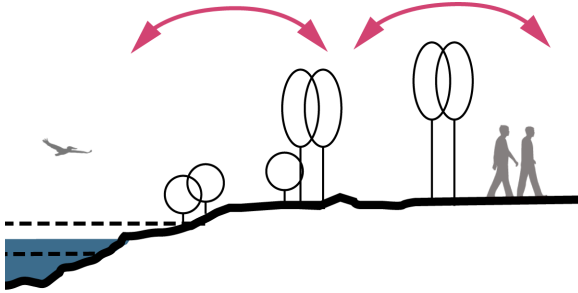
Shanghai Houtan Park

The provision of squares, platforms or specific defined areas can provide ample space for social and commercial events as well as other group activities such as singing and square dancing. In Shanghai Houtan Park, the 'hanging gardens' and floating docks are designed as nodes on the pedestrian network, creating areas in which small groups can gather.

5.3 Design strategies for lacustrine UWPs

In UWP Type B, the 'lacustrine UWP' denotes a wetland park where natural or artificial lakes or reservoirs occupy a dominant landscape. Lakes in urban areas are significantly affected by human activities, and there are two general types of spatial structures. Some of them have been influenced by historical agricultural activities, forming a series of rivers, farmlands, and fishponds to present a network-like spatial structure. Others have been artificially transformed into a central lake surface with a flatter coastline, shorter perimeters, and smaller changes in curvature. This type can provide natural habitats and serve as an open space through the design of transition areas and through controlling the intensity of use in different areas.

5.3.1 B1: Designing Transition Zones

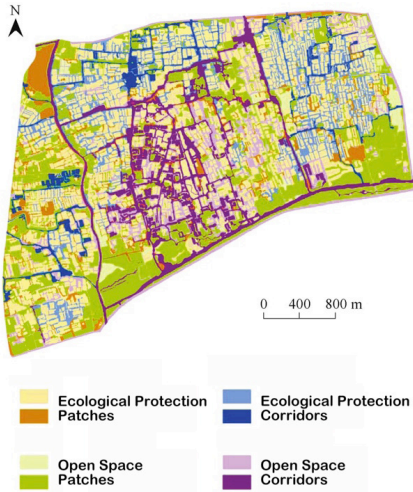


Many lake-type UWPs can play a significant role in ecological protection due to the large area of the protection they offer. More and more efforts are making the boundaries between natural and open spaces more flexible. This flexibility can provide people with more opportunities to engage with nature while meeting the needs of education, leisure, and entertainment.

However, some sensitive species and ecosystems depend on special protection, whether they have special requirements for privacy or are particularly sensitive to external influences. This dependence requires a buffer for these species: for example, dividing protected areas and public activity areas to adjust the intensity of human use in different areas. In order to better protect biodiversity, relevant areas of wildlife are specifically identified.

B1.1
Divide into protected areas and open space

Tangshan Nanhu Eco-City Central Park, Beijing Olympic Forest Park, and Xixi Wetland Park



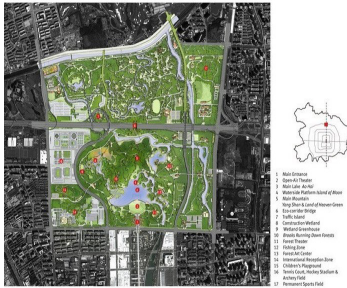
With this design tool, an urban wetland park establishes both protected areas and open spaces. The protection area refers to the landscape that can be used for ecological protection without human disturbance; the open space area refers to the landscape that provides viewing, leisure, recreation and education functions for human beings. For example, in Xixi Wetland Park, the landscape is divided into three levels according to the functional classification system. The first-class classification is based on the attribute characteristics of the park landscape elements and is divided into two types: patch and corridor. The secondary classification is based on the functional characteristics of landscape elements and is divided into ecological protection types and open space types.

Xixi Wetland Park

The distribution of corridors and patches within ecological protection types and open space types. Retrieved from Li et al. (2011, pp. 1025).

B1.2
Certain sensitive areas are designed expressly for wildlife

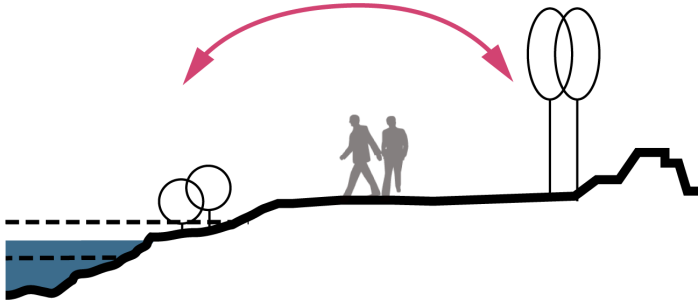
Tangshan Nanhu Eco-City Central Park, Beijing Olympic Forest Park, and Xixi Wetland Park



Beijing Olympic Forest Park

In many cases, sensitive areas that focus on wildlife protection are considered to be designed in parks. In the Olympic Forest Park, the North Park is designed to be a natural wild jungle focussed on ecological protection and restoration functions, preserving original natural landforms and vegetation as much as possible. It differs from the South Park, which is mainly engaged in recreation and entertainment functions, providing service facilities and event space for the public.

5.3.2 B2: Connecting biotope with open space systems

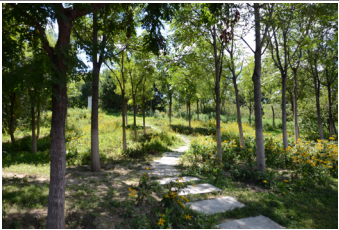


The combination of valuable biotopes and available open spaces is a common and effective way to extend protected wetlands to additional open spaces. By intelligently combining different needs, biotopes in urban wetland areas can be quite recognisable, as their expansion into open space systems will bring direct added value to the population. The diverse structure of the wetland areas enhances the value of entertainment. A basic prerequisite for successful realization—from the perspectives of both ecological protection and open space use—is that biotopes that are as insensitive as possible are directly adjacent to the areas with human use. Otherwise, it may be advisable to design transition zones (see B1). Common design measures for connecting biotopes with open spaces of lake-type UWPs include creating corridors, trail systems designed to encourage visitors to explore, and submersible stepped-terraces that descend down to the lake.

B2.1*Beijing Olympic Forest Park***Creating corridors**

Beijing Olympic Forest Park

Creating corridors is a design possibility to help create a continuous green space system that connects the partitioned areas of the park to better meet the needs of wildlife and people. In the Beijing Olympic Forest Park, a highway divides the park into a South Park and a North Park. In order to maintain the connection of wildlife habitats and pedestrians, an elevated eco-corridor was constructed.

B2.2*Beijing Olympic Forest Park, Carmel Clay Central Park, and Tangshan Nanhu Eco-City Central Park***Trail systems designed to encourage visitors to explore (the woods areas or hill)**

Beijing Olympic Forest Park

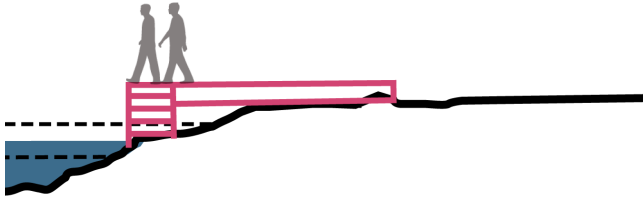
The design of the trail system in the forest area or in the hills encourages visitors to explore the woods and grasslands or native areas within and outside the trail system, providing opportunities for intimate contact with nature and creation of memories related to nature. For example, many such routes are designed on the hills of the South Park of the Beijing Olympic Forest Park.

B2.3*The Morton Arboretum Meadow Lake***Submersible stepped-terraces descend down to the lake**

The Morton Arboretum Meadow Lake

One possibility to connect biotope with open space is to create submersible stepped-terraces. These terraces gradually descend to the bottom of the lake, interacting directly with the water's edge and allowing a feeling of immersion in the landscape. In the Morton Arboretum Meadow Lake, two limestone stepped terraces are designed like this. They are home not only to turtles and frogs, but also provide opportunities for people to observe them at close range.

5.3.3 B3: Contacting with water



The urban wetland environment not only increases biodiversity and improves microclimate, but also serves as an important place for active environmental education. Humans can come into contact with water and related flora and fauna to observe, understand, and experience them. Close contact with water promotes sustainable thinking and action, thereby indirectly protecting water resources and the natural environment for future generations. A series of design measures can intensify this contact with water in urban wetland parks: for example, creating boardwalks, waterside buildings, walking dams, stairs, boat docks and extensive boardwalks, and waterfalls along the water's edge.

B3.1 **Create boardwalks near the water**

Xixi Wetland Park, Beijing Olympic Forest Park, Carmel Clay Central Park, and Tangshan Nanhu Eco-City Central Park



Xixi Wetland Park

Creating boardwalks is a common design measure for UWPs. These boardwalks support people's activities, such as touching or observing water, plants, and animals, and they are walking paths that bring people into or out of this part of the water. For example, in Xixi Wetland Park, there are many such boardwalks that lead people to the water.

B3.2*Xixi Wetland Park***Put buildings at the water edge**

Xixi Wetland Park

Putting buildings on the water's edge is a common measure used in traditional Chinese gardens. There are many forms of these buildings, such as 'Xie', which refers to a waterside pavilion; 'Fang', which refers to a marble boat; and 'Ting', which refers to a pavilion. In Xixi Wetland Park, there are many such waterside buildings that bring people closer to the water and let visitors feel in touch with the water.

B3.3*Xixi Wetland Park***Create walking dams**

Xixi Wetland Park

Xixi Wetland has retained thousands of persimmon fish ponds and mulberry fish ponds. This kind of pond is a traditional production method to show the sustainable use of farming culture, and it is a model for harmonious coexistence between residents and wetland ecosystems. The vertical bank of this pond retains the possibility of people coming into contact with water. In the design of wetland parks, walking dams like this bank can be designed to contribute to the sustainable thinking characteristic of ancient agricultural production.

B3.4*Xixi Wetland Park***Create stairs near the water**

Xixi Wetland Park

In the water towns south of the Yangtze River in China, stairs are usually designed at the border between buildings and rivers for people to enter ships or to wash clothes by the water. In Xixi Wetland Park, the design of the stairs can achieve a close connection between people and water. There are several different design types depending on the shape of the steps, such as rectangular and semi-circular steps.

B3.5*Tangshan Nanhu Eco-City Central Park***Boat docks and extensive boardwalks**

Tangshan Nanhu Eco-City Central Park

One design possibility is to set up boat docks along the lakeshores. These docks, combined with extensive boardwalks, take people to the water's edge and connect to other passages in the park. In Tangshan Nanhu Eco-City Central Park, docks and boardwalks designed like this create a variety of opportunities to come into contact the water, such as boating, walking along the lake, and touching or closely observing water, wetland plants, and animals.

B3.6*Beijing Olympic Forest Park*

Design waterfalls

Beijing Olympic Forest Park

A waterfall combined with stone is a common design way in the traditional Chinese garden art. Based on the terrain, stones are piled up, and water is drawn from top to bottom to form a natural waterfall. This waterfall design tries to hide the traces of the work as much as possible, emphasizing the naturalness of the environment. In Beijing Olympic Forest Park, the waterfall is designed according to this principle, providing people with space to feel the water and nature through their senses of sound, touch, and sight.

5.3.4 B4: Varying the lakeshore reinforcement



In the past, some lakes were affected by improper renovation, their lakeshores were stiff, and their coastlines were short. This earlier landscape alteration has greatly undermined the continuity of the lake wetland ecosystem. Therefore, in order to restore the natural processes of lakes and wetlands, the reconstruction of embankment reinforcement has become an important strategy. Important design measures, such as stone revetments, plants placed along the water's edge, and gabions embankments, provide a diverse range of habitats and provide accessible open spaces having contact with water, while the lakeshore is still protected.

B4.1*Railroad Park and Carmel Clay Central Park***Stone revetment**

Stone revetment is a common measure to reinforce the lakeshore. For example, in the Carmel Clay Central Park, local stones combined with bioengineering are used to stabilize the bank. These piled stones provide a diverse habitat for aquatic and amphibious organisms.

Carmel Clay Central Park

B4.2*Xixi Wetland Park, The Morton Arboretum Meadow Lake, and Tangshan Nanhu Eco-City Central Park***Planted edge**

Plants along the water's edge help to restore the structural integrity of natural wetlands while providing the necessary habitat for certain wildlife. The large amount of vegetation and planted edges in Xixi Wetland creates an original natural landscape and beautifully green scenery.

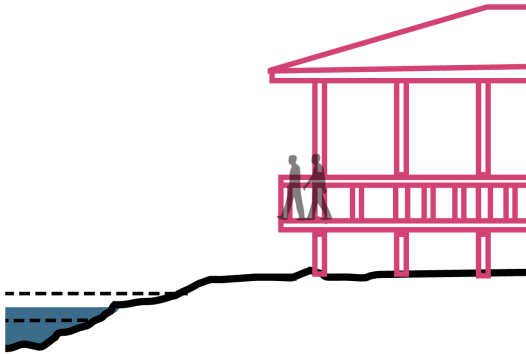
Xixi Wetland Park

B4.3*Tangshan Nanhu Eco-City Central Park***Gabions embankment to stabilize the lakeshore**

Gabions, sometimes combined with plant material, can be placed on lakesides to protect the lakeshore and mitigate the effects of erosion and settlement on the revetment. In the Tangshan Nanhu Eco-City Central Park, a combination of gabions with branches of abandoned plant material from the park and willow posts are used to construct embankment.

Tangshan Nanhu Eco-City Central Park

5.3.5 B5: Cultivating characteristics



Modern urban landscapes' characteristics mainly depend on a highly unified contemporary element. However, where historical landscape structural elements, historical sites, or traditional forms of land management still exist, they add local characteristics to the urban landscape. These characteristics can be used to enhance the character of a place, both in terms of tourism appeal and in increasing the identity of local citizens. Planners and designers can take advantage of these features to create a more diverse landscape. This strategy is often identified in the early stages of UWP planning and design, and common design measures include the preservation and restoration of historical landscape structures and building structures.

B5.1*Xixi Wetland Park***Historic landscape structure**

Xixi Wetland Park

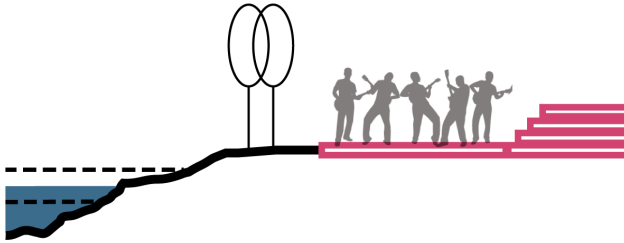
Historical landscape elements, plant communities, and topographical features reflect previous uses and landscapes. Careful design or restoration of these can also be the goal of ecological protection and public space use. Especially in urban environments, historical structures are often rare and threatened by over-development, so it is especially important to preserve them here. For example, in Xixi Wetland Park, thousands of persimmon fish ponds and mullet ponds have been preserved. This kind of pond is a traditional production method that demonstrates the sustainable use of farming culture, and is a model for the harmonious coexistence of wetland human residents and wetland ecosystems. In order to achieve continuity of conservation goals, some of the indigenous farmers are involved in the permanent maintenance of these structures.

B5.2*Xixi Wetland Park***Historical buildings**

Xixi Wetland Park

In some historic UWPs, historical buildings are preserved and restored as important landscape nodes, which can greatly enhance the cultural value of urban wetland parks. For example, there are many historic buildings in Xixi Wetland Park. They showcase the characteristics of traditional Chinese courtyards, such as Gaozhuang from the Qing Dynasty.

5.3.6 B6: Integrating publics



As an important green space in the city, the lake-type urban wetland park has great potential to motivate public use, due to its large lake area and rich landscape elements. The measures to achieve this strategy are mainly to meet the basic needs of the public as much as possible on the basis of preserving the ecological resources of the original site: for example, preserving the original fruit trees and setting up a public orchard provide opportunities for the public to participate in urban agriculture; establishing wetland botanical gardens to protect and display wetland plants; educating the public to protect wetland resources; designing the pathways to combine the forests and plants in the outer circle of the park, which provides the public with opportunities for fitness and interaction with nature.

B6.1

Public orchards

Xixi Wetland Park



Public orchards can help preserve original fruit trees and allow the public to experience the joy of picking fruit. In Xixi Wetland Park, an orchard area with more than 10,000 persimmon trees provides a venue for the Xixi 'Fire Persimmon Festival' from September to October each year. Visitors pick persimmons under the guidance of a professional fruit grower. These professional fruit farmers are generally former local villagers, who are very familiar with the environment and the persimmon trees.

B6.2
Educating the public to protect wetlands

Xixi Wetland Park



Xixi Wetland Park

Through the design of exhibition venues and signs, UWPs offer the public, especially teenagers and children, opportunities to learn about wetlands and enhance their ecological awareness. For example, Xixi Wetland Park, which was selected as the base of practice education for primary and middle school students in Hangzhou, specially designed a wetland botanical garden. There are various exhibition areas in this garden to display wetland plants in the ecological diversity of the Xitang system, rivers, and beaches.

B6.3
Looped running pathway

Beijing Olympic Forest Park and Carmel Clay Central Park



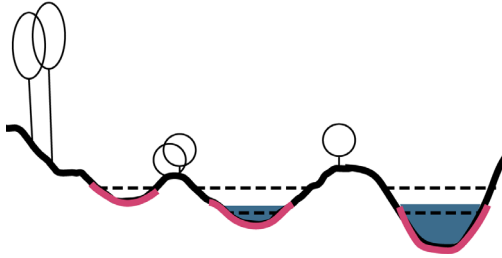
Beijing Olympic Forest Park

Combining runway design with UWP forests enhances public exercise and opportunities for natural contact. For example, in the Olympic Forest Park, South Park's looped plastic runway, including a 3-km running route and a 10-km running route, attracts a large number of tourists and local residents to run and exercise. This runway, distributed in the outer circle of the park road, combines the dense forests and plants around it to provide runners the sense of running in the forest.

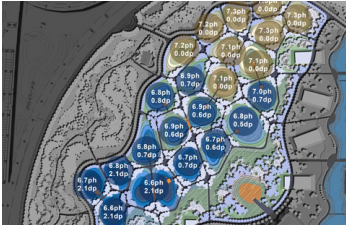
5.4 Design strategies for palustrine UWPs

As UWP Type C, the 'palustrine UWP' is a park where seasonal basin wetlands dominate the landscape, built by the artificial restoration of ponds and degraded wetlands. It usually represents the transformation of a former brownfield site in a populated community into a functional and attractive wetland landscape. Due to the serious damage to the base ecosystem and the short time available for natural restoration, the palustrine UWP has relatively poor environmental quality, a single spatial type, and poor landscape diversity. Owing to the artificial excavation of multiple water bodies, the spatial structure is scattered, and the degree of landscape fragmentation is relatively high. In addition, this type of wetland park has less isolation and buffer areas from populated areas and is primarily affected by human activities. This type of park provides a symbiotic area for people and animals by improving the quality of public spaces and complementing the habitat system in the city area.

5.4.1 C1: Increasing diversity



In many ways, the concept of diversity has an important impact on landscape design. The specific space of the landscape design should be accepted by many different people at the same time, for example local residents, tourists, children, and adults. A successful ecosystem, designed or natural, is possible only through a harmonious combination of countless plant and animal species. Therefore, we attach importance to the diversity of the environment. The strategy of increasing diversity leads to more attractive spaces for humans, animals, and plants. In palustrine-type UWP design, measures presented in this design strategy include creating ponds of various depths, increasing the number of small wetlands, and creating diverse water storage areas.

C1.1**Create ponds of various depths***Qiaoyuan Park*

Qiaoyuan Park

Ponds of different sizes and depths are created in the park, and finally mixed pools, seasonal pools, and dry voids are supplied by rainwater and groundwater. With subtle changes in groundwater levels and pH, the seasonal vegetation forms a low-maintenance and 'disordered' native landscape and aesthetics.

This design measure was applied to Qiaoyuan Park. The original terrain of the park gradually decreases from northeast to southwest, and pond designs of different depths are combined with microtopography. Water flow channels are also provided between these ponds. In dry ponds, soil can be improved by seasonal rain washing and filtration. In deeper ponds, stormwater runoff and nutrients are captured and stored.

C1.2**Increase number of small wetlands***Qunli Wetland Park and Qiaoyuan Park*

Qunli Wetland Park

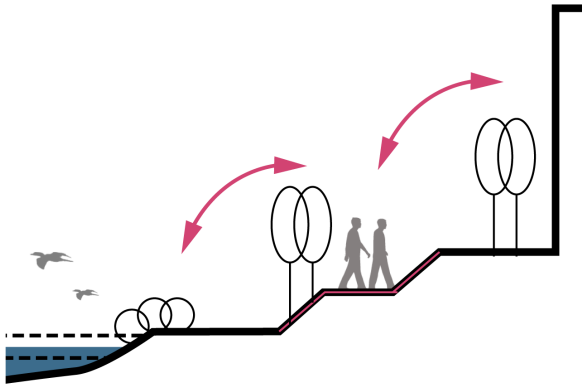
Designing a series of small wetlands on the outskirts of the park helps treat rainwater and reduce the possibility of contamination of the internal natural wetlands. These small wetlands can also be designed to provide people with space for relaxation and rest. In Qunli Wetland Park, rainwater around impervious areas and roads is collected through pipelines into these small wetlands. After deposits and contaminants are gradually removed, it flows into the natural wetlands.

C1.3**Various water storage areas***Maurice Rose Airfield, Frankfurt Bonames*

Maurice Rose Airfield, Frankfurt Bonames

A temporally and spatially variable water surface can be created by water storage. In the Maurice Rose Airfield in Frankfurt-Bonames, the water storage area including the gravel area and the sealed area creates a variety of habitats and brings diversity in appearance. Meanwhile, this design measure creates an obstacle to preventing unnecessary entry.

5.4.2 C2: Designing transition zones

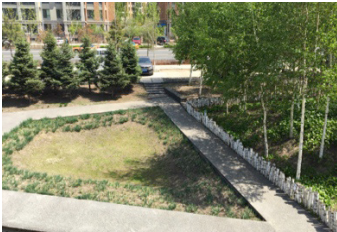


By designing the transition area, a designer can subtly integrate ecologically valuable areas into public open spaces without fences or barriers. Since urban open spaces are close to people's daily residences, this strategy can actively promote people's contact with nature. Especially in heavy development areas, this contact with nature often disappears in people's daily lives. Transition zones provide opportunities to protect adjacent areas from negative effects such as noise, shielding unsightly areas, and in turn possessing valuable biomes and habitats. In the palustrine-type UWP design, the proposed measures in this design strategy include leaving the natural core, creating buffers, and dividing different areas by use intensity.

C2.1*Qunli Wetland Park***Leave the natural Core**

Qunli Wetland Park

The existing natural areas are preserved, allowing animals and plants to maintain their balance without human interference. For example, Turenscape's plan for Qunli Wetland Park tried to leave untouched the degraded wetlands in the centre of the site.

C2.2*Qunli Wetland Park, Rudow Park, and Palmisano Park***Create buffers**

Qunli Wetland Park

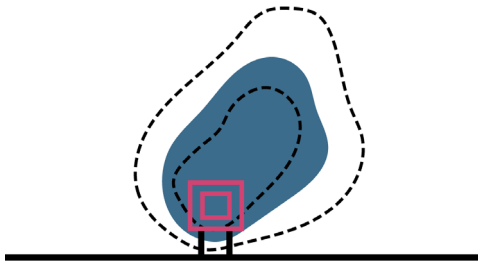
Buffer zones are designed between the human settlements and natural areas. For example, cutting and filling techniques are used to create a necklace of ponds-and-mounds around the natural wetlands in Qunli Wetland Park. These ponds create storm water filtrating and cleansing buffer zones for the core wetland, as well as a transition area between nature and the urban landscape.

C2.3*Maurice Rose Airfield, Frankfurt Bonames, and Rudow***Divide different areas by use intensity***Park*

Maurice Rose Airfield, Frankfurt Bonames

Different areas are divided according to the intensity of use, such as the active area, transition area, and intensive use area. In this way, valuable areas of plants and animals can be protected while different spatial sequences can be created. For example, in Maurice Rose Airfield, between intensive recreation areas and valuable nature reserves, in the natural succession area, reusable and layered concrete slabs are also used to create a place to experience and understand natural processes on the broken asphalt surface.

5.4.3 C3: Contacting with water



The aquatic environment in urban areas brings great educational, cultural, and recreational value to the residents, in addition to helping to improve the climate and provide habitat. Contact with the aqueous environment enables people to better understand nature and promote thinking and action to better protect natural resources for future generations. For palustrine UWPs, designers create a range of spaces through a variety of design measures to promote people's close proximity to water. For example, many wetland parks create raised platforms and boardwalks near the water and bridges.

