SFG1660

World Bank Financed Jingzhou Historic Town Conservation Project Environment Assessment Report

(APPRAISAL REVISED)

Hubei Academy of Environmental Sciences

2015/7/31

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ABBREVIATIONS AND ACRONYMS

CH	Cultural Heritage
CNY	China Yuan
CMC	Construction Management Center
DA	Designated Account
DRC	Development and Reform Commission
EA	Environmental Assessment
EAR	Environmental Assessment Report
ECOP	Environmental Codes of Practice
ESMP	Environmental & Social Management Plan
EPB	Environment Protection Bureau
FIRR	Financial Internal Rates of Return
FY	Fiscal Year
JHTC	Jingzhou Historic Town Conservation Project
MOF	Ministry of Finance
MMT	Multi-Modal Transport
NMT	Non-Motor Transport
NCB	Notional Competitive Bidding
NDRC	National Development and Reform Commission
O&M	Operation and Maintenance
PDO	Project Development Objective
PLG	Project Leading Group
PMO	Project Management Office
PAD	Project Appraisal Document
PIA	Project Implementing Agency
RMB	Renminbi
RAP	Resettlement Action Plan
SORT	Systematic Operations Risk-Rating Tool
SA	Social Assessment
TOR	Terms of Reference
TTL	Task Team Leader
WTP	Willingness-to-pay
WWTP	Waste Water Treatment Plant

1 INTRODUCTION

1.1 Background

Located in the middle south of Hubei Province and in the very heart of Jianghan Plain, Jingzhou Municipal spans on both sides of the middle reaches of the Yangtze River. It is among the ***State-List Famous Historical and Culture Cities*** firstly issued by the State Council in 1982, and also listed in ***China's Top Tourist Cities*** **and** ***China's Top Landscape Garden Cities*****.** As an important port in the middle reaches of the Yangtze River, a key industrial base and a base of light and textile industry in central China, Jingzhou is reputed as the *"steel waist"* of the Yangtze River Economic Belt.

Jingzhou Municipal has a history of over 2600 years. It is the cradle of the Chu Culture and used to be the cultural center in the Three Kingdom Period (220-280 A. D.). In 689 B.C., King of Chu State made Ying (now Jinan Town in Jingzhou District, Jingzhou Municipal) the capital, and it captured the title for 20 Chu dynasties for as long as 411 years. Jingzhou Historic Town Wall is one of the best preserved and largest historic town wall in southern China. Jingzhou historic town covers an area of 4.5 km2 (east-west diameter of 3.75km, and south-north diameter of 1.2km within the city). The wall was built in the Spring and Autumn & Warring States periods (770 B.C. – 221 B. C.), 8.83 m high with a circumference of 10.5 km. Most existing buildings within the Wall were built in the late Ming and early Qing dynasties (about 60 years during 1627 A.D. – 1684 A.D.) Moreover, the Xiongjiazhong Chu Tombs in Chuandian Town (45km to the northeast of Jingzhou Municipal) is even larger than the Luojiakeng Qin Tomb (Tomb of a Duke of Qin) found in Shaanxi Province, and it is one of the largest, best preserved tombs of Chu royalties. It also houses a full range of mausoleums.

Jingzhou Municipal has a total area of 14,067 km^2, accounting for 7.6% of total area of Hubei Province. The urban area is 1, 576 km^2 and the urban built-up area is 64.9 km^2. Jingzhou now administers 3 districts: Jingzhou District, Shashi District and Jingzhou Development Zone, and 3 counties: Jiangling County, Gong'an County and Jianli County. According to statistics in 2014, Jingzhou has a registered population of 6.5845 million, of which 5.7442 million is permanent population. The city had a regional GDP of 148.049 billion CNY, fiscal revenue of 13.381 billion CNY (yearly increase of 18.2%), ranking forth economically among the cities in Hubei Province. The whole city was visited by 22.6745 million domestic tourists (an increase of 20.9%), enjoying tourism revenue of 13.772 billion CNY (an increase of 24.1%).

Nevertheless, despite of the fast social and economic development of Jingzhou Municipal, poor implementation of previous plans and laws and regulations and timeworn infrastructure are putting more pressure on the conservation of the cultural heritages in Jingzhou. Currently, due to limited sewage interception, the household solid waste and waste water from nearby residents are directly drained into the moat. Worse still, the few preserved ancient buildings and other cultural heritages are now more susceptible to damages due to lack of maintenance, conflictions in land use and pressure from redevelopment. Some planned green lands are occupied; rivers are filled for land reclamation, and buildings in some key areas are constructed too close and of poor quality. The city is economically and industrially incapable of protecting the numerous cultural heritages in the historic town, making its title as a national famous historic and cultural city more a name than reality. As the whole nation is attaching more importance to the conservation of cultural heritages, Jingzhou is also putting more emphasis on the protection and utilization of cultural heritages. Under this context, the municipal government of Jingzhou Municipal proposed the "World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project" (hereinafter referred to as “JHTP”) to the NDRC and the MOF to specially work on the restoration of historic walls, environmental improvement of water systems inside and outside the historic town, improvement of traffic conditions and tourism-related infrastructures, construction of green belts around the historic town, restoration and protection of the Confucius Temple as well as capacity building of organizations, so as to support the protection and utilization of cultural heritages. The total investment of the project is about 1.081 billion CNY, including World Bank loan of 100 million USD (about 615 million CNY). The expected implementation period of the proposed project is from January 2016 to December 2020, and the tentative closing date of the project is December 31, 2020. Project location is shown in Figure 1-1.

To lay a good foundation for project implementation, the Jingzhou Municipal People’s Government established a Project Management Office of the PLG in Jingzhou Municipal, so as to account for the preparation, implementation, management and supervision of the proposed project. The Deputy secretary of the Municipal government is the director of the PMO, general manager, and deputy general manager of municipal city investment company, director from Municipal Finance Bureau, deputy director of Jingzhou district and researcher from MDRC are the deputy directors of the PMO; the PMO has four divisions which respectively are responsible for administration, procurement management, financial management and project management. The project involves 6 Project implementing agencies (PIA): Jingzhou Construction Project Management Center, Jingzhou Culture, Tourism and Investment Company and Municipal Transit Company.

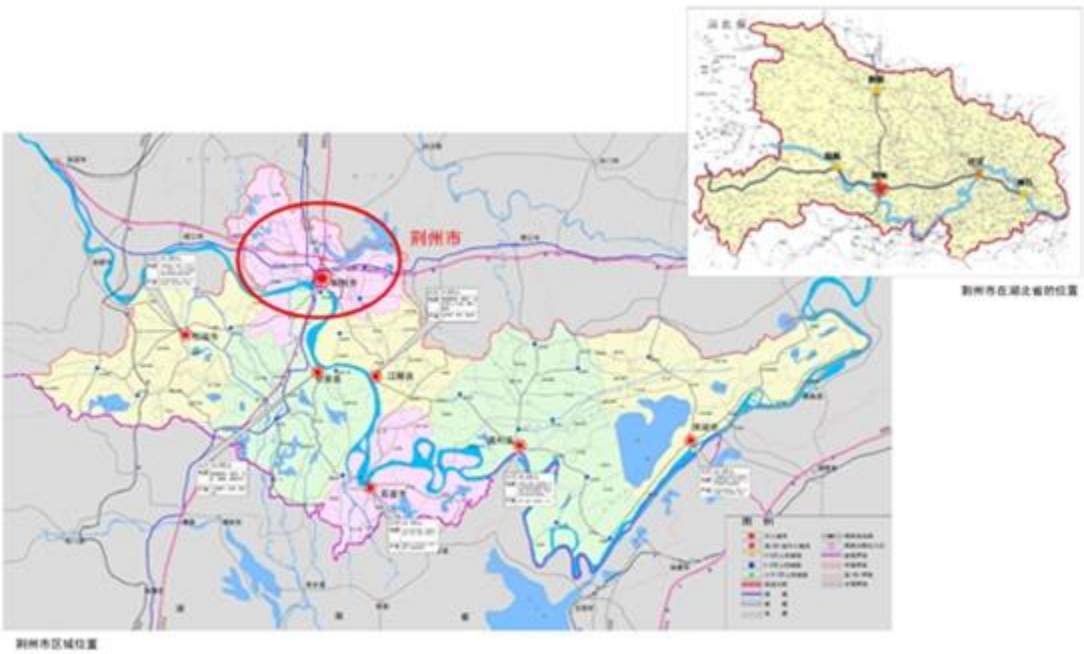


Figure 1.1-1 Location map of Jingzhou Municipal and the Project

1.2 EA Objective

The objective of the EA is to predict and analyze the impact of the project on natural, social and ecological environment of the affected regions based on the characteristics of the project through comprehensive site survey, assessment and analysis on the project area; put forward practicable and feasible mitigations of the adverse impacts of project construction so as to minimize these adverse impacts; correlate the project to the regional plan and the construction of the Jingzhou historic town and even the whole Jingzhou Municipal, to facilitate the virtuous circle of the ecological environment in the project area, and to achieve the best benefits on the society, environment and economy. Meanwhile, the environmental impact assessment further demonstrates the environmental feasibility of the project and supplements project design documentation, which will facilitate the commencement of the project; besides, it provides scientific basis for the environment management, supervision, monitoring and acceptance inspection of the environmental protection administrative authorities and the construction units.

1.3 Framework of Applicable Laws and Regulations

1.3.1 Laws and regulations

(1) Law of the People's Republic of China on Environmental Protection, revised on April 24, 2014, coming into force on January 1, 2015;

(2) Law of the People's Republic of China on Appraising of Environmental Impact, coming into force on September 1, 2015;

(3) Amendment of Regulations of Environmental Protection Departments and Regulatory Documents, former State Administration of Environmental Protection Order No. 6, coming into force on July 8, 1999;

(4) Law of the People's Republic of China on the Prevention and Control of Water Pollution, revised on February 28, 2008, coming into force on June 1, 2008;

(5) Law of the People's Republic of China on the Prevention and Control of Atmospheric Pollution, revised on April 29, 2000, coming into force on September 1, 2000;

(6) Law of the People's Republic of China on Prevention and Control of Pollution From Environmental Noise, issued on October 29, 1996, coming into force on March 1, 1997;

(7) Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Wastes, revised on December 29, 2004, coming into force on April 1, 2005;

(8) Cleaner Production Promotion Law of the People's Republic of China, coming into force on July 1, 2012;

(9) Land Administration Law of the People's Republic of China, issued and coming into force on August 28, 2004;

(10) Water and Soil Conservation Law of the People's Republic of China, coming into force on March 1, 2011;

(11) Order of the President of the People's Republic of China No. Nine: Law on Wild Animal Protection of the People's Republic of China, coming into force on March 1, 1989;

(12) Order of the National Development and Reform Commission of the People's Republic of China No. 9: Catalogue for Guiding Industry Restructuring (2011 Version), coming into force on June 1, 2011;

(13) Order of the National Development and Reform Commission No. 21: Decision of the National Development and Reform Commission on Amending the Relevant Entries under the Catalogue for Guiding Industrial Restructuring (2011 Version), coming into force on May 1, 2013;

(14) Order of the Ministry of Environmental Protection No. 2: Catalogue for Classification and Management of Environmental Assessment for Development Projects, October 1, 2008;

(15) Ministry of Environmental Protection [2012] No. 77: Notice on Further Strengthening Environmental Assessment Management and Environmental Risk Prevention;

(16) State Council document G.F. [2011] No. 35: Opinions of the State Council on Strengthening the Focus of Environmental Protection Work;

(17) State Council document G.F. [2011] No. 42: Notice of the State Council on Issuing the “Eleventh Five-Year Plan” for National Environmental Protection;

(18) Notice on issuing Guidance on Disclosure of Government Information on Environmental Assessment of Development Projects (Trial), General Office of Ministry of Environmental Protection, November 14, 2013;

(19) Former State Administration of Environmental Protection document H.F. [2006] No. 28: Notice on Issuing Interim Methods for Public Participation in Environmental Assessment;

(20) Former State Administration of Environmental Protection document H.F. [2003] No. 11: Notice on Promulgating the List of the First Group of Alien Invasive Species of China;

(21) Ministry of Environmental Protection document H.F. [2010] No. 4: Notice on Promulgating the List of the Second Group of Alien Invasive Species of China;

(22) Regulations on Environmental Protection Management of Hubei Province, coming into force on December 2, 1994;

(23) Ministry of Commerce, Ministry of Public Security, Ministry of Construction, Ministry of Communications (S.G.F. [2003] No. 341) Notice on Prohibiting Concrete Mixing in Construction Sites in Urban Areas of Cities from a Certain Time;

(24) Regulations on Environmental Protection Management of Hubei Province, coming into force on December 2, 1994;

(25) Regulations on Prevention and Control of Atmospheric Pollution of Hubei Province (passed on December 3, 1997 at the thirty-first meeting of the Eighth Standing Committee of the People's Congress of Hubei Province; revised on July 30, 2004 at the tenth meeting of the Tenth Standing Committee of the People's Congress of Hubei Province);

(26) E.Z.F. [2012] No. 90 Suggestions of the People's Government of Hubei Province on the Implementation of Strengthening Lake Protection and Management, issued by the General Office of the People's Government of Hubei Province on October 26, 2012;

(27) E.Z.B.F. [2012] No.25: Notice of the General Office of the People's Government of Hubei

Province on Issuing Methods for Examination and Approval of Environmental Assessment Documents of Development Projects by Authorities at Different Levels;

(28) E.H.F. [2015] No. 11: Notice on Further Adjusting Graded Limits of Authority of Reviewing and Approving Project Environmental Assessment, issued on June 30, 2015;

(29) E.Z.B.F. [2000] No. 10: Notice on Classification of Environmental Functions of Surface Water in Hubei Province Issued by Hubei Environmental Protection Bureau Forwarded by the General Office of the People's Government of Hubei Province;

(30) Regulations on Prevention and Control of Water Pollution of Hubei Province (passed at the second meeting of the Twelfth Standing Committee of the People's Congress of Hubei Province on January 22, 2014);

(31) Decision of the State Council on the Implementation of the Scientific Outlook on Development and Strengthening Environmental Protection (G.F. [2005] No. 39, December 3, 2005);

(32) The National Program for Ecological Environment Protection, November 26, 2000;

(33) Interim Methods for Supervision and Management of Water and Soil Conservation and Ecological Construction Projects, S.J.G. No. 79;

(34) Interim Methods for Public Participation in Environmental Assessment, H.F. [2006] No. 28;

(35) Law of the People's Republic of China on Protection of Cultural Relics passed on June 29, 2013 at the third meeting of the Twelfth Standing Committee of the National People's Congress.

1.3.2 Technical specifications

(1) Technical Guidelines for Environmental Assessment – General (HJ2.1-2011);

(2) Technical Guidelines for Environmental Assessment –Atmospheric Environment (HJT2.2-2008);

(3) Technical Guidelines for Environmental Assessment –Surface Water Environment (HJ/T2.3-93);

(4) Technical Guidelines for Environmental Assessment –Acoustic Environment (HJT2.4-2009);

(5) Technical Guidelines for Environmental Assessment – Ecological Environment (HJ19—2011);

(6) Specifications for Environmental Assessment of Highways (JTGB03—2006);

(7) Method for Estimation of Air Pollution from Vehicular Emission in Urban Area (HJ/T180-2005).

1.3.3 Project-related plannings

(1) Outline of the Twelfth Five-Year Plan for the Economic and Social Development of Jingzhou;

(2) Statistical Bulletin of the Economic and Social Development of Jingzhou in 2011;

(3) Outline of the Twelfth Five-Year Plan for the Water Development of Jingzhou;

(4) Preliminary Design Report of Urban Flood Control Project of Jingzhou Municipal (2003);

(5) Flood Control Analysis Report of Jingzhou Municipal (2011);

(6) Special Plan for Central Urban Area Drainage Project of Jingzhou Municipal;

(7) Planning Results for Protection of the Famous Historic and Cultural City of Jingzhou Approved by the Hubei Provincial Government

(8) Specifications for the Master Plan and Design of Jingzhou Historic Town Scenic Area;

(9) Plan for Protection of the Famous Historic and Cultural Town of Jingzhou (2010-2030);

(10) Master Plan of Jingzhou Municipal (2011~2020);

(11) Master Plan of the Jingzhou Section of Western Hubei Ecological and Cultural Tourism Circle (2009);

(12) Master Plan of the Jingzhou Historic Town Scenic Area (2011-2020);

(13) Master Plan for Protection of Walls and Cultural Relics in Jingzhou (2009);

(14) Detailed Regulatory Plan for Development of Jingzhou Historic Town Scenic Area (2011-2020);

(15) Notice of the General Office of State Council on Strengthening Wetland Protection and Management (G.B.F. [2004] No. 50);

(16) Plan for Prevention and Control of Water Pollution in the Four-lake Basin (2008)

(17) Recent Plan for Urban Construction of Jingzhou Municipal (2011-2015);

(18) Plan of Urban Green Space System of Jingzhou Municipal (2011-2020);

(19) Plan of Urban Blue Line of Jingzhou Municipal;

(20) Functional Zoning of Water Environment in Jingzhou Municipal;

(21) Plan for Comprehensive Improvement of Water Environment in Urban Area of Jingzhou (2010-2020).

1.3.4 World Bank Safeguard Policies

According to relevant regulations of the World Bank, special attention should be paid to the interests of the public during project implementation, which is also the objective of the EA report. Hence, the assessment agency has verified and confirmed the safeguard policies of the World Bank according to the relevant provisions of World Bank document, with results shown in Table1-1.

Table 1-1 World Bank Safeguard Policies

No.	World Bank Safeguard Policies	Yes	No	Remarks
1	OP4.01 Environment Assessment	X		OP 4.01 is triggered, and the EAR, ESMP, EA summary (both Chinese and English versions) will be prepared according to the requirements of OP 4.01.
2	OP4.04 Natural Habitats	X		The proposed project is involved the definition of the natural habitats in the OP4.04.
3	OP4.09 Pest Management		X	The restricted insecticide and herbicide definite by OP4. 09 are not involved in both the construction and operation stage of the project.
4	OP4.10 Indigenous People		X	The project does not involve ethnic minority issues.
5	OP4.11 Physical Cultural Resources	X		The project involves protection and restoration of cultural relics. The cultural heritages involved in the project are confirmed and a special chapter is written to analyze the impact of the project on cultural relics.
6	OP7.6 Projects in Disputed Areas		X	There is no controversial area in the project.
7	OP4.37 Safety of Dams		X	There is no dam in the project area.
8	OP7.50 Projects on International Waterways		X	There are no international waters in the project area.
9	OP4.36 Forestry		X	There is no natural forest or artificial forest in the project area.
10	OP4.12 Involuntary Resettlement	X		The East Gate Visitors' center subcomponent involves resettlement and special analysis is done on resettlement.

1.3.5 Project Documents

(1) Letter of Entrusting Hubei Academy of Social Sciences to Conduct Environmental Assessment of World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project by Jingzhou World Bank Loan Project Management Office, Sep. 11, 2014;

(2) Proposal of World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project, by Jingzhou Institute of Urban and Rural Planning, Jan. 2014;

(3) Hubei Jingzhou Historic Town Restoration and Protection Project Feasibility Study Report – Main Report, by T.Y. Lin International, Jun. 2015;

(4) Hubei Jingzhou Historic Town Restoration and Protection Project Feasibility Study Report –Restoration and Preservation of Historic Town Wall, by T.Y. Lin International, Jun. 2015;

(5) Hubei Jingzhou Historic Town Restoration and Protection Project Feasibility Study Report –Protection and demonstration of Confucius Temple, by T.Y. Lin International, Jun. 2015;

(6) Hubei Jingzhou Historic Town Restoration and Protection Project Feasibility Study Report –Special Report on Tourism, by T.Y. Lin International, Jun. 2015;

(7) Hubei Jingzhou Historic Town Restoration and Protection Project Feasibility Study Report – Special Report on Water Environment Analysis and Technical Solutions, T.Y. Lin International, Jun. 2015;

(8) Hubei Jingzhou Historic Town Restoration and Protection Project Feasibility Study Report – Special Report on Transportation and Technical Solutions, by T.Y. Lin International, Jun. 2015;

(9) Hubei Jingzhou Historic Town Restoration and Protection Project Feasibility Study Report –Special Report on the Institutional Management of Jingzhou Historic Town, by T.Y. Lin International, Jun. 2015;

(10) Hubei Jingzhou Historic Town Restoration and Protection Project Social Impact Assessment, Centre for Involuntary Resettlement, Wuhan University, Dec. 2014;

(11) Hubei Jingzhou Historic Town Restoration and Protection Project Resettlement Action Plan, Jingzhou Historic Town Restoration and Protection Project Management Office, May 2015;

(12) China: Hubei Jingzhou Historic Town Restoration and Protection Project Scoping Mission (December 11-13, 2013);

(13) China: Hubei Jingzhou Historic Town Restoration and Protection Project Identification Mission Aide Memoire (April 21-26, 2014);

(14) China: Hubei Jingzhou Historic Town Restoration and Protection Project Preparation Mission Aide Memoire (October 13 – 17, 2014);

(15) Summary of Public Consultation Meeting on the Environmental Assessment of Hubei Jingzhou Historic Town Restoration and Protection Project (November 28, 2014);

(16) China: Hubei Jingzhou Historic Town Restoration and Protection Project Pre-appraisal Mission Aide Memoire (January 26- 29, 2015);

(17) Hubei Jingzhou Historic Town Restoration and Protection Project Component: Water Environment Pre-appraisal Mission Aide Memoire, (May 5-8, 2015)

(18) China: Hubei Jingzhou Historic Town Restoration and Protection Project Pre-appraisal Strengthening Mission (June 24-29, 2015).

1.4 Functional Zoning and Sensitive Receptors

1.4.1 Functional zoning

According to *Notice on Classification of Environmental Functions of Surface Water in Hubei Province* Issued by Hubei Environmental Protection Bureau and Forwarded by the General Office of the People's Government of Hubei Province as well as the *Response Letter on the Applicable Standards for Environmental Assessment of the World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project* by Jingzhou Environmental Protection Bureau, the functional zoning of the project is detailed in Table 1-2.

Table 1-2 Functional zoning of the project area

Environmental elements	Area and scope	Class of function
Ambient air	Jingzhou historic town area	GB3095-2012 Class II
Environmental	Road: the first row of residential building on the sides of a road (three-storey	GB3896-2008

Environmental elements	Area and scope	Class of function
noise	or above buildings); Class I and Class II standards apply for adjacent area, respectively 50m and 30m within the boundary line of the road (buildings with less than three floors)	Class 4a
	Schools (beyond Class 4a)	GB3896-2008 Class I
	Other areas (beyond Class 4a)	GB3896-2008 Class II
Surface water	Moat	GB3838-2008 Class III
	Taihugang Channel	
	North Lake	
	West Lake	
	Horse Wash Pond	
	Jiulaoxiandu Scenic Area	
	Northeast Pond	
	Jingsha River	
	Gangnan Canal	
Underground water	The whole project area	GB/T14848-93 Class III

1.4.2 Sensitive receptors

The project covers a wide area of Jingzhou District and Chuandian Town of Jingzhou Municipal. Sensitive receptors of the project include schools, and cultural heritage preservation units, etc.

