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A Restoration on Yongding River, Beijing

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A Restoration on Yongding River, Beijing

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Abstract

This article is focusing on post restoration project and related research project appraisals about Yongding River through researches, reports and news from professional and authoritative institutes in China about ecologically, socially and politically pre-restoration background, restoration process and post-restoration evaluation. Mainly, I combined field trip observation and user feedback questionnaires and interviews, in order to judge the functioning condition and operating efficiency of the ecological restoration project of Yongding River in Beijing. Along with field trip from downstream to upstream, basing on the zoning map of “Yongding River Green Ecological Corridor”, dividing the river into urban, suburb and outskirts context section, I conducted separate observation analysis, interviews and combined with water resources monitoring reports to evaluate the restoration project at the public accessible level.

Introduction

Yongding River originates from the southern margin of the Inner Mongolia Plateau and the northern part of the Shanxi Plateau, with a basin area of 47,000 square kilometers. It then flows through Hebei Province, Beijing, and ends up in Haihe River in Tianjin, which flows into the Bohai Sea at Binhai District, Tianjin [1]. Yongding River and Haihe River are separately considered to be the “mother river” of the most important metropolis, Beijing and Tianjin. The length of the river is 747 kilometers, with an average drop of 2.85%.

[3]

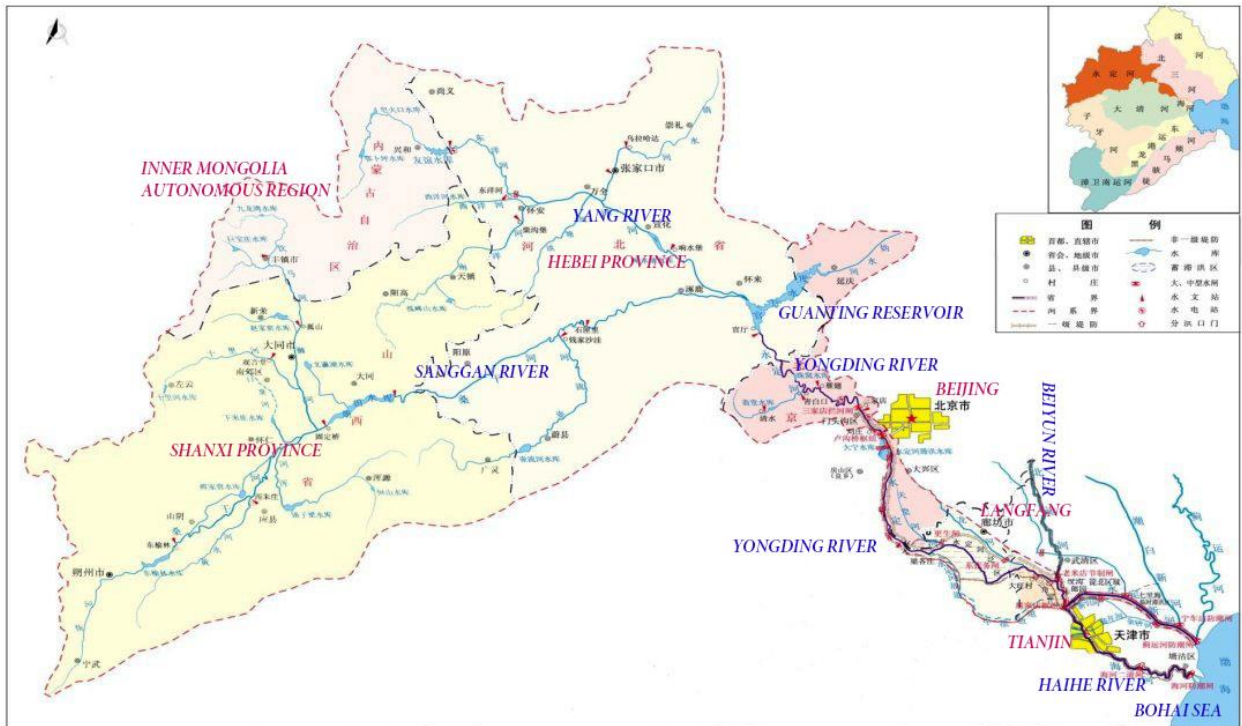


Figure 1. Map of River Distribution in Yongding River Basin (edited by the author) [3]