C3.1

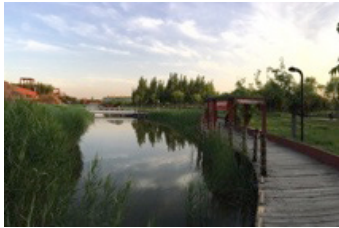
Create raised platforms

Qunli Wetland Park and Qiaoyuan Park



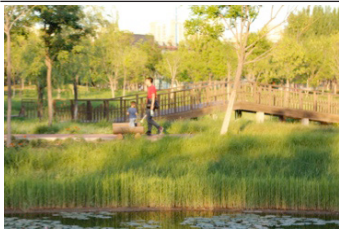
Qunli Wetland Park

Raised platforms are designed in the wetlands and ponds where visitors can sit on these them and experience the feeling of being surrounded by aquatic plants. They also provide space to watch and get close to the water, to rest, and to chat with other people, such as in Qunli Wetland Park.

C3.2*Qiaoyuan Park and Magnuson Park***Create boardwalks near the water**

Qiaoyuan Park

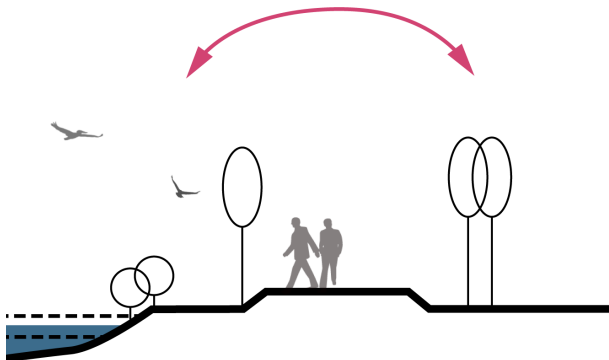
Placing boardwalks by the water is a common design measure for palustrine UWPs. The boardwalk along the water in Qiaoyuan Park gives people a pleasant waterscape experience and the opportunity to get close to the water and to aquatic plants.

C3.3*Qiaoyuan Park and South Los Angeles Wetland Park***Bridges**

Qiaoyuan Park

Bridges are cleverly designed between wetland bubbles and connected to the parade trails. They provide visitors with a continuous walking experience and the opportunity to immerse themselves in the beautiful native grass and wildflower landscape.

5.4.4 C4: Combining habitat with open space



The combination of less sensitive biotopes and available open spaces is a common and effective way to extend wetlands into open spaces. By intelligently

combining different needs, biotopes in urban wetland areas can be quite recognizable, as their expansion into open space systems directly adds value for the population. For palustrine-type urban wetland parks, common design measures include creating recreation trails along the filtration ponds and creating observation platforms in the ponds.

C4.1
Recreation trails along the filtration ponds

South Los Angeles Wetland Park, Qiaoyuan Park, Maurice Rose Airfield, Frankfurt Bonames, and Palmisano Park



Recreation trails are designed along the filtration ponds. The trails between ponds in Qiaoyuan Park are connected into a net and extend into the interior of the community, giving people the opportunity to be close to wetlands and the plant community.

Qiaoyuan Park

C4.2
Almost every pond has an observation platform

Qiaoyuan Park



Setting observation platforms in the wetlands and ponds is a means of combining open space use with ecological habitats. Signs appear on each type of community plot to provide a scientific explanation of each type of natural ecosystem, including water, vegetation, and species, to help people gain knowledge about the local natural system while experiencing the beauty of the native landscape.

Qiaoyuan Park

5.5 Strategies related to the list of challenges

The proposed strategic framework has proved feasible to address all design challenges relating to ecological enhancement and open space use. We found that the proposed strategic framework could basically cover the design challenges of Section 4.2, in which the two goals of maintaining biodiversity and creating spaces for recreational activities are central (see Figure 5.3).

| | Challenges 1-13 | | | | | | | | | | | | |
|---|---|-----------------------------|--------------------------|------------------------------|--|--------------------|----------------------|------------------------|-----------------------------------|-------------------------------|--------------------------------|---|---------------------------------------|
| | Increasing the connectivity of habitats | Controlling water pollution | Maintaining biodiversity | Controlling invasive species | Maintaining structural integrity of wetlands | Erosion regulation | Reducing flood risks | Storm water management | Preserving the cultural resources | Providing necessary amenities | Encouraging full participation | Creating spaces for recreational activities | Providing opportunities for education |
| Strategies for Riverine UWP | | | | | | | | | | | | | |
| A1 Tolerant of water-table changes | | | | | | | | X | | X | | | |
| A2 Increasing floodplain space | | X | | | | X | X | | | | | X | |
| A3 Varying the riverbank reinforcement | | X | X | X | | | | | | | | | |
| A4 Placing above the water | | | | | | | | X | | X | X | | |
| A5 Increasing complexity | X | X | X | | | | | | | | | | |
| A6 Contacting with water | | | | | | | | X | | X | | | |
| A7 Integrating the public | | | | | | | | | X | X | X | | |
| Strategies for Lacustrine UWP | | | | | | | | | | | | | |
| B1 Designing transition zones | | X | X | | | | | | | | | X | |
| B2 Connecting biotope with open space systems | X | X | | | | | | | | | | X | |
| B3 Contact with water | | | | | | | | | | | | X | |
| B4 Varying the lakeshore reinforcement | | | | X | | | | | | | | | |
| B5 Cultivating characteristics | | | | | | | X | | | | | | |
| B6 Integrating the public | | | | | | | | | X | X | X | | |
| Strategies for Palustrine UWP | | | | | | | | | | | | | |
| C1 Increasing diversity | | X | | | | | | | | | | X | |
| C2 Designing transition zones | | X | X | | | | | | | | | X | |
| C3 Contact with water | | | | | | | | | | | | X | |
| C4 Combining habitat with open space | X | | | | | | | X | | X | | | |

Figure 5.3 Design strategies related to challenge types

In addition, the findings demonstrate numerous strategies that can address multiple challenges and goals simultaneously; for example, 'A2: Increasing floodplain space' is related to maintaining biodiversity, reducing flood risks, storm water management, and creating spaces for recreational activities. Moreover, 'A3: Varying the riverbank reinforcement' is linked to maintaining biodiversity, maintaining wetland structural integrity, and erosion regulation. Similar strategies include 'A4: Placing above the water', 'A5: Increasing complexity', 'A7: Integrating the public', 'B1: Designing transition zones', 'B2: Connecting the biotope with open space systems', 'B6: Integrating the public', 'C2: Designing transition zones', and 'C4: Combining habitat with open space'.

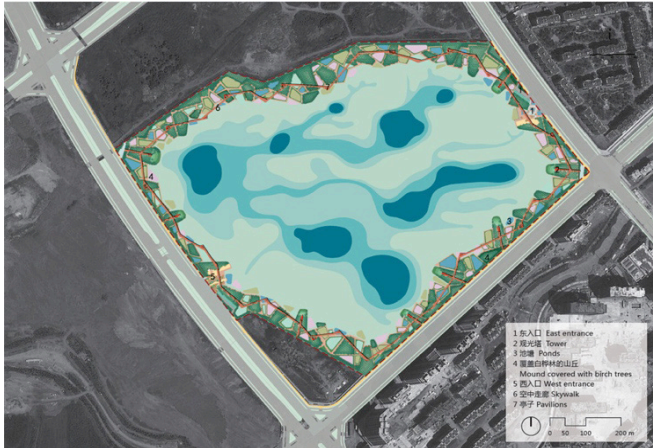
5.6 Summary

In this chapter, the core of the thesis is developed from the connection of the theoretical framework in Chapter 4 and examples of good practice: a variety of design strategies and measures for the integration of ecological aspect and the use of open space in urban wetland areas. Sections 5.2–5.4 present 4–7 superordinate design strategies, which establish the framework for design measures and tools. Of course, for this part of the research, it is impossible to cover all the possibilities, but the vast majority of the design measures are expressed and transformed into usable design knowledge. Additionally, it should be noted that each measure does not exist independently. For a certain park or design task, multiple measures can be used together. The design measures serve as inspirations for new multifunctional approaches and can be transferred in future design tasks for relevant situations.

Chapter 6 In-depth case studies

This chapter addresses the third research question: what benefits do selected UWP design guidelines yield on concerns of ecology and open space use in practice, as exemplified in six Chinese case studies? It focuses on in-depth analysis and reflection on the application of the selected design measures in these case studies. It analyses these cases through field research combining with secondary data. First, it evaluates the benefits of parks in terms of concerns of ecology and open space use, and then it evaluates the relationship between the benefits and the design measures used. The benefits of open space use for each case study are developed from the evidence of park characteristics in Table 2.2 of Chapter 2.

6.1 Qunli Wetland Park



Project Location: Qunli New District, Harbin City, Heilongjiang Province, China

Project Classify: Palustrine UWP

Project Scale: 30 ha

Design Time: 2009-6

Construction Time: 2011

Client: The Municipal Government of Harbin City

Designer: Turenscape

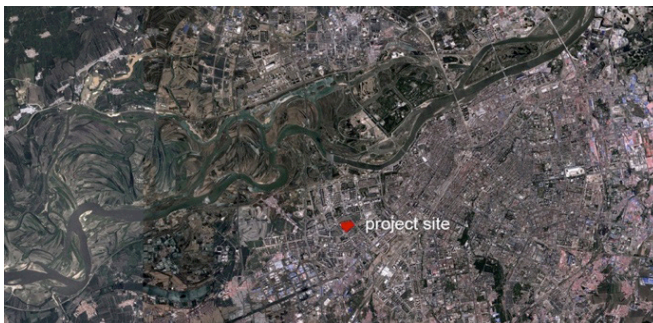


Figure 6.1 Plan of Qunli Park and location in Harbin.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Qunli is a new community located in the west of Harbin City, located in Heilongjiang Province in northeastern China. In 2009, the local government commissioned Turenscape to design a wetland park in the centre of Qunli District, covering an area of 34.2 ha. The park was initially a degraded wetland, surrounded by roads and intensive urban development. Therefore, the water source of this former wetland was cut off, and the survival of the wetland was threatened. The challenge is clear. The location of the park was originally a protected natural wetland. However, with the development and construction of the city, the habitat has been degraded, and the wetland landscape is gradually disappearing. In addition, flooding and water logging have been frequent in the history of this area. The design of the park should be able to cope with this problem. The project demonstrates that the proposed wetland park, which acts as a green sponge, cleans and stores urban rainwater, can be combined with other ecosystem services to prevent damage caused by urban encroachment, while turning the site into a beautiful green space for the new urban community.

6.1.1 Design measures in the park

The design attempts to work with nature rather than trying to create a new environment. The main concept for the development of Qunli Wetland Park is to make it into ecological infrastructure, consequently providing the services of multiple eco-systems for the city. Important specific design measures include the following four types: 'C1.2: Increase number of small wetlands', 'C2.1: Leave the natural core', 'C2.2: Create buffers', and 'C3.1: Create raised platform'.

C1.2: Increase number of small wetlands



Rainwater in the surrounding impervious areas and roads are collected through pipelines into sedimentation pond in the park. It then enters the treatment ponds where sediments and pollutants are gradually removed. Finally, it flows into the natural wetland. After cleaning, the water seeps into the water table.



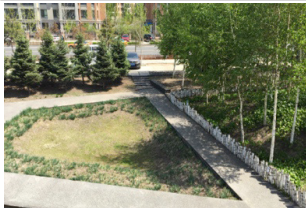
Native wetland grasses grow in the ponds at various depths, and groves of native silver birch trees (*Betula*) create a dense forest setting.

C2.1: Leave the natural core



Turenscape's plan for Qunli Wetland Park sought to leave the existing degraded wetland in the middle of the site untouched. This allows the flora and fauna to maintain their own balance without interference from humans.

C2.2: Create buffers



Cut-and-fill technique was used to create a necklace of ponds-and-mounds surrounding the former wetland. This pond-and-mound peripheral ring surrounding creates a storm water filtrating and cleansing buffer zone for the core wetland, and a welcoming landscape filter between nature and city.

C3.1: Create raised platform



Raised platforms in these small wetland pools are designed for providing a space for sitting, viewing and getting close to water, taking rest, and chatting with other people.

6.1.2 Open space use

This project provides a platform for people to watch and understand wetland landscape through the construction of recreational space, which is a good place for citizens to take rest as well as promote the development of the surrounding urban areas.

Behaviour-mapping analysis

According to the on-site behaviour-mapping analysis, people mainly walk and stand in Qunli Wetland Park. The most active park use area is on the periphery of the wetlands, on the network of paths and on the platforms, as shown in Figure 6.2.

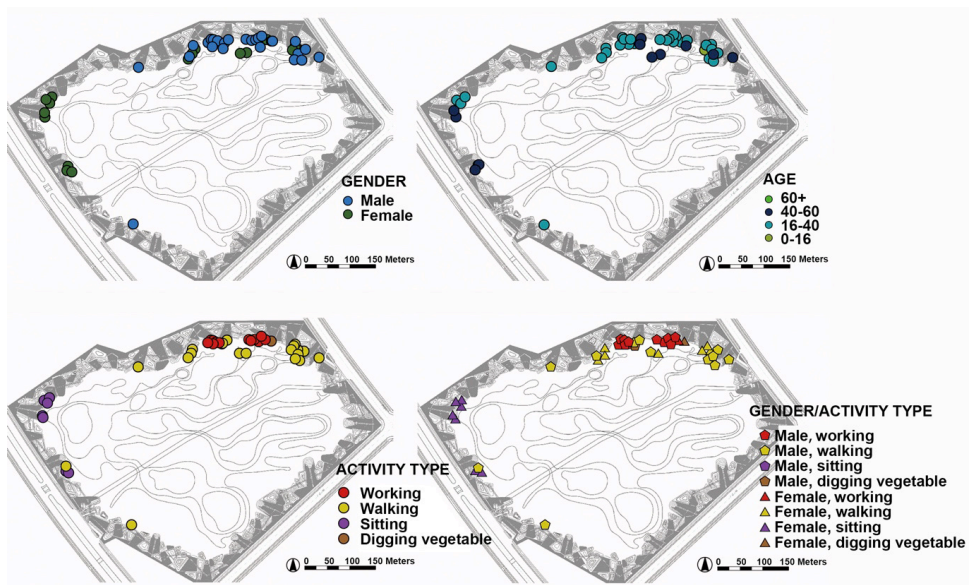


Figure 6.2 Behaviour-mapping in Qunli Wetland Park.

Four groups are divided according to gender, age, activity type, and gender mix activity type.

What typical activities could be discerned? Where are these activities?

Walking was recorded most in the park. Walking was recorded twice as often as sitting. The locations of people walking or sitting are mostly along patches determined by paths, especially on the north side of the park.

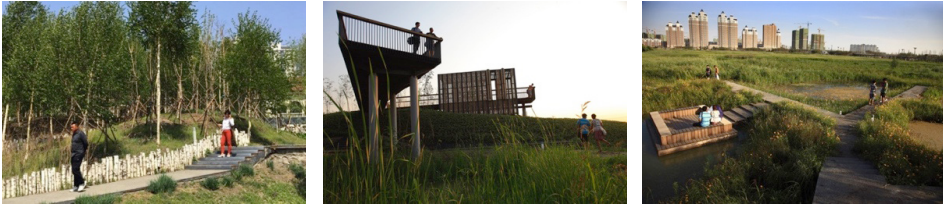


Figure 6.3 Typical use in Qunli Park

Which visitor groups have the most recorded visits? Where are they?

There are predominantly female visitors sitting on the benches (2–3 people a group, communicating face-to-face) in the western area and in the shade of large trees. Male visitors mostly walk around the park or on the small hills in the north, bordering the adjacent residential areas. At the transparent edge in the north eastern part of the park, a group of construction workers use the shade of the trees to take a rest while working. Young people walk through the park quickly, while senior visitors have longer stay in the park mainly in the quieter area with shades.

Based on the distance from the park’s spatial nodes (e.g., path and edges), four spaces can be identified in the park: patches partitioned by inner paths, areas along the paths, area near the edge, and central spaces that are not partitioned by paths. Among them, activities mostly occur in the peripheral area including the partitioned one by inner path or along the paths. No human activity was observed in the central spaces that are not partitioned by paths or the area attached to the south eastern edge of the park, which lies along a busy road.

Evaluation of the five aspects of open space use

An evaluation of the five aspects of open space use found that the benefits of Qunli Park are mainly reflected in features, aesthetics, and access (see Table 6.1). They specifically include increasing natural features, supporting recreation, providing beautiful scenery with nature and greenery, improving access to open space.

Table 6.1 Potential effects and evidence of open space use of Qunli Park

| Open space use | Benefits and effects | Evidence | Source |
|----------------|--|---|--|
| Features | <ul style="list-style-type: none"> • Increasing natural features | Diverse plant species and bird resources | (Sun, Wang, Xu, & Jing, 2013); My field research |
| | <ul style="list-style-type: none"> • Supporting recreation | Elevated bridges, observation towers, paths and viewing platforms | My field research |

| | | | |
|------------|---|---|---------------------------------------|
| Aesthetics | • Providing beautiful scenery with nature and greenery | Park's large area of green vegetation, abundant wild animals, and the 'birds and flowers' environment, highly valued by users | (Hou & Qiao, 2013); My field research |
| Access | • Improving access to open space | The park provides public space for residential communities nearby; 5 bus lines. | (Hou & Qiao, 2013); My field research |

Features

In terms of park characteristics, the performance of Qunli Park is as follows: 1. It offers a variety of facilities including: elevated bridges, observation towers, paths and viewing platforms. 2. It has a wealth of natural features, such as plant species and bird resources, and providing visitors with intimate experience of natural landscapes. This project preserved a large number of original poplar and willow trees with good growth conditions, and appropriately increased the dicotyledonous herb varieties to increase the richness of the natural landscape (Sun et al., 2013).

Aesthetics

Qunli Park provides beautiful scenery with nature and greenery, as highlighted by parks users and evidenced in Hou and Qiao's survey in 2013. Of the respondents, 42.8% gave a high evaluation of the overall environment of the park (Hou & Qiao, 2013). Among all the reasons, the park's large area of green vegetation, abundant wild animals, and the 'birds and flowers' environment were highly valued by them (Hou & Qiao, 2013).

Access

Qunli Park provides public space for many residential communities nearby. According to Hou and Qiao's survey, most of the users come from neighbourhoods near Qunli Wetland Park, such as Lishui Lilac Garden, Zhuanshi Garden, or Qunli Xinyuan. Most users (70.2%) can walk to the Wetland Park within 30 minutes (Hou & Qiao, 2013). In addition, there are five bus routes at the entrance to the park, which is convenient for long-distance visitors.

Reflection on problems and negative effects

According to field research, there are some problems in Qunli Park that affect their use of open space. These problems include the lack of amenities such as shade facilities, fitness exercises, or children's play facilities; inadequate upkeep and management, such as wild grass growing too long or even obstructed roads; and seats and observation platforms are not in good condition.

6.1.3 Ecological concerns

The ecological evaluation found that the benefits of Qunli Park are mainly reflected in its consideration of biodiversity, restoring the natural structure, and storm water retention (see Table 6.2). These benefits include, more specifically, increasing species diversity, improving water quality, and storing storm water.

Table 6.2 Potential effects and evidence of ecological aspects of Qunli Park

| Ecological aspects | Benefits and effects | Evidence | Source |
|---------------------------------|---------------------------------------|--|------------------------------------|
| Consideration of biodiversity | • Increasing species diversity | Compared to other urban parks, Qunli Wetland Park has a high diversity and evenness of bird communities; 49 species of birds were observed; 137 species of vascular plants are investigated by field survey. | (Li & Mu, 2014; Wang et al., 2015) |
| Restoring the natural structure | • Improving water quality | Artificial wetland pool systems are evidenced to have a clear purification effect on water quality. | (Li, 2013) |
| Storm water retention | • Storing storm water | The rainwater storage capacity is 71,906 m ³ (under normal conditions) and 1,370,675 m ³ (under maximum rainwater storage conditions). | (Li, 2013) |

Consideration of biodiversity

Qunli Wetland Park's support for biodiversity is reflected in two aspects: firstly, the number of birds and ecological diversity: according to Wang et al.'s survey of the distribution and number of birds in seven urban green spaces in Harbin in March–May 2014, the number of bird species observed in Qunli Park was 49, and the species diversity indices (H: 4.34) and evenness indices (E: 0.77) were relatively high (Wang et al., 2015). Compared to other urban parks, Qunli Park has higher habitat heterogeneity (Wang et al., 2015); in addition to the rich woodlands, there is a larger area of water. The woodland provides ample food and habitat for the forest birds, and the waters provide suitable habitat for many migratory water birds, so the diversity of the avian community is higher. Secondly, the diversity of vegetation types is high: According to Li and Mu's field survey, there are 137 species of vascular plants in 41 families 96 genera in the native vegetation composition of the wetland park (Li & Mu, 2014).

Restoring the natural structure

The artificial wetland pool system of Qunli Wetland plays a role in improving water quality. According to the results of two field measurements conducted by

Li in 2011 and 2012, the artificial wetland pool system has a clear purification effect on water quality (Li, 2013). Wetland pools with poor water quality are distributed on the outermost side, while water quality close to the inner native wetlands is better (Li, 2013). The purified water quality can meet the normal growth requirements of the vegetation.

Storm water retention

Qunli Wetland Park has great potential for water storage. Using the wetland elevation data model, Li calculated that the normal water storage capacity of the group wetland park is 71,906 m³ and the maximum water storage capacity is 137,675 m³ (Li, 2013). If the rainwater pipe is laid well, by collecting rainwater, the water source of wetlands can be recharged, and urban rainwater in a wide range of surrounding areas can be effectively utilized.

Problems and negative effects

Drawing water from Songhua River to recharge wetland is against the original design intention. According to the calculation and research of Li (2013), Qunli Wetland Park has great potential for rainwater harvesting and utilization. If this method is used to replenish the wetland, the expected ecological and landscape effects can be achieved. However, due to the relatively low and unevenly distributed rainfall in Harbin City, the method of recharging wetlands through rainwater collecting has not been well adopted. Since May 2012, Qunli Wetland Park has started to draw from Songhua River as a wetland water source. Water from Songhua River is directly injected into the original wetland, instead of flowing through wetlands from the outer layer through pipes. This use of the river has led to most of the peripheral constructed wetland systems being severely deficient in water, while the constructed wetlands connected to the native wetlands have sufficient or even excessive amounts of water.

6.1.4 Summary

The benefits of Qunli Wetland Park are identified and summarized in this section (see Figure 6.4). The benefits of open space use mainly include increasing natural features, supporting recreation, providing beautiful scenery, and improving access to open space. The ecological effects mainly include increasing biodiversity, improving water quality, and storm water retention.

The design measures and benefits have also been analysed and are summarized in Figure 6.4. Design measures such as ‘C1.2: Increase number of small wetlands’ aid storm water retention and helps to provide beautiful scenery, increase biodiversity, and improve water quality. ‘C2.1: Leave the natural core’ helps to increase natural features, provide beautiful scenery and increase biodiversity. ‘C2.2: Create buffers’ is helpful to increase natural features and support recreation. ‘C3.1: Create raised platform’ provides places for people to rest and observe, which is beneficial to support recreation and improve access to open space.

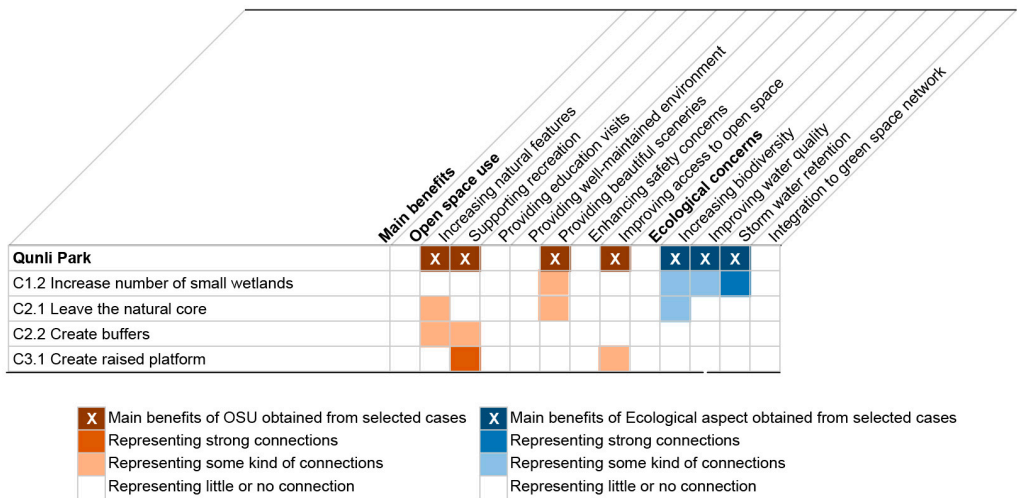


Figure 6.4 Design measures and benefits matrix in Qunli Wetland Park.

Reflection

At the same time, my observations also noticed that Qunli Park has two major problems: The first is the management of the park, which is reflected in the lack of high-quality shade, rest areas, and amusement equipment, as well as in the poor maintenance, such as too-rough plants and seats in bad condition. Secondly, many wetland cells are very dry and have poor water features. These problems are likely to further hinder people from entering the park, reducing the use of the park, thus causing waste of public space resources in this region.