1.4.2.1 Sensitive receptors of the Component A

The proposed project Component A includes 6 sub-components: Restoration and Preservation of Historic Town Walls, Environment improvement and utilization of Jingzhou Kaiyuan Taoist Temple, Upgrade of Exhibition of Jingzhou Museum Treasure Hall Cultural Objects, Restoration and Reutilization of Historic Buildings, Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park and Promotion of Tourism Development. Of these subcomponents, the former 5 subcomponents involve construction activities while the last “Promotion of Tourism Development” Construction is mainly about capacity building of related organizations and institutions. As construction activities only happen within the construction site and are done mainly by manual and mechanical equipment, the sensitive receptors are mainly the cultural relics, while the sensitive receptors of environmental impact are also the cultural relics and a few external sensitive receptors. Sensitive receptors of the proposed project component A are shown in Table 1-3 and Figure 1.4-1~Figure 1.4-4.

Table 1-3 List of sensitive receptors of Component A

Cultural Relics Protection Units			
No.	Name	Location	Class of protection

1.1	West Wall	Jingzhou historic town	National (forth group, approved in 1996)
1.2	Xiongjiazhong Tomb Chu Tombs	45km north of downtown Jingzhou	Provincial (second group, approved in 1981)
1.3	Jingzhou Museum	North of Jingzhou Middle Road	AAAA level scenic area (2000)
1.4	Historic buildings	13 buildings in total on East Dam Street and South Gate Avenue	No. 18 East Dam Street, No. 10 folk house, and No. 46 folk house are provincial level cultural sites, others are ordinary cultural relics and folk houses.
1.5	Kaiyuan Taoist Temple	West of Jingzhou Museum	National (sixth group, approved in 2006)
School			
1.6	Jingzhou Westgate High School	East of West Historic Town Wall	43 classrooms, with 2500 students
Note: Since construction is not carried out in the night, it has minor impacts on the residents. For this reason, residents are not selected as sensitive receptor of the proposed project.			

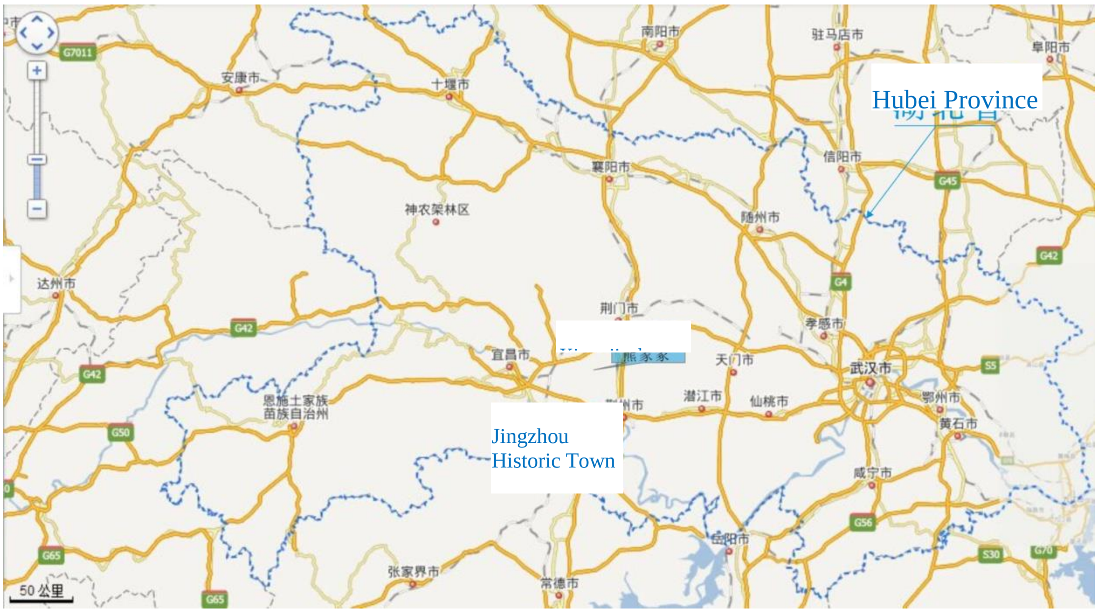


Figure 1.4-1 Location map of Jingzhou Historic Town and Xiongjiazhong Tomb

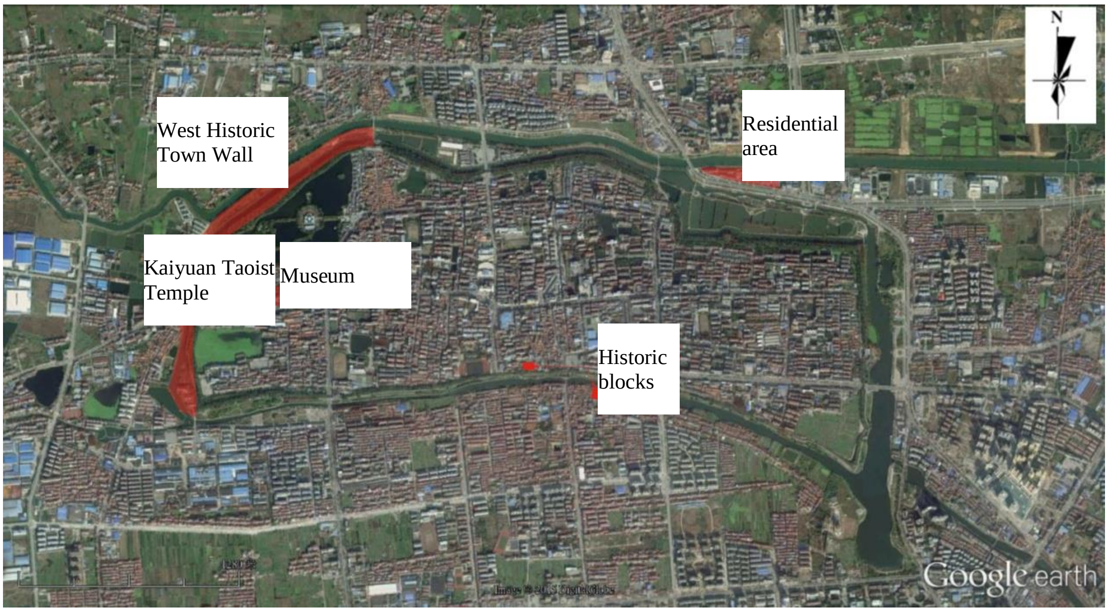


Figure 1.4-2 Distribution of sensitive receptors in the Historic Town area of Component A

Figure 1.4-3 Xiongjiazhong Tomb – a sensitive receptor of Component A

Figure 1.4-4 Distribution of sensitive receptors in the historic town area of Component A

1.4.2.2 Sensitive receptors of the Component B

The Component: Improvement of ecological system and water environment is located in the historic town area, including: dredging of rivers and lakes, sewage pipeline networks, rivers and lakes wetland, and water system interconnection. Construction scope includes not only the construction sites but also the temporarily occupied land. Construction is mainly by mechanical equipment. The affected targets area main the waters such as fish ponds occupied temporarily and the residents surrounding the construction area, and the environmental Sensitive receptors are mainly the water systems in the historic town and nearby residents. Sensitive receptors of the water environment and ecological system subcomponent are shown in Table 1-4~Table 1-5 and Figure 1.4-5.

Table 1-4 List of sensitive receptors of the Component B-Water Body

No.	Name	Position	Function
1		Water Body	
1.1	Moat	Outside the Historic Town Wall	Landscape
1.2	West Lake	West in the Historic Town Wall	Landscape
1.3	Northeast Water Pond	Northest in the Historic Town	Landscape

		Wall	

Table 1-5 List of sensitive receptors of the Component B- Community

2	Community			
2.1	Residents in Fanrong Street	West of the West Gate	37	150
2.2	Jingzhou District Disabled Person Recover Center	North of the South Gate Avenue		170
2.3	Jingzhou Dongfanghong Middle School	East in the historic town		1800
2.4	Jingzhou Institute of Socialism	Near the Horse Horse wash pond		110
Note: Since construction is not carried out in the night, it has minor impacts on the residents. For this reason, school and recovery center are selected as sensitive receptors. Fanrong Street is selected as sensitive receptor because it is in the west side of the temporary site for stacking sludge.				

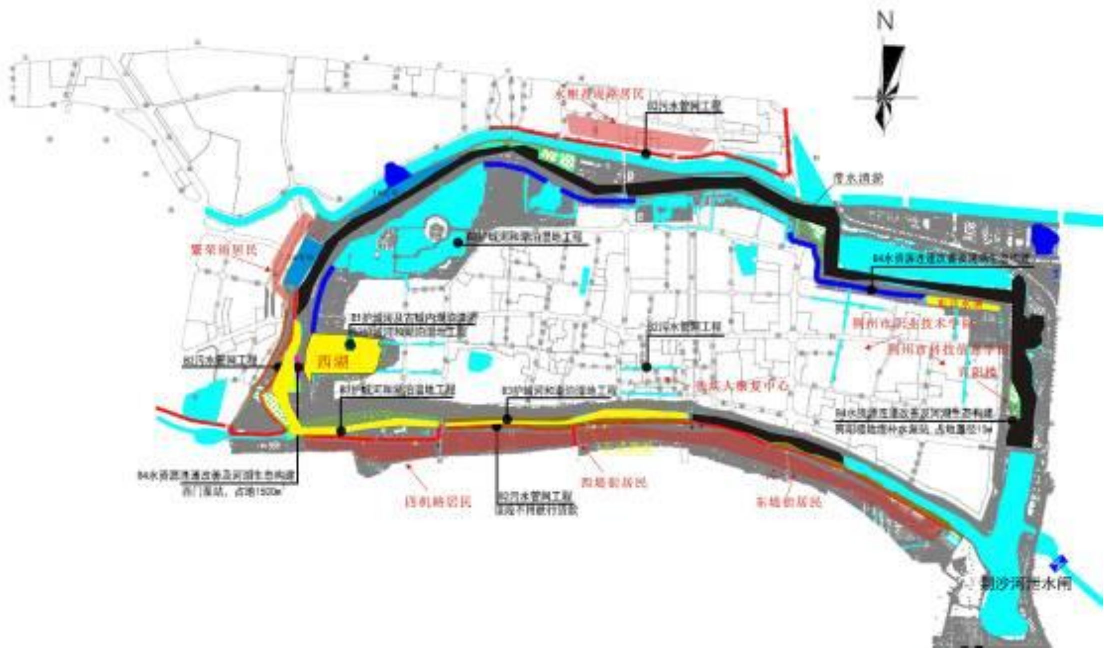


Figure 1.4-5 Distribution of sensitive receptors of Component B

1.5 Applicable Standards

According to *Response Letter on the Applicable Standards for Environmental Assessment of the World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project (JHTC)* by Jingzhou Municipal EPB, the environmental quality standards and discharge standards are detailed in Table 1-6 to Table 1-14.

Table 1-6 List of applicable standards

Type of standard	Standard No.	Name of standard	Assessment receptors	Class/ level
Quality standards	GB3095-2012	Environmental Air Quality Standards	Atmospheric environment in the project area	Level II
	TJ36-79	Hygienic Standards for the Design of Industrial Enterprises		One-time value
	GB3838-2002	Surface Water Environmental Quality Standards	Moat, Taihugang Channel, North Lake, West Lake, Horse Wash Pond, Gangnan Canal, Jingsha River, and other proposed water systems to be connected	Class III
	GB3096-2008	Sound Environment Quality Standards	Road: 1st row residential building on the sides of a road (3-storey or above buildings); Class 1 and Class 2 standards apply for adjacent area, respectively 50m and 30m within the boundary line of the road (buildings with less than 3 floors)	Class 4a
			Schools (beyond Class 4a)	Class 1
			Other areas (beyond Class 4a)	Class 2
	GB/T14848-93	Underground Water Quality Standards	Underground water in each subproject area	Class 3
Discharge standards	DB11/501-2007	Integrated Emission Standards of Air Pollutants	Waste gas at car park	Level II
	Stench prevention methods (Japan)		Stench from garbage dump	——
	GB8978-1996	Integrated Waste Water Discharge Standard	Waste water from construction	Level III
			Visitors' center	
	GB22337-2008	Emission Standard for Community Noise	Class 4 area surrounding the visitors' center	Class 4
			Class 2 area surrounding the visitors' center	Class 2
			Class 1 area surrounding the visitors' center	Class 1
	GB1495-79	Allowable Noise Limits for Motor Vehicles	Vehicles on the road sections under renovation or transformation	—
	GB12523-2011	Noise Limits for Construction Sites	Noise from construction sites	—
	GB15618-1995	Environmental Quality Standard for Soils	Dredged sediment	Level II
	GB4284-84	Control Standards for Pollutants in Sludge from Agricultural Use		—
	GB18918-2002	Pollutant Discharge Standard of Municipal Wastewater Plants		—
	GB/T23486-2009	Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge Used in		—

Type of standard	Standard No.	Name of standard	Assessment receptors	Class/ level
		Gardens or Parks		
	GB/T23485-2009	Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Land filling		—
	HJ350-2007	Standard of Soil Quality Assessment for Exhibition Sites (Interim)		Class B

Table 1-7 Environmental air quality standards, unit: mg/Nm³

Standard No.	Name of standard	Indicator	Time interval (hour)	Daily average	Annual average	Assessment receptors
GB3095-2012	Environmental Air Quality Standards	PM_{10}	-	0.15	0.07	Environmental air in the project area Level II
		SO_2	0.50	0.15	0.06	
		NO_2	0.20	0.08	0.04	
TJ36-79	Hygienic Standards for the Design of Industrial Enterprises	NH_3	0.2	-	-	Environmental air in residential area
		H_2S	0.01	-	-	

Table 1-8 Surface water quality standards, unit: mg/L (excluding pH)

Standard No.	Name of standard	indicator	Class III (mg/L)	Assessment receptors
GB3838-2002	Surface Water Environmental Quality Standards	pH	6～9	Moat, Taihugang Channel, North Lake, West Lake, Horse Wash Pond, Gangnan Canal, Jingsha River, and other proposed water systems to be connected
		Water temperature	Average weekly temperature rise ≤1; average weekly temperature drop ≤2	
		Dissolved oxygen	≥5	
		SS	≤30	
		COD	≤20	
		BOD_5	≤4	
		Oil	≤0.05	
		Ammonias	≤1.0	
		Total phosphorus	≤0.2(0.05 for lake and reservoir)	
		Total nitrogen	≤1.0	
		fluoride	≤1.0	
		fecal coliforms	≤10000	

Table 1-9 Regional environmental noise standard, unit: dB(A)

Standard No.	Name of standard	Indicator	Day	Night	Assessment receptors
GB3096-2008	Sound Environment Quality Standards	Sound level: L_{Aeq}	70	55	Road: the first row of residential building on the sides of a road (three-storey or above buildings); Class 1 and Class 2 standards apply for adjacent area, respectively 50m and 30m within the boundary line of the road (buildings with less than three floors), Class 4a
			60	50	Other areas (outside of Class 4a range), Class 2
			55	45	Schools (outside of Class 4a range), Class 1

Table 1-10 Underground Water Quality Standards, unit: mg/L

Standard No.	Name of standard	Indicator	Class III (mg/L)	Assessment receptors
GB/T14848-93	Underground Water Quality Standards	pH	6.5~8.5	Each subproject area
		Total hardness	≤450	
		Total dissolved solids	≤1000	
		Permanganate index	≤3.0	
		Ammonia nitrogen	≤0.2	
		Nitrates	≤20	
		Nitrites	≤0.02	
		Volatile phenol	≤0.002	
		Total Cyanides	≤0.05	
		Fe	≤0.3	
		Mn	≤0.1	
		Pb	≤0.05	
		Cd	≤0.01	
		As	≤0.05	
		Hg	≤0.001	
		Cr^{6+}	≤0.05	
		Total Coliforms	≤3.0	

Table 1-11 Waste gas pollutants emission standards

Standard No.	Name of standard	Indicator	Control item	Allowable maximum emission concentration (mg/m³)	Allowable maximum emission rate	
					Exhaust funnel (m)	Emission rate (kg/h)
DB11/501-2007	Integrated Emission Standards of Air Pollutants	Exhaust from car parks	NO_2	0.6	2.5	0.0034
			CO	15	2.5	0.076

Note: (1) Exhaust funnel shall be lower than 15m, and limits of emission concentration of air pollutants in exhaust funnel shall be 5 times of "Threshold Concentration for Fugitive Emission (mg/m^3); when the height of exhaust funnel is smaller than the minimum height listed in Table 1, emission rate limits shall be 50% of the emission rate limit calculated by extrapolation; while exhaust funnel shall not be above 5m taller than the buildings within a radius of 200m, the emission rate limits shall be deducted by another 50%.

Table 1-12 Waste water discharge standards

Standard No.	Class of standard	Indicator	Unit	Discharge value	Pollution source
GB8978-1996 Integrated Waste Water Discharge Standard	Class III	pH	-	6～9	Waste water from construction and domestic waste water
		SS	mg/L	400	
		BOD_5	mg/L	300	
		COD	mg/L	500	
		Oil	mg/L	30	
		NH_4-N	mg/L	45	

Table 1-13 Noise pollution control standard values, unit: [dB(A)]

Standard No.	Control standards	Control targets	Day	Night	Control Class/Level
GB12523-2011	Emission Standard of Environment Noise for Boundary of Construction Site	Noise at boundary of construction site	70	55	Level I
GB22337-2008	Emission Standard for Community Noise	Class 4 area surrounding visitors' center	70	55	Class IV
		Class 2 area surrounding visitors' center	60	50	Class II
		Class 1 area surrounding visitors' center	55	45	Class I
GB1495-79	Allowable Noise Limits for Motor Vehicles	Vehicle	82		Level I

Table 1-14 Sludge and sediment control standard values, unit: mg/kg

Indicator	Class II standard in Environmental Quality Standard for Soils	Control Standards for Pollutants in Sludges from Agricultural Use	Pollutant Discharge Standard of Municipal Wastewater Plants	Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge Used in Gardens or Parks	Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Landfilling	Standard of Soil Quality Assessment for Exhibition Sites (Interim)
pH	6.5~7.5	≥6.5	≥6.5	≥6.5	5~10	N.A.

Indicator	Class II standard in Environmental Quality Standard for Soils	Control Standards for Pollutants in Sludges from Agricultural Use	Pollutant Discharge Standard of Municipal Wastewater Plants	Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge Used in Gardens or Parks	Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Landfilling	Standard of Soil Quality Assessment for Exhibition Sites (Interim)
Water content	N.A.	N.A.	N.A.	40	60	N.A.
Organic matter	N.A.	N.A.	N.A.	≥25	N.A.	N.A.
Cyanide	N.A.	N.A.	N.A.	N.A.	10	8
Total nitrogen Total phosphorus	N.A.	N.A.	N.A.	≥0.3	N.A.	N.A.
Mercury	0.5	15	15	15	25	50
Zinc	250	1000	3000	4000	4000	1500
Copper	200	500	1500	1500	1500	600
Cadmium	0.3	20	20	20	20	22
Lead	300	1000	1000	1000	1000	600
Total chromium	300	1000	1000	1000	1000	610
Total selenium	N.A.	N.A.	N.A.	N.A.	N.A.	1000
Nickel	50	200	200	200	200	2400
Arsenic	30	75	75	75	75	80

1.6 Impact Screening

Based on the project nature, engineering features and implementation phase (construction phase and operation phase) and environmental characteristics of project area, factors which may impact natural and social environment, cultural heritage protection are identified. Moreover, the indirect and induced impacts will also be identified.

1.6.1 Identification of environmental impacts

1.6.1.1 Impacts during construction

The three project subcomponents (Preservation of cultural heritage and promotion of tourism development, Improvement of ecological environment and water environment of the Historic Town, and Upgrade of transport convenience of the Historic Town) will produce wastes during construction and operation. The screening subject and period of each subcomponent are listed in Table 1-15.

Table 1-15 Screening phase of each subcomponent

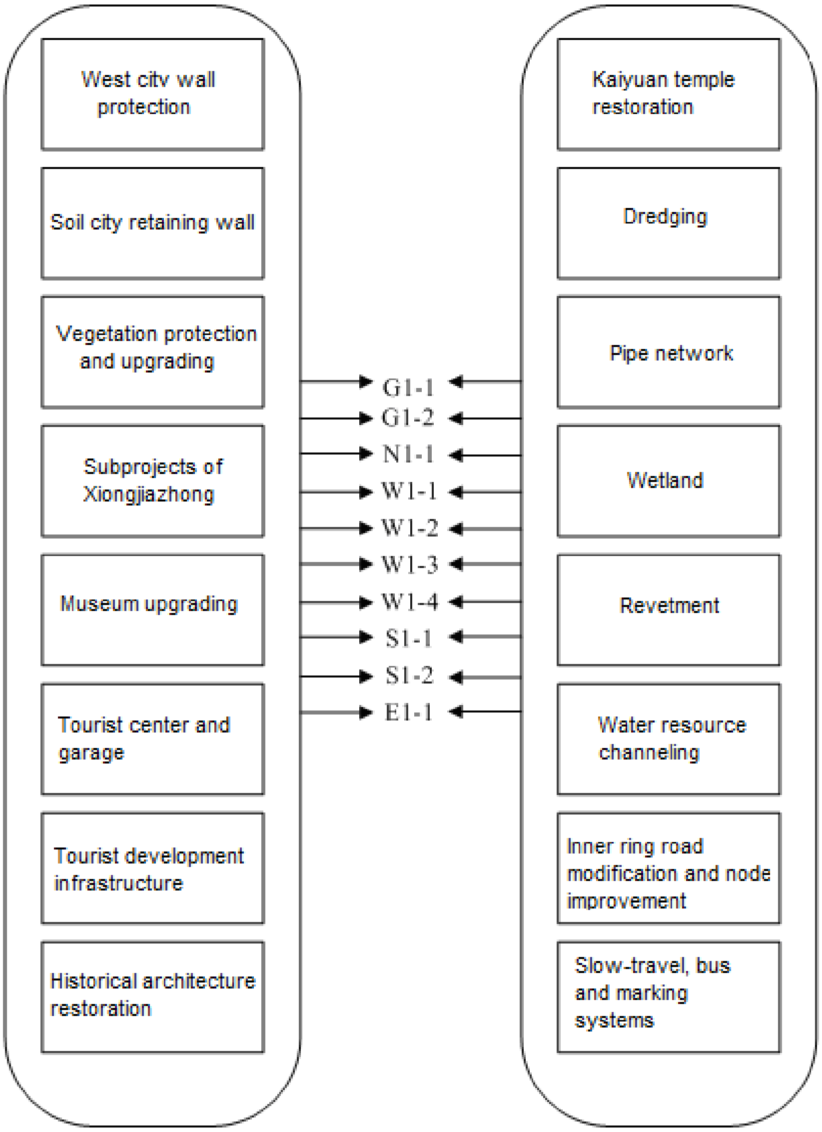
Subcomponent		Construction phase	Operation phase
Component A: Preservation of cultural heritage and promotion of	Protection Works of West Historic Town Wall	√	x
	Works of Building Historic Town Wall's	√	x

	Subcomponent	Construction phase	Operation phase
tourism development	Retaining Wall		
	Preservation and Restoration of Plants on Historic Town Wall	√	x
	Road and Greening Environment Work	√	x
	Scenic Spot Construction Work	√	x
	Preservation and Exhibition of other Removable Cultural Objects	√	x
	Comprehensive Reconstruction of Treasure Hall Buildings	√	x
	Treasure Hall Exhibition Work	√	x
	Installation Work of Treasure Hall	√	x
	Environmental landscape and ancillary works	√	x
	Restoration and reutilization of historic buildings of Jingzhou Museum	√	x
	Landscape and Infrastrucrture Work of Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park	√	x
	Relics Noumenon Exhibition Work of Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park	√	x
	Work of Unearthed Cultrural Relics Exhibition Hall of Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park	√	√
	Work of Park Area Identification and Guide- to-Visitors System of Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park	√	x
	Park Area Management System Work of Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park	√	x
	Visitors'Center	√	√
	Construction and Improvement of Greenbelt such as Parks and Gardens	√	x
	Historic Town Tourism Logo and Guide to Visitors Information Service System	√	x
Component B: Improvement of Ecological Environment and Water Environment of Historic Town	Dredging Subproject of the Moat and LHT	√	x
	Sewage Pipe Network Subproject	√	x
	Subproject of the Moat and Lake Wetland	√	√
	Improvement of Water Resource Connection and Ecological Building of River and Lake	√	√
Component C: Upgrading Traffic Convenience of Historic Town	Subproject of Inner Ring Road Improvement	√	x
	Improvement of inner ring road node:	√	x

	Subcomponent	Construction phase	Operation phase
	Improvement of Key Nodes inside Town.	√	x
	Improvement of Jingzhou Avenue/Jingzhou South Road node	√	x
	Improvement of Jingzhou Avenue East Gate Visitors' Center Node	√	x
	Bike System Improvement	√	x
	Pedestrian System Improvementl	√	x
	Improvement of pedestrian crossing facilities:	√	x
	Public Transit System	√	x
	Connection bus system	√	x
	Historic town – Xiongjiazhong Tomb Tourism Public Transit System:	√	√
	Static Traffic Logo System	√	x
	Dynamic Traffic Logo System	√	x
Component D: Project Management and Strengthening Institutional capability	Consultancy Service of Design Review, Project Management and Monitoring Evaluation	x	x
	Procurement of Offic Facilities for PMO and Implementing Agencies	x	x
	Training and study tour	x	x
	Subject research, management system	x	x

Civil works that implement similar construction methods underwent a unified analysis, based on which separate analysis is conducted on three special works: Xiongjiazhong Tomb excavation, dredging in city moat and lakes and ponds, and sewage piping.