However, downstream of Yongding River after Guanting reservoir in Beijing have been gone empty for decades due to the climate change and upriver damming since 1970s [2]. Yongding River restoration is a large project with a span of more than 10 years, decided and guided by national government, and organized,

cooperated and conducted by several province and Beijing, Tianjin government to solve the drying up problem after 30 years.



Figure 2. Drying up downstream Yongding River; Sanjiadian Reservoir section, Beijing, 2007. [8]

1. Restoration Background Study

1.1 Yongding River ecological restoration process

1.1.1 Background statement

Back to the 1980s, the Yongding River was still a "yellow sandy river", as the city of Beijing expanded and population density increased, water resources began to become extremely scarce. In February 2016, CPC General Office of the State adopted “Coordinated Development for the Beijing-Tianjin-Hebei Region Plan Outline (Public Draft) [4]”, an important strategic decision. The "Plan Outline" clearly stated and emphasized ecological management and restoration direction of "Six Rivers and Five Lakes", 6 key rivers and 5 lakes and wetland of Haihe basin, which includes Yongding River. [4]

The major problems existed in 2016 before the “Plan Outline” was, first, poor water resources endowment and serious overload; second, low environmental bearing capacity and serious pollution; third, inefficient

ecological space and functional degradation; fourth, insufficient flood control capacity in some river sections; fifth, weak regional collaborative management capabilities. [3]

According to the “Plan Outline”, government started to implement ecological water replenishment, diverting water from Shanxi Province from the Yellow River across the basin to supplement the water source of Yongding River [4].

1.1.2 Restoration in process

In 2009, Beijing government had determined to restore the Yongding River, after 30 years of drying out. In July of that year, the Beijing Municipal Party Committee and Municipal Government reviewed and approved the "Yongding River Green Ecological Development Zone Construction Plan". [9]

According to the goal and prospect of the government on Yongding River in the “Plan Outline” [3], the restoration strategy and organization will base on the basin’s natural and ecological condition, and follow the idea that “take the Yongding River basin as a whole and zones as units”. Yonding River is divided into “water conservation zone” (upstream before Sanjiadian Reservoir, Hebei Province, Beijing), “plain urban zone” (Sanjiadian Reservoir to Lianggezhuang, Beijing, Hebei Province), “plain suburb zone” (Hebei Province, Tianjin), “coastal zone” (Tianjin), in which the “water conservation zone” and “plain urban zone” in Beijing are separately playing the role of increasing water conservation capacity, maintaining river ecological base flow and construct sports, relaxing and recreational space by restoring wetland parks [3].