In general, Qunli Wetland Park has achieved certain effects in terms of ecology and open space use, but has more potential than is being tapped. Issues related

to poor maintenance and water sources deserve further attention and improvement. In fact, in this park, especially in the transition areas, adding shady areas and maintaining seats and viewing platforms may be helpful. In addition, the transition zone can be improved by designing with some 'clues to care' (Nassauer, 1995; Nassauer, Wang, & Dayrell, 2009), such as designing some well-trimmed landscape elements on the periphery of the transition from nature to residential areas. These clues can inform the public that this is a well-maintained green space and suggest that it is a park, not a pristine place or a wasteland. The central area is designed and retained as a more natural and rougher landscape to maintain natural habitat while avoiding human interference.

6.2 Qiaoyuan Wetland Park



Figure 6.5 Plan of Qiaoyuan Wetland Park and Location in Tianjin.
Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

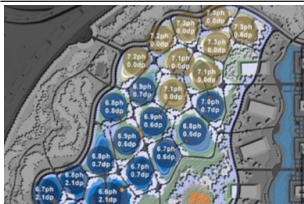
This is a 22-ha park is located in the northern coastal city of Tianjin. The west and north of the park are highways and overpasses, and the south and east are densely populated residential areas. The site had previously been a mil-

itary shooting range and then a garbage dump. Polluted urban storm water runoff was discharged to the site, water accumulated at the site, and the soil was heavily polluted, physiologically saline and alkaline, making it a challenging environment for plants. In response to residents' appeals for environmental improvements in the site, the Tianjin government signed a contract with landscape architects to initiate renovation of the degraded site. The overall design goal of the project is to create a public wetland park that provides a diverse range of natural services to the city and surrounding urban residents.

6.2.1 Design measures in the park

The landscape architects proposed a main strategy inspired by the adaptive vegetation community: they did not attempt to restore the site to a historical natural state, but reconstructed natural functions through regenerative design, allowing the dynamic process of adaptation and succession to occur, and ultimately creating diverse habitats that require minimal management. Important specific design measures include the following: 'C1.1: Create ponds with various depths', 'C1.2: Increase number of small wetlands', 'C3.1: Create raised platform', 'C3.2: Create boardwalks near the water', 'C3.3: Create bridges', 'C4.1: Recreation trail along the filtration ponds', and 'C4.2: Almost every pond has an observation platform'.

C1.1: Create Ponds with Various Depths



The original terrain of the Qiaoyuan Park was gradually reduced from northeast to southwest, and ponds at different elevations were designed to be combined with micro topography. Water flow channels are also provided between these ponds. The pond design of Qiaoyuan Park significantly helps to remove alkali from higher locations and accumulate salt at lower locations.

C1.2: Increase number of small wetlands



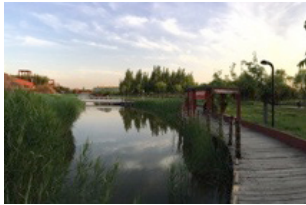
The park's 21 small wetland pools range in diameter from 10–40 m, in addition to its different depths (1–5 m). Some pools are underground, and some are above the ground. During the rainy season, due to shallow groundwater, some pools become wetlands, some become seasonal pools, and some become dry caves. This pond system can help capture storm water runoff.

C3.1: Create raised platform



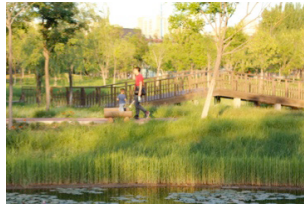
There are wooden platforms in these wetlands where visitors can sit on these platforms and experience the feeling of being surrounded by vegetation. These platforms also provide a space for viewing and getting close to the water, taking a rest, and chatting with other people.

C3.2: Create boardwalks near the water

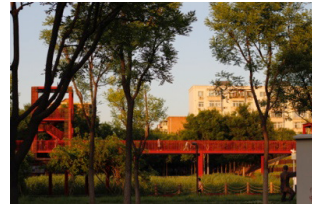


Boardwalks along the water give people a pleasant waterscape experience and the opportunity to get close to water and aquatic plants.

C3.3: Create bridges



Small bridges are cleverly designed between wetland bubbles and connected to the parade trails. The bridges provide visitors with a continuous walking experience and the opportunity to immerse themselves in the beautiful native grass and wildflower landscape.



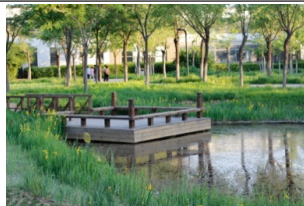
In addition, there are elevated bridges in the south and east of the park, connecting several raised mounds, providing people with space for walking and viewing.

C4.1: Recreation trail along the filtration ponds



In the background of the restored natural environment, a trail system is introduced. The trails between the depressions and the wetland ponds are connected in a web and extend into the interior of the community, giving people the opportunity to be close to wetlands and to the plant community.

C4.2: Almost every pond has an observation platform



Most wetland pools have an observation platform that is a means of combining public space use with ecological habitat. Design signs appear on each type of community plot to provide a scientific explanation of each type of natural ecosystem, including water, vegetation, and species, to help people gain knowledge about the local natural system while experiencing the beauty of the native landscape.

6.2.2 Open space use

The project has added 22 ha of public open space in Tianjin, including wetland space, highland space, and hydrophilic space. A number of ponds, platforms, and bridges have been designed to combine plant communities, allowing urban dwellers and visitors to immerse themselves in beautiful native plant landscapes

to come into intimate contact with nature.

Behaviour-mapping analysis

According to on-site behaviour-mapping analysis, people mainly play and walk in Qiaoyuan Park. The most active park use area is located in the centre of the small square, the path around the wetlands, and the playground, as shown in Figure 6.6.

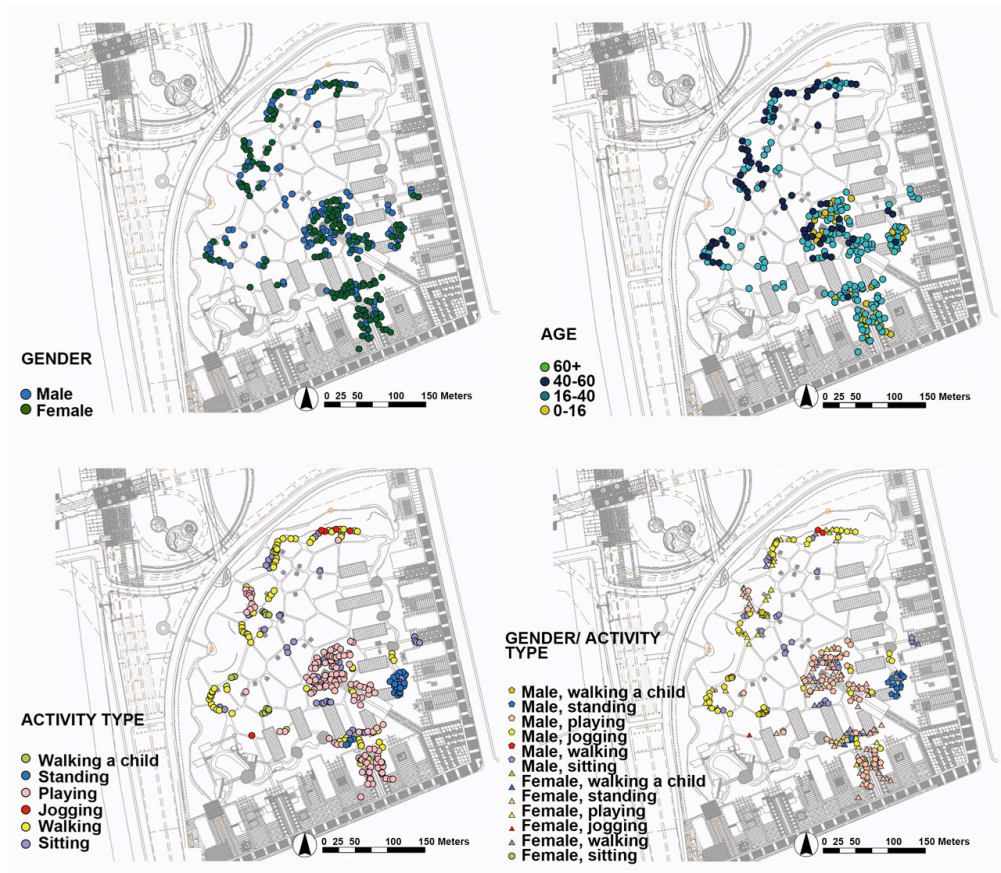


Figure 6.6 Behaviour-mapping in Qiaoyuan Wetland Park. Four groups are divided according to gender, age, activity type and gender mix activity type.

What typical activities can be seen? Where are these activities?

Play is the most common activity recorded in the park, followed by walking. The location of the play is mainly concentrated in the small square in the centre and the children’s playground in the south; the walking area is mostly along the path, especially in the northern part of the park.

Which visitor groups have the most recorded visits? Where are they?

In the Central Square and the South Playground, mainly male or female young visitors play with their children. Senior visitors mostly walk on the path along the wetland area, which is a popular way to exercise among Chinese middle-aged people.

Evaluation of the five aspects of open space use

An evaluation of the five aspects of open space use found that the benefits of Qiaoyuan Park are mainly reflected in features, aesthetics, safety, and access (see Table 6.3). They specifically include increasing natural features, supporting recreation, providing educational visits, creating beautiful scenery with nature and greenery, enhancing safety concerns, and improving access to open space.

Table 6.3 Potential effects and evidence of open space use of Qiaoyuan Park

| Open space use | Benefits and effects | Evidence | Source |
|----------------|---|---|---|
| Features | <ul style="list-style-type: none"> • Increasing natural features | Park plantings included 58 varieties of perennials and 50 varieties of woody plants; presence of 2,950 shade trees. | (Rottle & Lacson, 2011) |
| | <ul style="list-style-type: none"> • Supporting recreation | Providing various facilities: walking paths and trails; platforms for sitting and watching; terraced area for sitting; plaza for events; children’s playground. | My field research |
| | <ul style="list-style-type: none"> • Providing education visits | The Bridge Museum in the Bridge Park provides educational opportunities for approximately 500 children in nearby schools. | (Huang, Xu, & Liu, 2013; Rottle & Lacson, 2011); Qiaoyuan Park Administration |
| Aesthetics | <ul style="list-style-type: none"> • Providing beautiful scenery with nature and greenery | Lots of trees, attractive plants around trails; according to the survey by Rottle and Lacson, 83.2% of respondents indicated that they approve of the ecological style of the park. | (Rottle & Lacson, 2011); My field research |
| Safety | <ul style="list-style-type: none"> • Enhancing safety concerns | Existence of safety supervision: two security service stations at the entrance to the park; security guards patrol the park. | My field research |
| Access | <ul style="list-style-type: none"> • Improving access to open space | The park provides public space for 20,000 residents nearby, within a 15-minute walk and 26 bus routes. | Data from Qiaoyuan Park Administration;(Huang, et al., 2013) |

Features

Qiaoyuan Park has a rich variety of park features, including the presence of natural features, providing a variety of facilities and educational opportunities.

Among them, the presence of natural features is reflected in the park's rich tree species, including 58 perennials, 50 woody plants, and 2,950 shade trees (Rottle & Lacson, 2011); it offers a wide range of facilities, including walking paths and trails, platforms for sitting and watching, a terraced area for sitting, a plaza for events, and a children's playground (see Figure 6.7); this park can also support a series of educational activities and summer activities, such as the Bridge Museum, which provides educational opportunities for about 500 children in nearby schools (Huang, et al., 2013; Rottle & Lacson, 2011).



Figure 6.7 Facilities in Qiaoyuan Park. Note. 1: walking path; 2: platform for sitting and watching; 3: terraced area for sitting; 4: plaza for events; 5 and 6: children's playground.

Aesthetics

The park offers natural and green beauty, such as many trees and attractive plants around the trail; in Rottle and Lacson's (2011) survey, 83.2% of respondents to a questionnaire about the landscape performance of Qiaoyuan Park said they agree with the park's ecological style.

Safety

There is safety supervision in the Qiaoyuan Park. Two security service stations are positioned at the entrance to the park, and park administrators occasionally patrol the park to monitor and discourage uncivilized behaviour (see Figure 6.8).

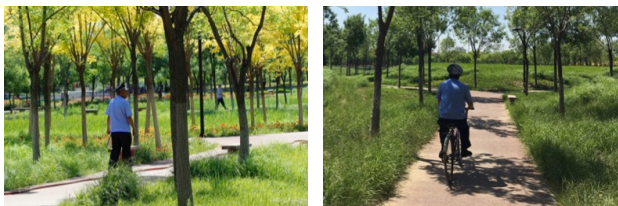


Figure 6.8 Safety Supervisors inspecting inside the park. Note. According to my observation.

Access

The Park has improved access to open spaces for surrounding residents. According to statistics from the Qiaoyuan Park Administration, the park provides public space for 20,000 residents nearby. These residents can reach the public within 15 minutes on foot, and there are 26 bus routes that stop the entrance of the park (Huang, et al., 2013).

6.2.3 Ecological concerns

The ecological evaluation found that the benefits of Qiaoyuan Park are mainly reflected in consideration of biodiversity, restoring the natural structure, and storm water retention (see Table 6.4). They specifically include increasing species diversity, improving soil and water quality, and storing storm water.

Table 6.4 Potential effects and evidence of ecological aspects of Qiaoyuan Park

| Ecological aspects | Benefits and effects | Evidence | Source |
|---------------------------------|---|---|--|
| Consideration of biodiversity | <ul style="list-style-type: none">• Increasing species diversity | Number of herbaceous plants has increased significantly, from 5 species to 96 species; the number of tree species increased from 2 to 50; the number of animal species increased to 6, including ducks, geese, foxes, hedgehogs, rats, and weasels. | (Lin, 2015); My field research |
| Restoring the natural structure | <ul style="list-style-type: none">• Improving soil alkalinity and water quality | The pH value of the pond areas was significantly lower than that of the non-designed areas; soil pH dropped from 7.7, now fluctuating around 7.2, and water pH dropped from 7.4 to 7 or less. | (Huang, et al., 2013; Rottle & Lacson, 2011) |
| Storm water retention | <ul style="list-style-type: none">• Collecting storm water and recharging ground-water | Under the conditions of 10-year rainstorm, 20-year rainstorm and 50-year rainstorm, the amount of infiltration increased by 88.3%, 81.6%, and 76.0%, respectively, and the surface runoff decreased by 73.0%, 62.5%, and 52.0%, respectively. | (Huang, et al., 2013) |

Consideration of biodiversity

After the completion of Qiaoyuan Park, biodiversity increased significantly, providing habitat for new wildlife. According to the statistics of plant and animal species of Lin's investigation of Qiaoyuan Park in 2011, the number of herbaceous plants has increased significantly, from 5 species (4 species of xerophytes, 1 species of aquatic plants) to 96 species (85 species of xerophytes, 11 species of aquatic plants); the number of tree species increased from 2 to 50; the number of animal species increased to 6 species, accounting for ducks, geese, foxes, hedgehogs, rats, and weasels (Lin, 2015).

Restoring the natural structure of the wetland system

Qiaoyuan Park has achieved a significant desalination design, which has improved the soil pollution and serious salinization of the original site. A comparative study by Huang et al. found that the pH value of the pond areas was significantly lower than that of the non-designed areas, and soil salinity was accumulated at a lower level both in the microenvironment inside the ponds and in the overall space of the pond area. Similarly, the field measurements of Rottle and Lacson in 2008–2010 also proved this effect. Samples of soil and water from the bottom of both wet ponds and dry ponds were measured. As a result, it was found that the soil pH decreased from 7.7, instead fluctuating around 7.2, and the pH of the water dropped from 7.4 to 7 or lower (Rottle & Lacson, 2011).

Storm water retention

As a low-lying site, Qiaoyuan Park has a strong ability to collect rainwater and recharge groundwater. The runoff through the park can be substantially eliminated inside the park, and it hardly burdens urban drainage. This is evidenced by research from Huang et al. in 2013. They calculated the amount of infiltration, evaporation, water storage, and surface runoff before and after the completion of Qiaoyuan Park through different heavy rains. Huang et al. concluded that under the conditions of 10-year rainstorm, 20-year rainstorm, or 50-year rainstorm, the amount of infiltration increased by 88.3%, 81.6% and 76.0%, respectively, and the surface runoff decreased by 73.0%, 62.5%, and 52.0%, respectively (Huang, et al., 2013). The amount of rainwater infiltration after completion is greater than that before completion, indicating that the park is more conducive to recharging groundwater. Only about 10 m³ of rainwater will be discharged from the park when it encounters a 50-year flood (Huang, et al., 2013).

6.2.4 Summary

Benefits of Qiaoyuan Park are identified and summarized in this section, see Figure 6.9. The benefits of open space use mainly include increasing natural features, supporting recreation, environmental education, providing beautiful scenery, enhancing safety concerns, and improving access to open space. The ecological effects mainly include increasing biodiversity, improving water quality, and retaining storm water.

The design measures and effects have also been analysed and summarized in Figure 6.9. Among them, design measures such as ‘C1.1: Create ponds with various depths’ helps to increase natural features, provide beautiful scenery, and improve water quality, and it supports storm water retention. ‘C1.2: Increase number of small wetlands’ is helpful to provide beautiful scenery, increase biodiversity, and improve water quality and it supports storm water retention.

Measures like 'C3.1: Create raised platform', 'C3.2: Create boardwalks near the water', 'C3.3: bridges', 'C4.1: recreation trail along the filtration ponds', and 'C4.2: Almost every pond has an observation platform' help to achieve the benefits of open space use such as supporting recreation and improving access to open space.

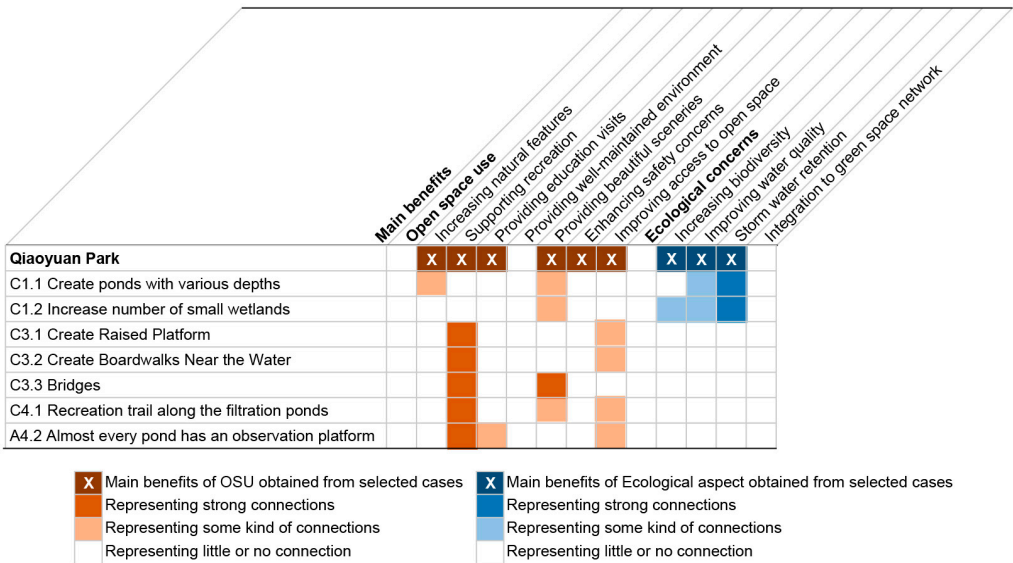
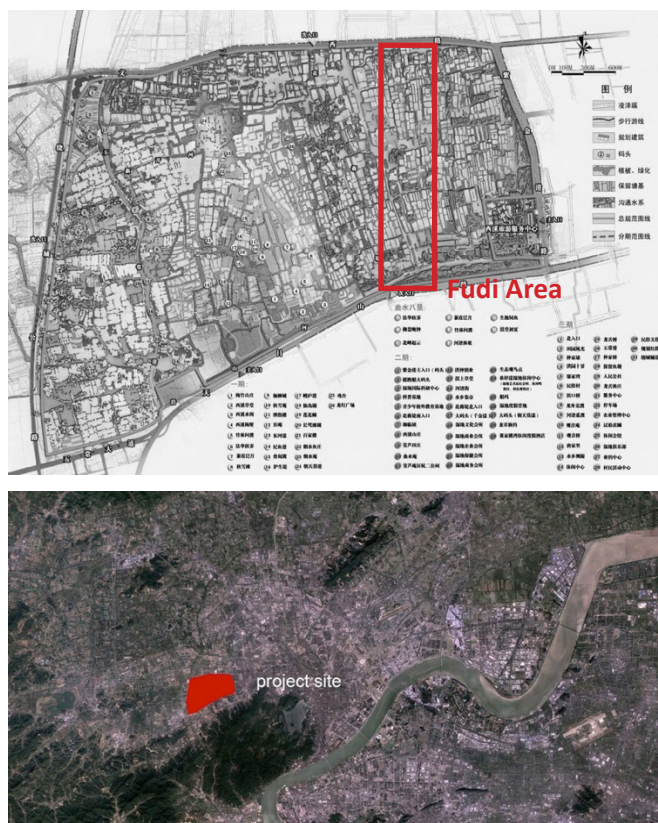


Figure 6.9 Design measures and benefits matrix in Qaoyuan Park.

Reflection

In terms of ecological considerations, Qiaoyuan Park has basically achieved the goal of improving soil quality and water quality, retaining rainwater, and increasing species diversity. We should also see that due to the small area of this wetland park and the dense surrounding residential areas, the effect is not particularly good in increasing species diversity, such as the number of animals. In terms of public space use, the bridge garden is well represented by adequate facilities, large areas of shade and greens, security enhancements, and opportunities for wetland education and natural contact for people, especially for children.

6.3 Xixi wetland park



Project Location: Hangzhou City, Zhejiang Province, China

Project Type: Lacustrine UWP

Project Scale: 1150 ha

Design Time: 2001–2010

Construction Time: 2010

Client: Hangzhou Municipal Government

Designer: Hangzhou Garden Design Institute

Figure 6.10 Plan of Xixi Wetland Park and location in Hangzhou. Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Xixi Wetland Park is located in the west of Hangzhou, 5 km from West Lake. The formation of the Xixi Wetland can be traced back to the Eastern Han Dynasty (AD 172), and it was later developed in the Tang and Song Dynasties, reaching its pinnacle in the Ming and Qing Dynasties. After more than 1,800 years of human intervention and utilization, it has become a typical secondary wetland. Affected by the urban expansion in the 1980s and now, the ecological environment of Xixi Wetland has been severely damaged, and the original wetland natural landscape area is shrinking. In order to protect this ‘kidney of the city’, the restoration project for the Xixi Wetland ecosystem has been launched. In 2005, the China State Forestry Administration approved Xixi Wetland as China’s first national-level wetland park. Through a series of ecological restoration measures, the ecology,

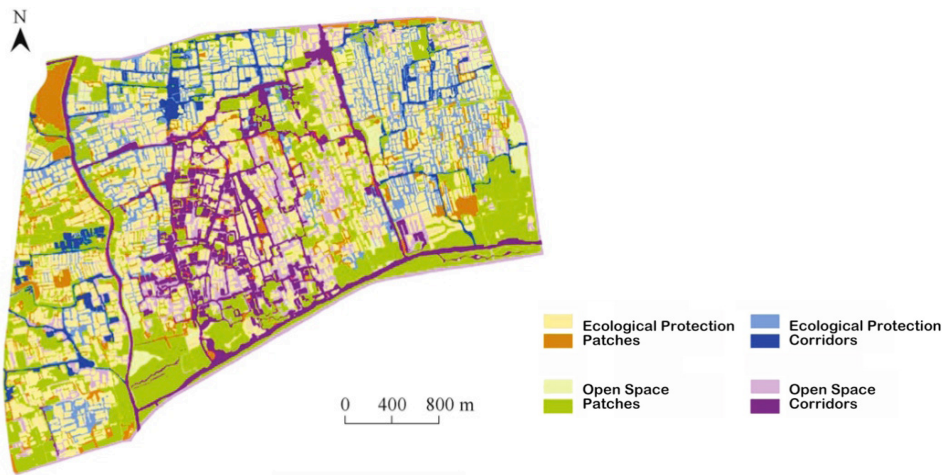
landscape, and environment of the wetland where the park is located have been greatly improved. Xixi Wetland has become an important part of Hangzhou's green space ecosystem, improving urban air and providing sufficient water and good climatic conditions for the city.

6.3.1 Design measures in the park

Landscape architects believe that the pattern and shape of the wetland should be adapted to the characteristics of the local wetland. The project divides the entire park into a multi-level protected area based on the specific conditions of the wetland. The specific design measures mainly include the following list.

B1.1: Divide into protected areas and open space

B1.2: Certain sensitive areas are designed expressly for wildlife



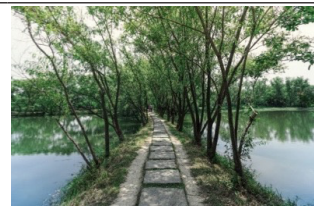
The distribution of corridors and patches within ecological protection types and open space types in Xixi Wetland Park. Retrieved from (Li, Liu, Zheng, & Cao, 2011) p.1025.

Xixi Wetland Park is divided into ecological protection area (orange and blue parts in diagram) and open space area (green and purple parts in the diagram). In the ecological protection area there are several sensitive zones, which are focus on wild-life protection.

B3.1: Create boardwalks near the water

B3.2: Put buildings at the water edge

B3.3: Create walking dams



These boardwalks not only carry people's activities, such as coming into contact with or observing the water, plants, and animals, but also as a walking channel to bring people into or out of this part of the water space.