I Civil engineering



G: waste gas, N: noise, W: waste water, S: solid waste, E: ecological impact

Figure 1.6-1 Impact screening during civil construction

Impact periods during civil construction are as follows:

G1-1: Flying dust during construction period, and the main pollutant is TSP.

G1-2: Waste gas will be generated from bulldozer and truck to be used during construction, and the main pollutants include SO_2 and NO_2.

N1-1: Noise will be generated from large construction machines such as dredging pump, excavator, bulldozer, agitator and concrete mixer; for example, the noise of a dredging pump can be as high as 104dB, of excavator 98dB, and of bulldozer 100dB, etc. Transportation vehicles generate noise with engine and horn, featuring strong source and mobility.

W1-1: Reinforced concrete will generate alkali wastewater from washing, which has relatively high concentration of suspension and the pH value may be 9~12. The project will establish sludge wastewater sedimentation tank in every construction area in a centralized way, and the water will be used for concrete after being treated to standards.

W1-2: Waste water that contains oil and silts may be caused by washing the transportation vehicles, which should go through sedimentation treatment and used for road cleaning; the collected floating oil and silts will be moved out for disposal.

W1-3: some components will set up berm area with soil bags, which may cause water seepage, waste water from excavation face and rainwater accumulated in foundation pit that mainly contains silts. Foundation pit wastewater will be used for cleaning road after being treated with grade II sedimentation. The collected silts will be moved out for disposal.

W1-4: domestic water generated by construction personnel mainly comes from the toilet in construction site and the main pollutants include COD, BOD_5 and ammonia nitrogen. Existing living facilities around the construction site will be used as possible.

S1-1: construction waste and demolition waste will be timely cleared up at the construction site for construction reuse after the project developer and project contractor contact the local sanitation department.

S1-2: domestic waste will be cleared up by sanitation department while the project contractor should educate the construction personnel not to litter waste so that a hygienic environment for worker to work and live can be guaranteed.

E1-1: The main ecological environment impact during construction period includes damage to surface vegetation when cleaning up the site during construction and water and soil loss from the exposed surface by site excavation.

II Pollution generation from dredging

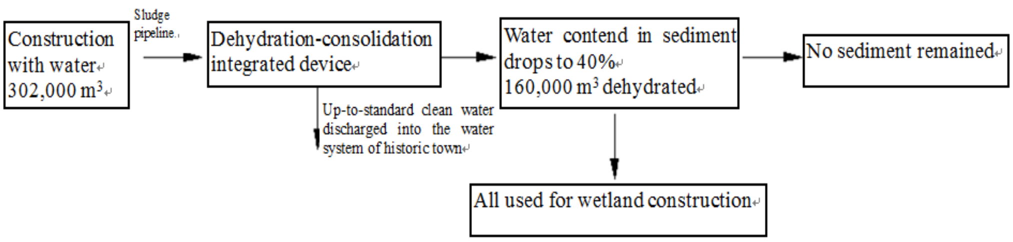


Figure 1.6-2 Dredging process

Phases that produce waste include:

G1-3: during construction, organic matters in the sediment may decompose and generate foul gas ammonia and H_2S as sediment is agitated and piled up.

W1-5: The sludge has high water content after dredging. The filtrate from dehydration and supernatant from spill pit will produce pollutants such as TP, TN and SS during dehydration and consolidation. Coagulant sedimentation will be used to treat the remaining water at storage yard to grade A standard specified in Discharge Standard of Pollutants for Municipal Sewage Plant (GB18918-2002) and discharged to the nearby surface water body.

S1-3: About 300,000m^3 of sludge will be dredged. Two storage yards for receiving sludge will be chosen, which will go through dehydration. Some dried sludge will be reused for constructing wetlands and revetments, and some will be reused for city greening.

E1-2: Sediment dredging influences the aquatic ecology of rivers and lakes, and sludge treatment site affects the ecological environment around the site. These ecological disturbances during construction are unfavorable but last only for a short period of time.

D1-1: Filtrate from sludge in the storage yards may seep into the underground water, therefore anti-seeping measures should be taken at the storage yards.

III Pollution generation during pipeline construction

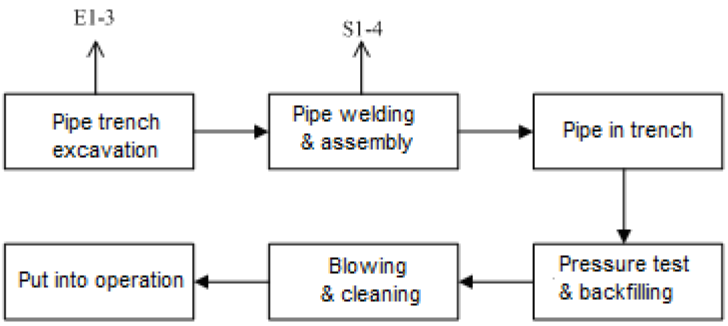


Figure 1.6-3 Pollution generation during pipeline construction

Pollution generation during pipeline construction:

S1-4: Abandoned pipe materials are collected and recycled by pipe supplier.

E1-3: Soil and vegetation are damaged when pipe trench is excavated. Soil should be excavated, piled and backfilled layer by layer.

(4) Pollution generation from excavation works of Xiongjiazhong Tomb

S1-5: Surface of pit wall after excavation needs to be solidified with curing agent. Abandoned earthwork mixed with curing agent and remaining agent is handed over to Jingzhou Museum for bio-safety treatment of later period.

S1-6: Unearthed relics will be sterilized with formalin, commercial sterilizing agent or octyldiether; here there is no waste fluid discharge.

1.6.1.2 Sensitive receptors of the Component A

Unlike the construction phase, environmental impact during operation phase is relatively small, which mainly comes from building of Xiongjiazhong Tomb exhibition hall, vistors' center and parking lot, tourist infrastructure, improvement of water resource channeling and ecological building of river and lake.

I Vistors' center and parking lot

G2-1: the air pollution source mainly comes from automobile tail gas from the ground parking lot and underground car park. Tail gas is unlikely to accumulate on the ground parking lot because the space is wide open and the air flows well, so, its impact to surrounding environment is relatively small because the pollutant is likely to disperse. Therefore, only pollution from underground parking lot is taken into account; the main pollution factors include NO_2 and CO, which are discharged from a 2.5m-high discharge outlet on the ground.

W2-1: The main pollution factors of domestic sewage from tourists are COD and NH_4-N, which will enter the municipal sewage pipe network and finally go into the Waste Water Treatment Plant (WWTP) located in the Caoshi Town before being discharged.

N2-1: Vehicles entering the parking lot area will generate noise from horn, engine, air intake, gas exhaust, transmission system and body vibration, etc., the noise value is 70~75dB(A).

N2-2: Noise will come from underground parking lot fan, water pump and outdoor unit of central AC. The noise that the outdoor unit of single air conditioner is about 65-70dB(A); foundation vibration reduction and building sound isolation will be adopted for noise reduction.

N2-3: Noise from social life such as increasing visitors at the vistors' center will reach 70dB(A) and above after the project is completed.

S2-1: domestic waste generated by tourists will be cleared up and move out by sanitation department on a regular basis.

II Xiongjiazhong Tomb Phase 2 Construction

W2-2: the main pollution factors are COD and NH_4-N, which will enter the municipal sewage pipe network and be treated with the proposed micro-power sewage treatment device to be built before being discharged for agricultural irrigation.

S2-2: domestic waste generated will be cleared up and move out by sanitation department on a regular basis.

III Water resources channeling and construction of rivers and lakes ecology

W2-3: connection of rivers and lakes will turn static water into flowing water, which may disturb sediments in rivers and lakes and cause re-suspension of sediments in lake and river, so, more pollutants of sediments from rivers and lakes will be released to the rivers and lakes body, and the effect of rivers and lakes water quality improvement by water supply sub-component will be negatively affected.

N2-4: after the project is completed and put into operation, pumping houses established in controlled projects such as Ximen pumping station and Binyanglou pumping station will generate relatively high noise (about 90~99dB); the noise reducing measures include using low noise equipment, installing sound cover and adopting double wall for plant.

S2-3: after the project is completed and put into operation, sludge or sediments will be generated in pumping station and culvert, which will be cleared up by municipal department on a regular basis.

1.6.2 Screening of Social Impact

(1) Social impact during implementation of each sub-component (restoration of historic town wall, improvement of water system, traffic improvement, land requisition and house demolition); traffic congestion, public security and health issues during construction phase;

(2) Impact on the accessibility of commercial activities; impact on lotus roots pond and fish pond; impact on tourism income of project construction

1.6.3 Screening of Impact on Cultural Heritage

The cultural sites involved in the proposed project are: Jingzhou historic town wall, Kaiyuan Taoist Temple, Xiongjiazhong Tomb, Jingzhou Museum, buildings on historic blocks. The assessed impact is the impact on these cultural sites during construction, such as construction vibration, etc.

1.6.4 Screening of Induced Impacts

(i) Impact of tourist influx on local culture;

(ii) Impact of tourist influx on the accommodation capacity of local catering industry;

(iii) Impact of tourism industry on local economy;

(iv) Impact of tourist influx on public transportation;

(v) Pressure on environmental protection facilities from tourists;

(vi) Potential of crime rate increase;

(vii) Impact of excavation on underground water

1.6.5 Conclusion of the Impacts Screening

Based on the above impact screening and public consultation, impacts are screened as following:

Table 1-16 Conclusion of impacts screening

Impact	Key assessment	Minor assessment
Construction impact	Dredging	Civil construction, Xiongjiazhong Tomb excavation works, pipeline construction and other environmental impact during construction
Social impact	All the identified content	N.A.
Impact on cultural heritage	All the identified content	N.A.
Induced impact	All the identified content	N.A.

1.7 Evaluation Grade

According to the principles and methodology of determining the level and scope of evaluation, the Project Office has determined evaluation level and scope of each evaluation factor.

1.7.1 Ambient air

The air pollutants of the proposed project mainly come from automobile exhaust produced in operation of the parking lot of visitors' center. However, the proposed project produces less waste gas, so various pollutants estimated account for below 10% of standard pollutants and air in areas of sub-projects is good. Therefore, impact of air is evaluated as Grade 3.

1.7.2 Surface water

Sewage in the project area mainly comes from domestic sewage produced by visitors' center and rain water on bridges and roads, so there is simple water quality and less sewage discharge (less than 1000 m^3/d). Therefore, according to the relevant standards of *Technical Guide of Environmental Assessment for Surface Water* (HJ/T2.3-93), impact of surface water is evaluated as Grade 3.

1.7.3 Acoustic environment

Impact on acoustic environment is mainly the noise produced by machinery and vehicles in construction phase and there is less noise in operation phase. Therefore, according to the relevant standards of *Technical Guide of Environmental Assessment for Noise* (HJT2.4-2009), impact on acoustic environment is evaluated as Grade 3.

1.7.4 Underground water

In terms of *Technical Guide of Environmental Assessment for Underground Water* (HJ610-2011), the proposed project belongs to Type II construction project. Based on nature and features of the proposed project, water supply and discharge scale is "small-medium"; variation scope of underground water levels is "small-medium"; since there are no such sensitive areas as rural centralized drinking water sources around 500 m of the project area, the sensitivity of underground water is "Insensitive"; extent of hydro geological problems caused by the project construction is "weak-medium"; based on stipulations of evaluation levels of Type II construction project in Table 6 of *Technical Guide of Environmental Assessment for Underground Water* (HJ610-2011), impact on underground water is evaluated as Level 3.

1.7.5 Ecological environment

The evaluation level of ecological impact is confirmed according to Table 1 in *Technical Guide of Ecological Environmental Assessment* (HJ19-2011). The classification of evaluation grade of ecological impact assessment is shown in the Table 1-17.

Table 1-17 Classification of evaluation work of ecological impact assessment

Ecological sensitivity of impacted area	Land (water area) coverage scope of project		
	Area≥20km² Or length≥100km	Area 2km²～20km² Or length 50km～100km	Area≤2km² Or length≤50km
Special ecological sensitive area	Level 1	Level 1	Level 1
Important ecological sensitive area	Level 1	Level 2	Level 3
General area	Level 2	Level 3	Level 3

PS. In terms of UNESCO list, Jingzhou Historic Town is in the waiting list of the world cultural heritage sites, not the awarded World Cultural Heritage, and the project area is not the special sensitive area. Therefore, ecological impact of the proposed project is evaluated as Level 3. The evaluation grade of various environmental elements is shown in the Table 1-18.

Table 1-18 Evaluation Grade of the

Item	Evaluation level
Surface water	Grade 3
Ambient air	Grade 3
Noise	Grade 3
Ground water	Grade 3
Ecological environment impact evaluation	Grade 3

1.8 Assessment Scope, Period and Focus

1.8.1 Evaluation Scope

Based on environmental baseline of the project area and according to relevant technical guides, the Project Office has confirmed evaluation scope and content of assessment, as shown in Table 1-19.

Table 1-19 Evaluation scope of the Project

Evaluation factor	Evaluation scope	Evaluation period
Surface water (including sediment)	Moat, Taihugang Channel, Gangnan Canal, Jingsha River, North Lake, West Lake, Horse Wash Pond, water system to be interconnected; agricultural harbor district	Construction phase, operation phase
Air	In a circle with radius of 2.5 km with south gate of the Historic Town as the center; In a circle with radius of 2.5 km with Xiongjiazhong Tomb as the center;	Construction phase, operation phase
Noise	200m surrounding areas of subcomponents	Construction phase
Underground water	5km away from the center of south gate of the Historic Town	Construction phase
Ecological environment	Construction area: lay 2-meter pipes along pipeline and 200-meter pipes along the road. Vegetation-covered area, moat, Taihugang Channel, North lake, West Lake, Horse Wash Pond	Construction phase, operation phase
Cultural relics protection	Cultural relics protection area of the project location	Construction phase, operation phase
Social impact	Social environment of project area	Construction phase, operation phase
Induced impact	Project area	Construction phase, operation phase

According to suggestions of World Bank experts, the impact on project-associated area shall be included in this EAR. For this reason, the upstream and downstream project-associated areas are assessed, as listed in the following Table 1-20.

Table 1-20 Evaluation scope of the linked project

Evaluation object	Evaluation content	Evaluation scope	Evaluation period	Reason for evaluation
Surface water	Impact of tail water of South sewage plant and Caoshi WWTP	Gangnan Canal, Taihugang Channel	Operation phase	Waste water in operation phase is planned to discharge into South sewage plant and Caoshi WWTP
	Impact of water replenishment engineering on water system of the Historic Town	Water system of the Historic Town	Operation phase	Although water replenishment engineering is not within the project scope, it has the direct relationship with the proposed

Evaluation object	Evaluation content	Evaluation scope	Evaluation period	Reason for evaluation
				project
Disposal of solid waste	Feasibility of waste incineration engineering	N.A.	Operation phase	Domestic garbage

1.8.2 Evaluation Period

In terms of evaluation period, the environmental impact evaluation will cover the construction stage and operation stage. The baseline evaluation is the year of 2015, and the impact evaluation on construction stage is the years of 2016-2017. As the proposed project implementation period is 2016-2020, the environmental impact evaluation on the operation stage is the year of 2020 beyond.

1.8.3 Evaluation Focus

Based on the pollution characteristics of the proposed project, existing environmental situation in the project area and relevant environmental protection regulations and policies, the EAR will focus on the environmental assessment as follows: (1) Environmental impact of dredging; (2) Social impact of project implementation; (3) impact on cultural heritage; (4) induced impact during project implementation.

2 PROJECT DESCRIPTION

2.1 General

2.1.1 Project Development Objective

The project development objective is to conserve cultural heritage, improve water quality and tourism services in project areas in Jingzhou Municipality.

2.1.2 Project Components

The project includes four core components: A. Cultural Heritage Conservation and Tourism Services Improvement; B. Water Environment Improvement; C. Transport Improvement; and D. Assistance to Project Management and Capacity Building. This package of interventions offers an integrated approach to achieve the Project Development Objectives. In addition to conserving the universal value of the cultural heritage sites, the project strives to address the binding constraints for the growth of tourism industry, such as lack of quality cultural heritage sites and interpretation, absence of well-designed tourist routes, poor water environment, and decreasing accessibility. The investments are prioritized according to its potential contribution to the conservation of cultural heritage sites and tourism development. The heritage sites chosen are those with the most historical value, among the top tourist destinations (the Ancient City Wall, the Jingzhou Museum), and with the greatest potential to become anchor tourism destinations (Xiongjiazhong Archaeological Park and the city moat). The improvement of accessibility to these cultural heritage sites and water quality will help achieve the synergies necessary to contribute to the twin goals sustainably. The contents of the components are as following.

Component A: Preservation of cultural heritage and promotion of tourism development, including 6 subcomponents of Restoration and Preservation of Historic Town Wall, Environment improvement and utilization of Jingzhou Kaiyuan Taoist Temple, Upgrade of Exhibition of Jingzhou Museum Treasure Hall Cultural Objects, Restoration and Reutilization of Historic Buildings, Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park, and Support Tourism Development. Total budget is 559.8165 million CNY, account for 51.79%.

***Component B: Improvement of Ecological Environment and Water Environment of Historic* Town** including 4 subcomponents of Dredging Subproject of the Moat and LHT, Sewage Pipe Network Subproject, Subproject of the Moat and Lake Wetland, Improvement of Water Resource Connection and Ecological Building of River and Lake. Total budget is 351.4793 million CNY, account for 32.52%.

Component C: Upgrading Traffic Convenience of Historic Town, including 5 subcomponents of Road Traffic System, Non-motor Traffic System, Public Transit System, Traffic Sinage System and Technical Support. Total budget is 134.8587 million CNY, account for 12.48% .

Component D: Project Management and Strengthening Institutional capability, including 4 subcomponents of Consultancy Service of Design Review, Project Management and Monitoring Evaluation, Procurement of Office Facilities for PMO and Implementing Agencies, Training and study tour, Subject research and management system. Total budget is 34.7856 million CNY, account for 3.22%.

Total project investment is 1.081 Billion CNY, of which the World Bank loan is 100 Million USD (about 61.5 Million CNY in the Feasibility Study Report) and the rest comes from domestic fund. The project implementation period is January 2016– December 2020, with project contents listed in the following Table 2-1.