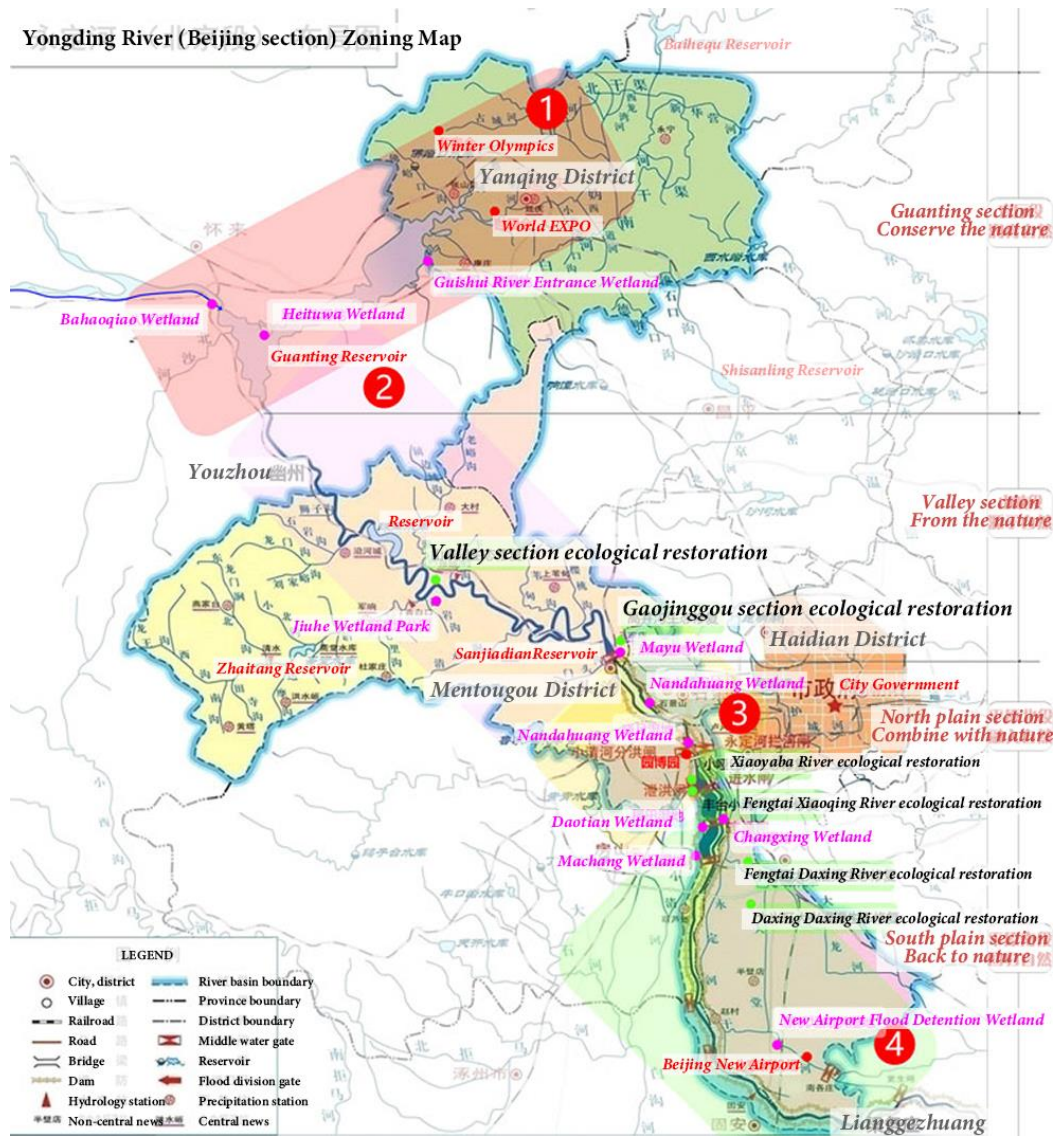


Figure 3. Yongding River (Beijing Section) Zoning Map. Made by Beijing Institute of Water, edited by the author. ^[16]

After several years of rectification, by 2013, Beijing had completed the 18.4 kilometers of Yongding River's ecological restoration project of "Five Lakes, One Line and One Wetland", including Machang Wetland, and New Airport Flood Detention Wetland, which are showing in the zoning map below. ^[9] 2019 was a key construction year for the “Yongding River Green Ecological Corridor” project, when 9 mainstream projects in Fengtai, Fangshan, and Daxing District, which played an important part of the coordinated development

of Beijing, Tianjin and Hebei was expected to start construction by 2019. [9]



Figure 4. Yongding River Beijing section's replenishment in 2020. [17]

On February 12th, 2020, water flowing from Guanting Reservoir in north of Beijing arriving the boundary of Beijing and Tianjin marked the first overall water replenishment of Yongding River Beijing section since 1995 [17]. In the following month, a total of 170 million cubic meters of water from Guanting Reservoir that introduced from the Yellow River supply to Yongding River. This raised the groundwater level by an average 2.1 meters from the Chenjiazhuang to Daxing Cuizhihuiying section in Mentougou and further improved the water ecological environment of southwestern Beijing. [17]