In Xixi Wetland Park, pavilions are set up in the water to bring people closer to the water, allowing visitors to come and feel the contact with water.

Walking dams connect the agricultural ponds to provide people with the possibility of contact with water and help to stimulate sustainable thinking about ancient agricultural production.

B3.4: Create stairs near the water



In wetland parks, designing stairs can achieve close contact between people and water.

B4.2: Planted edge



Plants around the edge of the water help to restore the structural integrity of natural wetlands while providing the necessary habitat for certain specific wildlife. The large amount of vegetation and planted banks in Xixi Wetland creates an original natural landscape and beautiful green scenery.

B5.1: Historic landscape structure



Xixi Wetland has retained thousands of persimmon fish ponds and mulberry fish ponds. This kind of pond is a traditional production method to show the sustainable use of farming culture, and it is a model for the harmonious coexistence between wetland residents and wetland ecosystems.

B5.2: Historical buildings



There are many historic buildings in the park. They exhibit the characteristics of traditional Chinese courtyards, such as the Gaozhuang of the Qing Dynasty.

B6.1: Public orchard



The orchard area with persimmon trees provides a venue for the Xixi 'Fire Persimmon Festival' from September to October each year. Visitors pick persimmons under the guidance of a professional fruit grower. These professional fruit farmers are generally former local villagers, who are very familiar with the environment and persimmon trees.

B6.2: Educating the public to protect wetlands



The Wetland Botanical Garden in Xixi Wetland Park set up an exhibition hall to display the wetland plants in the ecological diversity of the Xitang system, rivers, and beaches. Xixi Wetland was selected as a venue for the education of primary and middle school students.

6.3.2 Open space use

The Xixi Wetland is divided into the wetland ecological protection and cultivation area in the east, the wetland ecological tourism and leisure area in the central part, and the wetland ecological landscape enclosed area in the west. Each protected area has a different ecological rational capacity, in which case human activities are moderate. The use of public space is mainly concentrated in the wetland ecotourism and recreation area in the central part. Among them, the open space area called Fudi is the only part of the park that is open to the public. The Fudi is 2,300-m long and 7-m wide with a total area of about 0.8 km². It is the main thoroughfare through the Wetland Park and establishes tourist facilities connected to the surrounding attractions.

Behaviour-mapping analysis

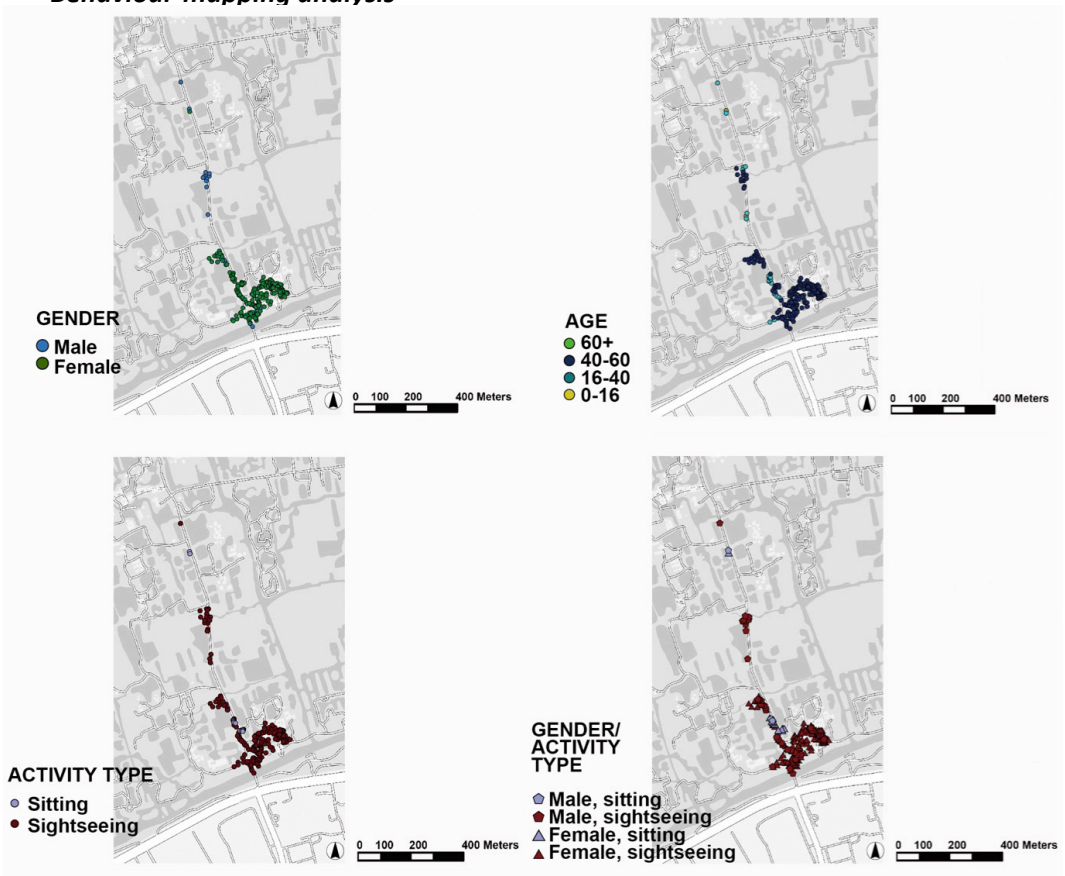


Figure 6.11 Behaviour-mapping in Fudi area in Xixi Wetland Park.

Only the Fudi area in Xixi is free and open to the public. Four groups of park visitors are divided according to gender, age, activity type, and gender mix activity type.

According to my on-site behaviour-mapping analysis in the Fudi area, most human activity in the park is sightseeing. The most actively use area is located near the entrance to the bridge, as shown in Figure 6.11.

What typical activities could be discerned? Where are these activities?

The most often observed activities in the park are sightseeing tours. Sightseeing here refers to the general explanation of a series of behaviours such as walking, sitting, and purchasing tickets of a large number of tour group members following their tour guide (see Figure 6.12). In addition, it was observed that a small number of individual visitors were sitting and resting.

What visitor groups are most recorded? And where are they?

Female visitors were observed to be more active in the Fudi area. Whether in the tourist group or as individual visitors, the number of female tourists far exceeds the number of male tourists.

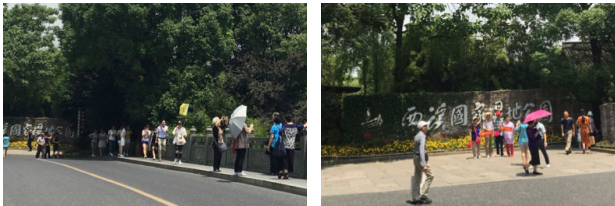


Figure 6.12 Typical use in Xixi Wetland Park in Fudi Area

Evaluation of the five aspects of open space use

An evaluation of open space use found that the benefits of Xixi Wetland Park are mainly reflected in its features, condition, aesthetics, safety, and access (see Table 6.5), which include increasing natural features, supporting recreation, providing education visits, providing a well-maintained and clean environment, providing beautiful scenery with nature and greenery, enhancing safety concerns, and improving access to open space.

Table 6.5 Potential effects and evidence of open space use of Xixi Wetland Park

| Open space use | Benefits and effects | Evidence | Source |
|----------------|---|--|---|
| Features | <ul style="list-style-type: none"> • Increasing natural features • Supporting recreation • Providing education visits | <p>Large-area and various types of vegetation</p> <p>Bridges, observation pavilions, walking paths and viewing platforms, and sightseeing boats</p> <p>The National Wetland Museum of China in the Park, which provides free education visits for the public</p> | <p>(Jiang, Wu, Ding, Liu, & Jiang, 2008); My field research</p> <p>My field research</p> <p>My field research</p> |

| | | | |
|------------|---|---|---|
| Condition | • Providing well-maintained and clean environment | Equipment and facilities in good condition; good sanitary conditions | My field research |
| Aesthetics | • Providing beautiful scenery with nature and greenery | ‘Big’, ‘beautiful’ and ‘quiet’, ‘original natural’ natural scenery perceived as most attractive | (Ruan & Zhang, 2017); My field research |
| Safety | • Enhancing safety concerns | Plants maintained well; existence of safety supervision | My field research |
| Access | • Improving access to open space | Attracts a large number of tourists and local residents; good accessibility | (Sang, Shu, Zhu, & Su, 2013); My field research |

Features

Xixi Wetland Park has a variety of park features, including natural landscapes, offering a variety of facilities and educational visits. Among them, increasing natural features is reflected in large areas and various types of vegetation: for example, 476 vascular plants, including 76 species of trees, 74 species of shrubs, 17 species of woody vines, and 307 species of herbaceous plants (Jiang et al., 2008). In addition, the park offers a range of recreational facilities: for example, three levels of walking trails connect important nodes, traditional bridges, and pavilions for people to rest and watch, and sightseeing boats provide people with a special experience. The park can also support a range of educational activities, such as the China National Wetland Museum built in Xixi Wetland Park, providing a free place for the public, especially young people, to experience and understand the science of wetlands and to raise awareness of the importance of wetland conservation.

Condition

According to my field research, the park is able to provide a relatively clean and well-maintained environment. This ability is reflected in the good facilities and equipment in the park, and the relatively good sanitary conditions.

Aesthetics

Xixi Wetland offers a wealth of natural and green beauty. By collecting the online texts of tourists’ evaluation of Xixi Wetland Park, Ruan and Zhang (2017) found that the positive views of tourists on the Xixi Wetland are mainly reflected in the natural landscape, using the words ‘big’, ‘beauty’, ‘original’, and ‘quiet’.

Safety

The Park's enhancement of safety is reflected in the diligent maintenance of plants and the presence of safety supervisors.

Access

Due to its popularity and convenient location in the city, Xixi Wetland Park attracts a large number of tourists and local residents. For example, during the Spring Festival of 2016, Xixi Wetland received more than 160,000 tourists.³ In addition, Xixi Wetland has good accessibility and is one of the most accessible areas in Hangzhou scenic area. Using the minimum distance method and road network-based travel cost analysis, Sang et al. (2013) calculated that the average time for Hangzhou residents to reach Xixi Wetland was 16.88 minutes.

6.3.3 Ecological concerns

The ecological evaluation found that the benefits of Xixi Wetland Park are mainly reflected in consideration of biodiversity, restoring the natural structure, and storm water retention (see Table 6.6). They specifically include increasing species diversity, improving water quality, and storing storm water.

Table 6.6 Potential effects and evidence of ecological aspects of Xixi Wetland Park

| Ecological aspects | Benefits and effects | Evidence | Source |
|---------------------------------|---------------------------------------|---|---|
| Consideration of biodiversity | • Increasing species diversity | Vascular plants have increased from 221 to 476 species, and birds have increased from 89 to 126 species. | (Jiang et al., 2008) |
| Restoring the natural structure | • Improving water quality | Water quality in the core area could reach the surface water quality III~IV (level) standard. | (Chen & Chen, 2016; Jiang et al., 2008) |
| Storm water retention | • Storing storm water | Surface water storage capacity of Xixi wetland is about 11.7 million m ³ at the normal water level | (He, 2010) |

3 Source: http://www.hangzhou.gov.cn/art/2016/2/14/art_812264_416163.html

Consideration of biodiversity

The biodiversity of Xixi Wetland Park has increased significantly. For example, the number of vascular plants has increased from 221 to 476, and the number of birds has increased from 89 to 126, accounting for 50% of the total number of birds in Hangzhou (Jiang, et al., 2008).

Restoring the natural structure

Since the completion of the park's construction, the water quality of the Xixi Wetland has been significantly improved. Previously, in 2003, the water quality of the Xixi Wetland waters and surrounding rivers was basically below surface water quality Level V. According to the investigation and research by Jiang et al. (2008), after the completion of the first phase of the project in 2005, the water quality in the core area could reach a standard of surface water quality of Levels III~IV. From 2011 to 2015, the total water quality of Xixi Wetland was better, basically at Level II, as evaluated by Chen and Chen (2016), using a fuzzy comprehensive evaluation method and the Shannon–Wiener index.

Storm water retention

The capacity of flood control and storage of Xixi Wetland has been continuously enhanced. According to the research by He (2010), the average annual water level of the river in the park has increased from 1.15 m to more than 1.6 m. At the current water level, the surface water storage capacity is about 11.7 million m³, and when a 20-year flood occurs, the capacity is nearly 30 million m³.

6.3.4 Summary

The benefits of Xixi Wetland Park are identified and summarized in this section (see Figure 6.13). The benefits in open space use mainly include increasing natural features, supporting recreation, providing education visits, providing a well-maintained and clean environment, providing beautiful scenery with nature and greenery, enhancing safety concerns, and improving access to open space. The ecological effects mainly include increasing species diversity, improving water quality, and storing storm water.

The design measures and effects have also been analysed and summarized in Figure 6.13. Design measures such as 'B1.1: Divide into protected areas and open space' and 'B1.2: Certain sensitive areas are designed expressly for wildlife' serve to support habitat and increase biodiversity. Measures such as 'B3.1: Create boardwalks near the water', 'B3.2: Put buildings at the water edge', 'B3.3: Create walking dams', and 'B3.4: Create stairs near the water' support recreation and help to provide beautiful scenery. 'B4.2: Planted edge' expands the park's natural features and helps to provide beautiful scenery, increase biodi-

iversity, store storm water, and improve water quality. 'B5.1: Historic landscape structure', 'B5.2: Historical buildings', and 'B6.1: Public orchard' help support recreation and provide beautiful scenery. 'B6.2: Educating the public to protect wetlands' helps provide education visits..

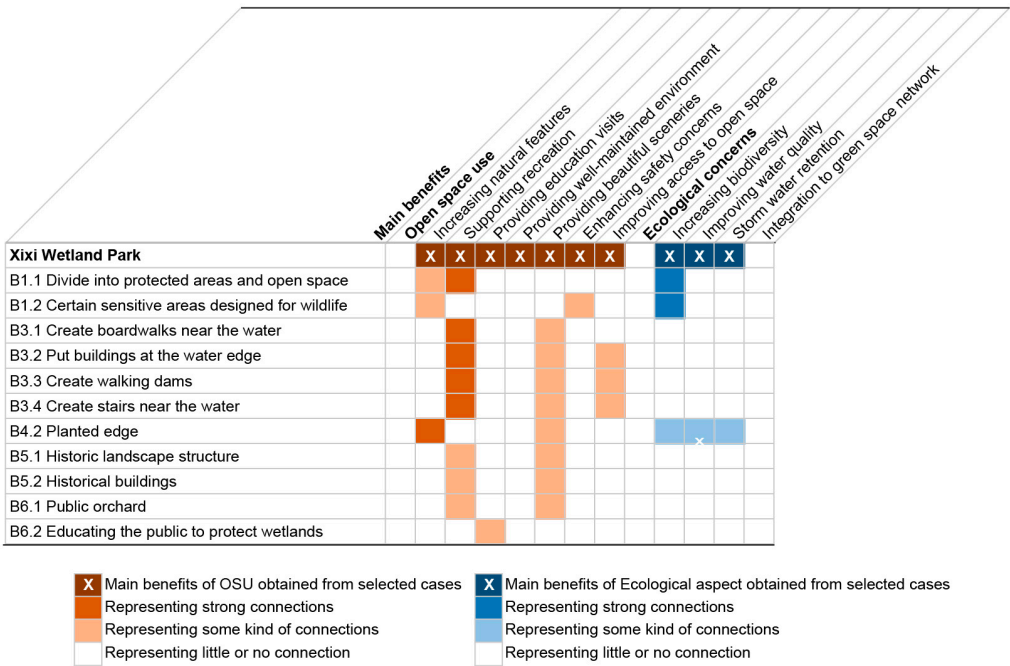


Figure 6.13 Design measures and benefits matrix in Xixi Wetland Park

Reflection

In terms of ecological considerations, Xixi Wetland Park has achieved good results in increasing biodiversity, improving water quality, and retaining rainwater. With a large area of wetlands and good protection measures, this park has provided enormous ecological benefits for the entire city of Hangzhou. In terms of public space use, Xixi Wetland Park, as one of Hangzhou's most famous tourist attractions, has received many visits and much attention. At the same time, issues that should be noted include the lack of diversity in the form of open space use, the area of activity being too large and scattered, and some areas being too dense with visitors.

6.4 Beijing Olympic Forest Park

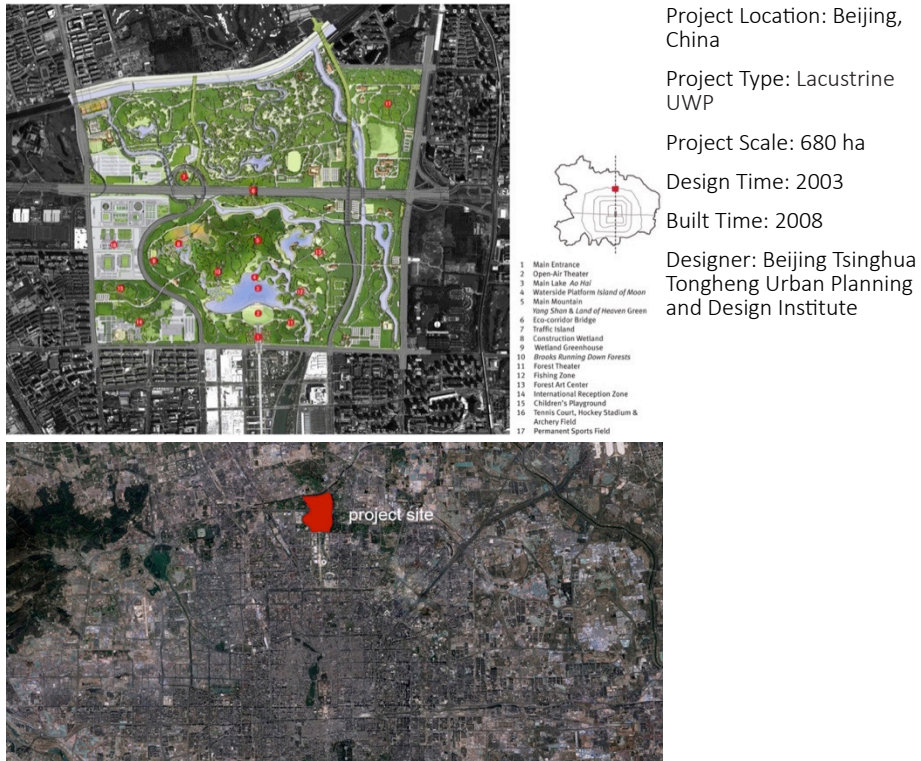


Figure 6.14 Plan of Beijing Olympic Forest Park and location in Beijing. Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

In 2002, the Beijing Municipal Commission of Urban Planning organized an international competition for conceptual planning and design of Beijing Olympic Green. In 2003, Sasaki Associates, Inc. and the Beijing Tsinghua Tongheng Urban Planning and Design Institute won the competition. Built as part of the Olympic Green for the 2008 Summer Games, the 680 ha Olympic Forest Park is the largest public green space ever built in Beijing.

6.4.1 Design measures in the park

This project was built for the Olympics, and its long-term goal is to form a multi-purpose park. The design incorporates traditional Chinese garden art and modern ecological techniques, emphasizing the harmony between humans and nature. Important design measures in this thesis include the following types: 'B2.1: Creating corridors', 'B2.2: Trail system designed to encourage visitors to

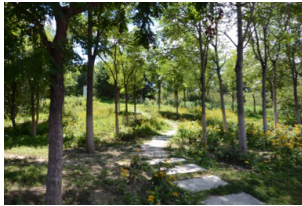
explore (the woods areas or hill)', 'B3.1: Create boardwalks near the water', 'B3.6: Design waterfalls', and 'B6.3: Looped running pathway'.

B2.1: Creating corridors



A large ecological corridor with a length of 218 m across the highway was designed to maintain wildlife and pedestrian connections, connecting the South part and the North part of the park.

B2.2: Trail system designed to encourage visitors to explore (the woods areas or hill)



In the context of the restored natural environment, a trail system was introduced. These trails connect into a network and extend into the interior of forests, giving people the opportunity to access wetlands and plant communities and encourage people to explore natural woods and hills.



Similarly, walkable trails extend into the interior of the wetlands, encouraging people to come into contact with wetland plants and learn about wetlands process.

B3.1: Create boardwalks near the water



The boardwalk along the water not only brings people's activities, such as observing the water, plants and animals, but also acts as a walking path to bring people into or out of this part of the water.

B3.6: Design waterfalls.



A waterfall combined with stone is a common design combination in traditional Chinese garden art. Based on the terrain, stones are piled up and water is drawn from top to bottom to form a natural waterfall. This waterfall design tries to hide the traces of the work as much as possible, emphasizing the naturalness. It provides a space for people to feel the water and nature through their senses of sound, touch, and sight.

B6.3: Looped running pathway



South Park's looped plastic runway, including a 3-km running route and a 10-km running route, attracts a large number of tourists and local residents to run and exercise. This runway, distributed in the outer circle of the park road, combines the dense forests and plants around it to provide an atmosphere for running in the forest.

6.4.2 Open space use

This park was divided into two parts by the Fifth Ring Road. The northern part is designed as a nature reserve that protects regional ecosystems and restores habitat, with some service facilities. The south part is a concentrated area of open space use, with a variety of landscape settings including gathering places, winding paths, and observation points.

Behaviour-mapping analysis

According to the field behaviour-mapping analysis in the south part, people mainly walk and play in Olympic Forest Park. The most active park use area is located around Aohai Lake and wetland area, as shown in Figure 6.15 and 6.16.

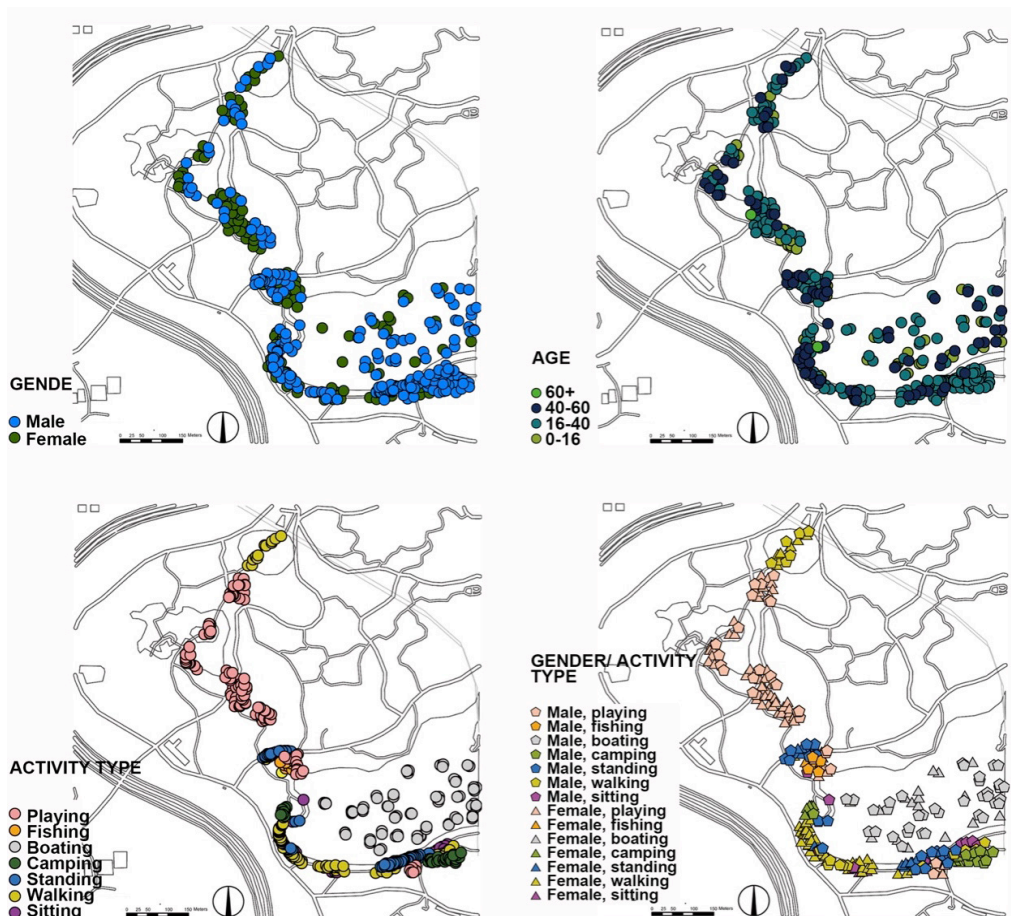


Figure 6.15 Behaviour-mapping in Beijing Olympic Forest Park, South Garden. Four groups of visitors are divided according to gender, age, activity type and gender mix activity type.

What typical activities can be seen? Where are these activities?

Walking is recorded in the park at most, followed by playing and standing. The location of the walking is mainly concentrated in the wetland area in the north and Aohai Lake in the south; the playing position is located between wetlands and the lake.

Which visitor groups have the most recorded visits? Where are they?

Male or female young visitors are the most common, among which young males mainly stand and walk near Lake Olympian, and young females mainly play with friends or children in the waterfall area and near the wetlands.