Table 2-1 List of Project Components

Project No.	Subproject Name	Subproject Description
A	**Preservation of cultural heritage and promotion of tourism development;**	
A1	**Restoration and Preservation of Historic Town Wall**	
A1-1	Protection Works of West Historic Town Wall	Repair of brick town wall: with length of 2196m, converted into façade area of 12, 609 m^2, repair of piled brick wall: 2196m, repair of wall top footpath: 4831.2 m^2, backfill 1518.3m^3, repair of earthen town wall: backfill 6307.6 m^3
A1-2	Works of Building Historic Town Wall's Retaining Wall	Building retaining wall: 960m^3
A1-3	Preservation and Restoration of Plants on Historic Town Wall	Environment improvement of vegetation on town wall: including 1. Reservation and protection of excellent vegetation; 2. Removal and replacement of bad vegetation; 3. Supplementary planting and upgrade of excellent vegetation. Total area is 94800m2.
A2	**Environment improvement and utilization of Jingzhou Kaiyuan Temple**	
A2-1	Road and Greening Environment Work	Road repair, affectation of vegetation and restoration of wall..
A2-2	Scenic Spot Construction Work	Including construction of Square outside the Front Gate, Square inside Front Gate, Xianyun Pavilion, Lotus Bloom 7 Gentlemen and Double-Pavilion Tablet Corridor.
A2-3	Preservation and Exhibition of other Removable Cultural Objects	Mainly including restoration of Shinshi Archway, Preservation & Exhibition of Stone Stele and Carvings and Preservation of Stone Manger Site, etc.
A3	**Upgrade of Exhibition of Jingzhou Museum Treasure Hall Cultural Objects**	
A3-1	Comprehensive Reconstruction of Treasure Hall Buildings	Adjustment of visitors' tour line, adding construction of public service facilities, additional construction of barrier-free facilities, earthquake fortification and transformation of buildings, remoulding of heat preservation and energy-saving of buildings, waterproofing of roofs & dampproofing of ground and transformation buildings' appearance.
A3-2	Treasure Hall Exhibition Work	1. Chu Le Palace is planned to be upgraded into a multifunctional new exhibition hall with both performance and exhibition conten; 2. For the part "Phoenix Mountain No.168 Han Tom Exhibition", it is planned to add exhibition content about site of excavation and background introduction, to be showcased using way of multimedia. 3. For the part "Ancient Lacquer Woodware Boutique Exhibition" , it is planned to add exhibits to extend introduction to archaeological achievements of Chinese ancient lacquer culture and lacquer-making technique as well as colored drawing.; 4. For the part "Chu-Han Embroidery Exhibition", it is planned to add technological process of ancient silk fabrics and imitative

Project No.	Subproject Name	Subproject Description
		traditional loom.
A3-3	Installation Work of Treasure Hall	1. Optimize the air-conditioning equipment, using air-cooling module set and fan coil or cabinet type, hanging-type air processor, new fan and air dehumidifier to form a half-centralized air-conditioning system, focusing on humidity control. Lake water type water source heat pump will serve as cold and heat source; 2. Security and protection facilities include adjustment, with additional alarm points, demolition and restoration of fire control broadcasting system, and installation and perfection of automatic spray and auxiliary gas fire-extinguishing system.
A3-4	Environmental landscape and ancillary works	Demolishing entrance hall, and its left side room will be rebuilt into a rest pavilion. Demolishing most of the entrance road in front of the entrance hall, with treatment method of landscape design to create a view enjoying platform at entrance space and build a barrier-free slope around the pavilion.
A4	Restoration and Reutilization of Historic Buildings	2 building districts which are formed into a group are selected, which involve 13 historic buildings and land parcels,and serve as demonstration points for restoration and reutilization of historic buildings of Jingzhou Historic town heritage preservation project, total floor area is 4282 ㎡.
A5	Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park	
A5-1	Landscape and Infrastrucrture Work	Primarily includes Chu Yulin Landscape Work, Farmland Clear-up Work, Phase II Parking Lot Construction Work,,Parking Lot and Main Ring Road Asphalt Pavement Work, Academic Exchange Center Rebuilding Work, Outdoor Greening Spray System Construction Work and Visitors Service Facility Construction Work
A5-2	Relics Noumenon Exhibition Work	Including work of Horse & Chariot Pit Relics Preservation Exhibition Hall and Work of Junshi Grave Sacrificial Pit Preservation Exhibition.
A5-3	Work of Unearthed Cultrural Relics Exhibition Hall	Mainly including Exhibition Hall construction work, Exhibition Hall and Surrounding Landscape Work, Indoor Exhibition Work, and Multifunctional Hall Equipment Procurement
A5-4	Work of Park Area Identification and Guide- to- Visitors System	Including Logo System Work, Guide-to-Visitors System Work and On-line Museum Construction
A5-5	Park Area Management System Work	Including Public Management System Construction and Security and Proection Management System Construction.
A6	Support Tourism Development	
A6-1	Visitors'Center	East Gate Visitors' Center 2451 ㎡, parking system
A6-2	Construction and Improvement of Greenbelt such as Parks and Gardens	
A6-3	Historic Town Tourism Logo and Guide to Visitors Information Service System	
B	Improvement of Ecological Environment and Water Environment of Historic Town	

Project No.	Subproject Name	Subproject Description
B1	Dredging Subproject of the Moat and LHT	The moat and fish ponds on both sides, West Lake, northeast ponds, including dreging and delivery of sediment, totally 301,900 cubic meters
B2	Sewage Pipe Network Subproject	Including 3 parts, i.e. newly building trunk sewer outside the moat, supplement and improvement of combined sewage trunk sewer in Historic Town, and supplement of combined collecting pipe in Historic Town
B3	Subproject of the Moat and Lake Wetland	The moat artificial wetland, ecological revetment and artificial wetland of lake and pond
B4	Improvement of Water Resource Connection and Ecological Building of River and Lake	Including water connection of Historic Town, improvement of Historic Town water source (water supplement) and construction of power system.
C	**Upgrading Traffic Convenience of Historic Town**	
C1	**Road Traffic System**	
C1-1	Subproject of Inner Ring Road Improvement	Modification of part of motor vehicle driveway and pavement based on organization scheme of inner ring road local counterclock wise one-way and local two-way traffic .
C1-2	Improvement of inner ring road node:	Improvement is conducted for intersections of Inner Ring Road/Ying Du Road (New South Gate), Inner Ring Road/Ai Min Road (Old South Gate), Inner Ring Road/Renmin Road (New North Gate), Inner Ring Road/Tuotafang Road, Inner Ring Road/Jingzhou South Road (East Gate). Measures for improvement comprise optimized intersection channelization design, added pedestrian crossings and non-motor vehicle lanes.
C1-3	Improvement of Key Nodes inside Town.	5 nodes of Jingzhou Middle Road/Yingdu Road, Jingzhou Middle Road/Qu CNY Road, Jingzhou South Road/Qu CNY Road, Jingzhou Middle Road/Remin Road and Jingzhou North Road/Renmin Road intersections, and measures for improvement comprise optimized intersection channelization design, optimized signal light timing scheme and improvement of non-motor lane and pedestrian crossing facilities, etc.
C1-4	Improvement of Jingzhou Avenue/Jingzhou South Road node	Optimized intersection channelization design, optimized signal light timing scheme and improvement of non-motor lane and pedestrian crossing facilities to meet demand of transportation in 2020 and reduce delay at nodes.
C1-5	Improvement of Jingzhou Avenue East Gate Visitors' Center Node	At this node, there is now no channelized marked line and no signal control. When East Gate Visitors' Center is completed, it is necessary to conduct a supplementary node channelization reconstruction and adopt signal control
C2	**Non-motor Traffic System**	
C2-1	Bike System Improvement	(1) For the current roads where motorized and non-motor lineation type bike land with width of non—motorized lane over 1.5 m and 4-lane two-way motorized lane, such as Jingzhou Middle Road (West Gate-Qu CNY Road) section and Qu CNY Road, etc. colored asphalt bike lane is to be used; (2)In Inner ring road motorized one-way section, motorized and non-motor separation type bike land is to be newly established, where, motorized and non-motor separation guard bar is needed; (3) In the scenic spot, colored asphalt bike lane special bike lane is newly equipped to form a system with road network slow running

Project No.	Subproject Name	Subproject Description
		lane; (4) Auxiliary facilities such as bike lane system indication signs will be established.
C2-2	Pedestrian System Improvement	(1) In the roads with pedestrian width over 6m (Jingzhou North Road, Qu CNY Road, Jingzhou Middle Road and Jiangzhou East Road), isolation column for prohibiting motorized drive-in is to be established, and on-road parking is to be cleared out; (2)Improvement of inner ring road sidewalk and pedestrian crossing facilities;(3) Restoration and improvement of riding track.
C2-3	Improvement of pedestrian crossing facilities:	Current 12 locations of zebra marking will be reconstructed into vertical zebra crossing, added with yellow flashing light, it is proposed that 4 locations with intersection signal lights are adjusted.
C3	**Public Transit System**	
C3-1	Connection bus system	Line 1 and Line 2 are ring road bus. In Line 1, it runs along inner ring road counterclockwise, established with 18 bus stations ; In Line 2, it runs along riding track clockwise, totally equipped with 15 stations
C3-2	Improvement public transit system inside historic town	(1) Reconstruction of bus shelter of public transit. current 12 straight-line bus platforms will be rebuilt as harbor type ones;(2)28 eletronic station boards are established; (3)3 public transit Lines 15, 18 and 103 with 30 buses will be upgraded to be hybrid power new energy buses.
C3-3	Historic town – Xiongjiazhong Tomb Tourism Public Transit System:	It starts from East Gate Visitors' Center, passing Jingzhou Avenue, North Ring Road and Jingying Line to arrive at terminal station Xiongjiazhong Tomb, with whole journey of around 40 km and average running time of 1.5 h. 2 stations are established, i.e. East Gate Visitors' Center and Xiongjiazhong Tomb Station. 10 hybrid power tourism buses (each with 45 seats) are needed.
C4	Connection Bus System	Conducting planning of connection bus route network, stations and transport capacity. Needing to equip 10 sets of 18-22 seats clean energy tour bus, with 56 station boards being installed.
C4	**Traffic Logo System**	
C4-1	Static Traffic LogoSystem	Including traffic signs outside and inside Historic Town (signs about scenic spots are to be designed and completed in special plans of tourist attractions, and signs about traffic have been incorporated in above subprojects, so they are not repeated here).
C4-2	Dynamic Traffic Logo System	Including parking guidance logo information system and historic town dynamic traffic guidance-control center.
C5	Technical Support	Research on Planning and Management of Parking in Historic Town.
D	**Project Management and Strengthening Institutional capability**	
D1	Consultancy Service of Design Review, Project Management and Monitoring Evaluation	Including project management consultancy, bidding agency, resettlement plan, environment, social external monitoring, resettlement external monitoring consultancy service, and environment management plan external monitoring consultancy service.
D2	Procurement of Offic Facilities	Including development, commissioning and maintenance of

Project No.	Subproject Name	Subproject Description
	for PMO and Implementing Agencies	subprojects of collaborative office management system and engineering project management.
D3	Training and study tour	Including international and domestic training; training of residents' competence of tourism service; special training of historic- cultural heritage preservation of the historic town (conducting survey and clear-up of relevant agencies in relation to preservation of Jingzhou cultural relics, carrying out training of technique for preservation of historic town's historic-cultural relics. Training of competence of managing cultural heritages.).
D4	Subject research, management system	Including research of hydraulic power water quality model, construction of relevant management website and related plans.

2.1.3 Project Location

For specific project schemes, refer to the feasibility report and report for each specific component or subcomponent. This environmental assessment only provides analysis for Component A, B and C, while Component D only listed in Table 2-1 as a part of the project but it will not be analyzed in this EAR. The location of the project components is shown in the figure 2.1-1.

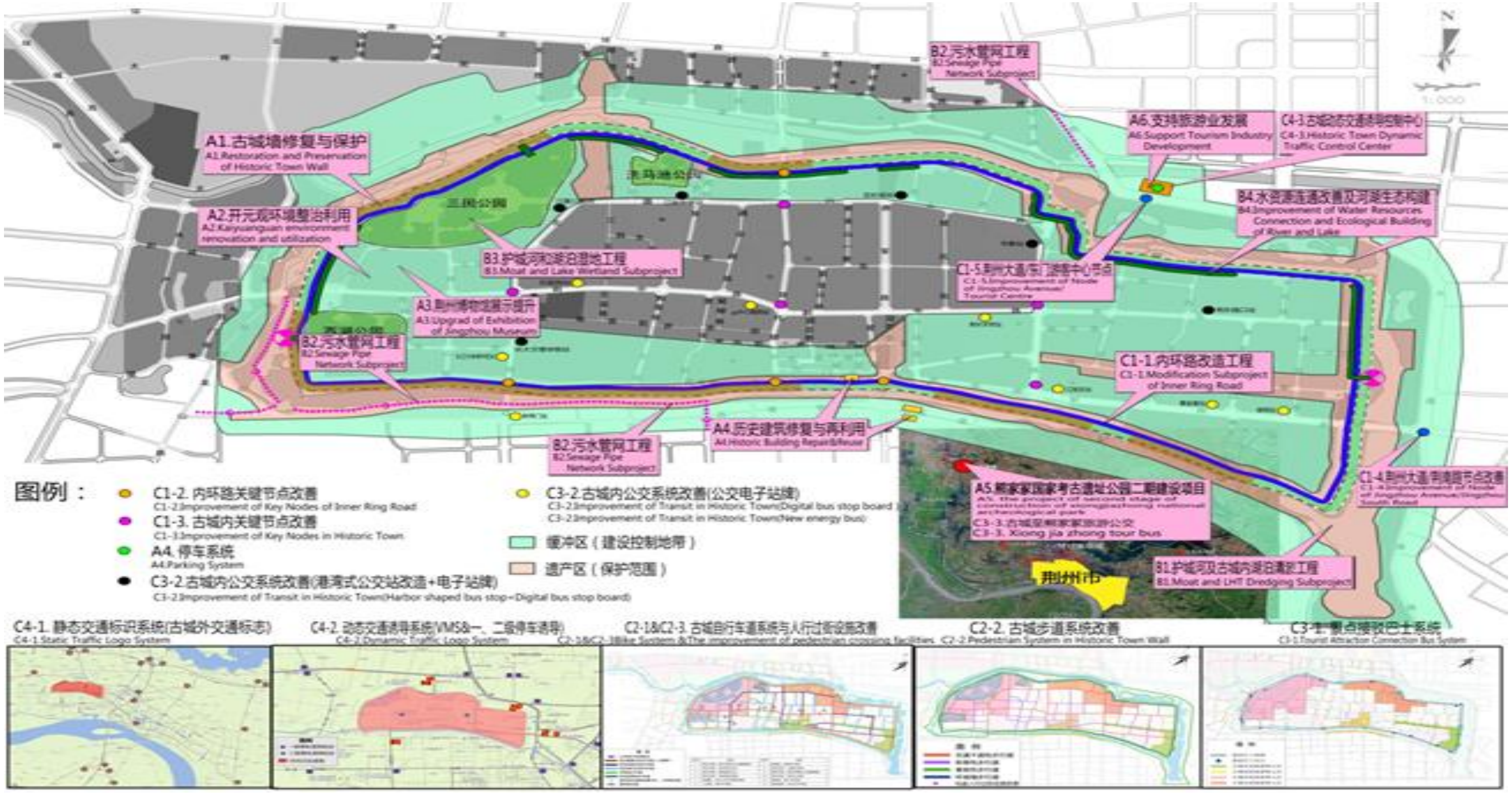


Figure 2.1-1 Location of the Project

2.2 Project Description

2.2.1 Component A

Component A: Cultural Heritage Conservation and Tourism Services Improvement. This component aims to conserve Jingzhou's key cultural heritage assets and to also improve select tourism services. It comprises of six subcomponents as follows:

(i) A1- Conservation of a segment of the City Wall which has been damaged by years of neglect, weather and invasive vegetation; the project will introduce a more systematized approach to the conservation and restoration of all of the unique features of the wall;

(ii) A2- Piloting of the conservation and regeneration of 13 historical buildings along Dongti Street and Nanmen Street;

(iii) A3- Support to the Xiongjiazhong Archaeological Park, possibly including the construction of a museum to display the archaeological findings, protection and display building of the subordinate tombs, lighting and interpretation of the horse-and-chariot chamber in the exhibition hall, provision of tourist service facilities and the installation of safety and surveillance system; [to be determined at Appraisal]

(iv) A4 - Upgrading of the Jingzhou Museum, including the renovation, redesign of the exhibition schemes, and procurement of special equipment for the three treasure halls;

(v) A5- Support to the conservation of Kaiyuan Taoism Temple, including environmental improvements such as repair of roads, drainage, enhancement of the landscapes, and display/exhibition on evolution of Taoism, ancient bells and stone inscriptions;

(vi) A6- Support to tourism development by constructing one tourist information center near the Eastern Gate of the JHT, creating or improving the green spaces and establishing a tourism signage and tour navigation system.

2.2.2 Component B

Component B: Water Environment Improvement. This component aims to systematically improve the water ecosystem in the moat, lakes and ponds through the following activities:

(i) B1- Dredging the Moat and Lakes within and around the Historic Town, to remove and safely dispose 250,000 to 300,000 cubic meters (m3) of inorganic and organic deposits;

(ii) B2- Internal Drainage Network and Interceptor Sewers around the Historic Town, including the improvements to the internal combined sewer network within the Historic Town and to the ring of interceptor combined sewer collector around the Historic Town.

(iii) B3- Wetlands Creation along the Moat and Lakes, including the construction of wetlands and the construction of an ecology embankment along the moat as well as the creation of wetlands in the dredged lakes.

(iv) B4- Enhanced Interconnectivity of Water Bodies and Flow Augmentation through the investment in culverts, conveyance pipes, 1 rubber dam, 3 pump stations, and their ancillary facilities.

2.2.3 Component C

***<u>Component C: Transport Improvement</u>*.** This component aims to facilitate access to the cultural heritage sites for residents and tourists alike by improving non-motorized transport and public transport options. It will also help improve movement of tourists by signage upgrading. Concretely it will include the following:

(i) C1- Urban roads improvement, including Inner Ring Road rehabilitation and optimization of key junctions.

(ii) C2- Non-Motor Transport (NMT) Improvement, including the investments in establishing color-paved bicycle lanes, dedicated NMT roads and facilities to enhance walking safety.

(iii) C3- Public transport improvement such as upgrading the mini-bus system for tourism, procuring new hybrid buses, establishing a new tourism bus line to connect to Xiongjiazhong Archaeological Park and improving the bus stops.

(iv) C4- Transport signage upgrades through provision of signs leading to tourist destinations around the historic town, the Variable Message Sign (VMS) at key entrances to the old town and real-time parking guidance signage; and building a management center to monitor the real time traffic and tourism volumes for management and emergency response purposes.

2.2.4 Component D

<u>Component D: Assistance to Project Management and Capacity Building.</u> This component aims to strengthen the technical and institutional capacity of the Project Management Office and Project Implementing Agencies. The main context of this component includes: project management assistant in the project implementation; research on traffic management of Historic Town; management website construction; research on the protection and regulation mode of Jingzhou historical and cultural blocks; training and study tour; Procurement of Office Facilities for PMO and Implementing Agencies; external monitoring and consulting services for environmental management plan; immigration external monitoring and consulting services; study on comprehensive management mechanism of water environment.

(i) ***<u>D1- Consulting services for project management</u>*** Project management consulting services in the project implementation;

(ii) ***<u>D2- Research on traffic management of Historic Town</u>*** Research on traffic management of Historic Town; Including following content: traffic organization of the inner city of Historic Town. Study on parking planning in Historic Town. Study on traffic microcirculation in Historic Town . Optimization of transportation infrastructure in Historic Town . Research on traffic intelligence in Historic Town .

(iii) **D3- Management Information System Construction** Including following content: Establish a project office website, containing project introduction, project general situation, institution setting, implementation stage image of the progress, the government and various departments and the implementation mechanism of sub links, automatic office processing sub links etc. Manage the maintenance of the site during the implementation of the project. Configure computer room and database

(iv) ***D4- Research on the protection and regulation mode of Jingzhou historical and cultural blocks*** Including following content: Status quo and protection of Jingzhou historical and cultural blocks . Comparative study on the protection and development pattern of Jingzhou historical and cultural blocks . Research on the protection and development model of Jingzhou historical and cultural blocks. Suggestions on protection and utilization of Jingzhou historical and cultural block . Protection measures of Jingzhou historical and cultural blocks in the near future to carry out the task suggestion. Research on the protection of Jingzhou historical and cultural blocks and supporting policies. Study on the implementation of the time series of the protection measures of the Jingzhou historical and cultural blocks.

(v) ***D5-Training and study tours for project management and strengthening institution capacity*** Including international and domestic training; training of residents' competence of tourism service; special training of historic- cultural heritage preservation of the historic town (conducting survey and clear-up of relevant agencies in relation to preservation of Jingzhou cultural relics, carrying out training of technique for preservation of historic town's historic-cultural relics. Training of competence of managing cultural heritages.)

(vi) ***D6-Office equipment*** Including development, commissioning and maintenance of subprojects of collaborative office management system and engineering project management

(vii) D7- External monitoring and consulting services for environmental management plan

(viii) D8- Immigration external monitoring and consulting services

(ix) D9- Study on comprehensive management mechanism of water environment

2.3 Project Location

The specific project location is shown in the Figure2.3-1 ~ Figure 2.3-7 in below.

Figure 2.3-1 Map of Location of Historic town restoration, enhancement of museum, environmental management of Kaiyuan Taoist Temple, restoration of historic blocks, visitors' center and parking lot