1.2 Expectation of Yongding River restoration

The expectation of overall completion of “Yongding River Green Ecological Corridor” is by 2025. [3] According to Deng Zhuozhi, deputy chief engineer of Beijing Water Resources Planning and Design Institute, Yongding River will become a hometown river again. According to the relevant person in charge of the Municipal Water Affairs Bureau, in the future, the Beijing section of the Yongding River will form a

blue-green eco-corridor, three ecological nodes where forests and waters blend together, and three sections with outstanding features. [10]



Figure 5. Planning of the Future of Yongding River, made by Beijing Institute of Water, made by Beijing Institute of Water, edited by the author.

The government is also planning the “Yongding River Green Ecological Corridor”, as illustrated in figure 5 above, as an armature connecting three essential suburban ecological nodes, Beijing Daxing Airport, New Shougang Corporation, Guanting Reservoir, natural green space along the river at Yanqing District [10] and forming the new axis to nature in western Beijing.

2. Appraisal Methods and Results

2.1 Methodology

2.1.1 Standards for successful urban river restoration

(1) Ecologically success evaluation

River restoration aims to maintain or increase ecosystem goods and services while protecting downstream and coastal ecosystems. ^[14] The criteria for measuring ecological success goes to five part. Firstly, the design should be based on a specified guiding image of a more dynamic healthy river that could exist at the site; secondly, the river's ecological condition must be measurably improved; thirdly, the river system must be more self-sustaining and resilient to external perturbations with minimal maintenance; fourthly, no lasting harm to the ecosystem during the construction phase; fifthly, pre- and post- assessment must be completed and open to public. ^[14] Due to limitation on personal data collection, this paper will mostly focus on the fifth criteria and second, third criteria and through field observation on vegetation, water and river channel.

(2) User feedback

As for urban river specifically, due to its changing role from practical consideration of transportation ability, potable water supply, industrial use into aesthetic and social function, designed landscapes of leisure and consumption become an important component of urban river restoration projects. ^[15] Yongding River flows from outskirts, suburb and urban context in Beijing, through Mentougou, Shijingshan, and Fengtai District. As a result, the paper will also focus on evaluation of aesthetic, recreational function of the urbanized section by user feedback analysis.

2.2 Restoration evaluation

2.2.1 Academic report on environment

Since 1980s, due to drought and low precipitation, upstream of Yongding River dam construction and industrial development and poor environmental protection consciousness, the water in Yongding River kept

polluted and decreased, in 1997 Guanting Reservoir could not support the city's potable water anymore. [17]

In 2004, the Heituwa Wetland was built as an experimental wetland and became an ecological barrier for the Guanting Reservoir. 40% of the river water entering the reservoir is introduced into this wetland, through the sedimentation of the stabilization pond, and then through the plant pond and gravel bed for deep purification. This wetland can reduce about 14% of the total pollution in the Yongding River, and it can also increase the water quality by a level. After a multiple approach including this experiment, the Guanting Reservoir restored its function as a source of drinking water in 2007. [17]



Figure 6. Comparison of water samples in Heituwa Wetland.

A study analyzed spatial and temporal variation on the basis of 11 water quality parameters at 10 monitoring sites of 'Five Lakes on One Route' for Yongding River during April and September of 2011 and 2016. The groundwater quality at eight monitoring sites kept the same level or became better, which demonstrated that the construction of the river ecological restoration projects of 'Five Lakes on One Route' is important

for protecting the groundwater resource. [7]