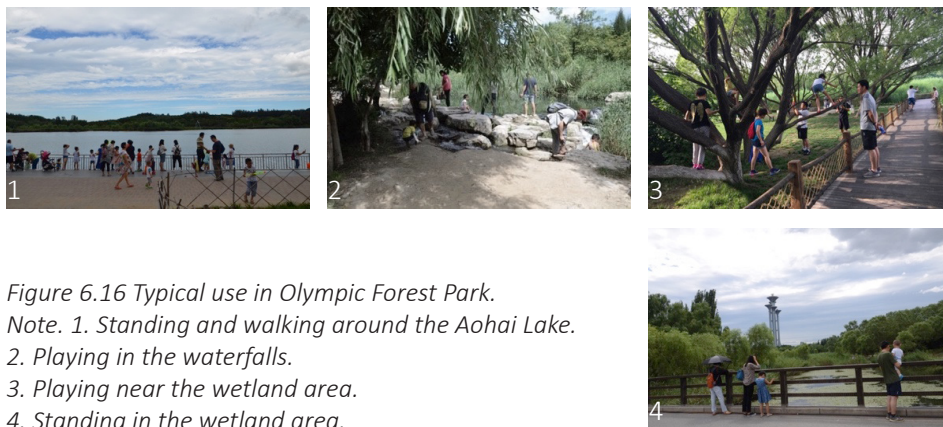


Figure 6.16 Typical use in Olympic Forest Park.
 Note. 1. Standing and walking around the Aohai Lake.
 2. Playing in the waterfalls.
 3. Playing near the wetland area.
 4. Standing in the wetland area.

Evaluation of the five aspects of open space use

An evaluation of the five aspects of open space use found that the benefits of Beijing Olympic Forest Park are mainly reflected in features, aesthetics, and access (see Table 6.7). They specifically include increasing natural features, supporting recreation, providing beautiful scenery with nature and greenery, and improving access to open space.

Table 6.7 Potential effects and evidence of open space use of Beijing Olympic Forest Park

| Open space use | Benefits and effects | Evidence | Source |
|----------------|--|--|---|
| Features | <ul style="list-style-type: none"> • Increasing natural features • Supporting recreation | <p>Large-area and various types of vegetation</p> <p>Running tracks, boats, walking trails, children's playgrounds, fishing areas, waterfalls, small forest theatres, and lounge areas</p> | <p>My field research</p> <p>My field research</p> |

| | | | |
|------------|---|--|--|
| Aesthetics | • Providing beautiful scenery with nature and greenery | Natural atmosphere; 'pure and fresh', 'good environment' or 'forest oxygen bar' are descriptions offered by most users | My field research; (Wang, Jin, Liu, Li, & Zhang, 2018) |
| Access | • Improving access to open space | Accessible by public transport; About 40,600 total visitors to the park on the peak day | (Hu, Wu, & Duan, 2006); My field research |

Features

The park is rich in natural features. More than 600,000 seedlings have been planted in the park, with a green coverage rate of 95.6%, including more than 200 species of shrubs and more than 100 ground-cover and aquatic plants. Additionally, there are a number of facilities in the park, such as running tracks, boats, walking trails, children’s playgrounds, fishing areas, waterfalls, small forest theatres, and lounge areas.

Aesthetics

The park offers natural and green beauty, such many trees, natural water and stone landscapes, and charming plants around the trail. Through the methods of social media data collection and traditional surveys, Wang et al. (2018) found that the overall natural atmosphere of the Beijing Olympic Forest Park left a deep impression on users. Users often describe the atmosphere of the park as ‘pure and fresh’, a ‘good environment’ or a ‘forest oxygen bar’.

Access

Public transport, including the Metro Olympic branch and bus system, provides the Olympic Forest Park with a one-way daily passenger capacity of 26,000 passengers, which can meet the needs of 75% of peak day visitors (Hu et al., 2006).

6.4.3 Ecological concerns

The ecological evaluation found that the benefits of Beijing Olympic Forest Park are mainly reflected in consideration of biodiversity, storm water retention, and integration with a green space network (see Table 6.8). They specifically include increasing species diversity, storing storm water, and integration with a green space network.

Table 6.8 Potential effects and evidence of ecological aspects of Beijing Olympic Forest Park

| Ecological aspects | Benefits and effects | Evidence | Source |
|-------------------------------|---------------------------------------|--|--|
| Consideration of biodiversity | • Increasing species diversity | 128 species of spontaneous plants; 212 species of vascular plants; 66 species of birds | (Li, Dong, Guan, Zhao, & Wu, 2018); (Zhang, 2015) |

| | | | |
|------------------------------------|---|--|---------------------------|
| Storm water retention | • Storing storm water | Collecting approximately 1.34 million m ³ of rainwater per year. | (Dvorak, Li, & Luo, 2012) |
| Integration to green space network | • Integration to green space network | The elevated ecological corridor across the highway is designed to provide connectivity for animals and pedestrians. | My field research |

Consideration of biodiversity

The park provides a rich habitat for a variety of flora and fauna. Investigations have found, for example, 128 species of spontaneous plants (Li et al., 2018), 212 vascular plants, and 66 species of birds (Zhang, 2015).

Storm water retention

Using a variety of low-impact development techniques to trap rainwater on the site, including porous paving, vegetation depressions and retention ponds, the park collects 95% of rainfall, equivalent to collecting approximately 1.34 million m³ of rainwater per year (Dvorak et al., 2012). The park could cope with a 50-year storm in 2011, when many nearby areas were heavily inundated.

Integration to green space network

A highway separates the park’s south area and north area. In order to maintain wildlife and pedestrian access, a 60-m-wide, 218-m-long elevated eco-corridor was designed and built to connect the park.

6.4.4 Summary

The benefits of Beijing Olympic Forest Park are identified and summarized in this section (see Figure 6.17). The benefits in open space use aspect mainly include increasing natural features, supporting recreation, providing beautiful scenery with nature and greenery, and improving access to open space. The ecological effects mainly include increasing biodiversity, storm water retention, and integration with a green space network.

The design measures and effects have also been analysed and summarized in Figure 6.17. Design measures such as ‘B2.1: Creating corridors’ serve to increase species diversity and integrate the green space network and help to increase natural features, support recreation, provide beautiful scenery, and improve access to open space. ‘B2.2: Trail system designed to encourage visitors to explore (the woods areas or hill)’ and ‘B3.1: Create boardwalks near the water’ serve to support recreation and help provide beautiful scenery. ‘B3.6: Design waterfalls’

serves to support recreation, helps increase natural features, and provides beautiful scenery. 'B6.3: Looped running pathway' serves to support recreation.

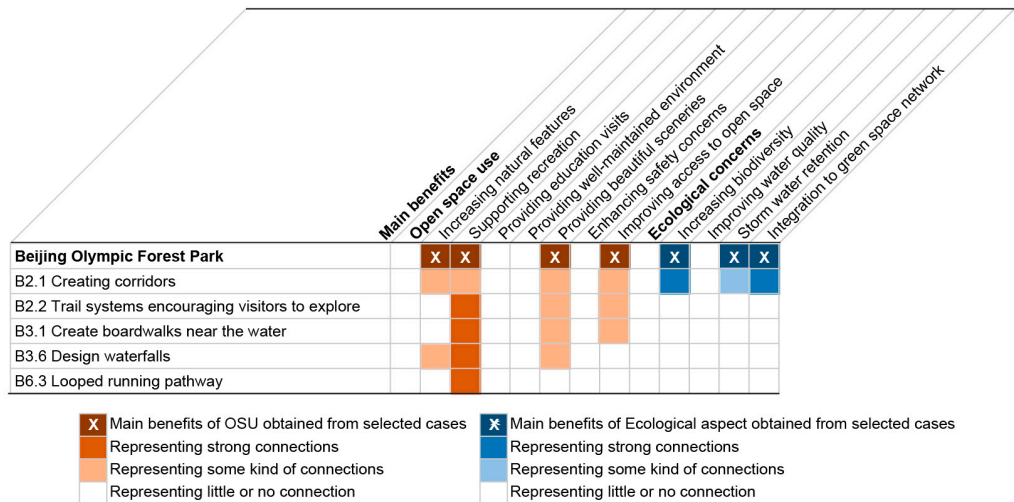
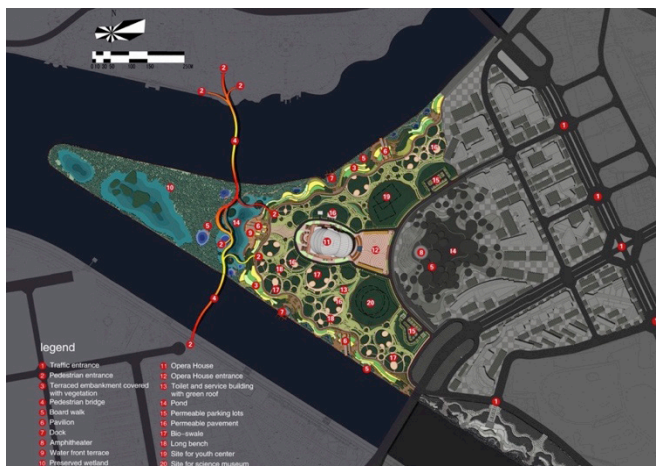


Figure 6.17 Design measures and benefits matrix in Beijing Olympic Forest Park

Reflection

From the perspective of open space use, the park provides a public green space with high cultural value, which satisfied the needs of people during the Olympic games and continues to do after the Olympics, for fitness, recreation, and natural contact. However, from the perspective of ecological facilities, there is a weak point. The design team believes that the principles of ancient Chinese traditional garden art emphasize the artificial emergence of nature. Among them, mountain piling and water formation are one of the most important elements. Therefore, an artificial mountain and a dragon-shaped body of water were designed and constructed. Technologies like this are not recommended for urban wetland parks in those cities where water resources are scarce.

6.5 Yanweizhou Park



Project Location: Jinhua City, Zhejiang Province, China

Project Type: Riverine UWP

Project Scale: 26 ha

Design Time: 2010-8-

Construction Time: 2014-5-

Client: Jinhua Municipal Government

Designer: Turenscape



Figure 6.18 Plan of Yanweizhou Park and location in Jinhua.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

This project is located in the centre of Jinhua City in central Zhejiang province in eastern China. Located where the Wuyi River and Yiwu River converge to form Jinhua River, this 64-acre natural riparian wetland is called Yanweizhou, literally meaning ‘the sparrow tail’. The three rivers (each >100-m wide), divided the densely populated communities in the region. These green spaces have not been fully utilized due to poor geographical location. In addition, most riverside wetlands include debris and damage caused by sand mining and concrete flood-walls. In response to the challenges posed by these site conditions and the goal of providing open space for dense urban centre’s residents while preserving the remaining riparian habitats, landscape architects have designed a wetland park.

This project addresses flooding through water-adapted solutions and restores wetlands that have been degraded by existing sand mining sites, while also providing residents with a colour bridge that is closer to the two banks.

6.5.1 Design measures in the park

The main solution of the Yanweizhou Park project is to design water-resilient terrains and plantings to adapt to monsoon floods, demonstrating a flexible ecological solution for large-scale flood management. Important specific design measures include the following types: 'A1.1: Paths within the floodplain', 'A1.2: Submersible platforms', 'A1.3: Social event grounds', 'A1.4: Submersible vegetation', 'A2.1: Reshaping the floodplain with more gently sloping banks', 'A3.1: Terraced bank', 'A3.4: Plants embankment', 'A4.3: Bridge over the water', 'A4.4: Buildings on piles', 'A5.2: Terraced wetlands', and 'A6.1: Boardwalks near banks'.

A1.1: Paths within the floodplain *A1.2: Submersible platforms* *A1.3: Social event grounds*



Paths are just above the five-year flood level, which affords visitors an intimate naturalistic experience during most of the year, and the paths are submersible during the flood time.



Platforms that are designed in the floodplain provide space for viewing, resting, and touching the water. They connect with path system and are submersible during the flood.



The circular space combined with trees provides a shady space for meeting, gathering, educational activities, or other social activities.

A1.4: Submersible vegetation *A2.1: Reshaping the floodplain with more gently sloping banks* *A3.1: Terraced bank*



Flood-adapted native vegetation was used in the design to accommodate annual fluctuations of the water table.



Reshaping the cross section of the floodplain, creating a lower and sloped embankment by excavation can provide more drainage space for the flood.



A terraced bank was constructed by removing the concrete floodwall and applying a cut-and-fill approach that balances the earthwork on-site.

A3.4: Plants embankment



The park has a large number of perennial ornamental grasses that are cold tolerant and have low maintenance demands. These grasses combine trees such as metasequoia, black mulberry, and acacia to create a peaceful rural landscape.

A4.3: Bridge over the water



Inspired by the vernacular Bench Dragon Dancing, the pedestrian bridge was designed to link the riverbanks in both the southern and northern city districts and to connect the park with the city. The bridge is above the 200-year flood level, and it is above the well-preserved riverine wetlands, allowing visitors to get in touch with water.

A4.4: Buildings on piles



The modern pavilions are designed on the pile, providing a platform for people to climb up and to look over the park, and they can also be used during the flood season.

A5.2: Terraced wetland



The terraced wetland created a flood control area that allows people to enjoy the dense grasses.

A6.1: Boardwalks near banks



Boardwalks near banks not only carry people's activities, such as touching or observing water, plants, and animals, but also as walkways to bring people into or out of this part of the water space.

6.5.2 Open space use

This project provides the surrounding residents with open space for daily use. At the same time, it also provides space for the temporary and intensive use of the audience of the opera house adjacent to the park.

Behaviour-mapping analysis

According to on-site behaviour-mapping analysis, people mainly sit and walk in Yanweizhou Park. The most active park use area is located in the centre of the park, as shown in Figure 6.19.

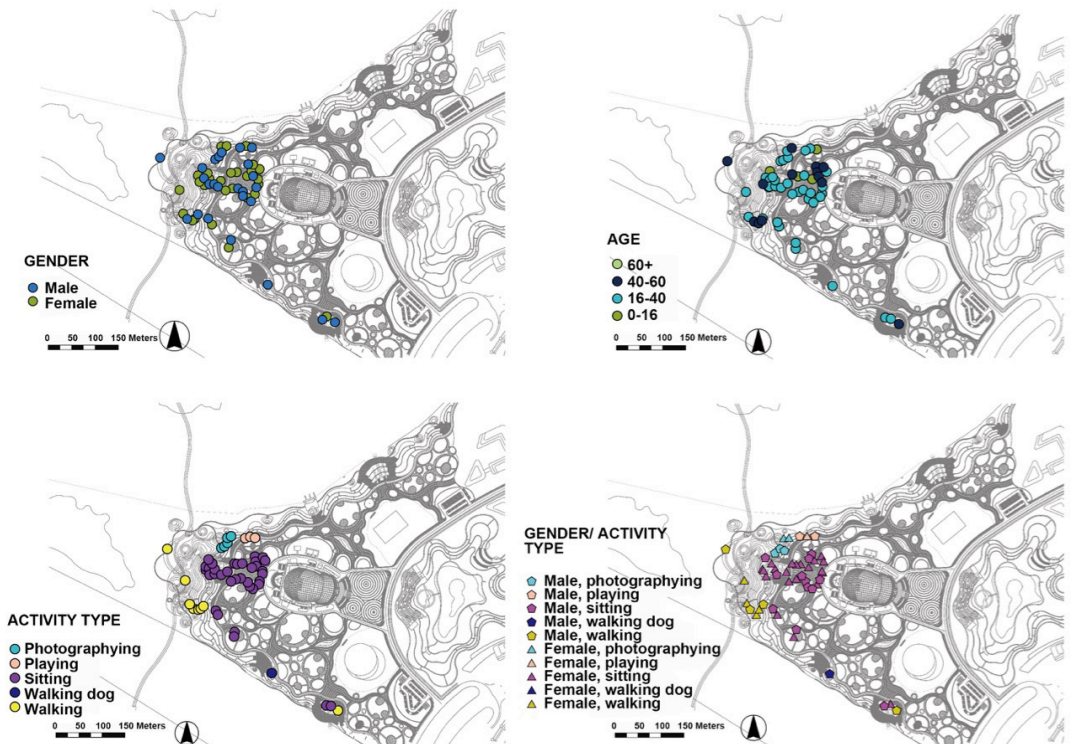


Figure 6.19 Behaviour-mapping in Yanweizhou Wetland Park. Four groups are divided according to gender, age, activity type, and gender mix activity type.

What typical activities can be seen? Where are these activities? Sitting is most often recorded in the park, followed by walking. The location of the sitting is mainly concentrated in the shade square and the viewing pavilion, in the centre of the park (see Figure 6.20). The walking position is mainly near the wetlands and along the pedestrian bridge (see Figure 6.20).



Figure 6.20 Typical use in Yanweizhou Wetland Park. Note. 1. Sitting in the view pavilion. 2. Sitting in the shade square in the centre of the park. 3. Walking along the pedestrian bridge.

Which visitor groups have the most recorded visits? Where are they?
 Young women are most often recorded, mainly sitting and resting in the Shade Square and the viewing pavilion.

Evaluation of the five aspects of open space use

An evaluation of the five aspects of open space use found that the benefits of Yanweizhou Park are mainly reflected in features and access (see Table 6.9). They specifically include increasing natural features, supporting recreation, and improving access to open space.

Table 6.9 Potential effects and evidence of open space use of Yanweizhou Park

| Open space use | Benefits and effects | Evidence | Source |
|----------------|--|---|--|
| Features | <ul style="list-style-type: none"> • Increasing natural features • Supporting recreation | Rich natural vegetation Pedestrian bridge, observation pavilions, walking paths and viewing platform | My field research My field research |
| Access | <ul style="list-style-type: none"> • Improving access to open space | Good accessibility, with most nearby residents arriving by foot or bike | My field research; (Turenscape, 2018) |

Features

The park has a rich natural vegetation landscape. In addition to preserving trees, shrubs, ground cover, and aquatic plants in the original site, it also replanted a large amount of native vegetation. In addition, facilities such as a pedestrian bridge, observation pavilions, walking paths, and viewing platforms are also available.

Access

The park’s good accessibility provides great convenience to nearby residents. According to the survey of Turenscape (2018), the proportion of residents arriving by foot is 61.05%, and the proportion of bicycles arriving at the park is 14.74%. The proportion of arrivals by car is only 18.95%, and the frequency of visits by this type of resident is relatively low (Turenscape, 2018). In addition, the landscape pedestrian bridge crosses the rivers and connects the north and south areas of Jinhua City, making it convenient for residents to walk across the river and enter the park.

6.5.3 Ecological concerns

The ecological evaluation found that the benefits of Yanweizhou Park are mainly reflected in consideration of biodiversity and storm water retention (see Table

6.10). They specifically include increasing species diversity and storing storm water.

Table 6.10 Potential effects and evidence of ecological aspects of Yanweizhou Park

| Ecological aspects | Benefits and effects | Evidence | Source |
|-------------------------------|---|---|-------------------|
| Consideration of biodiversity | <ul style="list-style-type: none"> • Increasing species diversity | A variety of habitats; wide variety of plants. | My field research |
| Storm water retention | <ul style="list-style-type: none"> • Storm water retention | Terraced wetlands and permeable paved surfaces in the park are designed to collect rainwater. | My field research |

Consideration of biodiversity

The park is slightly arranged and designed on the basis of the original pond and highlands, forming a variety of habitats such as beaches, ponds, marshes, islands, and forests. There are a wide variety of plants, including algae, submerged plants, floating plants that optimize water quality, berry plants that provide food for birds and other animals, and native vegetation with seasonal changes.

Storm water retention

The infiltration cover design that can be seen everywhere in the park is conducive to storm water retention, including large-scale sand pavement in the human activity area, bubble-like rainwater collection pools, and permeable road pavement and parking lots. In addition, the terraced planting belt on the riverbank in the park has the functions of both storm water retention and flood control.

6.5.4 Summary

Benefits of Yanweizhou Park are identified and summarized in this section (see Figure 6.21). The benefits of open space use mainly include increasing natural features, supporting recreation, and improving access to open space. The ecological effects mainly include increasing species diversity and storm water retention.

The design measures and effects have also been analysed and summarized in Figure 6.21. Design measures such as ‘A1.1: Paths within the floodplain’, ‘A1.3: Social event grounds’, ‘A4.3: Bridge over the water’, ‘A4.4: Buildings on piles’, and ‘A6.1: Boardwalks near banks’ serve to support recreation. ‘A1.2: Submersible platforms’ helps to improve access to open space and storm water retention. ‘A1.4: Submersible vegetation’ helps to increase natural features, expanding

biodiversity and storm water retention. 'A2.1: Reshaping the floodplain with more gently sloping banks' helps to support recreation, improve access to open space, increase biodiversity, and store storm water. 'A3.1: Terraced bank' serves to increase biodiversity and help support recreation and store storm water. 'A3.4: Plants embankment' and 'A5.2: Terraced wetland' help to increase natural features and biodiversity. 'A4.3: Bridge over the water' serves to support, increase, and improve access to open space.

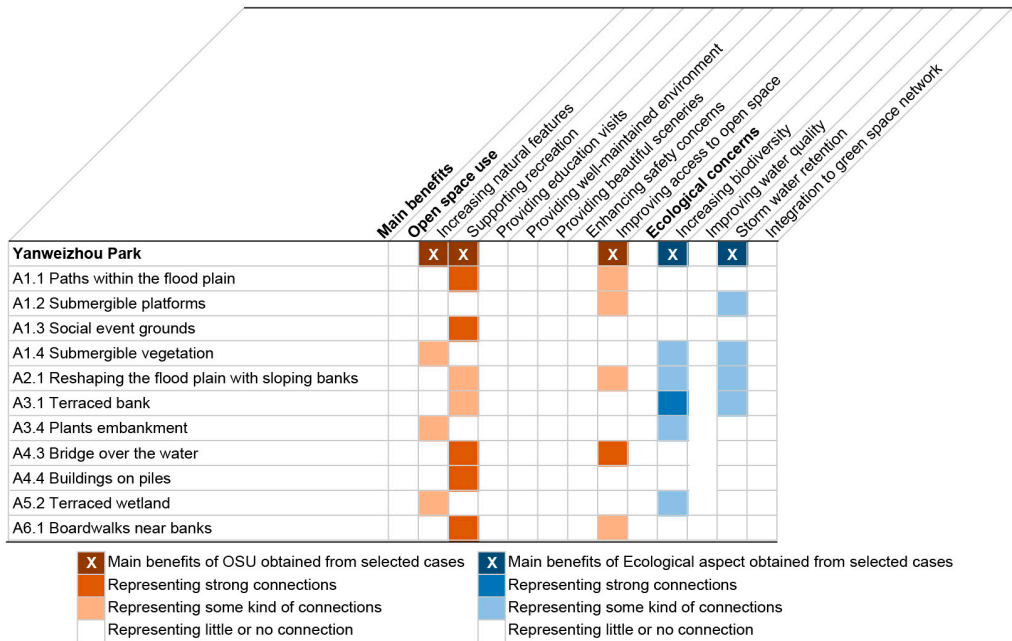


Figure 6.21 Design measures and benefits matrix in Yanweizhou Park

Reflection

This project designed a park that could be submerged. On the one hand, through ecological embankment design, vegetation design (i.e., for accommodation to drought and flood), and 100% permeable pavement design, it achieves ecological resilience and timely storage of storm water in the flood season; on the other hand, both in the flood season and the non-flood period, it can provide residents with appropriate open space for activities. Therefore, it has achieved its design goals well in terms of ecological considerations. In terms of public space use, there is still some potential to be emphasized in terms of safety and park facilities. For example, it would be appropriate to add some fitness equipment and in the park, such as in the wetland area below the pedestrian bridge, it would be appropriate to install more lighting.

6.6 Harbin Culture Center Wetland Park

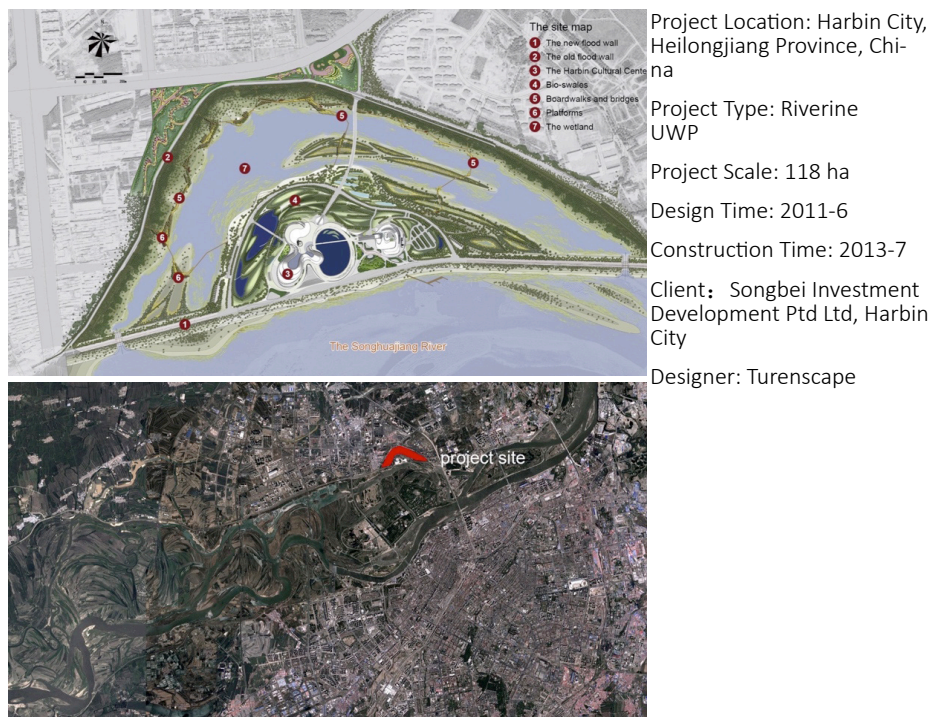


Figure 6.22 Plan of Harbin Cultural Center Wetland Park and location in Harbin. Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

This project is located in Jiangbei New District of Harbin City and is affected by floods due to its location in the lower reaches of the Songhua River. The original site has a 500-year floodwall, and the wetland habitat has been deteriorating as the floodwall cuts off the water. Meanwhile, polluted rainwater from the northern cities and wastewater from new waterworks are discharged into the river, resulting in lower water quality in the Songhua River. With the rapid expansion of the population and the further development of the city, more public open space has been fervently desired. To solve these problems, landscape architects seek a solution that combines public spaces with an elastic wetland landscape.