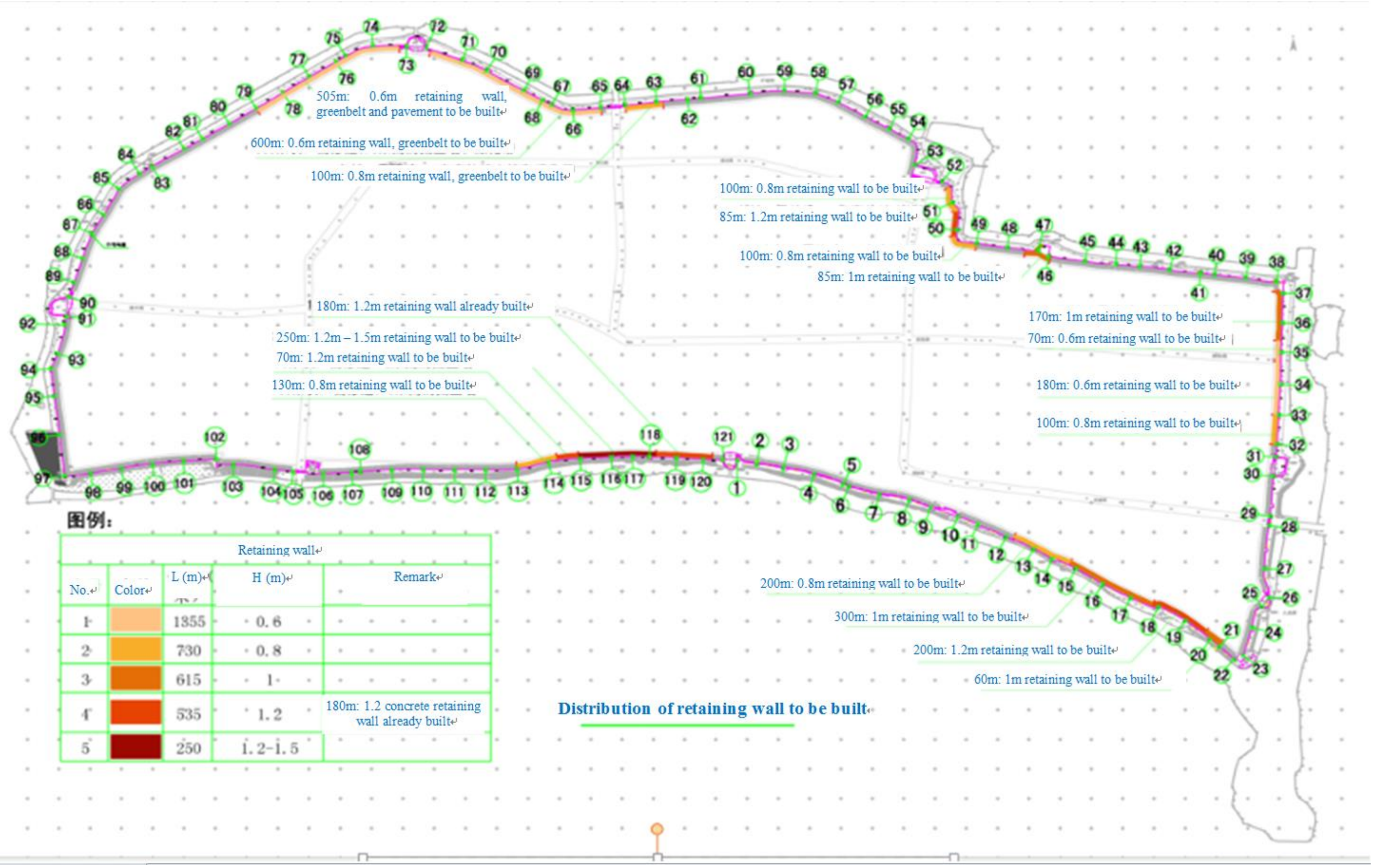


Figure 2.3-2 Distribution of retaining wall

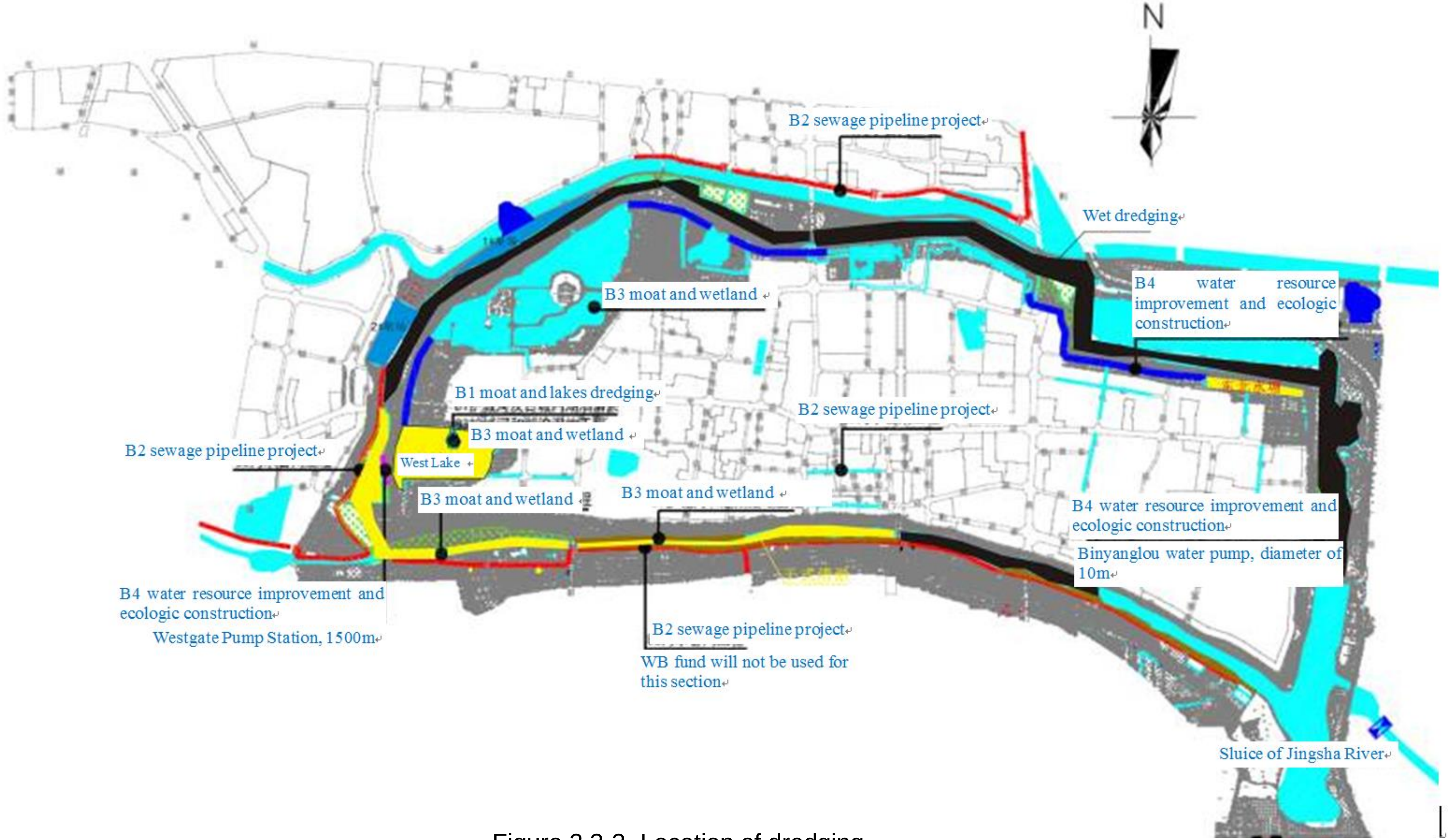


Figure 2.3-3 Location of dredging

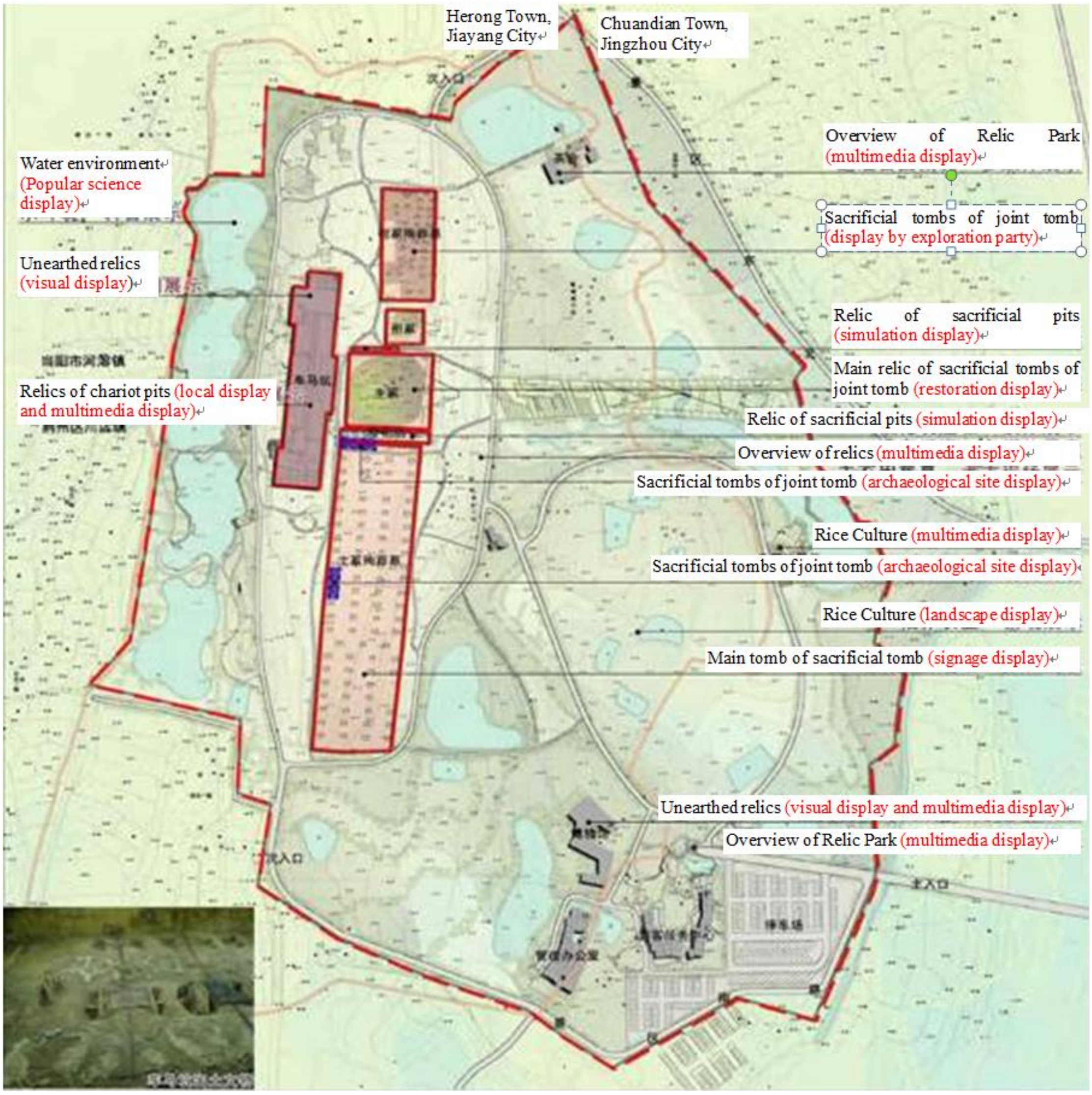


Figure 2.3-4 Location of the Xiongjiazong Tomb

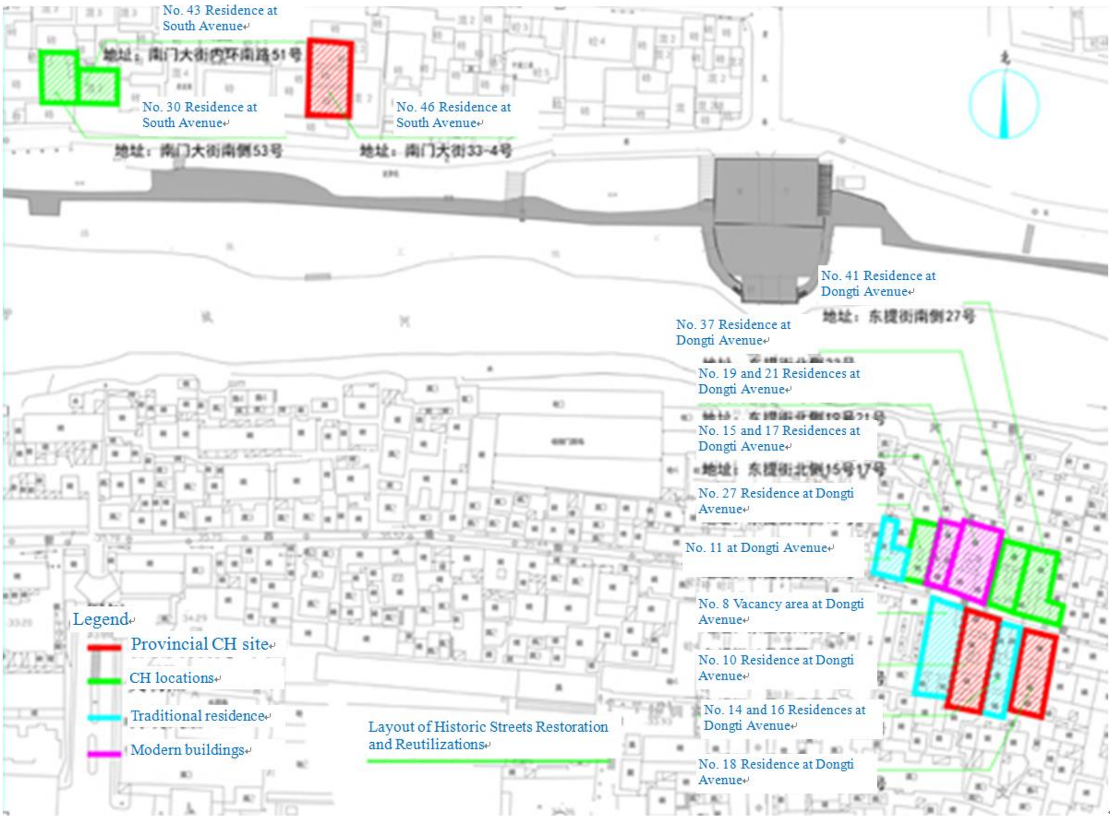


Figure 2.3-5 Location of the Historic Block of the Cultural Heritage

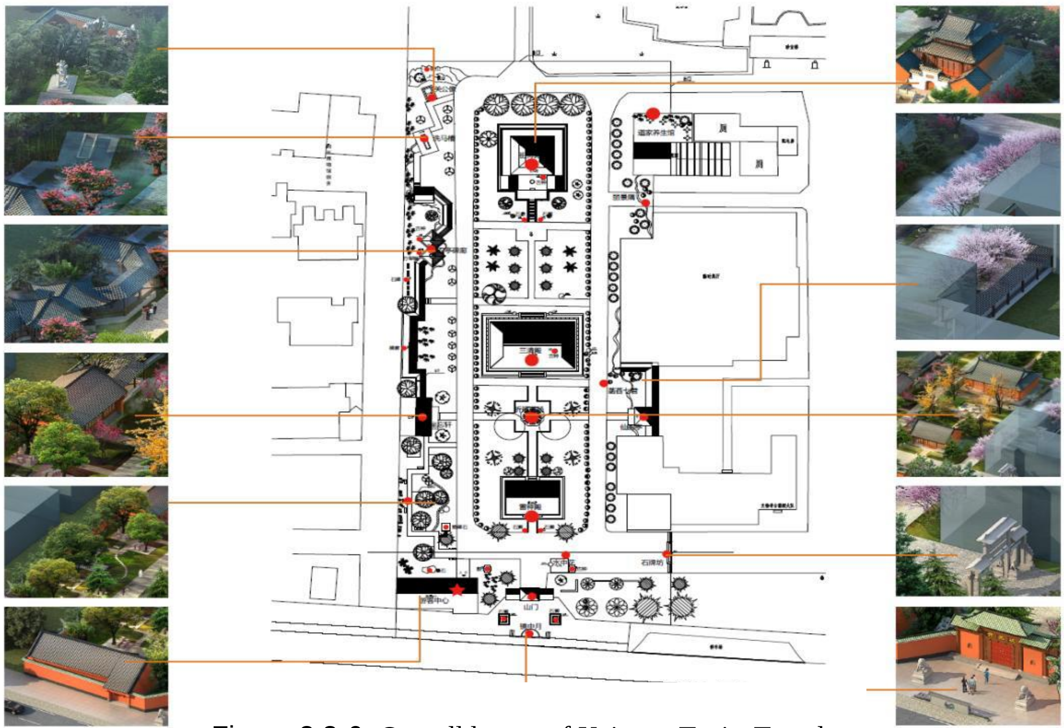


Figure 2.3-6 Overall layout of Kaiyuan Taoist Temple

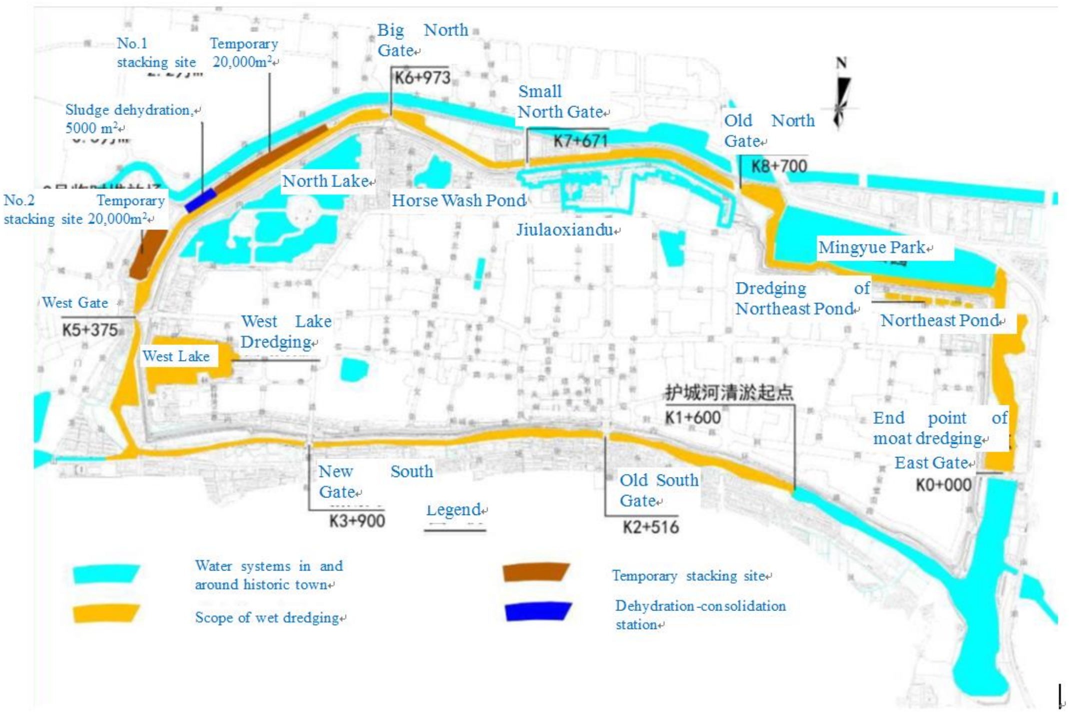


Figure 2.3-7 Location of the sludge treatment

2.4 Construction Activities

Construction works and schemes of each project component are listed in the following table.

Table 2-2 List of the Construction methods

No.	Component and subcomponent			Construction methods	Materials needed
1	Component A: Preservation of cultural heritage and promotion of tourism development	Historic town wall preservation	Protection of west wall	Maintenance, crack repair, repairing and strengthening, removal and reconstruction, backfill of loess area	Lime paste, filling mortar, lime rice syrup, city wall bricks, loess
2			Retaining wall	Lay grey sandstone with 300 mm fracture surface along the inner side of the earth wall in sections where mud retaining wall needs to be built	Sandstone
3			Plantation protection and restoration	Reserve native vegetation and remove epigenetic vegetation at the foot of the city wall, dig out tree root systems, and plant in the gaps; then do greening of the city wall according to the actual situation	Afforestation
4		Environment improvement and utilization of Jingzhou	Road and Greening Environment Work	Repair roads, afforestation, repair of walls	Afforestation, sandstones

No.	Component and subcomponent			Construction methods	Materials needed
5		Kaiyuan Temple	Scenic Spot Construction Work	Construction restoration, afforestation	Sandstone, wood, tiles, etc.
6			Preservation and Exhibition of other Removable Cultural Objects	Cultural heritage protection	Sandstone, etc.
7		Upgrade of Exhibition of Jingzhou Museum Treasure Hall Cultural Objects	Comprehensive Reconstruction of Treasure Hall Buildings	Remove some buildings and construct new buildings; earthquake fortification and transformation of buildings; remoulding of heat preservation and energy-saving of buildings; waterproofing of roofs & dampproofing of ground and transformation buildings' appearance.	Sandstones, roof tiles, heat insulating materials and waterproofing materials, etc.
8			Treasure Hall Exhibition Work	Interior decoration, showcase replicas and handcrafts; props making. Professional showcase and lighting; copy display, etc.	Finishing materials, lamps and props materials, etc.
9			Installation Work of Treasure Hall	Monitor system modification, fire alarm system modification as well as automatic gas extinguishing system, central air-conditioning system and elevator.	Monitor system, fire alarm system, automatic gas extinguishing system, central air-conditioning system and elevator.
10			Environmental landscape and ancillary works	Demolishing entrance hall, space renovation and build a barrier-free slope around the pavilion.	Building materials and sandstones, etc.
11		Restoration and Reutilization of Historic Buildings	Restoration and Reutilization of Historic Buildings	Repair, reconstruction and ground improvement.	Sandstones, roof tiles and wood
12		Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park	Landscape and Infrastructure Work	Landscape work, farmland clear-up work, parking lot construction, road asphalt pavement work, outdoor greening spray system construction work and visitors service facility construction Work	Asphalt, sandstones, outdoor greening spray system, rest chair, trash bins and clear-up and transport system, etc.
13			Relics Noumenon Exhibition Work	Basic decoration, exhibition display, electrical engineering, one art restoration; modification of ventilation and dehumidification system, modification of temporary exhibition booth of Junshi Grave, pit logo exhibition of main Junshi Grave, exhibition of other Junshi Grave, simulation display of sacrificial pits and pits logo of Junshi Grave, etc.	Finishing materials, exhibition display materials and pit logo, etc.
14			Work of Unearthed Cultrual Relics Exhibition Hall	Construction work of exhibition hall of unearthed cultural relics, surrounding landscape work and exchange center equipment procurement.	Building material, finishing material and some equipment.
15			Work of park area	Including logo system work, guide-to-visitors system work and on-line museum	Display system, portable multimedia

No.	Component and subcomponent			Construction methods	Materials needed
			Identification and guide- to-visitors system	construction	.interpretation system, multi-media interactive platform, information platform of on-line museum.
16			Park area management system work	Including public management system construction and security and protection management system construction.	Pipeline, video surveillance systems, information network system, public address system, mainframe, vanguard, system of fire auto-alarm and fire fighting blocking, electronic patrol system.
17		Support tourism development	Visitors' center	Main building, square paving, landscape greening, road construction, parking pot construction, machine translation ,parking signs, parking lots management system, light construction.	Building materials, granite, green plant, parking lots management system, light signals.
18			Construction and improvement of greenbelt such as parks and gardens	Construction and improvement of greenbelt	Green plants.
19			Historic town tourism logo and guide to visitors Information Service System	Logo, navigation information service system construction	Logo, navigation information service system.
20	Component b: improvement of ecological environment and water environment of historic town	Dredging subproject of the moat and lht	The moat and fish ponds on both sides, West Lake, northeast ponds, including dredging and delivery of sediment	Water dredging, sediment transport, mud transportation pipeline, sediment transport relay pumping station, consolidation of sediments dehydration station, temporary yard for sediment, pioneer road construction	Dredging equipment, sediment transport equipment, mud-conveying pipes, sediment transport relay pumping station, consolidation of sediments dehydration station.
21		Sewage pipe network subproject	Sewage pipe network subproject	Trench excavation, pipeline welding, assembly, lower tube into the groove, pressure test, soil backfill, ash cleaning, putting into operation。	Hdpe double-wall corrugated pipe, rcp of national gradeII.
22		Subproject of the moat and lake wetland	Subproject of the moat and lake wetland	Aquatic organisms planting and cultivation, ecologic revetment construction	Aquatic organisms, greening vegetation ,little concrete.
23		Improvement of water resource connection and ecological building of	Improvement of water resource connection and ecological building of river	Dynamical system、water connection, water supplement project	Rubber dam, axial-flow pump, solution-type aeration machine, underwater flow booster, ecological landscape

No.	Component and subcomponent			Construction methods	Materials needed
		river and lake	and lake		plants, water pump station, water replenishing pipe.
24	Upgrading traffic convenience of historic town	Road traffic system	Subproject of inner ring road improvement	Construction of pavement, sidewalk and ancillary works, old road reconstruction	Asphalt concrete, tack asphalt coat, prime coat oil, crushed stones, cement mortar, curb stone.
25			Improvement of inner ring road node:	Optimize traffic markings and logos	Traffic markings and logos
26			Improvement of Key Nodes inside Town.	Optimize traffic markings and logos, compact green belt, widen and compact entrance.	Traffic markings and logos construction material.
27			Improvement of Jingzhou Avenue/Jingzhou South Road node	Optimize traffic markings and logos and widen lanes.	Traffic markings and logos construction material.
28			Improvement of Jingzhou Avenue East Gate Visitors' Center Node	It is necessary to conduct a supplementary node channelization reconstruction and adopt signal control	Traffic signals.
29		Non-motor traffic system	Bike System Improvement	Motorized and non-motor separation guard bar and marking, colored asphalt bike lane, indication sign for bike lane are to be newly established.	Motorized and non-motor separation guard bar; colored asphalt.
30			Pedestrian System Improvement	Newly isolation column for prohibiting motorized drive-in, and restoration of blue flagstone and curb stone of riding track are needed.	Isolation column, blue flagstone and curb stone.
31			Improvement of pedestrian crossing facilities:	Current zebra marking will be reconstructed into vertical zebra crossing, added with yellow flashing light.	Oil paint, yellow flashing light.
32		Slow Traffic System	Connection bus system	Stop board and vertical poles will be built.	Stop board, vertical pole.
33			Improvement of public transit system inside historic town	The bus station and bus shelter will be reconstructed. Electronic bus stop information board, electric stop board, management platform of electric stop board and new energy bus will be used.	Electronic bus stop system, electric stop board, management platform of electric stop board, new energy bus.
34			Historic town – Xiongjiazhong Tomb Tourism Public Transit System:	Hybrid power new energy buses and bus stops in initial and terminal stations	Hybrid power new energy buses and bus stops in initial and terminal stations.
35		Traffic logo	Static traffic	Set up road signage	Road signage.