2.2.2 Field trip observation

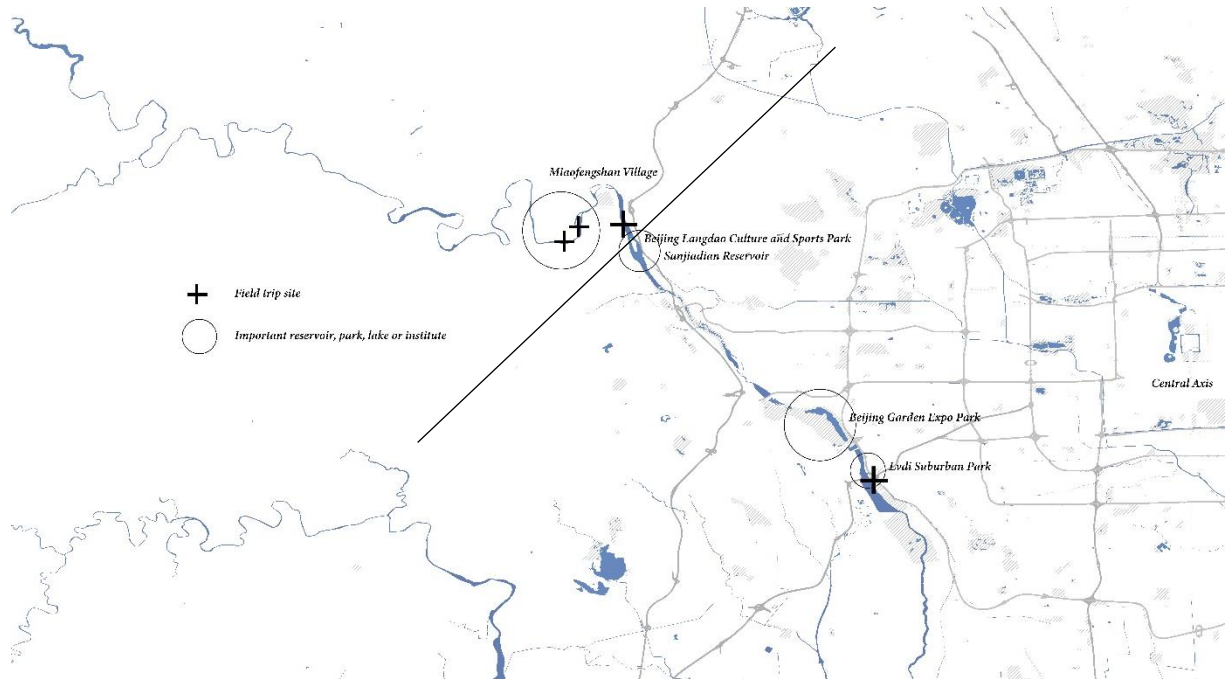


Figure 7. Field trip route, made by the author

Basing on the restoration zoning, I separately visited sites in “water conservation zone” and “plain urban zone”, and geographically Yongding River flow through outskirts, suburb and urban context in Beijing, I chose Miaofengshan section in “water conservation zone” as “outskirts context section”, Beijing Langdao Cultural Sports Park section and Lvdi Suburban Park in “plain urban zone” as “suburban context section” and “urban context section”.

Twice of the field trip were separately November 7th (Saturday, sunny, 23°C) and November 16th (Wednesday, sunny, 18°C).

(1) Urban context section

The urban context sections of Yongding River are composed of suburb parks including Lvdi Suburb Park, Beijing Garden Expo Park, Yongding River Leisure Forest Park, etc. and “Five Lakes” located at Yongding River Ecological Corridor. The site I visited, Lvdi Suburb Park with an area of 105 hectares, is the largest suburb and most invested suburb park in Beijing. It began to open to the public for free since 2009.



Figure 8. Field photos of Lvdi Suburb Park (taken by the author)

Due to the Yongding River Ecological Corridor construction, the park now has lush vegetation in good condition, plentiful biodiversity and adequate water. The fundamental plant species and their growing condition are showing in the form below.