6.6.1 Design measures in the park

This project has transformed previously degraded wetlands into a functional wetland park that can be used to regulate rainwater and clean up urban surface runoff and tail water from water supply plants. Meanwhile, landscape architects set up a low maintenance program for the park to restore habitat and allow public access. A variety of floating connections, including sidewalks and seating

areas built on the water, have been introduced to enable people to be close to nature without disturbing nature. Important design measures include the following types: ‘A1.1: Paths within the floodplain’, ‘A2.1: Reshaping the floodplain with more gently sloping banks’, ‘A2.2: Vernal pools’, ‘A4.5: Raised boardwalks and platforms’, and ‘A6.1: Boardwalks near banks’.

A1.1: Paths within the floodplain *A2.1: Reshaping the floodplain with more gently sloping banks*



The paths in the floodplain provide visitors with an intimate natural experience for most of the year and can be submerged in the water during floods.



Reshaping the shape of the cross-section of the floodplain, creating more gently sloping embankments by excavation, can provide more drainage space for the flood.

A2.2: Vernal pools



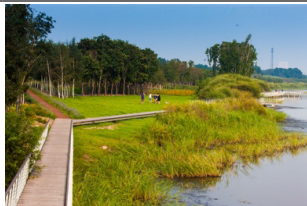
A series of vernal pools are built around the central wetland. They are temporarily wetland pools with seasonal flooding, and they dry out every year or at regular intervals. These wetlands provide unique habitat that supports a diverse collection of organisms. At the same time, rainwater runoff from the Southern park and the Northern City can be collected and purified. These pools also reduce sediment, suspended solids, and heavy metals in rainwater before rainwater flows into the central wetland.

A4.5: Raised boardwalks and platforms



The annual fluctuations in the groundwater level create inaccessible, muddy, and messy riverbanks, which pose a huge challenge to turning wetlands into accessible open spaces throughout the year. The design strategy is to set boardwalks and a bridge network that are above the water surface. These boardwalks and platforms are separated from the edges of the ground and wetlands, thus minimizing the impact on the natural environment within the site.

A6.1: Boardwalks near banks



The boardwalk near the river bank can not only allow for people’s activities, such as touching or observing water, plants, and animals, but also as a pedestrian passage for people to enter or exit this part of the park.

6.6.2 Open space use

Behaviour-mapping analysis

The project provides people with a large public space that is close to the wetland landscape. According to on-site behaviour-mapping analysis, people mainly walk in Cultural Center Wetland Park. The most active park use area is located along patches determined by paths, as shown in Figure 6.23 below.

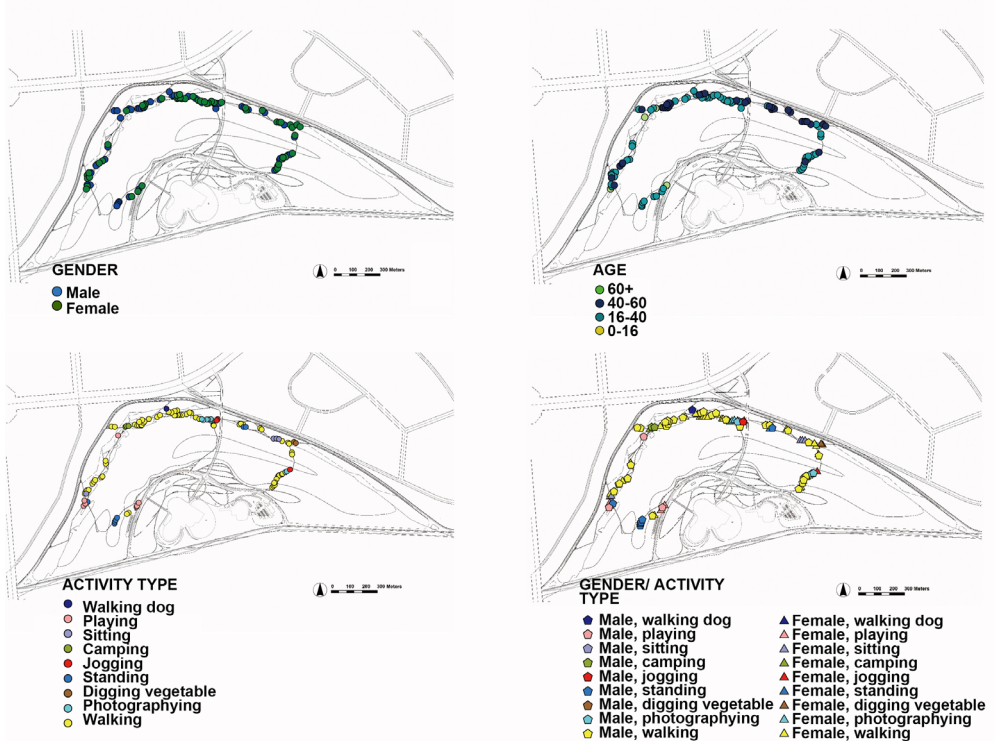


Figure 6.23 Behaviour-mapping in Harbin Culture Center Wetland Park.

Four groups are divided according to gender, age, activity type, and gender mix activity type.

What typical activities can be seen? Where are these activities?

Walking was recorded mostly in the park, followed by photographing. The locations of people walking or photographing were mostly along patches determined by paths (see Figure 6.24), especially along the raised boardwalks.

Which visitor groups have the most recorded visits? Where are they?

In the areas of the paths and boardwalks, mainly male or female young visitors walk and take photographs. Senior visitors mostly walk on the path along the wetland area.

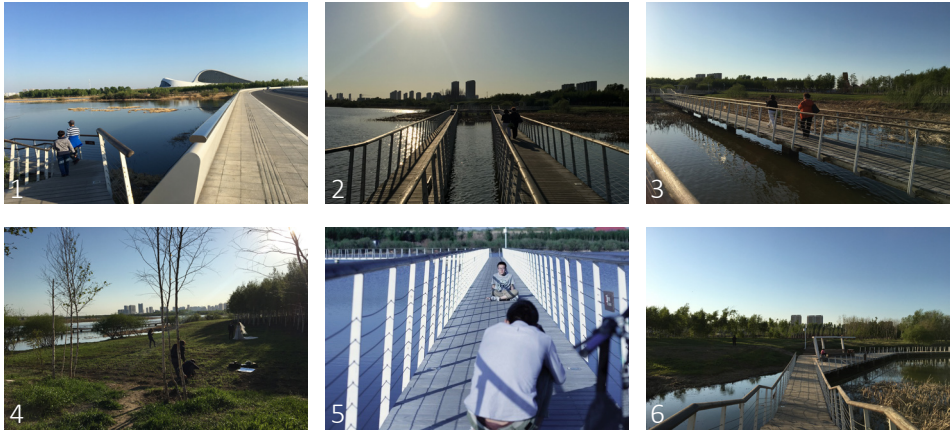


Figure 6.24 Typical use in Harbin Cultural Center Wetland Park.
 Note. 1–3. Walking along the raised boardwalks. 4. Taking wedding photos in the north of the park. 5. Photographing on the boardwalk. 6. Sitting on the platforms.

Evaluation of the five aspects of open space use

An evaluation of the five aspects of open space use found that the benefits of Harbin Cultural Center Wetland Park are mainly reflected in features, aesthetics, and access (see Table 6.11). They specifically include increasing natural features, supporting recreation, providing beautiful scenery with nature and greenery, and improving access to open space.

Table 6.11 Potential effects and evidence of open space use of Harbin Cultural Center Wetland Park

| Open space use | Benefits and effects | Evidence | Source |
|----------------|---|--|-------------------|
| Features | <ul style="list-style-type: none"> • Increasing natural features | Large-area and various types of vegetation | My field research |
| | <ul style="list-style-type: none"> • Supporting recreation | Viewing platforms, walking trails and paths, resting groves | My field research |
| Aesthetics | <ul style="list-style-type: none"> • Providing beautiful scenery with nature and greenery | Lush vegetation with wild animals; opportunity to penetrate the groves and meadows | My field research |
| Access | <ul style="list-style-type: none"> • Improving access to open space | Good accessibility; barrier-free recreation system | My field research |

Features

The park has good natural resources, mainly composed of natural water systems and river beach oases, as well as intertwined trees and aquatic plants. In addition to preserving trees, shrubs, ground cover plants, and aquatic plants in the original location, the park has replanted a large amount of native vegetation. In addition, viewing platforms, walking trails and paths, resting groves, and other facilities are available to support people's access and activities.

Aesthetics

The park offers the opportunity for people to get in touch with nature and with green beauty. For example, lush vegetation attracts a variety of wild animals, with a network of walking trails and bridges above the wetlands, allowing visitors to come into contact with nature without disturbing animal activities. At the same time, the continuous walking network also leads people to penetrate the groves and meadows, providing a rich experience for visitors.

Access

The park has improved the accessibility of the open spaces of the surrounding residents. The completely barrier-free recreation system is designed to allow people of all physical conditions to enter and touch nature.

6.6.3 Ecological concerns

The ecological evaluation found that the benefits of Harbin Cultural Center Wetland Park are mainly reflected in consideration of biodiversity, restoring the natural structure, and storm water retention (see Table 6.12). They specifically include increasing species diversity, improving water quality, and storing storm water.

Table 6.12 Potential effects and evidence of ecological aspects of Harbin Cultural Center Wetland Park

| Ecological aspects | Benefits and effects | Evidence | Source |
|---------------------------------|---|---|---------------------------------------|
| Consideration of biodiversity | <ul style="list-style-type: none">• Increasing species diversity | Forest and grass cover area has increased; diverse habitats; rare birds exist | My field research; (Liu, 2016) |
| Restoring the natural structure | <ul style="list-style-type: none">• Improving water quality | The filter swales and pools around the wetlands | My field research; (Turenscape, 2015) |
| Storm water retention | <ul style="list-style-type: none">• Storm water retention | 20,000 cubic meters of water handled during the rainy season | My field research; (Turenscape, 2015) |

Consideration of biodiversity

After the park has been built, the number and types of vegetation has significantly increased. For example, according to the analysis of site GIS data and on-site field calculations by Liu (2016), the natural succession of plants has covered most of the bare soil, and the forest and grass cover area has increased by more than 120,000 m² from 2012 to 2016. In addition, the site has diverse habitats, as well as many aquatic animals and rare birds, such as *Podiceps grisegena*, a national second-class protected species in China.

Restoring the natural structure

Before the rainwater flows into the centre of the wetland, the swales and pools around the wetlands can reduce the sediment and suspended solids and heavy metals from storm water. In addition, the 1,500 m³ of tail water discharged from the nearby waterworks first enters the wetland for purification and then flows into the river (Turenscape, 2015).

Storm water retention

This wetland park collects a large amount of storm water from the Southern Cultural Center and the Northern District of the city. The wetland system combines the surrounding pools and swales to handle 20,000 m³ of water during the rainy season (Turenscape, 2015).

6.6.4 Summary

The benefits of Harbin Cultural Center Wetland Park are identified and summarized in this section (see Figure 6.25). Benefits in open space use mainly include increasing natural features, supporting recreation, providing beautiful scenery with nature and greenery, and improving access to open space. The ecological effects mainly include increasing species diversity, improving water quality, and storing storm water.

The design measures and effects have also been analysed and are summarized in Figure 6.25. Design measures such as 'A1.1: Paths within the floodplain', 'A4.5: Raised boardwalks and platforms', and 'A6.1: Boardwalks near banks' support recreation. 'A2.1: Reshaping the floodplain with more gently sloping banks' also supports recreation, provides beautiful scenery, increases biodiversity, and stores storm water. 'A2.2: Vernal pools' helps to increase natural features and beautiful scenery, and serves to increase biodiversity, improve water quality and store storm water.

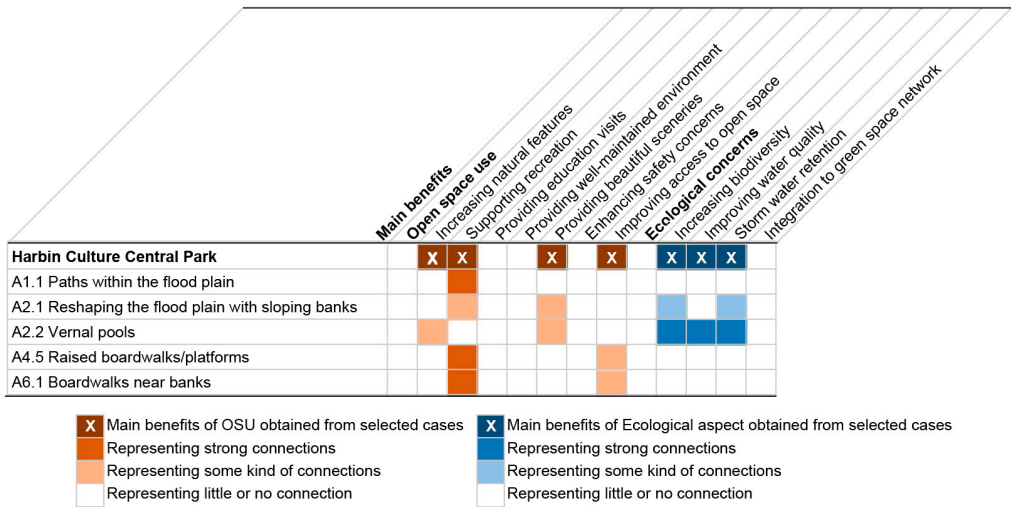


Figure 6.25 Design measures and benefits matrix in Harbin Cultural Central Park

Reflection

This project has basically achieved its design goals in terms of ecological considerations, such as flood control and water purification. In terms of open space use, there are slight deficiencies in terms of security enhancements and park conditions. Although the design team introduced a ranch project, with the introduction of livestock to control the length of natural plants to achieve low maintenance, the effect is not particularly good. According to my on-site investigation, the vegetation growth in some areas is very poor and the equipment lacks maintenance. In addition, there is little research and only a few studies have evaluated the Harbin Cultural Center Wetland Park. Subsequent recommendations may include appropriate maintenance measures and a regular assessment system to detect the growth and condition of park plants.

6.7 Summary

The summary results of the park benefits and design measures are shown in Figure 6.26. All parks have realised the benefits of open space use, including increasing natural features, supporting recreation, and improving access to open space, as well as the ecological benefits of increasing biodiversity and storm water retention. However, some of the potential benefits remain unrealised, such as the benefits of open space use, including providing education visits, providing a well-maintained environment, and enhancing safety concerns, as well as ecological benefits of integration with a green space network.

The analysis and summary of the design measure and the benefits of the park show that the selected design measures of these cases are largely consistent with the evaluation results of these parks (see Figure 6.26). For example, in Yanweizhou Park and Harbin Cultural Center Wetland Park, some design measures such as 'A1.4: Submersible vegetation', 'A3.4: Plants embankment', and 'A5.2: Terraced wetlands' help to increase natural features. Some other measures such as 'A1.1: Paths within the floodplain', 'A1.3: Social event grounds', and 'A4.3: Bridge over the water' are used to support recreation. Still others, such as 'A3.1: Terraced bank' and 'A2.2: Vernal pools', are used to increase biodiversity, and 'A1.2: Submersible platforms' and 'A2.1: Reshaping the floodplain with more gently sloping banks' help to store storm water.

These design measures have basically achieved their intended purposes, and one design measure may carry multiple benefits. For example, design measure 'A2.1: Reshaping the floodplain with more gently sloping banks' helps to support recreation, increase biodiversity, and store storm water. 'A2.2: Vernal pools' helps to increase natural features and serves to increase biodiversity, improve water quality, and store storm water.

As for the behaviour-mapping analysis and activity statistics of the six parks, as shown in Table 6.13, the results tell us that the number of people's activities and the variety of types of activities in some parks are relatively high, for example, Qiaoyuan Park, Harbin Cultural Center Wetland Park, and Olympics Forest Park. These parks have realised more benefits in terms of open space use and ecological aspects than other ones.

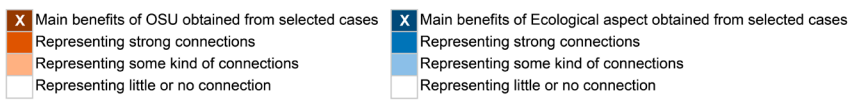


Figure 6.26 Design measures and benefits matrix in six Chinese cases

Table 6.13 Sum of number of people involved in activities for all six observed parks

| Activities | Qunli Park | | | | Qiaoyuan Park | | | | Xixi Wetland Park | | | | Olympic Park | | | | Yanweizhou Park | | | | Harbin Cultural Center I | | | | |
|--------------------|------------|----|-----|------|---------------|----|-----|------|-------------------|-----|-----|------|--------------|----|-----|------|-----------------|----|-----|----|--------------------------|----|-----|-----|------|
| | M. | F. | All | % | M. | F. | All | % | M. | F. | All | % | M. | F. | All | % | M. | F. | All | % | M. | F. | All | % | |
| Sitting | 0 | 7 | 7 | 17.1 | 23 | 26 | 49 | 17.1 | 3 | 13 | 16 | 6.2 | 15 | 8 | 23 | 6 | 12 | 21 | 33 | 66 | | 4 | 4 | 8 | 3.9 |
| Standing | | | | | 9 | 9 | 18 | 6.3 | | | | | 58 | 28 | 86 | 22.4 | | | | | | 6 | 1 | 7 | 6.9 |
| Walking | 12 | 7 | 19 | 46.3 | 37 | 39 | 76 | 26.5 | | | | | 49 | 55 | 104 | 27 | 4 | 4 | 8 | 16 | | 32 | 34 | 66 | 64.7 |
| Camping | | | | | | | | | | | | | 10 | 14 | 24 | 6.3 | | | | | | 2 | 1 | 3 | 2.9 |
| Jogging | | | | | 3 | 2 | 5 | 1.7 | | | | | | | | | | | | | 1 | 2 | 3 | 2.9 | |
| Playing | | | | | 59 | 71 | 130 | 45.3 | | | | | 26 | 62 | 88 | 22.9 | 2 | 1 | 3 | 6 | | 3 | 4 | 7 | 6.9 |
| Fishing | | | | | | | | | | | | | 4 | 2 | 6 | 1.6 | | | | | | | | | |
| Boating | | | | | | | | | | | | | 36 | 17 | 53 | 13.8 | | | | | | | | | |
| Photographing | | | | | | | | | | | | | | | | | 3 | 2 | 5 | 10 | | 4 | 5 | 9 | 8.8 |
| Walking dog | | | | | | | | | | | | | | | | | 1 | 0 | 1 | 2 | | 1 | 0 | 1 | 1 |
| Doing exercise | | | | | | | | | | | | | | | | | | | | | | | | | |
| Walking a child | | | | | 5 | 4 | 9 | 3.1 | | | | | | | | | | | | | | | | | |
| Entertainment | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sightseeing | | | | | | | | | 50 | 191 | 241 | 93.8 | | | | | | | | | | | | | |
| Working | 11 | 2 | 13 | 31.7 | | | | | | | | | | | | | | | | | | | | | |
| Digging vegetables | 1 | 1 | 2 | 4.9 | | | | | | | | | | | | | | | | | 0 | 2 | 2 | 2 | |
| | | | 41 | 100 | | | 287 | 100 | | | | 257 | 100 | | | 384 | 100 | | | 50 | 100 | | | 102 | 100 |

Limitations and future direction

It should be noted that the results of the design strategy and benefit evaluation are not completely coincidental. For example, some effects are not reflected in existing design measures, which may be due to other factors such as park management, maintenance, the location of the park, or demographic factors. In addition, certain strategies and measures may have other potential benefits that are not fully considered in this study. Later evaluators and researchers can also combine these other factors and tap into more potential benefits in the assessment.

Chapter 7 Discussion and conclusion

This chapter summarizes the conclusions of this study. First, it briefly discusses the study's findings concerning the research questions, and it compares with the results of similar studies. Then, it reviews the limitations of the study and its future prospects. Finally, it gives a few recommendations for application in practice.

7.1 Summary and discussion of major findings

This thesis had the aim of developing a framework of integrated design guidelines for UWPs in China, combining concerns of ecology and open space use. The findings in this research have successfully enhanced the knowledge base of UWP functions and design choices in China, which can be summarized by the following answers to the initial three research questions.

Question1: What are the key characteristics and design challenges of UWPs in different urban contexts?

In Section 4.1, three UWP types are identified based on geomorphology and hydrological cycles (see Table 4.3). The three identified UWP types each share distinct characteristics. Riverine UWPs are dominated by river systems, including rivers, creeks and floodplains. Lacustrine UWPs, include lakes, ponds and other artificial bodies of open water. Palustrine UWPs include parks with permanently or intermittently inundated basins, small and shallow ponds or swamps of various and variable sizes and shapes. The classification of UWPs provides a basis for UWP analysis under different geomorphological and hydrological conditions and serves as a foundation for the proposed design strategies. This UWP classification can be applied to other wetland-dominated urban landscapes elsewhere in the world.

The UWPs in this study are classified by developing a typology primarily based on their respective wetland characteristics and landscape elements. This typology draws on the classification process of the National Wetlands Inventory (NWI) (Cowardin, Carter, Golet, & LaRoe, 1979) and the geomorphic approach proposed by Semeniuk and Semeniuk (1995). The types of wetlands discussed in this study are generally compatible with the classification of NWI and Semeniuk and Semeniuk. However, some other categories, such as marine wetlands, are not discussed in this study because they are beyond the scope of urban wetland park research. In addition, there are similarities between the classification results in this study and those identified by Cheng et al. (2012, p. 24). The five types of wetland parks: lake, river, coastal, farmland, and restoration, which is studied by Cheng et al., can be covered in my three types of urban wetland parks.

In Section 4.2, a checklist of 13 challenge types is identified (see Table 4.4) by drawing on relevant literature containing challenges and recommendations for

urban wetland design. Key challenges and requirements are highlighted such as ‘controlling water pollution’, ‘maintaining biodiversity’, ‘maintaining wetland structural integrity’, practicing ‘erosion regulation’, ‘reducing flood risks’, implementing ‘stormwater management’. Those challenges assist in our understanding of the major related tasks. This overview demonstrates that these thirteen main types of design challenges need to be addressed in order to achieve the goals of ‘sustainable parks’, which are required by policies and conventions. New landscape design guidelines need to be developed for these design challenges.

Question2: What integrated design guidelines can be proposed that combine the concerns of ecology and open space use in UWPs?

In Chapter 5, a framework of integrated design guidelines is developed for China’s UWPs, including 17 design strategies and 57 design measures (see Sections 5.2–5.4). The proposed strategic framework has been proved to basically cover the design challenges of Section 4.2, in which the two goals of maintaining biodiversity and creating spaces for recreational activities are central (see Figure 5.3). In addition, the findings demonstrate numerous strategies that can address multiple challenges and goals simultaneously; for example, ‘A2: Increasing flood-plain space’ is related to maintaining biodiversity, reducing flood risks, storm water management, and creating spaces for recreational activities. Moreover, ‘A3: Varying the riverbank reinforcement’ is linked to maintaining biodiversity, maintaining wetland structural integrity, and erosion regulation. Similar strategies include ‘A4: Placing above the water’, ‘A5: Increasing complexity’, ‘A7: Integrating the public’, ‘B1: Designing transition zones’, ‘B2: Connecting the biotope with open space systems’, ‘B6: Integrating the public’, ‘C2: Designing transition zones’, and ‘C4: Combining habitat with open space’. This framework of guidelines is useful for analysing the quality of existing UWPs as well as for the design of future UWPs.

The approach used in this study to develop a design guide framework is related to the method used by Prominski et al. (2017) on designing urban river landscapes. For the riverine urban wetland parks of this study, certain design strategies are similar to Prominski et al., such as tolerant for water-table changes, increasing flood plan space and varying the bank reinforcement. However, this study extends existing knowledge by focusing on the Chinese context and by observing various water features outside the river, such as lakes and ponds in the lacustrine and palustrine urban wetland parks. For example, our research on UWPs in China reveals design strategies, such as connecting biotopes with open space systems and designing transition zones, which differ from the design strategies by Prominski et al. In addition, there are some design measures, such as putting pavilions at the water edge, designing waterfalls, or offering spaces

specifically for practicing instruments, which seem to be a specificity of the Chinese context.