No.	Component and subcomponent			Construction methods	Materials needed
		system	logo system		
36			Dynamic traffic logo system	Set up road signage	Road signage.
37		Consultancy service of design review, project management and monitoring evaluation	Consultancy service of design review, project management and monitoring evaluation	Including project management consultancy, bidding agency, resettlement plan, environment, social external monitoring, resettlement external monitoring consultancy service, and environment management plan external monitoring consultancy service	Consultancy service.
38		Procurement of offic facilities for pmo and implementing agencies	Procurement of offic facilities for pmo and implementing agencies	Including development, commissioning and maintenance of subprojects of collaborative office management system and engineering project management	Equipment procurement.
39	Project management and strengthening institutional ability	Training and study tour	Training and study tour	Including international and domestic training; training of residents' competence of tourism service; special training of historic- cultural heritage preservation of the historic town (conducting survey and clear-up of relevant agencies in relation to preservation of Jingzhou cultural relics, carrying out training of technique for preservation of historic town's historic-cultural relics. Training of competence of managing cultural heritages.)	-
40		Subject research, management system	Subject research, management system	Including research of hydraulic power water quality model, construction of relevant management website and related plans, real-time monitoring and decision-making of hydraulic power water quality system, drainage system model in integrated river basin in historic town, united dispatching and management system model of hydraulic power water quality, researches and countermeasures on evolution of ecosystems, defense and precaution of disasters, reinforcement on ability to improve the ecological environment (including training and studies of international and domestic institutions and related departments in Jingzhou Municipal), panning design and management research of parking in streets of historic town.	-

3 ENVIRONMENTAL AND SOCIAL BASELINE

3.1 Natural environment

3.1.1 Geographical location

Located in middle south of Hubei Province and central region of Jianghan Plain, Jingzhou Municipal is a vital traffic place and material distribution center which connects Wuhan in the east, Three Gorges in the west, Yangtze River in the south and Han River in the north. It not only bonds the economy of Sichuan, Hunan and Hubei provinces as an important port in the middle reaches of the Yangtze River, but also is the base for national textile industry, grain, cotton and oil production and freshwater fishery, which is well-known as State of Culture, Land of Plenty and Tourist Resort. The City is located at 111.15 to 114.05 degrees east longitude and 29.26 to 31.37 degrees north latitude. The east-west maximum horizontal distance is about 274.8 km and the south-north maximum vertical distance is about 130.2 km.

Walls of Jingzhou Historic Town are 5 km far away from the historical site of former capital of Chu State—Jinan Town in the north and 20 km away from Ancient Graves of Baling Mountain in the northwest. They are also close to intersections of National Highway 318 and 207 in the northeast and border on Shashi region in the southeast. In the south, the City is close to the Yangtze River; in the southwest, water of Juzhang River flows into the Yangtze River; in the north, the City is about 60 m away from Tiahugang reservoir.

3.1.2 Climate and weather

Jingzhou Municipal features subtropical monsoon climate with sufficient sunshine, abundant heat and long frost-free days. The annual radiation of sunshine totals to 104-110kcal/cm^2; annual sunshine hours are 1800 to 2000 hours; annual average temperature is 15.9-16.6℃; annual accumulative temperature of ≥10℃ reaches 5000-5350℃; frost-free period lasts for 242 to 263 days per year. In the past years, rainfall is between 1100 mm and 1300 mm per year. Therefore, adequate climate resources are helpful for crop growth. From April to October, rainfall accounts for 80% of the whole year, solar radiation accounts for 75%, and accumulative temperature of ≥10℃ accounts for 80%. The climate is suitable for growth of various crops.

3.1.3 Topography

Jingzhou Municipal connects mountains in the west of Hubei Province, spans Jianghan Plain in the east and lies in transition zones full of hills in the middle part. As a whole, the City presents high-west low-east in topography. For high mountains in the west, the general elevation (base level of the Yellow Sea, the same hereinafter) is between 600 m and 800 m. The terrain slopes downward from the west to the east and transits to the flood plain with the elevation of below 50 m. Daling of Xiejiaping Village of the west Songzi City is situated in the highest elevation of 815 m. Besides, Peach Blossom Mountain of Shishou is 340 m high, Huang Mountain of Gong'an is 264 m high and Baling Mountain in the north Jingzhou is 103 m high. Apart from some hills in the west of Songzi County and north of Jingzhou, other regions are vast and flat low plains with the elevation of below 50 m and relative height of no more than 20 m. In short, general plains cover the area of 12,219 km^2, accounting for 86.9% of the local territory area, while karst mountain areas cover the area of 1,840 km^2, and accounting for 13.1%.

3.1.4 Hydrology

Jingzhou Municipal is abundant of the water resource with hundreds of the rivers and lakes. Specifically, there are about a hundred rivers which all belong to the Yangtze River system, mainly including stem stream of the Yangtze River and its tributaries-Songzi River, Hudu River, Ouchi River and Tiaoxian River, etc.; there are over 30 lakes with more than a thousand mu which covers the total area of 80,000 hectares. Hereinto, Honghu Lake is the largest lake in Hubei Province, covering the total area of 35,000 hectares, and Changhu Lake comes second, with the total area of 12,000 hectares. Owning a large water area, the City features marshland and lake-oriented wetland resources. In history, aquatic products were mainly obtained by natural fishing, so the aquaculture covers only 1000 hectares of water area in 1952. Subsequently, with increasing development and use of water area, the aquaculture has covered 72900 hectares of water area in 2010, with 48% of ponds, 37.7% of lakes and 5.4% of reservoirs. See Figure 3.1-1for water system map of the Historic Town.

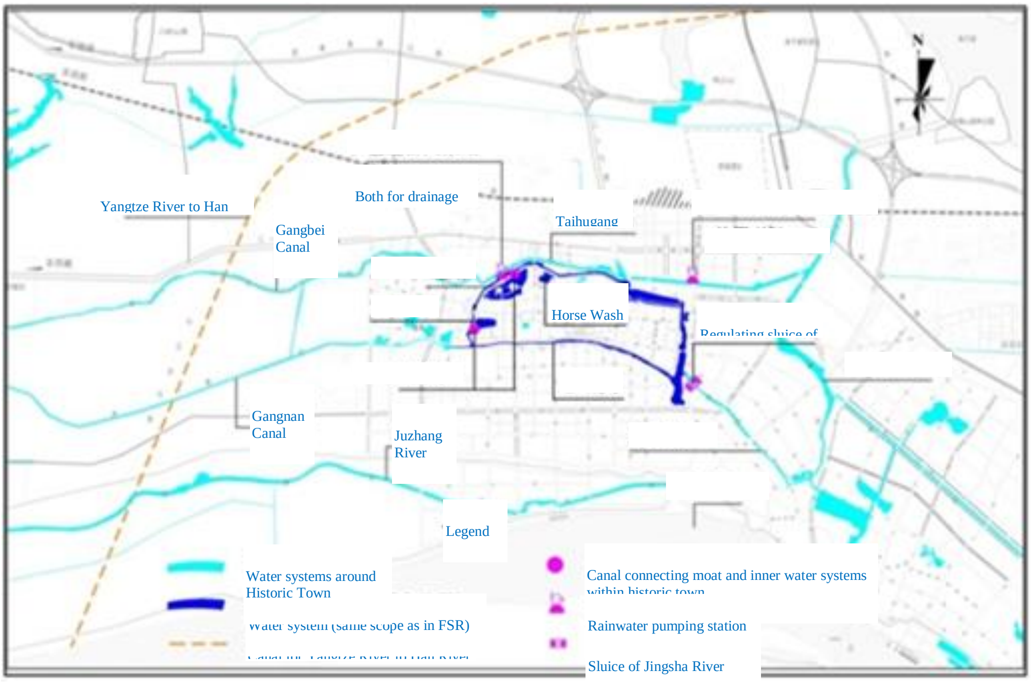


Figure 3.1-1 Water system map of the Jingzhou Historic Town

Water environment of the Historic Town consists of the water system in and around the Town. The water system around the Historic Town is composed of Taihugang Channel, Gangnan Canal and Jingzhou-Shashi River surrounding the Historic Town. In the past, these water bodies are integrated into the water system in the Historic Town, while at present they are separate but closely interrelated. Water system of the Historic Town is made up of a series of rivers and lakes inside and outside the Historic Town, including moat and water bodies inside the Historic Town. Water bodies inside the Historic Town refer to a series of independent lakes and ponds, including

West Lake, North Lake (the Three Kingdoms Park), Horse Wash Pond and ponds in the north of the Town. In history, these lakes and ponds are an organic whole and connected to the moat. The drainage area of water system inside the Historic Town totals to 17.5 km^2, including 4.5 km^2 inside and 13 km^2 outside. The water surface area inside the Historic Town is sums up to 0.88 km^2, including moat area of 0.61 km^2 and lake area inside the Town of 0.27 km^2. The water balance of the region is shown in the following Table 3-1.

Table 3-1　　Annual water balance of 2013 (Unit: $\times 10^4 m^3$)

Item of water flow into rivers								Total
Name	Rainfall into rivers	Surface runoff	Water replenishment of Gangnan Canal	Pipeline overflow	Water replenishment of Liumen pump station	Tail water discharge of sewage plant	Direct discharge of domestic sewage	
Total	94.35	1259.78	1672.20	148.06	239	1542.58	824.66	5780.63
Item of water flow out of the river								Total
Name	Evaporation	Water drainage of Jingzhou pump station	Water drainage of Jingzhou-Shashi River Gate	Water drainage of Liumen pump station				
Total	50.39	387.5	5307.91	28.08				5773.88
Annual storage capacity variation of water system of the Historic Town ΔV=6.75								
Note: as for the actually-measured water level of moat, we only collect water levels of flood season from May to mid-October. This Table assumes that the water levels of moat are consistent at the beginning and the end of the year 2013.								

From the Table 3-1 above, it can be seen that the water replenishment of Gangnan Canal, direct tail water discharge of sewage plant in south, surface runoff and direct discharge of domestic sewage are main water flow into rivers, accounting for 29%, 27%, 22% and 14% of the total water flow respectively. Water replenishment of Liumen pump station, direct rainfall into rivers and pipeline overflow separately accounts for 4%, 2% and 2%; water flow out of the river mainly comes from draining water of Jingzhou-Shashi River Gate which accounts for 91.9% of the total flow. Besides, draining water of Jingzhou pump station accounts for 6.7% and evaporation and draining water of Liumen pump station accounts for 1.4%.

Load of major pollution sources in the researched area of 2013, including COD_{Cr}, BOD_5, NH_4-N, TN and TP was estimated. Table 3-2 shows generation of pollution loads in the researched area, Table 3-3 presents statistics on current situation of pollution loads, and Table 3-4 lists total quantity of rain sewage discharged into rivers/lakes in the researched area.

Table 3-2　　Load information list of various districts in the research area

District name	Final flow direction of load	Remarks
Gangnan	Gangnna channel	Including direct discharge of domestic sewage, pollutants into rivers because of rainfall runoff and tail water from City south sewage plant
City west	West section of moat	Including direct discharge of domestic sewage and pollutants into rivers because of rainfall runoff
City south	South section of moat	Including direct discharge of domestic sewage, pollution sources into rivers because of rainfall runoff and domestic sewage from City south sewage plant
City east	East section of moat	Including pollution sources into rivers because of rainfall runoff and domestic sewage into Caoshi WWTP
Old city south	Enter City south sewage plant of moat through	Including overflowing water, domestic sewage into City south sewage plant and runoff pollution

District name	Final flow direction of load	Remarks
	overflow port	
Old city north	Enter Caoshi WWTP of moat through overflow port	Including overflowing water, domestic sewage into Caoshi WWTP and runoff pollution

Table 3-3 Statistics for present pollution load of 2013 in the research area (t/year)

Pollution source		Exterior source							Sediment release	Total
		Livestock pollution	Fertilizer pollution	Domestic pollution (non-overflow part)		Domestic pollution (overflow part)	Tail water from sewage plant	Dust fall		
				Sewage	Garbage					
Load quantity into rivers	COD_{Cr}	26	/	1,197	599	201	339	389	/	2,751
	BOD_5	11	/	465	60	71	116	77.8	/	801
	NH_4-N	0.53	/	99.8	1.9	14.8	18.4	19.5	/	155
	TN	2.1	47.3	211	12	31.6	52.7	19.5	37.1	413
	TP	0.85	10.8	14	2.4	2.2	2.1	3.9	1.7	38

Table 3-4 Total rain sewage discharged into rivers/lakes of 2013 in the research area (10^4m^3/year)

District	West section of moat	South section of moat	East section of moat	North section of moat	Gangnan Canal	North Lake	West Lake
Total rain sewage	80.9	1,074	90	54.7	744	13.7	4.8

3.2 Social environment

3.2.1 Economy

It is estimated that GDP of the whole city of 2013 is 133.49 billion CNY and increases 10.4% more than 2012 at comparable price, which has reached the best increase since the City was founded. To be specific, the primary industry completes 15.42 billion CNY, increasing 7.8%; the secondary industry completes 17.42 billion CNY, increasing 19.4%; the tertiary industry completes 19.13 billion CNY, increasing 10.1%. The per capita GDP increases from 6844 CNY in 2012 to 8093 CNY in 2013, surpassing 1100 dollars. The industrial structure rate has been adjusted from 28.9:32.4:38.7 in 2011 to 29.7:33.5:36.8 in 2013, and the shares of these three industries in increase of GDP are respectively 17.9%, 50.7% and 31.4%. Residents' consumption increases 4.7% more than that in 2012, which boosts 2.7 percentage points. Specifically, consumption of food, tobacco and articles, clothes, housing, household equipment and maintenance services and goods and services for entertainment, education and culture respectively increases 11.1%, 0.3%, 0.4%, 2.2%, 2.2% and 5.7%; consumption for medical care and traffic and communication separately declines 0.7% and 2.8%. The core CPI increases 1.4% more than that of the last year, and price of services rises by 2.3%. The out-of-factory price of industrial products increases 3.7% more than that of the last year and purchase price of raw materials, fuel and power rises by 2.3%. At the end of 2011, 2.997 million persons were employed in the whole city with an increase of 52 thousand persons more than the last year, including 373 thousand employees in cities and towns and 2.167 million rural labors. According to statistics of industrial and commercial authorities, there are 328.3 thousand privately-owned persons in cities and towns, increasing 4% more than that of the last year. From statistics of Labor Department, 94.5 thousand employees increase in cities and towns, 46 thousand rural labors are trained, 155 thousand rural labors are transferred and the unemployment rate registered in cities and towns is controlled within 4.3%.

3.2.2 Population and their living conditions

3.2.2.1 Population

The population of Jingzhou is administered respectively by East City sub-district office and West City sub-district office. The registered residents of Jingzhou are 106,240, among which 45,862 residents are registered in the West City sub-district, and 60,378 registered in East City sub-district. However, registered population outflow from West City sub-district is 20,102, and that of East City sub-district is 12,451. This is to say, among the permanent residents of the historic town, 86,138 are registered residents, 38,211 come from West City sub-district and 47,927 registered residents from East City sub-district. In terms of population inflow, the historic town has population inflow of 26,475 people, of which 11,842 live in West City sub-district, and 14,633 in East City sub-district.

In summary, the permanent residents of historic town are 112,613, including 86,138 registered residents, among which 50,053 residents are from West City sub-district and 62,560 are from East City sub-district.

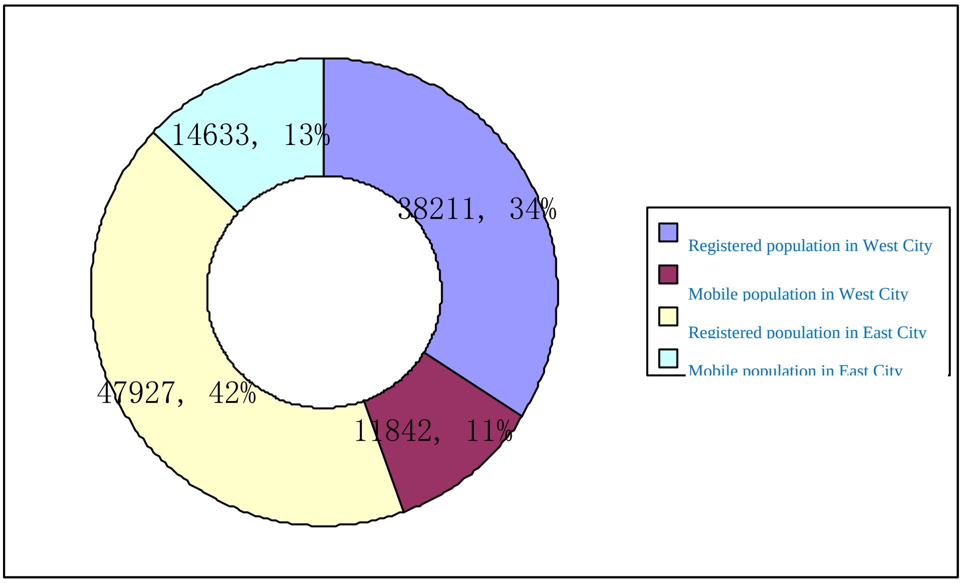


Figure 3.2-1 Classifications of permanent residents in Jingzhou Historic Town

3.2.2.2 Living conditions of residents

I Housing Condition

According to the sixth national population census of housing condition of permanent residents, household size is 2.69 and housing area per capita is 33.7 m^2 in historic town.

Table 3-5 Housing condition of residents in historic town

Sub-district Office	Family Size	Average Number of Room (Room/Household)	Per Capita Area	The Per Capita Housing
West City sub-district	2.70	2.84	33.00	1.05
East City Sub-district	2.69	2.65	34.27	0.99
Total	2.69	2.74	33.70	1.02

Data Sources: sixth national population census in Jingzhou Municipal

II Occupation and salary levels of the employed

The survey data indicates that the majority of residents in and around the historic town are engaged in trades and services, accounting for about 40% residents inside the historic town and one third of residents around the historic town. However, the ratio of teachers and government workers is higher within the historic town, while the ratio of manufacturing workers is higher outside the historic town.

Table 3-6 Employment of Residents in the Project Area (%)

Occupation	Inside the Historic Town	Outside the Historic Town	Percentage (%)
Grain and vegetable farmingd Other Types of Aquaculture	0.00	2.11	0.81
Industrial Worker	7.89	21.05	12.96
Trades, Transportation and Other Services	39.47	34.74	37.65
Teachers and Government Workers	19.74	10.53	16.19
Managers of Enterprises and Institutions	11.84	2.11	8.10
Others	21.05	29.47	24.29
Total	100.00	100.00	100.00

Data Source: Household survey data by SA consultant from Wuhan University, May, 2014.

From the survey, the average wage of the majority of residents is about 2,000 CNY per month. The average wage of residents inside and outside the town is about 1,764.75 CNY and 1,510.3 CNY per month respectively. In general, the employment wages is about 1,668 CNY per month.

Table 3-7 Salary level of the employed (%)

Wage level	Inside the town	Outside the town	Percentage (%)
Below and about 1,000 CNY	18.71	26.32	21.6
1,000-2,000 CNY	47.1	54.74	50
2,000-3,000 CNY	24.52	13.68	20.4
3,000-4,000 CNY	8.39	3.16	6.4
4,000-5,000 CNY	1.29	1.05	1.2
Above 5,000 CNY	0	1.05	0.4

Source: Household survey data from SA consultant of Wuhan University, May 2014.

Notes: This table is based on the feedback survey and so the data source is different from that of Jingzhou

Municipal Bureau of Statistics. Therefore, it may have disparities in income levels. Nevertheless, it still can embody the overall level and structure features.

III Household Income and Expenditure

According to the sampling survey of household income and expenditure of urban residents in Jingzhou in 2012 by Jingzhou Municipal Bureau of Statistics, per capital disposable income of urban households in Jingzhou (mainly comprised of residents inside the historic town) is about 18,210.68 CNY and per capital annual expenditure on consumption is about 13,096.1 CNY. Accordingly, the per capital disposable income of urban households in Shashi district outside the historic town is about 18,888.86 CNY and per capital annual expenditure on consumption is about 13,607.37 CNY. Therefore, it shows that the income and expenditure level of urban residents inside and outside the historic town is roughly flat.

Table 3-8 Income and Expenditure of Residents inside and outside the Historic Town (2012)

Project	Jingzhou District (inside the Historic Town)	Shashi district (outside the Historic Town)
I. Disposable Income	**18791.66**	**18888.86**
1. Salaries Income	8671.1	7932.91
Including: Salaries and Subsidy Income	7953.71	7717.90
2. Net Income	3505.55	2528.56
3. Property Income	1635.98	382.45
4. Transfer Income	7467.35	9893.32
Including: Old-age Pension	4763.93	7612.57
II. Consumption expenditure	**13096.1**	**13607.37**
1. Food	4224.98	6400.84
2. Clothes	1582.36	1121.60
3. Housing	1857.6	1324.29
4. Household Equipment and Services	501.48	733.11
5. Medical Care	1300.44	1094.85
6. Traffic and communications	846.91	832.67
7.Services for Education, Culture and Entertainment	987.34	1664.95
8.Miscellaneous Merchandise Service	671.96	435.06

Source: Jingzhou Urban Survey Consultant National Bureau of Statistics.

3.2.3 Cultural relics and historic sites

The name of Jingzhou derives from a sentence of Shangshu Yugong: the place connecting Hengyang and Chu State is Jingzhou, so Jingzhou was once one of nine states in ancient times; it is also named for the meandering and towering Jing Mountain in the border. Since Chu State was once built in Jing Mountain, Jing has the same meaning as Chu in ancient times and is also another name of ancient Chu State. As one of 24 historic towns in the first batch published in China, Jingzhou has the well-conserved and largest-scale ancient walls in South China. Dated back to earth walls during the Warring States period over two thousand years ago, these old walls were mainly conserved in Ming and Qing Dynasties. Originally, the walls had 6 gates, which are East Gate (Yinbin Gate), Little East Gate (Gong'an Gate), Front North Gate (Gongji Gate), Little North Gate (Yuan'an Gate), West Gate (Anlan Gate) and South Gate (Nanzheng Gate). Before building cities and walls, ancient people paid much attention to geomancy, such as Azure Dragon on the left and White Tiger on the right. For example, ushering guests from the east means flourish and prosperity, so the East Gate is dominant as the major access to usher guests. In 1982, Jingzhou was awarded one of national historic and cultural cities in the first batch and it was regarded to be in traditional urban style. Its abundant historic and cultural resources lie not only in complete and unique ancient walls in South China, well-known stories about the Three Kingdoms and Guan Yu relics, but also in cultural-center position of Hubei Province embodying splendid Chinese civilization. In 1996, Jingzhou ancient walls were declared as a national relic protection unit, and at present, they have been listed in tentative list for global cultural relics China applies to UNESCO for.

With rich cultural history, Jingzhou Historic Town owns a great many historic sites in and surrounding the City, such as Xirang in Dayu flood control, the former capital of ancient Chu State, relics of the Three Kingdoms period, traces of celebrities in all ages and other numerous sites. However, Jingzhou ancient walls are one of the most representative and significant historic sites. As is recorded in Book of Later Han Geographical Chronicle, construction of Jingzhou ancient walls can be dated back to King Li's dominant period of Zhou Dynasty over 2800 years ago. Moreover, it is scientifically verified through the newly-dug archaeological objects of ancient walls that, Jingzhou ancient walls are the only old walls in China which last for the longest ages, undergo the most dynasties and are evolved from earth walls. In March 1998, archaeological workers successively dug brick walls in the Song Dynasty and the Five Dynasties and earth walls in the Jin Dynasties and the Three Kingdoms period. After discovery of brick walls in the Five Dynasties 10 m below the existing walls, construction of Jingzhou brick walls can be dated back to over 400 years before the previously-agreed Ming Dynasty. Furthermore, this exploration also confirms that, Jingzhou ancient walls have no big changes since the Three Kingdoms period, with the displacement distance of only 50 m or so; and earth walls were built far earlier than brick walls. In August 2000 in the west side of Little North Gate of Jingzhou, archaeological workers discovered a 20-meter-long wall built with lime and sticky rice pulp in Chenghua period of the Ming Dynasty, which is unprecedentedly firm in spite of over 500 years.