Life-form		Species	Origin of species	Growing condition
Woody plant	Evergreen	<i>Sabina chinensis</i>	Exotic	Good
		<i>Sabina procumbens</i>	Exotic	Good
	Deciduous	<i>Salix matsudana Koidz</i>	Native	Good
		<i>Populus canadensis</i>	Exotic	Good
		<i>Lespedeza bicolor</i>	Exotic	Good
		<i>Vitex negundo</i>	Native	Good
		<i>Spiraea pubescens</i>	Native	Good
Liana plant		<i>Humulus scandens</i>	Native	Good
Herbaceous plant	Aquatic	<i>Phragmites australis</i>	Native	Good, need maintenance
		<i>Typha minima</i>	Native	Good, need maintenance
	Terrestrial	<i>Setaria viridis</i>	Native	Good
		<i>Portulaca oleracea</i>	Native	Good
		<i>Miscanthus sinensis</i>	Exotic	Good

Form1. Fundamental plant species in Lvdi Suburb Park, made by the author.

From the form above, we can find that both exotic and native plants are growing well in this section, among which salix and reeds make the majority number of the plant community along the bank, especially reeds were planted as a historically and culturally important species to form a famous scenery of Beijing. Salix is one of the most frequently used woody plants at river bank in Beijing as its great water-tolerate ability.

(2) Suburb context section

The second site is an unnamed river section north of Beijing Cultural Sports Park. The scenery here is obviously more natural with less landscape design. Similar with the first site, salix is the most frequently used woody plant along the river, but reeds are showing comparatively less quantity. Besides, less exotic plants, especially those for aesthetic use like silver grass (*Miscanthus sinensis*) are less likely to be used here.



Figure 9. Field photos of Suburban Yongding River (taken by the author)

Life-form		Species	Origin of species	Growing condition
Woody plant	Evergreen	<i>Sabina chinensis</i>	Exotic	Good
		<i>Sabina procumbens</i>	Exotic	Good
	Deciduous	<i>Salix matsudana Koidz</i>	Native	Good

Liana plant		<i>Humulus scandens</i>	Native	Good
Herbaceous plant	Aquatic	<i>Phragmites australis</i>	Native	Fine
	Terrestrial	<i>Setaria viridis</i>	Native	Good
		<i>Portulaca oleracea</i>	Native	Good

Form2. Fundamental plant species near Beijing Cultural Sports Park, made by the author.

(3) Outskirt context section



Figure 10. Field photos of Yongding River at Outskirts Beijing (taken by the author)

Life-form		Species	Origin of species	Growing condition
Woody plant	Evergreen	<i>Sabina chinensis</i>	Exotic	Good
	Deciduous	<i>Salix matsudana Koidz</i>	Native	Good

		<i>Ailanthus altissima</i>	Native	Good
		<i>Styphnolobium japonicum</i>	Native	Good
Liana plant		<i>Humulus scandens</i>	Native	Good
Herbaceous plant	<i>Terrestrial</i>	<i>Setaria viridis</i>	Native	Good
		<i>Imperata cylindrica</i>	Native	Good
		<i>Artemisia argyi</i>	Native	Good

Form3. Fundamental plant species at Miaofengshan section, made by the author.



Figure 11. Yongding River Valley at Mentougou District near Sanjiadian Reservoir.

This third site is next to Miaofengshan Village in Mentougou District. This site is almost at natural condition and vegetation is less organized or planned. For river protection, several kilometers of this section forbids visitors to get in. Compared to the photo of nearby space years ago, tremendous change happened as the water refilled the channel.

2.3 Users feedback

The field user experience research was conducted in October and November, when Beijing was during the

end of fall. Due to the temperate monsoon climate in Beijing, deciduous trees, understories and aquatic plant were showing obvious seasonal color changes, especially on reed, corkscrew willow, poplar, which are most common and featured Beijing indigenous species. With the mild temperature and beautiful natural scenery, this period are always popular hiking and sightseeing season in Beijing.



Figure 9. People's activities in Lvdi Suburb Park, Yongding River in Mentougou District, from left to right, up to down the activities are, (9-a) flying kites, (9-b) children catching fish in the pond, (9-c) walking across the stone path over the wetland, (9-d) women dancing together, (9-e) waiting for taking photograph of Beijing birds, (9-f) couple walking the dog.