Question 3: What benefits do selected UWP design guidelines yield on concerns of ecology and open space use in practice, as exemplified in six Chinese case studies?

In Chapter 6, the positive effects of selected design measures for six Chinese parks, in terms of ecological and open space use issues, are mainly confirmed. All parks have realized some of the benefits of open space use, including increasing the number of natural features, supporting recreational activities and events or improving access to open space, and some of the ecological benefits such as increasing biodiversity or stormwater retention (see Figure 6). However, other benefits are frequently not found, such as providing educational visits, providing a well-maintained environment or enhancing safety provisions for the benefits of open space use, or the integration into green space networks for the ecological benefits.

The analysis and summary of the design measures and the benefits of the parks show that the selected design measures used in these six cases bring the benefits in terms of ecological and open space use issues. For example, in Yanweizhou Park and Harbin Cultural Center Wetland Park, some design measures such as ‘A3.1 Terraced bank’ and ‘A2.2 Vernal pools’ are used to increase biodiversity, and ‘A1.2 Submersible platforms’ as well as ‘A2.1 Reshaping the flood plain with more gently sloping banks’ help to store stormwater. Other measures such as ‘A1.1 Paths within the flood plain’, ‘A1.3 Social event grounds’, ‘A4.3 Bridge over the water’ are used to support recreation.

These design measures have basically achieved the intended purpose, and one design measure may bring multiple benefits. For example, design measure A2.1 ‘Reshaping the flood plain with more gently sloping banks’ helps to support recreation, increase biodiversity and retain stormwater. A2.2 ‘Vernal pools’ helps to increase natural features and serves to increase biodiversity, improve water quality and store stormwater.

The result of assessing the real-world effects of selected design measures in ecological and open space use issues can help to concisely demonstrate and validate the role of specific design measures in landscape practices, providing reference and recommendations for design practitioners. The result can also help establish greater links between research on ecological aspects and open space use, especially for improving UWPs to achieve greater potential in these two areas.

7.2 Limitations of the research and scope for future research

One limitation of this study is that the exploration and summarisation of design strategies are fixed in time and do not cover all possibilities. Good-practice projects and reflections based on the current theoretical debate and knowledge must keep pace with the times, especially in China's urban environments marked by rapid urbanisation, which constantly necessitate new research and reflections.

Another limitation is that the potential benefit assessment is based on the preliminary data of the field study and the secondary data in the literature. Such temporariness may be sufficient to answer the third research question and the goal of this study, but future research may require more systematic assessments, as well as more on-site measurements and primary data.

More and more research is required to better understand whether and how design strategies and measures contributing to design improvement, acceleration, and creation in practice, as well as to gauge the consistency between the designer's concepts and objective evaluation criteria. In addition, in the context of rapid urbanisation, social factors merit further exploration, such as the transformation of urban residents' aesthetic awareness of natural landscapes in cities, differences in perceptions of UWP by the public and experts or designers, and differences between local residents and new immigrants in terms of their aesthetic preferences and perceptions of ecological processes in UWPs.

7.3 Recommendations for application in practice

Based on the findings of this research, a few recommendations can be considered for design practitioners. Careful attention must be paid to the following key steps, to ensure that a UWP design proposal will achieve its intended success.

Site identification and evaluation

It is important to have a review and understanding of such information about the amount and type of land, soil and water resources, the type and location of degraded and former wetlands, source of contaminated water and soils, presence of historical sites. For example, wetland planning requires an in-depth understanding of the water flow and nutrient loading into the wetland. This

analysis will help to design the number and size of wetlands better and to determine the selection of design strategies.

Refinement of design goals and key challenges

Design goals can be established by identifying functional deficits. For example, what water quality problems are on the site? Does the site have floodwater storage deficits? Does the site have enough space for human activities? Then it is important to evaluate the site to assess their functional capacity to meet the watershed goals. For example, what water quality enhancement potential does the site have? Is the site located in the fifty-year floodplain? Does the site locate in a populated community? Finally, according to the identification of assets and requirements, the main objectives of UWP design can be determined, such as restoring degraded wetlands and providing recreational activities. Meanwhile, key design challenges are also necessary to be identified, such as reducing flood risks and increasing biodiversity.

Selection and application of design measures to address design goals

Designers could learn from the successful design strategies and measures proposed here (section 5.1), for example, connecting the biotope with open space systems, and increasing floodplain space and complexity to enhance UWPs' design qualities and capacities in order to provide benefits for people and nature simultaneously. Attention should also be paid to the flexibility of the application for these design strategies and measures, for example selecting appropriate design strategies based on the corresponding wetland park type (section 5.2-5.4), designing artificial wetlands of appropriate size and number according to local water environment conditions, and designing areas with different intensity levels according to design goals. Additionally, it should be noted that each measure does not exist independently. For a certain park or design task, multiple measures can be used together. The design measures serve as inspirations for new multifunctional approaches and can be transferred in future design tasks for relevant situations.

Monitoring and evaluation of constructed UWP

UWP design does not end when the plan is constructed. Surveys and evaluations are essential and may be necessary over a period of years after the UWP construction. Built UWPs can be continuously monitored using the assessment criteria presented in this study to identify shortcomings and opportunities for management improvement. In addition, monitoring data and lessons from these projects are also valuable for improving design guidelines.

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Appendix: Supplementary projects for Chapter 5

Type A: Riverine UWP

- 1 Yanxiu Park, Liaoyang, China
- 2 Milliken State Park, Detroit, USA
- 3 Renaissance Park, Chattanooga, USA
- 4 Black Rock Sanctuary, Phoenixville, USA
- 5 Shanghai Houtan Park, Shanghai, China
- 6 Yuma East Wetlands, Yuma, USA
- 7 Zaragoza Water Park, Zaragoza, Spain

Type B: Lacustrine UWP

- 8 Railroad Park, Birmingham, Alabama, USA
- 9 The Morton Arboretum Meadow Lake, Lisle, USA
- 10 Carmel Clay Central Park, Carmel, USA
- 11 Tangshan Nanhu Eco-City Central Park, Tangshan, China

Type C: Palustrine UWP

- 12 Palmisano Park, Chicago, USA
- 13 South Los Angeles Wetland Park, Los Angeles, USA
- 14 Magnuson Park, Seattle, USA
- 15 Rudow Park, Berlin, Germany
- 16 Maurice Rose Airfield, Frankfurt Bonames, Frankfurt, Germany

01 Yanxiu Park

Beijing Tsinghua Tongheng Urban Planning and Design Institute, 2012
Liaoyang, China



Plan of Yanxiu Park and location in Liaoyang.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Yanxiu Park is a waterfront recreation park transformed from a government tree nursery in the expanding River-east district of the city of Liaoyang. It is located within the 100-year floodplain of the Taizi River and is surrounded by high-density development in the city's new River-east district. Incorporating new habitat systems, cultural facilities, and recreational opportunities, the park serves as a community amenity as well as an example for the resilient flood-control mechanism.

Open space use aspect

The park provides a variety of facilities for recreational activities. For example, an entry plaza with a lake view stepped seating area was designed to provide space for social and commercial events and activities such as plaza dancing. In addition, a variety of spaces were designed to accommodate daily recreation and exercise, including a looped running pathway through the park, a massage path for barefoot massages, a musician's pavilion designed for practicing instruments, tennis courts, a basketball court, and gym equipment. The park also provides lots of opportunities to come in contact with water; for example, wooden boardwalks, walking paths, and platforms along the Taizi River provide direct access to the riverfront.

Ecological aspect

The park created a side pond-channel system by connecting two existing gravel mining pits with a new winding creek to safely move floodwaters through and out of the park. The resilient design of the park accommodates floods, which annually inundate the site for an average of 3 to 5 days, and enhances the floodplain's ecological functions. In addition, the park provides more wildlife habitats by preserving the mature trees on site and reshaping the steep banks of the Taizi River and ponds.

Design measures

A1.2: Submersible platforms; A1.3: Social event grounds; A2.1: Reshaping the floodplain with more gently sloping banks; A3.1: Terraced bank; A3.2: Timber revetments; A3.3: Stone revetment; A4.1: Pavilions on piles; A5.3: Pond system; A6.2: Gently sloped open lawn area near the river; A6.3: Seating area with direct views to the Lake; A6.4: Waterfalls; A7.1: Walking clubs; A7.2: Space designed specifically for practicing instruments.

References

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02 Milliken State Park

SmithGroupJJR, 2010

Detroit, USA



Plan of Milliken State Park and location in Detroit.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Milliken Park, located near Detroit's riverfront, was transformed from a brown-field site underlain with contaminated soil and abandoned infrastructure. It provides river access and connects the old harbour to Rivard Plaza and the Riverwalk that leads towards downtown. The park features interpretive displays, a restored native habitat, and a wetland that treats storm water; it also provides residents with recreational access along the urban riverfront.

Open space use aspect

The park provides a space for outdoor recreation, exercise, relaxation, and educational visits. For example, interpretive shelters with signage illustrating the native, industrial, and social history of the riverfront are easily accessible for visitors. Other amenities such as concrete hardscapes and stainless-steel cable railing provide visitors with riverfront fishing accessibility. The wetland area also provides recreational access along the urban riverfront and open space for fishing, biking, and wildlife viewing.

Ecological aspect

This park features a restored native habitat and wetland that treats stormwater from adjacent lands. After being piped in, passed through a swirl separator, and then pumped into a sediment forebay, the stormwater passes through braided wetland streams in order to increase vegetation and stormwater interaction for maximum filtering before entering the Detroit River. Apart from that, the wetland provides habitat for aquatic plant species, native forb and grass species, and native tree and shrub species.

Design measures

A5.1: Establishing water's meandering path; A7.3: Fitness classes.

References

- Michigan Department of Natural Resources: Milliken State Park. Retrieved from <https://www.michigan.org/property/william-g-milliken-state-park-and-harbor>
- Deming, M. E., & Littleton, P. (2013). William G. Milliken State Park, Phase 2 Lowland Park. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0480>

03 Renaissance Park

Hargreaves Associates, 2006; Chattanooga, USA



Plan of Renaissance Park and location in Chattanooga.
Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

The 22-acre Renaissance Park is a brownfield redevelopment project on Chattanooga's North Shore. It was designed on a former industrial site. This project created a wetland system that now collects and cleans urban runoff generated on site and runoff brought onto the site via the North Market Street Branch stream, before releasing it into the Tennessee River. It also provides a backdrop for social engagement, healthy lifestyles, and environmental education.

Open space use aspect

This park has a variety of features and offers many facilities. Among them, trails and walkways provide opportunity for exercise, relaxation, and wildlife viewing. In addition, piers over wetlands and riparian banks provide environmental education and wildlife viewing opportunities. There are several interpretive signs illustrating the cultural history and stormwater treatment process. The park's landforms also provide an opportunity for recreation. A terraced amphitheatre that arises from the wetland bank provides a backdrop to the gathering space.

Ecological aspect

This park moved contaminated soil from the 100-year floodplain and sealed it safely within the park's iconic landforms. The portion of the site from which contaminated soils were excavated was redesigned as a constructed wetland. This wetland has a meandering water path established by gabions with wetland plantings, thereby treating runoff from the site. Floodplain storage of the site was increased through the excavation of contaminated soil and the construction of a wetland.

Design measures

A1.3: Social event grounds; A1.4: Submersible vegetation; A3.2: Timber revetments; A3.3: Stone revetment; A4.2: Elevated piers; A5.1: Establishing water's meandering path; A7.4: Gathering space for social groups.

References

- Hargreaves Associates: Renaissance Park. Retrieved from <http://www.hargreaves.com/work/chattanooga-renaissance-park/>
- Collett, B., & Taylor, J. (2014). Renaissance Park. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0660>

Background

The project constructed a range of quality wetland habitats in order to create a bird sanctuary for rare and endangered migratory waterfowl species while providing the public with a place to learn about the wetland environment. The park also includes a rain garden, butterfly garden, warm-season meadow, and biofiltration cells that filter stormwater runoff from the adjacent neighbourhood.

Open space use aspect

The park provides space and opportunities for educational visits and exploration. For example, for one of the site's educational interpretive exhibits, a 'bird's nest' was designed by reusing invasive *Ailanthus* branches. The nest offers visitors views to the wetlands and ponds below. The park also supports public environmental programs on topics such as wetlands, birding, salamanders, and the site's history. These educational programs for middle school students use nature-themed games and activities to teach about wildlife, habitat, and human impacts.

Ecological aspect

The park features a series of wetlands and meadows that support habitat for wildlife. For example, permanent ponds were designed to provide habitat for migrating birds; vernal pools were designed to support tree frog, salamander, and turtle habitats; new upland meadow was created to provide habitat for ground-nesting birds; a butterfly garden with special plant species was designed to provide habitat for pollinators. In addition, a biofilter, a rain garden, and vegetated swales were designed to capture and filter stormwater from the parking lot to the wetland.

Design measures

A2.2: Vernal pools; A4.5: Raised boardwalks and platforms; A7.3: Gathering space for social groups.

References

Myers, M., & Arnold, A. (2012). Black Rock Sanctuary. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0350>

Background

Houtan Park was built on the abandoned industrial site beside the Huangpu River. It was created for the 2010 Shanghai World Expo and still remains to be a public open space. It established an ecological purification model for the water system that can be replicated. It can treat polluted river water, alleviate urban flooding, increase habitat and biodiversity, and provide public access to the open space on the riverfront.

Open space use aspect

The park provided recreation and educational opportunities to city residents and visitors during and after the 2010 Shanghai World Expo. For example, the terrace design resolves the change in elevation from the road to the shoreline, creating a quiet valley that allows people to access the water. The pedestrian walking paths, boardwalks, and multiple footpaths through the terraces give visitors access to the inner spaces. Some reclaimed materials, such as steel, were used to construct the dock and garden to exhibit industrial relics.

Ecological aspect

The design created a linear constructed wetland that cuts through the centre of the park. This wetland treats contaminated water from the Huangpu River with different cleaning system stages including a stonewall waterfall, terraced fields, area of plants, cascading terraces, and a sand filtration area. In addition, several linear miles of natural wetland as well as the constructed wetland in the park support habitat for native plants and animals.

Design measures

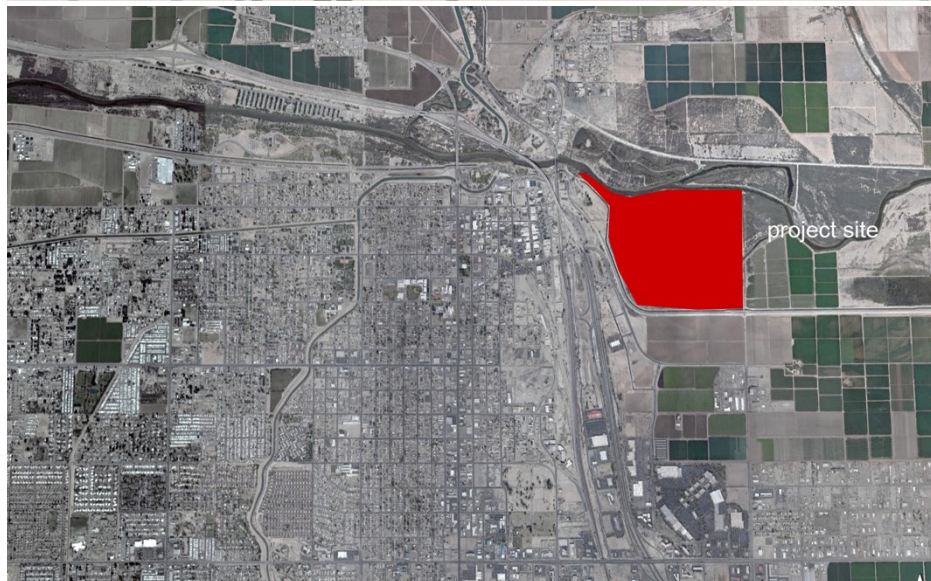
A3.3: Stone revetment; A4.5: Raised boardwalks and platforms; A5.2: Terraced wetlands; A6.1: Boardwalks near banks; A7.4: Gathering space for social groups.

References

- Turenscape: Shanghai Houtan Park. Retrieved from <https://www.turenscape.com/project/detail/443.html>
- Rottle, N., Lacson, D., Cromwell, P., Yeh, Y. J., & Hai, C. (2011). Shanghai Houtan Park. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0170>

06 Yuma East Wetlands

Fred Phillips Consulting, 2010; Yuma, USA



Plan of Yuma East Wetlands and location in Yuma.
 Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

The Yuma East Wetland (YEW) project was built on a wasteland along the Colorado River near the historic downtown of Yuma, Arizona. This project restored 350 acres of wetland and riparian ecosystems and reconnected the people with the river.

Open space use aspect

This project annually engages and educates volunteers who provide assistance with the restoration process. In addition, it provides recreational and educational opportunities for visitors and the local community, such as hiking, jogging, year-round swimming access, and the annual Birding and Nature Festival.

Ecological aspect

This project created a backchannel that returned water flow to the wetland by the excavation of sediment and restored the confluence of the Gila and Colorado Rivers. It also created riparian habitat for various species of wildlife, including threatened and endangered species. A lot of local, native plant materials are preserved and used for supplementing nursery materials, as well as for bioengineering along the river bank.

Design measures

A3.4: Plants embankment; A6.1: Boardwalks near banks.

References

Kondolf, G. M., Atherton, S. L., & Rubin, Z. K. (2013). Yuma East Wetlands, Phases 1 and 2. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0540>

07 Zaragoza Water Park

Aldayjover, 2005-2006; Zaragoza, Spain



Plan of Zaragoza Water Park and location in Zaragoza.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

This water park, transformed from the Ranillas Meander, was designed for the 2008 Zaragoza Expo with the intention of recalling the agricultural nature; after the Expo, it transitioned to be a permanent waterfront park. The final result is a multifunctional urban park that represents relationships between the territory, the Ebro River, and the urban environment. This park doubles the green space in Zaragoza while forming the western part of the city core and serving the metropolitan area and its inhabitants.

Open space use aspect

This park combines large green space with leisure activities, taking into account the daily use of its facilities by visitors and urban citizens. There is a dense network of vehicle paths, which provide opportunities for various sports such as cycling and jogging. In addition, people can take part in rafting, kayaking, and hydro speed activities in the adventure section of the park. This park has also made an attempt to concentrate on a wide variety of children's activities in specific areas. For example, in the south area, there is a leisure centre for children as well as a large children's theatre. These areas are vehicle-free and offer ample parking areas nearby.

Ecological aspect

The water system in this park organizes a living system that purifies the water from the Ebro River. Water enters through the northern end of the canal and is extracted at the southern end for different uses, such as irrigating the park and Expo site and supplying the water treatment ponds, wetlands, aqueduct, and watercourse. Before the water flows through the rest of the park, it is treated by green filters in the aqueduct. At the end of its journey, some water is recycled for irrigation and some is returned to the river through infiltration lagoons.

Design measures

A1.1: Paths within the floodplain; A1.4: Submersible vegetation; A2.2: Vernal pools.

References

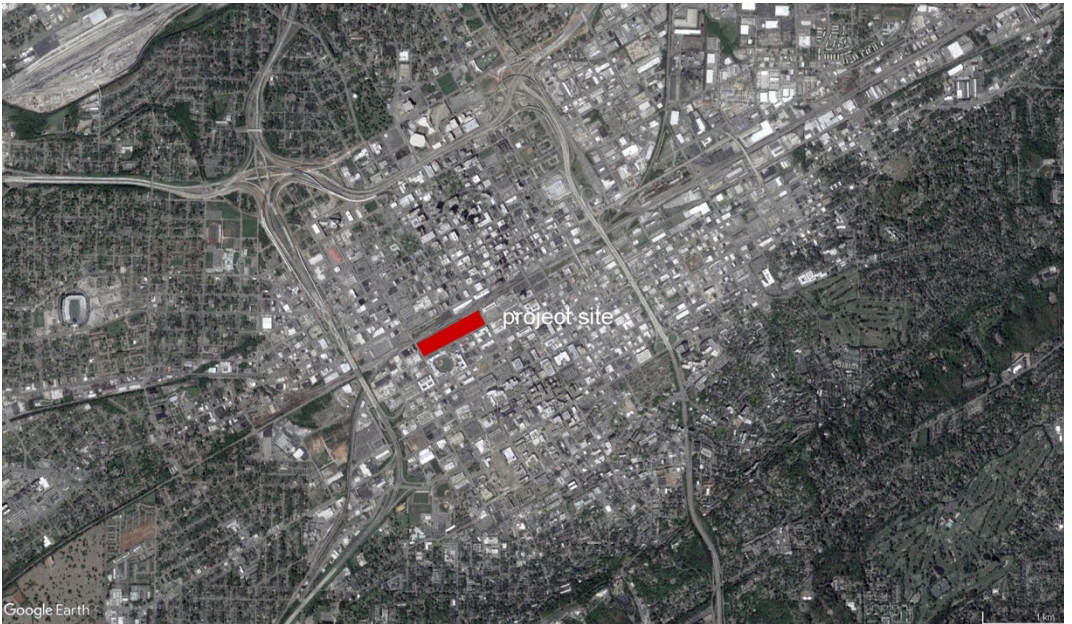
Aldayjover: Water Park for Expo 2008. Retrieved from <http://www.aldayjover.com/en/component/articulo/?idcategoria=17&idarticulo=431>

08 Railroad Park

Tom Leader Studio, Macknally Land Design, 2010; Birmingham, USA



Illustrative Plan



Plan of Railroad Park and location in Birmingham.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Railroad Park was built on the former site of warehouses and a yard for rail and steel industry waste. It was organized around the elevated railway line, making it an important connection point between the northern and southern parts of the city of Birmingham, Alabama. This project created required flood storage by digging a water system that includes a large irrigation reservoir, streams, and a series of ponds, and by creating a series of hillocks on the railway viaduct. It has become an important gathering place and a heavily used open space in the city.

Open space use aspect

This park features a variety of facilities for recreational activities. For example, outdoor gym equipment and skate bowls provide open-air exercise opportunities; play areas, such as the stream, are designed to encourage children to safely play while watching the trains go by; a series of rail-trails and looping trails provide a variety of routes for walkers, runners, and the casual stroller; an amphitheatre provides space for outdoor concerts, events, and performances.

Ecological aspect

The design created a chain of water features including a wetland, ponds, a lake, a rain curtain, and streams. Stormwater is filtered through the wetland before continuing into the lake and stream system. The circulating pond-stream system provides biofiltration and emergency flood storage for the surrounding watershed.

Design measures

B4.1: Stone revetment. B6.3: Looped running pathway.

References

- Tom Leader Studio, Railroad Park. Retrieved from https://tislarch.com/portfolio_page/railroad-park/
- LeBleu, C., Bowen, R., & Garrett, B. (2016). Railroad Park. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs1080>

Background

The Morton Arboretum Meadow Lake project was built on a former degraded retention pond and asphalt parking lot. The designers created a functioning wetland system and a permeable lot, helping to improve the water quality of the restored Meadow Lake, while also providing the public with more opportunities for sports and education.

Open space use aspect

This project provides outdoor space for walkers, joggers, and educational visitors. In addition, designers created limestone stepped-terraces that gradually descend down to the lake, allowing for direct interaction with the water's edge and providing an opportunity for people to observe turtles and frogs up-close.

Ecological aspect

Various ecological measures were used in this project to retain stormwater and improve the water quality of the lake. The permeable parking lot stores and slows stormwater through a subsurface gravel bed. Bioswales capture and infiltrate the runoff from the parking lot. The constructed wetland receives the overflow from the parking lot and bioswales and increases habitat around Meadow Lake.

Design measures

B2.3: Submersible stepped-terraces descend down to the lake; B4.2: Planted edge.

References

Mattson, M. P., & Hanson, S. (2014). The Morton Arboretum: Meadow Lake & Permeable Main Parking Lot. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0760>

10 Carmel Clay Central Park

SmithGroupJJR, 2007; Carmel, USA



Plan of Carmel Clay Central Park and location in Carmel.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Carmel Clay Central Park was transformed from an agricultural landscape. The Park Board identified their goals as achieving economic, environmental, and aesthetic aspirations while simultaneously striving for maximum recovery of the costs for operation and maintenance. The design achieved a park that balances intensively used built elements (for example, community centres, water parks, and parking lots) with passively used landscape features (for example, lagoons, trails, and forest wetlands).

Open space use aspect

The park provides public open space for recreation and relaxation for citizens and visitors. Park features include free access to woodlands, restored prairie and native plants, wetlands, and trails, as well as an active water park and sophisticated community centre. Boardwalks provide access to the park's lagoon and wetland for fishing and bird watching. In addition, meadows overlooking the lagoon accommodate daily recreation such as soccer practice and kite flying, as well as social gatherings and special events. The woods and prairie/native plant areas on and off the trail system encourage visitors to explore and connect with nature.

Ecological aspect

The park features a constructed lagoon and wetland which store and treat the site's stormwater runoff and the grey water from the water park before discharging it into Carmel Creek. In addition, the park preserves a large area of woods, including high-quality stands of beech-maple forest. Such forest provides special habitat for species such as bloodroot and pawpaw.