3.3 Protection planning and protection of cultural relics

3.3.1 Categories and historic value of regional cultural heritage

Cultural sites of Jingzhou Municipal total to 595 sites, including 15 national key cultural sites, 52 Hubei provincial cultural sites and 527 key cultural sites at city/county level. As for categories of cultural relics, ancient relics and ancient tombs sum up to 426 sites, accounting for 72% of the total relics; significant historic sites and representative buildings in modern times total to 131 sites, accounting for 22%.

The proposed project area includes Jingzhou District, Shashi District and Xiongjiazhong Tomb, the major cultural sites is shown in the Table 3-9~Table 3-12. There are the national level cultural relics total to 11 items, including Hubei Jinan Old Town, Ancient Graves of Baling Mountain, Jigong Mountain site, Jingzhou Ancient Walls, Yinxiang City site, three temples of Jinghzou (Kaiyuan Taoist Temple, Xuanmiao Temple and Taihui Temple), Jingzhou Long Life Pagoda, Horse Mountain Tombs and Yingcheng site. Moreover, provincial cultural sites sum up to 22 and urban cultural sites in Jingzhou and Shashi Districts amount to 107.

Jingzhou Ancient Walls have been in the short-list of the World Cultural Relics. Built in the Spring and Autumn period, Jingzhou Ancient Walls were once the official wharf of Chu State and then became the location of Jiangling government when original walls emerged. Since most of the existing ancient walls were built at the end of Ming Dynasty and the beginning of Qing Dynasty, they are the most wholly-conserved ancient walls in China which have higher historical value.

Table 3-9 List for national cultural sites in Jingzhou Municipal

National key cultural sites			
Batch	Counties	Unit name	Age
Batch 1	Jingzhou District	1-Hubei Jinan Old City-3	The Eastern Zhou Dynasty
Batch 3	Jingzhou District	2- Ancient Graves of Baling Mountain	From the Eastern Zhou Dynasty to Han Dynasty
Batch 4	Jingzhou District	3- Mount Jigong site	The Paleolithic Age
	Jingzhou District	4- Jingzhou Walls	Ming Dynasty, Qing Dynasty
Batch 5	Jingzhou District	5-Yinxiang City site	The Neolithic Age
Batch 6	Jingzhou District	6- Three temples of Jingzhou (Kaiyuan Taoist Temple, Xuanmiao Temple and Taihui Temple)	Ming Dynasty, Ming-Qing Dynasty
	Shashi District	7-Long Life Pagoda of Jingzhou	Ming Dynasty
	Jingzhou District	Yutai Mountain Tombs (incorporated into the Jinan Town)	The Spring and Autumn Period
	Shashi District	Star Temple Tombs(incorporated into the Jinan Town)	Zhou Dynasty, Han Dynasty
Batch 7	Jingzhou District	8- Horse Mountain Tombs	The Eastern Zhou Dynasty
	Jingzhou District	9- Ying City site	Qin Dynasty, Han Dynasty

Table 3-10 List for provincial cultural sites in Jingzhou Municipal

Provincial key cultural sites					
Unit name	**Date of batch**	**District**	**Address**	**Age**	**Remark**
Wancheng site	1956.11.15	Jingzhou District	Libu Town Yihe Village	The Six Dynasties	Originally published at Wancheng, Three Kingdoms, Wancheng Town of Jiangling County
Xiangxian King's Tomb	1956.11.15	Jingzhou District	Yingcheng Town Taihui Village Jiangtai	Ming Dynasty	Originally published at Jiangling Xiangxian King's Tomb, near Tiahui Temple in the west of Jiangling
Chengtian Temple Tombstone	1956.11.15	Jingzhou District	Inside Jinghzou Museum	Yuan Dynasty	Originally published at the front door of prefectural commissioner inside Jiangling County
Jingzhou South Gate Cathedral	Batch 5	Jingzhou District		Qing Dynasty	

Provincial key cultural sites					
Unit name	**Date of batch**	**District**	**Address**	**Age**	**Remark**
Libu Tractor	Batch 5	Jingzhou District		Qing Dynasty	
Jingzhou Confucius Temple	Batch 5	Jingzhou District		Qing Dynasty	
Meihuai Bridge	Batch 5	Jingzhou District		Qing Dynasty	
Iron Maiden Temple	Batch 5	Jingzhou District		Qing Dynasty	
Sunjiashan Tombs	Batch 5	Jingzhou District		The Eastern Zhou Dynasty	
Caiqiao site	Batch 6	Jingzhou District		Zhou Dynasty	
Historic blocks	——	Jingzhou District		Qing Dynasty	
Jingzhou urban residences	Batch 5	Jingzhou District, Shashi District		Qing Dynasty	
Chuanzhu Palace Theater Stage	Batch 5	Shashi District		Qing Dynasty	
Spring and Autumn Pavilions	Batch 5	Shashi District		Qing Dynasty	
Zhang Juzheng's Tomb	Batch 5	Shashi District		Ming Dynasty	
Phoenix Hill site	Batch 6	Shashi District		The Paleolithic Age	
Flood Diversion Monument of Jingzhou rivers	Batch 5	Shashi District		1952	Incorporated into Batch 4 Provincial flood-diversion sluice for protection of Jingzhou Rivers
Zhanghua Temple	1956.11.15	Shashi District	Taishiyuan Road of Victory Street Office	Yuan Dynasty, Qing Dynasty	Dynasty: Qing Dynasty. Originally published in the suburb of Shashi
Zhouliangyu Bridge site	1992.12.16	Shashi District	Yuqiao Development Zone	Shang Dynasty	Originally published at Chihu Road, Shashi City
Jingzhou Liang Dynasty Tomb	1956.11.15	Shashi District	Guanyindang Town Baidu Village	The Southern Dynasty (Liangtianjian ten years)	Originally published at Xinling Village of Jiangling
Hualang Temple site	Batch 6	Shashi District		The Neolithic Age—the Eastern Zhou Dynasty	
Xiongjiazhong Tomb	Batch 2	Chuandian Town		Chu Dynasty	

Table 3-11 List for urban cultural sites in Jingzhou District

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
Zhangjiashan an ancient site 1	1960.4.23	Jingzhou District	Jingzhou Rock Wool Factory	The Neolithic Age, Shang Dynasty, Zhou Dynasty	Ancient site	423100012	Doc. No.:(60) JWHZ No. 0013. Dynasty: later period of the Neolithic Age, Shang Dynasty, Zhou Dynasty, Han Dynasty. The originally-published address is

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
							Jingzhou South Temple area of Kongming sluice, Zhangjiashan
Ancient site Xirang 2	1960.4.23	Jingzhou District	Corner of the west walls outside New South Gate of Jingzhou walls	Xia Dynasty	Ancient site	4231000 13	Doc. No.:(60) JWHZ No. 0013. The originally-published address is the foot of ancient walls outside Jingzhou South Gate
Ancient kiln site 3	1960.4.23	Jingzhou District	Jing North Village, Ying Town	The Warring States period, Qin Dynasty, Han Dynasty	Ancient site	4231000 15	Doc. No.:(60) JWHZ No. 0013. The originally-published address is Hongjia Parapet in the north of Jingzhou. Destroyed.
Ancient kiln site 4	1960.4.23	Jingzhou District	Jing North Village, Ying Town	Han Dynasty	Ancient site	4231000 17	Doc. No.:(60) JWHZ No. 0013. The originally-published address is Hongjia Parapet in the west of Jingzhou. Destroyed.
Ancient site of the riverbank (Shaojiazui Ancient City) 5	1960.4.23	Jingzhou District	Shaojiazui, Miaohu Fishery of Jinan Town	Han Dynasty, Wei Dynasty	Ancient site	4231000 18	Doc. No.:(60) JWHZ No. 0013. The present name is Shaojiazui Ancient City. The originally-published address is Jiangtai Commune near Shaojiazui.
Caiyuanmen site 6	1987.4.18	Jingzhou District	Yangchang Village of Balingshan Township	The Neolithic Age	Ancient site	4231004 88	Doc. No.: JZW [1987] No.31. The originally-published address is Mapaoquan Village, Yangchang Township
Caitai site 7	1987.4.18	Jingzhou District	Wanghu branch of Tiahu Township	The Neolithic Age	Ancient site	4231004 89	Doc. No.: JZW [1987] No.31.
Warehouse platform site 8	1987.4.18	Jingzhou District	Yangchang Village of Balingshan Township	The Neolithic Age	Ancient site	4231004 90	Doc. No.: JZW [1987] No.31. The originally-published address is Mapaoquan Village, Yangchang Township
Dongyue Temple site 9	1987.4.18	Jingzhou District	Qingzhong Village of Balingshan Township	The Neolithic Age	Ancient site	4231004 91	Doc. No.: JZW [1987] No.31. The originally-published address is Qingzhong Village, Yangchang Township
Jigong Mound site 10	1987.4.18	Jingzhou District	Tongling Village of Balingshan Township	The Neolithic Age	Ancient site	4231004 94	Doc. No.: JZW [1987] No.31. The originally-published address is Tongling, Yangchang Township
Jing South Temple site 11	1987.4.18	Jingzhou District	Jingzhou Rock Wool Factory	The Neolithic Age	Ancient site	4231004 95	Doc. No.: JZW [1987] No.31.
Lijiatai site 12	1987.4.18	Jingzhou District	Leihu Village of Jinan Township	The Neolithic Age	Ancient site	4231004 96	Doc. No.: JZW [1987] No.31.
Lijiatai site 13	1987.4.18	Jingzhou District	Songbo Village of Jinan Township	The Neolithic Age	Ancient site	4231004 97	Doc. No.: JZW [1987] No.31.
Mingjia Camp site	1987.4.18	Jingzhou District	Chuandian Village of	The Neolithic Age	Ancient site	4231004 98	Doc. No.: JZW [1987] No.31.

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
14			Chuandian Township				
Sunjiabang site 15	1987.4.18	Jingzhou District	Gaoqiao Village of Mashan Township	The Neolithic Age	Ancient site	423100499	Doc. No.: JZW [1987] No.31.
Wawu Bay site 16	1987.4.18	Jingzhou District	Xinwan Village of Balingshan Township	The Neolithic Age	Ancient site	423100500	Doc. No.: JZW [1987] No.31. The originally-published address is Xinwan Village, Wangchang Township
Wazi Mountain site 17	1987.4.18	Jingzhou District	Yangqiao Village of Mashan Township	The Neolithic Age	Ancient site	423100501	Doc. No.: JZW [1987] No.31.
Wangjiachang site 18	1987.4.18	Jingzhou District	Wangchang of Balingshan Township	The Neolithic Age	Ancient site	423100502	Doc. No.: JZW [1987] No.31. The originally-published address is Wangchang Village, Wangchang Township
Zhujiatai site 19	1987.4.18	Jingzhou District	Zhuji Village of Jinan Township	The Neolithic Age	Ancient site	423100504	Doc. No.: JZW [1987] No.31.
Fujiapo site 20	1987.4.18	Jingzhou District	Caiqiao Village of Mashan Township	The Neolithic Age—Shang Dynasty	Ancient site	423100505	Doc. No.: JZW [1987] No.31.
Gongjiatai site 21	1987.4.18	Jingzhou District	Meihuai branch of Taihu Farm Township	The Western Zhou Dynasty	Ancient site	423100507	Doc. No.: JZW [1987] No.31.
Duijintai site 22	1987.4.18	Jingzhou District	Duijin Village of Mashan Township	The Eastern Zhou Dynasty	Ancient site	423100508	Doc. No.: JZW [1987] No.31.
Gepi Temple site 23	1987.4.18	Jingzhou District	Jinan Village of Jinan Township	The Eastern Zhou Dynasty	Ancient site	423100509	Doc. No.: JZW [1987] No.31. The originally-published address is Jinan Village, Garden Township
Guojia grassland site 24	1987.4.18	Jingzhou District	Songbo Village of Jinan Township	The Eastern Zhou Dynasty	Ancient site	423100510	Doc. No.: JZW [1987] No.31.
Hongshan Temple site 25	1987.4.18	Jingzhou District	Dual gate branch of Linghu Management area	The Eastern Zhou Dynasty	Ancient site	423100511	Doc. No.: JZW [1987] No.31.
Back Weijiashan site 26	1987.4.18	Jingzhou District	Guarantee branch of Linghu Management area	The Eastern Zhou Dynasty	Ancient site	423100512	Doc. No.: JZW [1987] No.31.
Yellow Mud Ditch site 27	1987.4.18	Jingzhou District	Yellow Mountain Village of Yingcheng Township	The Eastern Zhou Dynasty	Ancient site	423100513	Doc. No.: JZW [1987] No.31. The originally-published address is Huangshan Village, Caoshi Town

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
Jimingzui site 28	1987.4.18	Jingzhou District	Agricultural Sciences Institute of Linghu Management area	The Eastern Zhou Dynasty	Ancient site	423100514	Doc. No.: JZW [1987] No.31.
Kongming Gate site 29	1987.4.18	Jingzhou District	Xinsheng Village of Yingcheng Township	The Eastern Zhou Dynasty	Ancient site	423100515	Doc. No.: JZW [1987] No.31. The originally-published address is Xinsheng Village, Garden Township
Liujia Mound site 30	1987.4.18	Jingzhou District	Comprehensive factory of Linghu Management area	The Eastern Zhou Dynasty	Ancient site	423100516	Doc. No.: JZW [1987] No.31.
Tuojiang Temple site 31	1987.4.18	Jingzhou District	Guarantee branch of Linghu Management area	The Eastern Zhou Dynasty	Ancient site	423100518	Doc. No.: JZW [1987] No.31.
Weijia grassland site 32	1987.4.18	Jingzhou District	Ying North Village of Yingcheng Township	The Eastern Zhou Dynasty	Ancient site	423100519	Doc. No.: JZW [1987] No.31. The originally-published address is Ying North Village, Caoshi Town
Xilin Temple site 33	1987.4.18	Jingzhou District	Xinmiao branch of Taihu Farm	The Eastern Zhou Dynasty	Ancient site	423100521	Doc. No.: JZW [1987] No.31.
Xiongjiatai site 34	1987.4.18	Jingzhou District	Guarantee branch of Linghu Management area	The Eastern Zhou Dynasty	Ancient site	423100524	Doc. No.: JZW [1987] No.31.
Yangjiahuang site 35	1987.4.18	Jingzhou District	Tongqiao Village of Baling Township	The Eastern Zhou Dynasty	Ancient site	423100525	Doc. No.: JZW [1987] No.31. The originally-published address is Tongqiao Village, Yangchang Township
Zhoujiatai site 36	1987.4.18	Jingzhou District	Tianhe Village of Baling Township	The Eastern Zhou Dynasty	Ancient site	423100527	Doc. No.: JZW [1987] No.31. The originally-published address is Tianhe Village, Yangchang Township
Zhujianianpan site 37	1987.4.18	Jingzhou District	Caiqiao Village of Mashan Township	The Eastern Zhou Dynasty	Ancient site	423100528	Doc. No.: JZW [1987] No.31.
Phoenix place site 38	1987.4.18	Jingzhou District	Gaolu Village of Yingcheng Township	Han Dynasty	Ancient site	423100530	Doc. No.: JZW [1987] No.31. The originally-published address is Gaolu Village, Caoshi Town
Jiangzhangtai site 39	2000.12.12	Jingzhou District	Inside Jingzhou Middle School	The Eastern Han Dynasty	Ancient site	423101172	Doc. No.: JZH [2000] No.23.
Jiuli Mound (Fanji's Tomb) 40	1960.4.23	Jingzhou District	Ying North Village of Yingcheng Township	The Warring States period	Ancient tombs	423200006	Doc. No.:(60) JWHZ No. 0013. The present name is Fanji's Tomb. The originally-published address is about 2 miles in the southeast

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
							of Anjiacha.
Fairy Mound 41	1960.4.23	Jingzhou District	Yuechang Village of Jinan Township	The Warring States period	Ancient tombs	423200007	Doc. No.:(60) JWHZ No. 0013.
Qingzhongzi 42	1960.4.23	Jingzhou District	Yihe Village of Libu Township	Tang Dynasty	Ancient tombs	423200008	Doc. No.:(60) JWHZ No. 0013. The originally-published address is Group 1, Yihe Community of Wancheng Township.
Joint tomb of Zhangruji and his wife 43	1960.4.23	Jingzhou District	Taihui Village of Yingcheng Township	Ming Dynasty	Ancient tombs	423200010	Doc. No.:(60) JWHZ No. 0013. The originally-published address is in the east outside the Little North Gate. Destroyed.
Hantaijun's Tomb 44	1960.4.23	Jingzhou District	Zhuji Village of Jinan Township	Chongzhen Two Year of Ming Dynasty	Ancient tombs	423200011	Doc. No.:(60) JWHZ No. 0013. The originally-published address is Zhuchang, Huchang and Lichang of Zhuji Township. Destroyed.
Duijintai Tomb 45	1987.4.18	Jingzhou District	Duijin Village of Mashan Township	The Warring States period	Ancient tombs	423200378	Doc. No.: JZW [1987] No.31.
Leihu Tomb 46	1987.4.18	Jingzhou District	Leihu Village of Jinan Township	The Warring States period	Ancient tombs	423200379	Doc. No.: JZW [1987] No.31.
Mishiqiao Tomb 47	1987.4.18	Jingzhou District	West Gate branch of Linghu Management area	The Warring States period	Ancient tombs	423200380	Doc. No.: JZW [1987] No.31.
Tahui Temple Tomb 48	1987.4.18	Jingzhou District	Taihui Village of Yingcheng Township	The Warring States period	Ancient tombs	423200382	Doc. No.: JZW [1987] No.31. The originally-published address is Tiahui Village of Garden Township.
Wangchang Tomb 49	1987.4.18	Jingzhou District	Wangchang Village of Bailingshan Township	The Warring States period	Ancient tombs	423200383	Doc. No.: JZW [1987] No.31. The originally-published address is Wangchang Village of Wangchang Township.
Yueshan Tombs 50	1987.4.18	Jingzhou District	Yueshan Village of Yingcheng Township	The Warring States period	Ancient tombs	423200385	Doc. No.: JZW [1987] No.31. The originally-published address is Yueshan Village of Caoshi Township.
Caolinpu Tomb 51	1987.4.18	Jingzhou District	Guanping Village of Jinan Township	The Warring States period	Ancient tombs	423200386	Doc. No.: JZW [1987] No.31. The originally-published address is Jicheng Village and Guanping Village of Yutai Township in Jinan District.
Paimashan Tomb 52	1987.4.18	Jingzhou District	Paima Village of Jinan Township	The Warring States period, the Six Dynasties	Ancient tombs	423200387	Doc. No.: JZW [1987] No.31.
Yellow Mountain Tombs 53	1987.4.18	Jingzhou District	Yellow Mountain Village of	The Warring States period, Ming	Ancient tombs	423200388	Doc. No.: JZW [1987] No.31. The originally-published address is Yellow Mountain

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
			Yingcheng Township	Dynasty			Village of Caoshi Township.
Yuechang Tombs 54	1996.5.31	Jingzhou District	Yuechang Village of Jinan Township	The Warring States period	Ancient tombs	423200837	Doc. No.: JZF [1996] No. 51. The originally-published address is Leihu and Yuechang.
Zhuchang Tombs 55	1996.5.31	Jingzhou District	Zhuchang Taiping Shima Village of Balingshan Township	The Warring States period—Han Dynasty	Ancient tombs	423200838	Doc. No.: JZF [1996] No. 51.
Gepi Temple 56	1960.4.23	Jingzhou District	Jinan Village of Jinan Township	Ming Dynasty	Ancient building	423300012	Doc. No.:(60) JWHZ No. 0013. The originally-published address is Jiangtai Jinan Primary School. Destroyed.
Memorial Archway 57	1960.4.23	Jingzhou District	Inside Jingzhou Municipal	Ming Dynasty	Ancient building	423300013	Doc. No.:(60) JWHZ No. 0013. The originally-published address is near Sanbiguan of Gong'an Gate in Jingzhou. Destroyed.
Sanguanbi 58	1960.4.23	Jingzhou District	near Gong'an Gate of Jinghzou City	Ming Dynasty	Ancient building	423300014	Doc. No.:(60) JWHZ No. 0013.
Dolmen 59	1960.4.23	Jingzhou District	Inside Jingzhou Municipal	Lunar January of Wuzi year in the Ming Dynasty	Ancient building	423300015	Doc. No.:(60) JWHZ No. 0013. The originally-published address is near Gong'an Gate. Destroyed.
Memorial Archway in front of the Temple of Guanyu 60	1960.4.23	Jingzhou District	Inside Jingzhou Municipal	Qing Dynasty	Ancient building	423300017	Doc. No.:(60) JWHZ No. 0013. The originally-published address is South Gate of Jingzhou Municipal. Destroyed.
Duijintai Monument (two) 61	1960.4.23	Jingzhou District	Duijin Village of Mashan Township	Qing Dynasty	Cave temple and stone carving	423400006	Doc. No.:(60) JWHZ No. 0013.
Guangong Monument in Mapaoquan 62	1987.4.18	Jingzhou District	Mapaoquan Village of Baling Township	Qing Dynasty	Cave temple and stone carving	423400107	Doc. No.: JZW [1987] No.31. The originally-published address is Mapaoquan Village of Yangchang Township.
Site of the Seventh District Committee of Dangyang County and farmers' association 63	1987.4.18	Jingzhou District	Linghu Management area	1930	Modern significant historic sites and representative buildings	423500478	Doc. No.: JZW [1987] No.31. The originally-published address is Dual Gate Branch Group 4 of Linghu Farm.
Old site of Fengtai	1987.4.18	Jingzhou District	Linghu Management	1943	Modern significan	423500480	Doc. No.: JZW [1987] No.31. The originally-published

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
Township Government 64			area		t historic sites and representative buildings		address is Jinjiatai in South lake branch of Lignhu Farm.
Old pine trees 65	1987.4.18	Jingzhou District	Shuangzong Village of Chuandian Township	Ming Dynasty	Others	423600120	Doc. No.: JZW [1987] No.31.
Gingko trees 66	1987.4.18	Jingzhou District	Inside the Temple of Guanyu	Ming Dynasty	Others	423600121	Doc. No.: JZW [1987] No.31.
Gingko trees 67	1987.4.18	Jingzhou District	Yellow Mountain Village of Yingcheng Township	Ming Dynasty	Others	423600122	Doc. No.: JZW [1987] No.31.
Gingko trees 68	1987.4.18	Jingzhou District	Inside Jiangling Cinema	Ming Dynasty	Others	423600124	Doc. No.: JZW [1987] No.31.
Gingko trees 69	1987.4.18	Jingzhou District	Inside the yard of urban military sub-district	Ming Dynasty, Qing Dynasty	Others	423600126	Doc. No.: JZW [1987] No.31. Dead.
Hackberry trees 70	1987.4.18	Jingzhou District	Xinchang Village of Baling Township	Qing Dynasty	Others	423600127	Doc. No.: JZW [1987] No.31. Dead.
Gingko trees 71	1987.4.18	Jingzhou District	Inside the yard of District Government	Qing Dynasty	Others	423600128	Doc. No.: JZW [1987] No.31.