<i>Type</i>					
	Friend	Couple	Family	Other	Come Alone
<i>Do you come alone?</i>	12%	6%	72%	8%	2%

<i>Accessibility</i>				
	<1km	1-5km	5-10km	>10km
<i>How far do you live from here?</i>	3	14	23	10
	<5min	5-15min	>15min	
<i>How long did you travel here?</i>	0	14	36	
	Walk	Bicycle	Motorbike	Drive
<i>How did you come here</i>	3%	6%	15%	76%
	Almost daily	<Once a week	Monthly	Less than above
<i>How often do you visit the park?</i>	5%	8%	20%	67%

<i>Activity</i>					
	Walk the pet	Photography	Take a walk	Bring kids to play	Date
<i>What kind of activity do you like to do?</i>	9%	8%	36%	41%	6%
	Surprising	Wonderful	Great	So-so	Needs improvements
<i>How do you like the scenery of the park?</i>	15%	59%	23%	3%	0%
	<1year	1-3years	3-5years	5-10years	>10years
<i>How long have you been living in Beijing?</i>	1%	7%	13%	37%	42%

valid results: 52

Figure 10. User feedback questionnaire results, made by the author.

I collected and analyzed the data of the valid results of the questionnaires to make the form above, from which we can find that the most common user portraits are family members coming to the park by car at certain season or days of a year, and most of people talked with me gave really positive estimation on the restored riverside park and showed surprising attitude on the huge change of the river's scenery. Visitors also expressed great appreciation on the sufficient and free parking lot, since parking has been difficult and expensive especially in downtown Beijing.

Visitors' activities proves the ecological improvement, such as birds photography and catching fish and tadpole, which shows that the increasing bio-diversity and retrieved water ecological environment that

enables birds and aquatic animals life.

2.4 River operations

2.4.1 River Chiefs

Obeying the guidelines by the general office of CPC Central Committee ^[11] and in order to strengthen regional collaborative management capabilities ^[3], by 2017, there are a total of 546 “River Chiefs” in the Yongding River Basin, whose duty is to clean up and protect its water resources at their section of the Yongding River ^[10].



Figure 11. The River Chief, pointing at the river bed and the Swimming forbidden board next to him (taken by the author).

During the field trip, I also interviewed one of these “River Chiefs” at Yongding River section next to Beijing Langdao Culture and Sports Park. He had been working as a river chief for the local government for about half a year, before doing this job, he worked for the nearby community’s senior’s home as security. His daily job is walking along or riding motorbike to guarding several kilometers that he is in charged. This section of Yongding River forbids swimming, electric fishing, fishing, dispose industrial garbage or polluted water and any kind of activities that will destroy the ecological balancing at Yongding River.



Figure 12. The River Chief Information Board of Yongding River (Miaofengshan Section) at Outskirts Beijing (taken by the author).

River Chief system works from province or municipality level and each level of government until small villages ^[11], the contact information, duty, superiors and subordinate departments of a river chief are clearly listed on the board and open for public supervisory.

2.4.2 Ecological environment maintenance



Figure 13. People cutting down yellowed reed in fall (taken by the author).



Figure 14. Piled up yellowed reed in fall (taken by the author).



Figure 15. The worker telling me the skill of recognizing reed and the reason of cutting down yellowed reed (taken by the author).

During the second field trip in mid-November, the end days of fall, I also interviewed workers who were cutting down the yellow reeds and piled them up on the bank. They told me that their work was accelerating the death of reeds otherwise in the next year, old reeds would remain standing but actually withering and new reeds would not grow well. In order to keep the best reeds scenery, managers of the park hired them to cut down all the reeds at the end of fall each year.

3. Conclusions

In respond to the criteria for successful urban river restoration project in methodology section, firstly the river's ecological condition was largely improved compared to when the river dried out. As for the resiliency and self-sustaining ability, some of the vegetation like the reeds and ornamental Herbaceous plant require annually maintenance or replant, but the natural outskirts section is more self-sustainable, since less exotic and ornamental plant that need maintenance are planted there. Secondly, the water supply in the river, groundwater level, and water quality were measurably and obviously improved according to many reports from Beijing Institute of Water, Guanting Reservoir Management and other academic researches.