Design measures

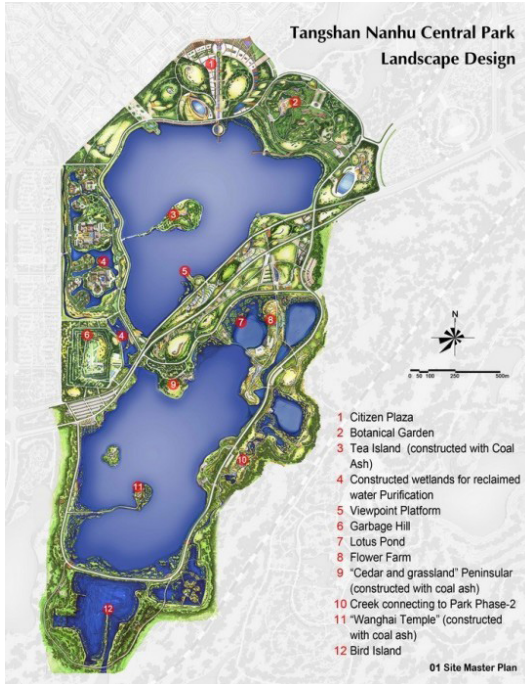
B2.2: Trail system designed to encourage visitors to explore (the woods areas or hill); B3.1: Create boardwalks near the water; B4.1: Stone revetment; B6.3: Looped running pathway.

References

- SmithGroupJJR: Carmel Clay Central Park. Retrieved from <https://www.smithgroup.com/projects/central-park>
- Deming, M. E., & Littleton, P. (2013). Carmel Clay Central Park. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0470>

11 Tangshan Nanhu Eco-City Central Park

Beijing Tsinghua Urban Planning & Design Institute, 2009; Tangshan, China



Plan of Nanhu Eco-City Central Park and location in Tangshan.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Tangshan Nanhu Central Park was built on the former coal mining site in the centre of Tangshan City. The site was heavily polluted and damaged after a massive earthquake in 1976 and was also used as a city landfill and sewage lagoon. By using a variety of integrated and sustainable strategies, such as stormwater management and habitat restoration, the project eventually transformed to become the largest urban central park in north-eastern China. The park provides both ecological values and open space use values for Tangshan city.

Open space use aspect

The park provides numerous recreational opportunities to residents and visitors. Boat docks and extensive boardwalks along the lakeshores provide the view of the water. In addition, a citizen plaza provides space for activities such as square dancing and tai chi. Other spaces within the park include a hill, a central island, and a botanical garden, providing scenic views as well as various recreational opportunities, such as walking, hiking, and picnicking.

Ecological aspect

The park provides various habitats, including woodland, bosque, grassland, and wetland for fish, reptile, amphibian, mammal, and bird species. In order to better protect the habitat, the park is divided into protected areas and open spaces. Certain sensitive areas are designed expressly for wildlife, preserving the natural vegetation with few interventions.

Design measures

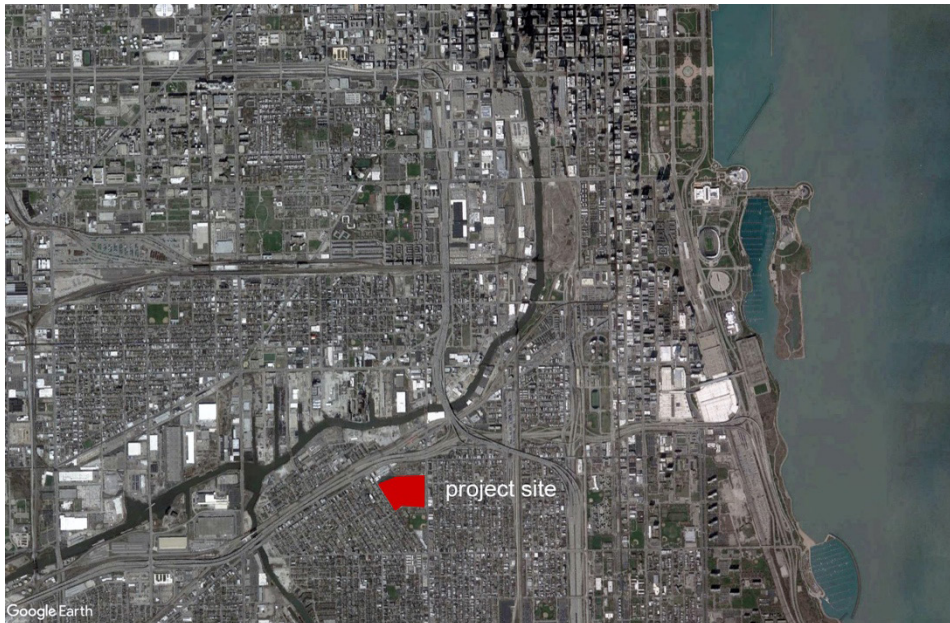
B1.1: Divide into protected areas and open space; B1.2: Certain sensitive areas are designed expressly for wildlife; B3.1: Create boardwalks near the water; B3.5: Boat docks and extensive boardwalks; B4.2: Planted edge; B4.3: Gabions embankment to stabilize the lakeshore.

References

- Beijing Tsinghua Urban Planning & Design Institute: Tangshan Nanhu Eco-City Central Park. Retrieved from <http://www.thupdi.com/project/view?id=1807>
- Dvorak, B., Li, M. H., & Luo, Y. (2012). Tangshan Nanhu Eco-City Central Park. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0300>

12 Palmisano Park

Site design group, ltd; D.I.R.T. Studio, 2010; Chicago, USA



Plan of Palmisano Park and location in the city of Chicago.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Palmisano Park was transformed from a former limestone quarry and landfill site. It is located in the heart of the Bridgeport community in southwest Chicago. The site plan of Palmisano Park shows wetland cells, the topographic Mount Bridgeport, accessible paths, a pond, walkways overlooking the pond constructed from reused city material, and a multipurpose field with a surrounding running path.

Open space use aspect

This park offers nature trails, boardwalks, and pedestrian paths for a variety of activities from nature walks to trail running. These paths are also connected to the ball fields of the adjacent park. In addition, this park provides spaces for programming and activities that include seasonal stewardship days, ecological learning, overnight camping, catch and release fishing, fossil hunting, and music and water shows.

Ecological aspect

Native wetland and prairie ecosystems in this park provide habitat for resident and migratory birds. In addition, by using native prairie plants that require no irrigation, this park saves a large amount of potable water and money, compared to irrigating an equivalent area of turf. This park also manages all rainfall for stormwater onsite, through bioswales, wetland cells, and a retention pond.

Design measures

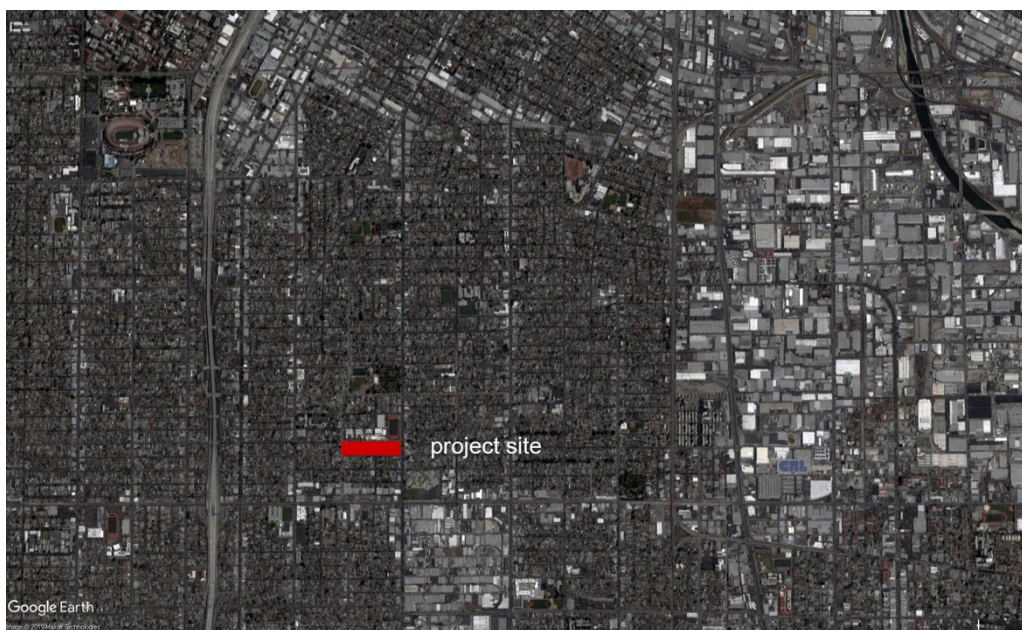
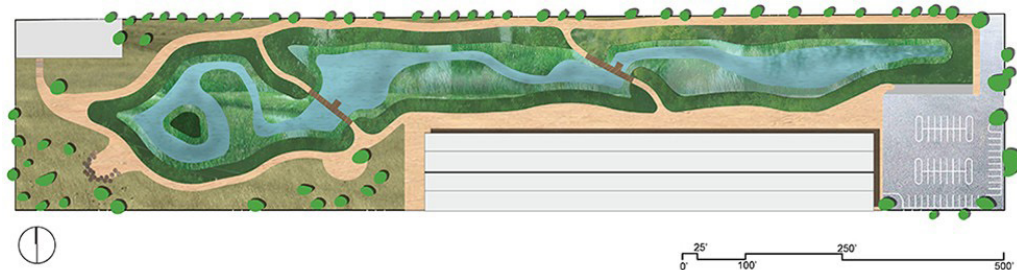
C2.2: Create buffers; C4.1: Recreation trail along the filtration ponds.

References

Mattson, M. P., & Hanson, S. (2014). Palmisano Park / Stearns Quarry. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0770>

13 South Los Angeles Wetland Park

Psomas, Mia Lehrer + Associates, 2011; Los Angeles, USA



Plan of South Los Angeles Wetland Park and location in Los Angeles.
Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

South Los Angeles Wetland Park was built on a former bus yard and brownfield at the centre of a densely populated community. Located within the Los Angeles River Watershed, it was transformed into a public nature park with sustainable rainwater treatment wetlands. This park captures and processes urban stormwater runoff while creating a neighbourhood-rejuvenating amenity.

Open space use aspect

The park features a series of recreation trails, boardwalks, observation decks, picnic areas, bridges, and educational signage. It provides a place for all ages to enjoy a variety of different activities such as jogging, fishing, walking, bird-watching; it also provides educational opportunities for the adjacent high school and elementary school.

Ecological aspect

The design created a series of wetlands that clean urban stormwater runoff. The runoff from traditional rainwater pipes is collected in the west of the site, diverted to the pre-treatment system, and delivered to the constructed wetlands for treatment. The treated water is then delivered back to the rainwater pipeline on the west side.

Design measures

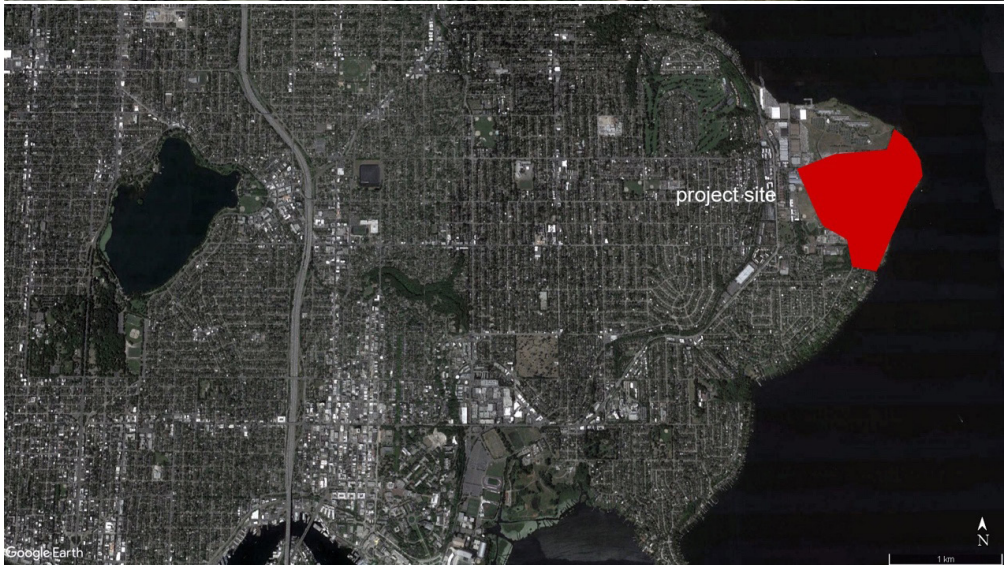
C3.3: Bridges; C4.1: Recreation trail along the filtration ponds.

References

- Shannon, K., & Hood, C. (2016). South Los Angeles Wetland Park. Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs1130>
- Psomas: South Los Angeles Wetland Park. Retrieved from <https://psomas.com/markets/south-los-angeles-wetland-park-2/>

14 Magnuson Park

The Berger Partnership PS, 2006-2012; Seattle, USA



Plan of Magnuson Park and location in Seattle.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Seattle's Magnuson Park was transformed from a former U.S. navy airfield. It is an urban park and includes ecologically rich wetlands, sports fields, and paths for exploration and education. It provides recreational value for visitors while at the same time providing ecological value; additionally, the park impressively utilizes re-used materials and resources found on-site to commemorate the site's history. The park creates an integrative space that meshes ecological and human needs with great success.

Open space use aspect

The park features wetlands and native plants, set within a network of trails and greens designed for recreation. For example, extensive boardwalks and trails allow for visitor access without disturbing sensitive wetland ecology. In addition, the park provides educational visits to urban middle school students.

Ecological aspect

After removing the impervious surface, this project created five distinct wetland systems: Northern Marsh, Entry Marsh, Marsh Ponds, Promontory Ponds, and Linked Marsh Ponds. The marsh ponds provide habitat for several special species such as the Pacific chorus frog. Apart from that, the site can detain water underneath the sports fields and in ponds and wetlands, helping reduce the amount of non-point source pollution from the surrounding neighbourhoods and roads.

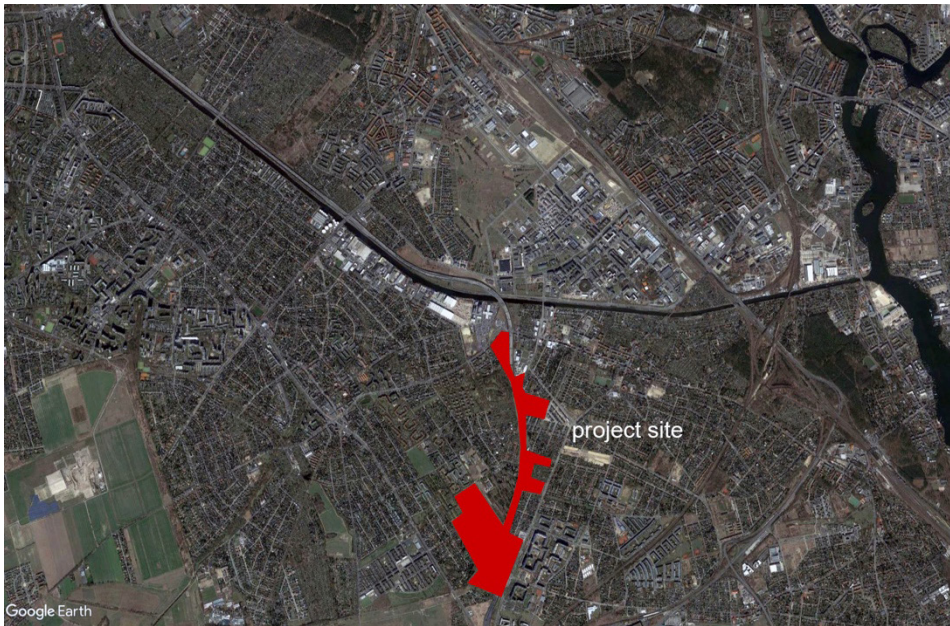
C3.2: Create boardwalks near the water.

References

Rottle, N., Lacson, D., & Michalak, J. (2012). Magnuson Park Wetlands and Active Recreation. The Landscape Performance Series. Landscape Architecture Foundation. Retrieved from <https://doi.org/10.31353/cs0370>

15 Rudow Park

ag.u Lange & Büro Grigoleit, 2005-2009; Berlin, Germany



Plan of Rudow Park and location in Berlin City.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Rudow Park is located on the border strip between the Berlin districts Rudow (West Berlin) and Altglienicke (East Berlin). It was developed to compensate for the construction of the highway and the related impacts on nature and landscape. The highway was built in order to connect these regions. The park is a sprawling meadow landscape that links the districts (that were separated for decades) and connects to the Brandenburg cultural landscape.

Open space use aspect

The park is accessible by a hierarchically structured walkway system, which is dominated by an asphalt road along the former Berlin Wall. The network consists of subordinate parallel and circular routes each in the northern and southern sections. This route allows trouble-free coexistence for pedestrians, cyclists, and skaters. The south end of the park is mainly agricultural land. In this part, the extensive meadow offers a natural landscape, including horses in pastures along with orchards and hedges — a stark contrast from the dense urban environment.

Ecological aspect

In this park, various ecological measures were taken to deal with the wasteland along the former Berlin Wall. For example, the design conserved old ponds and created more ponds and wetlands. The restored ponds and wetlands, as well as the areas around the exposed puddle, are reserved as a natural development area. To avoid visitors entering this space, the area is shielded by a natural fence, which was planted with new trees and combines well with the park.

Design measures

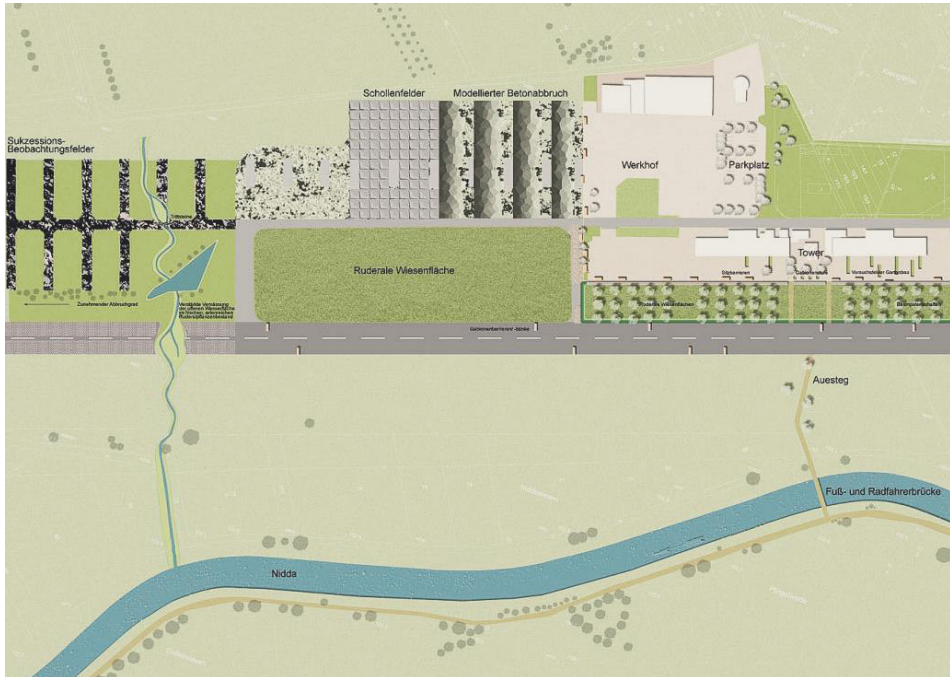
C2.2: Create buffers; C2.3: Divide different areas by use intensity.

References

- agu-berlin: Landschaftspark Rudow-Altglienicke. Retrieved from http://www.agu-berlin.de/rudow_alt.htm
- Prominski, M., Maass, M., & Funke, L. (2014). *Urbane Natur gestalten: Entwurfsperspektiven zur Verbindung von Naturschutz und Freiraumnutzung* [Designing urban nature: Design perspectives on the connection between nature conservation and open space use]. Basel: Birkhäuser. pp. 140-142.

16 Maurice Rose Airfield, Frankfurt Bonames

GTL Landscape Architects, 2002-2004; Frankfurt, Germany



Plan of Maurice Rose Airfield and location in Frankfurt.

Bottom image adapted from Google Earth. Map data: Google, DigitalGlobe.

Background

Maurice Rose Airfield, a former U.S. military airport in Frankfurt, was redesigned in 2004 to become a park. This park perfectly combines nature conservation and open space utility. It creates many biotopes for this area and provides recreational opportunities such as cycling, roller-skating, and skateboarding.

Open space use aspect

This park has become popular with teachers and students, and functions as an adventure place for children with parents. It conserved some of the installations of the old aerodrome and justified them to a new purpose for open space. For example, the concrete slabs from the former runway were reused to build the elevated viewing platforms. In addition, the flat surface of the rest hardscape can be used as a recreation area and skating surface. These design elements help to facilitate various experiences to the park users.

Ecological aspect

Instead of being removed, the hardscape in the site was broken up to provide living space for plants and animals. Because of the different degrees of demolition in each section, there are different phases of natural growth. These areas also have a deliberately unmanaged spill of water, which was piped from a former brook. As a result, this area creates opportunities for the unforeseeable development of biotopes.

Design measures

C1.3: Various water storage areas; C2.3: Divide different areas by use intensity; C4.1: Recreation trail along the filtration ponds.

References

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- Prominski, M., Maass, M., & Funke, L. (2014). *Urbane Natur gestalten: Entwurfsperspektiven zur Verbindung von Naturschutz und Freiraumnutzung* [Designing urban nature: Design perspectives on the connection between nature conservation and open space use]. Basel: Birkhäuser. pp. 168-173.

Illustration credits

All photographs not listed here were taken by the author.

Chapter 1-5

Section 5.2

A1.2, A3.2, A4.1, A5.3, A6.2, A6.3, A6.4, A7.2 Photographs: Tsinghua Tongheng Urban Planning and Design Institute (THUPDI)

A1.3, A4.2, A5.1 Photographs: Hargreaves Associates

A1.4, A2.1(down), A3.1, A3.3, A5.2, A7.4 Photographs: Turenscape

A2.2 Photograph: Landscape Architecture Foundation (Allison Arnold, CSI 2012)

A3.4 Photograph: Fred Phillips Consulting

A7.1 Photograph: Landscape Architecture Foundation (Clarissa Ferreira Albrecht da Silveira, CSI 2017)

A7.3 Photograph: Retrieved from Michigan Department of Natural Resources

Section 5.3

B1.2, B2.1, B3.5, B4.3 Photographs: THUPDI

B2.3 Photograph: Landscape Architecture Foundation (Mary Pat Mattson, CSI 2014)

B3.4 Photograph: China Tours Net

B4.1 Photograph: Landscape Architecture Foundation (Paul Littleton, CSI 2013)

B6.2 Photograph: Hangzhou Xixi National Wetland Park Official Website

Section 5.4

C1.1, C1.2, C3.1, C4.1 Photographs: Turenscape

C1.3, C2.3 Photographs: Institut für Freiraumentwicklung, Leibniz Universität Hannover

Chapter 6-7

Section 6.1

Figure 6.1(top): Turenscape

Section 6.2

Figure 6.5(top): Turenscape

Figure 6.7 (3,6): Turenscape

Section 6.3

Figure 6.10: Hangzhou Garden Design Institute

B1.1 Figure: retrieved from Li, Liu, Zheng, & Cao, 2011, p.1025.

B6.2 Photograph: Hangzhou Xixi National Wetland Park Official Website

Section 6.4

Figure 4.14(top): THUPDI

B2.1 Photograph: THUPDI

Section 6.5

Figure 6.18(top): Turenscape

A3.1, A3.4 Photographs: Turenscape

Section 6.6

Figure 6.22(top): Turenscape
A2.2, A6.1 Photographs: Turenscape

Appendix

- 01 (top): Beijing Tsinghua Urban Planning & Design Institute
- 02 (top): Michigan Chapter of the American Society of Landscape Architects
- 03 (top): City of Chattanooga Parks and Recreation
- 04 (top): KMS Design Group, LLC
- 05 (top): Turenscape
- 06 (top): Fred Phillips Consulting
- 07 (top): Aldayjover
- 08 (top): Tom Leader Studio
- 09 (top): The Morton Arboretum
- 10 (top): SmithGroup JJR
- 11 (top): Beijing Tsinghua Urban Planning & Design Institute
- 12 (top): Site design group, ltd with annotations by CSI Research Assistant, Sarah Hanson
- 13 (top): Psomas
- 14 (top): Berger Partnership
- 15 (top): au.g Lange
- 16 (top): GTL-landschaftsarchitekten

Eidesstattliche Erklärung

Hiermit versichere ich, die vorliegende Dissertation selbstständig angefertigt und keine anderen als die angegebenen Quellen und Hilfsmittel benutzt zu haben. Die Arbeit wurde noch nicht als Dissertation oder als Prüfungsarbeit vorgelegt. Ein Teil der Dissertation wurde mit Zustimmung des Betreuers (Prof. Dr. Martin Prominski) als folgender Artikel eingereicht:

Song, S., Albert, C., & Prominski, M. (2019). Exploring integrated design guidelines for urban wetland parks in China. Submitted to Landscape Research.

Ort, Datum

Song Song

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