The "Plan Outline" emphasized the importance of improving management weakness of the pre-restoration Yongding River. It clearly mentioned the requirement of strictly unified water resources management, reinforcing the monitoring of river space utility, promoting the reform of water, forest rights systems and improving the coordination mechanism of river basin management. ^[3] At the implementation level that open to public, the River Chief system is well operating and effectively forbids illegal utility of river space and water resources. The contact of River Chief, monitoring responsibility and ownership of certain section of the river is clearly, updated on the information board right next to the river. The whole system seems transparent to the public and available for public supervision.

On the other hand, users' questionnaires and interviews showed great reaction on the restoration project, especially the suburb park and open space that are easily accessible for the public. Yongding River corridor connecting lakes and wetland parks including Beijing Garden Expo Park, Lugou Bridge, Lvdi Suburb Park

provided plenty natural space supplement and abundant relaxing and recreational space for the public especially residents in southwestern Beijing.

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Appendices

Appendix 1: Interview guideline (for workers)

Date, interviewer:

Interviewee: (includes age, work position, hometown)

Interview Questions:

What is your job here? Who (government institution) are you working for?

Do you volunteer to work here?

How long have you been working here?

How was the condition (water level, water quality, plant growth condition, etc.) since you started to work here?

How long will you be working here? (and is your job periodic, like annually or seasonally?)

What did you do before work here? What was your job or duty before?

Appendix 2: User feedback questionnaire (handed out in Chinese and translated into English)

Lvdi Park, Yongding River User Experience Questionnaire

Hello dear interviewee, I am a environmental study and landscape design student from University of California Berkeley and Beijing Forestry University, I am doing a research about user experience Lvdi Park, could do you please take less than 5min to share with me your thoughts about the park? Thank you very much for your feedback and advice to make our city better!

Date ___/___/___

<i>Do you come alone?</i>	<input type="checkbox"/> Yes	<input type="checkbox"/> No		
<i>Who do you come with?</i>	<input type="checkbox"/> Friend	<input type="checkbox"/> Couple	<input type="checkbox"/> Family	<input type="checkbox"/> Other
<i>How far do you live from here?</i>	<input type="checkbox"/> <1km	<input type="checkbox"/> 1-5km	<input type="checkbox"/> 5-10km	<input type="checkbox"/> >10km
<i>How long did you travel here?</i>	<input type="checkbox"/> <5min	<input type="checkbox"/> 5-15min	<input type="checkbox"/> >15min	
<i>How did you come here</i>	<input type="checkbox"/> Walk	<input type="checkbox"/> Bicycle	<input type="checkbox"/> Motorbike	<input type="checkbox"/> Drive
<i>How often do you visit the park?</i>	<input type="checkbox"/> Almost daily	<input type="checkbox"/> < Once a week	<input type="checkbox"/> Several times a month	
	<input type="checkbox"/> Less than above			
<i>What kind of activity do you like to do?</i>	<input type="checkbox"/> Walk the pet	<input type="checkbox"/> Photography	<input type="checkbox"/> Take a walk	<input type="checkbox"/> Bring kids to play
	<input type="checkbox"/> Date	<input type="checkbox"/> Other _____		
<i>How do you like the scenery of the park?</i>	<input type="checkbox"/> Surprising	<input type="checkbox"/> Wonderful	<input type="checkbox"/> Great	<input type="checkbox"/> So-so
	<input type="checkbox"/> Needs improvement			
<i>How long have you been living in Beijing?</i>	<input type="checkbox"/> <1 year	<input type="checkbox"/> 1-3 years	<input type="checkbox"/> 3-5 years	<input type="checkbox"/> 5-10 years
	<input type="checkbox"/> >10years			
<i>Finally, do you have any comments or advice?</i>				