Table 3-12 List for urban cultural sites in Shashi District

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
The Neolithic Age site 1	1960.4.23	Shashi District	Sichang area of Guanyindang Township	The Neolithic Age	Ancient site	423100011	Doc. No.:(60) JWHZ No. 0013.
Baimiaozi (Sherushan) site 2	1960.4.23	Shashi District	Changgang Road in Lixin Township	The Eastern Zhou Dynasty	Ancient site	423100014	Doc. No.:(60) JWHZ No. 0013.
Choutandian Gongtou 3	1960.4.23	Shashi District	Yanyue Village of Guanyindang Township	Han Dynasty	Ancient site	423100016	Doc. No.:(60) JWHZ No. 0013.
Fanjiatai site 4	1987.4.18	Shashi District	Sichang Village of Guanyindang Township	The Neolithic Age	Ancient site	423100492	Doc. No.: JZW [1987] No.31.
Gaojia Land site 5	1987.4.18	Shashi District	Xintai Village of Guanyindang Township	The Neolithic Age	Ancient site	423100493	Doc. No.: JZW [1987] No.31.

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
Xujiatai site 6	1987.4.18	Shashi District	Niwan Village of Guanyindang Township	The Neolithic Age	Ancient site	42310 0503	Doc. No.: JZW [1987] No.31.
Shuiniuchang site 7	1987.4.18	Shashi District	Sihu Farm in Cenhe Township	The Neolithic Age—The Eastern Zhou Dynasty	Ancient site	42310 0506	Doc. No.: JZW [1987] No.31.
Longkou Village site 8	1987.4.18	Shashi District	Yanglin Village of Guanyindang Township	The Eastern Zhou Dynasty	Ancient site	42310 0517	Doc. No.: JZW [1987] No.31.
Wenjiagang site 9	1987.4.18	Shashi District	Guanyindang Township	The Eastern Zhou Dynasty	Ancient site	42310 0520	Doc. No.: JZW [1987] No.31. The originally-published address is Wengang of Xikou Township in Guanyin District.
Xiangtang Tomb site 10	1987.4.18	Shashi District	Niwan Village of Guanyindang Township	The Eastern Zhou Dynasty	Ancient site	42310 0522	Doc. No.: JZW [1987] No.31.
Yanglinkou site 11	1987.4.18	Shashi District	Guanyindang Township	The Eastern Zhou Dynasty	Ancient site	42310 0526	Doc. No.: JZW [1987] No.31.
Huanggang site 12	1987.4.18	Shashi District	Huanggang Village of Cenhe Township	Han Dynasty	Ancient site	42310 0531	Doc. No.: JZW [1987] No.31.
Junliutai site in the Neolithic Age 13	1987.9.22	Yuqiao Development Zone	Construction Village of Union Township	The Neolithic Age	Ancient site	42310 0551	Doc. No.: SZW [1987] No. 78.
Zhangjiatai site in the Neolithic Age14	1987.9.22	Shashi District	Baishui Village of Guanju Township	The Neolithic Age	Ancient site	42310 0552	Doc. No.: SZW [1987] No. 78.
Yangcha site in the ancient Western Zhou Dynasty 15	1987.9.22	Shashi District	Guanju Township	The Western Zhou Dynasty	Ancient site	42310 0553	Doc. No.: SZW [1987] No. 78.
Shuanglaotai site in the Eastern Zhou Dynasty 16	1987.9.22	Shashi District	Zhanggou Village of Lixin Township	The Eastern Zhou Dynasty	Ancient site	42310 0554	Doc. No.: SZW [1987] No. 78.
Songjialing site in the Eastern Zhou Dynasty 17	1987.9.22	Shashi District	Baishui Village of Guanju Township	The Eastern Zhou Dynasty	Ancient site	42310 0555	Doc. No.: SZW [1987] No. 78.
Xiyejia River site in the Eastern	1987.9.22	Shashi District	Changhu Village of Luochang	The Eastern Zhou	Ancient site	42310 0556	Doc. No.: SZW [1987] No. 78.

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
Zhou Dynasty 18			Township	Dynasty			
Fanjiayuan site in the Han Dynasty 19	1987.9.22	Shashi Farm	Fanjiayuan of Zhuanqiao Fishery	Han Dynasty	Ancient site	42310 0557	Doc. No.: SZW [1987] No. 78.
Welfare Home site in the Han Dynasty 20	1987.9.22	Shashi District	Zhujiatai Village of Guanju Township	Han Dynasty	Ancient site	42310 0558	Doc. No.: SZW [1987] No. 78.
Ancient City site of Shashi 21	1987.9.22	Shashi District	Victory Street	Qing Dynasty	Ancient site	42310 0559	Doc. No.: SZW [1987] No. 78.
King Chai's Tomb 22	1960.4.23	Shashi District	Qinggangling Village of Cenhe Township	The Five Dynasties	Ancient tombs	42320 0009	Doc. No.:(60) JWHZ No. 0013.
Yugangqiao Tomb 23	1987.4.18	Shashi District	Yaojialing Village of Cenhe Township	The Warring States period	Ancient tombs	42320 0384	Doc. No.: JZW [1987] No.31.
Sunshu'ao Tomb (Yiguan Mound) 24	1987.9.22published again	Shashi District	Inside Zhongshan Park	Qing Dynasty	Ancient tombs	42320 0404	Doc. No.: SZW [1987] No. 78.
Dongyue Temple 25	1960.4.23	Shashi District	Shancha Village of Cenhe Township	Qing Dynasty	Ancient building	42330 0016	Doc. No.:(60) JWHZ No. 0013. The originally-published address is
Shashi 26	1960.4.23	Shashi District	Bianhe Township	Qing Dynasty	Ancient building	42330 0018	Doc. No.: SZW [1987] No. 78.
Yiyang Temple 27	1960.4.23	Shashi District	Yiyang Village of Guanyindang Township	Qing Dynasty	Ancient building	42330 0020	Doc. No.:(60) JWHZ No. 0013.
Former residence of Quyuan (Jiangdu Palace) 28	1987.9.22	Shashi District	Jianghan South Road	Qing Dynasty	Ancient building	42330 0205	Doc. No.: SZW [1987] No. 78. Its present name is Jiangdu Palace. In 1987 when it was published, there were only two wing-rooms, while it was rebuilt in 1989. Pulled down.
Wenxing House 29	1987.9.22	Shashi District	End of Democracy Street	Qing Dynasty	Ancient building	42330 0206	Doc. No.: SZW [1987] No. 78.
Jinshi Memorial Archway 30	1987.9.22	Yuqiao Development Zone	Chihu Road in Shashi East Region	Ming Dynasty	Cave temple and stone carving	42340 0111	Doc. No.: SZW [1987] No. 78.
Revolutionary Martyr-Zhu Zilong's Tomb 31	1960.4.23	Shashi District	Qinghe Village of Guanju Township	Revolution period of 1911	Modern significant historic sites and representative buildings	42350 0038	Doc. No.:(60) JWHZ No. 0013. The year shall be 1907. The originally-published address is Jiangtai Commune.
Revolutionary site of No. 18, Qingyang	1960.4.23	Shashi District	Qingyangxiang Township	1938—1939	Modern significant historic sites and	42350 0041	Doc. No.:(60) JWHZ No. 0013.

Unit name	Date	Counties	Address	Age	Category	Unit code	Remark
Lane 32					representative buildings		
Revolutionary site of No. 77, Meitai Lane 33	1960.4.23	Shashi District	Meitaixiang Township	1945—1949	Modern significant historic sites and representative buildings	42350 0042	Doc. No.:(60) JWHZ No. 0013. Pulled down.
Revolutionary Martyrs' Monument in Zhongshan Park 34	1960.4.23	Shashi District	Zhongshan Park	1958	Modern significant historic sites and representative buildings	42350 0044	Doc. No.:(60) JWHZ No. 0013.
Old site of flood diversion headquater of Jingjiang River 35	1987.9.22	Shashi District	75 meters in north of Tongqu Road of Jiefang Street Office	1952	Modern significant historic sites and representative buildings	42350 0497	Doc. No.: SZW [1987] No. 78.
Martyrs' Cemetery 36	1987.9.22	Shashi District	Hongmen Road	1957	Modern significant historic sites and representative buildings	42350 0498	Doc. No.: SZW [1987] No. 78.

3.3.2 Cultural sites in the project areas

The proposed project areas involved the five cultural heritages including the Jingzhou Ancient Walls, Xiongjiazhong Tomb, Jingzhou Municipal Museum, 13 Historic architectures and Kaiyuan Taoist Temple. The construction activities description, the impact analysis, the mitigation and the management plan on these cultural heritages refer to the Chapter 7 of Physical Cultural Resources Management Plan for specific analysis.

3.3.3 Protection planning of cultural relics in project areas

In recent ten years, governments at provincial level, city, and county levels have formulated corresponding protective plans to protect cultural relics in Jingzhou. The major plans include Jingzhou Historic Town Protection Plan and Jingzhou Ancient Walls Protection Plan (from 2006 to 2020), which both concentrate on planning of the project areas and specify development focus and goal of project areas as well as capability building measures. These plans are also taken as important basis to formulate the project environmental assessment.

3.3.4 Protection and repair of cultural heritage sites

According to feasible sub-project reports on historic town protection, the Ancient Walls have been repaired for several times in the Qing Dynasty. During the initial period when the People's Republic of China was founded, the Walls lacked repairs for a long time. After 1980, our nation and government urged to repair the Walls. From 1985 to 2011, the Walls have been specially repaired for five times in total. The repair work includes repair of walls and construction of gates, etc.

3.4 Environmental Baseline

Based on the analysis of the project component, the proposed project is involved the definition of the natural habitats in the OP4.04, therefore the EA consultant collected the ecological baseline data in associated areas, analyzed the potential impacts and raised the mitigations.

3.4.1 Terrestrial ecological environment

3.4.1.1 Baseline ecological environment

The proposed project involves such water systems as moat, horse wash pond, North Lake, West Lake and Northeast pond, etc. It is seen through on-site survey that the project affected areas are plains, mainly including manually-controlled urban ecosystem (principal), forest ecosystem, grassland ecosystem and wetland ecosystem. Various species of plants distinctly distributed on the Ancient Walls, such as trees, bushes and grass, constitute a closed eco-corridor together with animals lodging in the plants, which is significant to protect biodiversity; the eco-corridor also acts as an important component of Jingzhou urban ecosystem and is compared to a gene pool of live plant seed resources. Vegetation in wetland ecosystem mainly includes aquatic vascular plants and bushes and grass in river shoals, which are the focus of ecological evaluation and protection in the proposed project.

3.4.1.2 Methods of survey

The survey on current situation of ecological environment of the proposed project is conducted based on field survey and the available documents, general survey and sampling and qualitative and quantitative analysis. Besides, interview with residents and forest workers in the surveyed areas also helps collect background information of regional ecological environment.

I Documents review

Collect and sort out the available documents on biodiversity in the project affected areas, and collect the information from the various authorities from forestry, environmental protection, water conservancy, agriculture and land resources, and refer to research papers on animals and plants officially published in the relevant field.

II Site investigation

Record types of vegetation in sample places with formation as unit, and slope aspect, slope and soil type, etc.; record superior plants in sample places and observe animals' activities; shoot appearance and structure of typical vegetation.

On the basis of analysis on previous materials of terrestrial plants in the evaluation area, the survey team confirms paths and time of on-site investigation according to the survey plan. During the survey, the team shall confirm species of plants, types of vegetation and living conditions of rare and endangered plants, etc.

3.4.1.3 Scope of survey

From September to October in 2014, the evaluation team has done an outdoor survey on the ecological environment (including vegetation and wild animals) in the proposed project areas. The scope of evaluation covers walls and banks of rivers and lakes in the repair project. The scope of survey shall be no less than that of evaluation.

Based on the field survey, the feasibility research team confirms typical community sections and does a survey on communities by means of relevant method. The consultation Company selects and divides path of survey which begins from the old South Gate towards west. Then the team shall investigate the 11 km-long Ancient Walls in order by 100 meters/section, and via on-the-spot survey, record growth of plants in each section of the Walls in the form of photos and words and formulate specific research table for each section.

3.4.1.4 Terrestrial plants

The vegetation type of the evaluation area is classified through comparison of the phytocoenosiums characteristics, according to the natural vegetation classification system of *China Vegetation*, based on field study and reference to relevant forestry survey data. The main natural vegetation of the evaluation area is classified into 3 vegetation type groups, 5 vegetation types, and 14 plant formations. And the number of plant species is up to about 300. The main vegetation types are shown in Table 2 - 13.

Totally speaking, though the soil city wall has been affected by human, there are various kinds of natural vegetation around it, and the distribution area is relatively narrow.

In the field investigation, national second-ranking key protection plants wild soybean and Chinese weeping cypress are founded.

(1) Chinese weeping cypress

According to field investigation and related data, Chinese weeping cypress is national class II key protected plants, and it's a precious timber specy, mainly used in high-class furniture, high-class decoration of office and residence, and wooden crafts processing, etc. It's a strategic resource in shortage as oil. It is a specy with multiple functions and high benefits. It is not only a superior tree specy to be used in timber forest and the construction of ecological landscape, but also a tree specy that the whole tree can be used. It can be used to extract and produce various chemical products, with high economic value. The branches, trunk and root of the tree can all be used to refine cedarwood oil, which can be used to produce a variety of chemical products. The remainder of the root used to refine cedarwood oil, can be smashed into powder as perfume, and exported to Southeast Asia, bringing high economic value.

Figure 3.4-1 Chinese weeping

(2) Wild soybean (Glycine soja)

Wild soybean (Glycine soja)is a leguminous plant attributes to bean, and national class II key protected plant. It is 1~4m long, with small stems and slender branchlets. And there are brown long hairs covering on the whole body. The leaf is composed of 3 little leaves, of which the length can be up to 14cm; the stipule is ovate-lanceolate, acute, with yellow pubescence. The apical lobule is ovoid or ovoid lanceolate, with length of 3.5~6cm, width of 1.5~2.5cm; the apex is from sharp to obtuse, with the base nearly rounded, entire; both sides are covered with silky rigid hairs. The lateral leaflets is obliquely ovoid lanceolate. It grows besides wet croplands, gardens, and gutters at the altitude of 150~2650 m.

Wild soybean is distributed in regions from cold temperate zone to subtropical zone, mostly growing in mountains, wet grasslands, on river coasts, lakesides, near bogs or in brushwoods, rarely found in forest or sand area that is windy and dry. It can be found to grow twining around other things in mountains, hills, plains, coastal beaches or islands. Wild soybean also has the character of salt resistance, cold resistance, and disease resistance. It's sibling specy of soybean, which is the main oil and grain crop in our country. So, wild soybean can be used to develop excellent soybean varieties. In the evaluation area, wild soybean has a certain distribution, accompanied with herbs

Table 3-13 Main Vegetation Types of the Historic town wall

	Vegetation type group	**Vegetation type**	**Tree specy**		**Growth**
Natural vegetation	Coniferous forest	Ⅰ.Warm coniferous forest	Chinese Weeping Cypress	Form *Cupressus funebris* Endl.	Good
	Broad-leaved forest	II. Deciduous broadleaved forest	Black Locust	Form *Robinia pseudoacacia* L	Good
			Chinese Wingnut	Form *Pterocarya stenoptera* C. DC	Good
			Paper Mulberry	Form *Broussonetia papyrifera* (Linn.)	Good
		III. Evergreen broad leaved forest	Broad-leaf Privet	Form *Ligustrum lucidum* Ait.	Good
			Camphor Tree	Form *Machilus ichangensis* Rehd. et Wils	Good
	Bushwood and scrub-grassland	IV. Bushwood	Glorybower	Form *Clerodendrum bungei*	Good
			Chinese Fan Palm	Form *Livistona chinensis (Jacq.)* R. Br.	Good
			Multiflora Rose	Form *Rosa* L.	Good
			Small-leaf Bramble	Form *Rubus parvifolius* L.	Good
		V. Scrub-grassland	Green Foxtail	Form *Setaria viridis* (L.) Beauv.	Good
			Annual Fleabane	Form *Erigeron annuus*(L.) Pers. (Aster an-nuus L.)	Good
			Caulis Akebiae	Form *CaulisAkebiae*	Good
			Chinese fever vine	Form *Paederia scandens* (Lour.) Merr.	Good

I Coniferous forest

In China, the coniferous forests in areas of subtropical zone are mostly secondary type, and cover a large area. In the area of the proposed project, the natural community is mainly composed of Chinese Weeping Cypress (*Cupressus funebris* Endl), which belongs to warm coniferous tree. Other species exist as accompanying species.

Chinese weeping cypress is national level II key protected wild plants. It's endemic tree of China with wide distribution in Zhejiang, Fujian, Jiangxi, Hunan, western Hubei, northern Sichuan and east of Daxiangling, eastern and central Guizhou, northern Guangdong, northern Guangxi, southeastern and central Yunnan. There are Chinese weeping cypresses grown out of the wall, of which the DBH is 5-20 cm, and the height is 3-8m. In addition, there are Black Locust (*Robinia pseudoacacia* L), *Broad-leaf Privet* (*Ligustrum lucidum*) and other broad-leaved trees. Bushwood is about 2m tall, with total coverage of about 30%～70%, and rich specy composition of Glorybower (*Clerodendrum bungei)*, Chinese Fan Palm (Livistona chinensis), Multiflora Rose (Rosa L), Green Foxtail *(Setaria viridis (L.) Beauv.),* Annual Fleabane (*Erigeron annuus*(L.) Pers. (Aster an-nuus L.)) and so on.

II Broad-leaved forest

Broad-leaved forest is a vegetation type distributed widely in the evaluation area, including evergreen broad-leaved forest, deciduous broad-leaved forest and evergreen and deciduous broad-leaved mixed forest. The community structure generally consists of tree layer, shrub layer and herb layer. Along the city wall, broad-leaved forests are distributed evenly. The main broad-leaved trees include *Black Locust* (*Robinia pseudoacacia* L)*, Chinese Wingnut* (*Pterocarya stenoptera* C. DC), Paper Mulberry (*Broussonetia papyrifera* (Linn.))*, Broad-leaf Privet* (*Ligustrum lucidum Ait*.)*, and* Camphor Tree (*Machilus ichangensis* Rehd. et Wils).

(1) Black Locust (Form *Robinia pseudoacacia* L)

Figure 3.4-2 Black locust (Robinia pseudoacacia L)

Black locust (*Robinia pseudoacacia* L) forests in the evaluation area are secondary forests, of which the distribution altitude is not high, human disturbance is serious, and distribution area is small. So the implementation of the project may have certain influence on them.

Black locust is a tree specy of temperate zone. It grows well in regions that the average annual temperature is 8℃~l4 ℃, and annual rainfall is 500~900mm. Especially in coastal areas with higher air humidity, it grows fast with straight and rounded truck. Its capability of wind resistance is poor, so if black locust grows in wind gap, the situations of wind-breakage, wind-fall, incline, and partial crown may be easy to occur.

The canopy density of the tree layer of black locusts in evaluation area is about 0.6, with the average height of 8 m, and DBH of 10-25 cm. The coverage of bush wood and scrub-grassland under the trees is 20～40% with uneven distribution and the height of 1～3m. The main species include: Chinese Fan Palm (*Livistona chinensis* (Jacq.) R. Br.), Small-leaf Bramble (*Rubus parvifolius* L.), Annual Fleabane (*Erigeron annuus(L.)* Pers. (Aster an-nuus L.)), Chinese fever vine (*Paederia scandens* (Lour.) Merr.).

In additon, large area of low little black locusts have a strong impact on the growing environment of other vegetations , which need remediation.

(2) Chinese Wingnut (Form Pterocarya stenoptera C. DC)

Chinese wingnut forests in the evaluation area are mainly distributed from the east gate to the new north gate counterclockwise.The constructive specy of the tree layer is Chinese wingnut, with the canopy density of 0.8, DBH 10 ~ 15 cm, and the height of 12~15m.

The bushwood layer under the trees is sparse, with coverage of less than 10%, consisting of multiflora rose (Rosa multiflora), rubus setchuenensis, paper mulberry (Broussonetia papyrifera) and coriaria nepalensis, etc. The herb layer consists of various species with the coverage of about 70%, such as greater plantain (Plantago major), wild carrot (Daucus carota), multiflora rose (Rosa L.), green foxtail (Setaria viridis (L.) Beauv.), annual fleabane (Erigeron annuus(L.) Pers. (Aster an-nuus L.)), calamint (Phytolacca acinosa), buttercup (Ranunculus sp.), rough cocklebur (Xanthium sibiricum), and so on.

Among them, there are some well-grown plants with medicinal value, such as mugwort and green foxtail.

(3) Paper Mulberry (Form Broussonetia papyrifera (Linn.))

Paper Mulberry is the most widely distributed vegetation, and one of the main vegetation types in the evaluation area. It is mainly distributed around the soil city wall.

Figure 3.4-3 Paper mulberry (*Broussonetia papyrifera* (Linn.))

The community of paper mulberry is with a single and neat structure, a relatively high coverage of 70%-100%, and average height of about 17m. Due to the high coverage, the herbs under the trees are sparse, with the coverage of less than 10%. They have a little ecological value, and some of them have medicinal value, such as wild chrysanthemum flower and mugwort. In addition, there are some little paper mulberries grown out of the wall, some of which destroy the city wall and block pedestrian access.

(4) Broad-leaf Privet (Form Ligustrum lucidum)

Broad-leaf privet is widely distributed and one of the main vegetation types in the evaluation area. It is mainly distributed on the wall from the old south gate to 2km~4km from it counterclockwise and around the houses. Broad-leaf privet is the single dominant community, with canopy density of about 0.8, DBH of about 3-8cm, height of 6～12 m. The composition of bushwood layer under the trees is rich, among which rhus is seen occasionally. The herb layer is sparse, with the

Figure 3.4-4 Broad-leaf privet (Ligustrum lucidum) coverage of about 30%, consisting of calamint (Phytolacca acinosa), buttercup (Ranunculus sp.), rough cocklebur (Xanthium sibiricum), and so on.

(5) Camphor Tree (Form *Machilus ichangensis* Rehd. et Wils)

Camphor tree is a native specy with beautiful effect, and has little destructive effect to the city wall. It is widely distributed, and one of the main vegetation types in the evaluation area, with canopy density of about 0.6, DBH of about 4-7cm, height of 8～14 m. The composition of bushwood layer under the trees is rich, among which rhus is found occasionally. The herb layer is sparse, with the coverage of about 30%, consisting of greater plantain, (Plantago major), multiflora rose (Rosa L.), green foxtail (Setaria viridis (L.) Beauv.), annual fleabane (Erigeron annuus(L.) Pers. (Aster an-nuus L.)).

Figure 3.4-5 Camphor Tree (*Machilus ichangensis* Rehd. et Wils)

III Bushwood

In terms of type, the bushwood of the proposed project belongs to featured plant, such as Chinese Fan Palm, and native specy, such as glorybower and multiflora rose. They have little destructive effect to the city wall.

(1) Glorybower (Form. *Coriaria sinica*)

Glorybowers are mainly distributed under Chinese wingnuts and paper mulberries and mixed forest of both in the evaluation area.

The coverage of bushwood is 30%, and the height is 1.5m. Glorybower is the dominant specy, accompanied with multiflora rose (Rosa L.), Rubus setchuenensis, and coriaria nepalensis, etc. The coverage of the herb layer is about 50%, and the height is about 70cm, mainly consists of green foxtail, hispid arthraxon, wild chrysanthemum(Dendranthema indicum), sambucus chinensis, artemisiaselengensis turcz, horseweed herb, Chinese mosla herb(Elsholtzia ciliata), nightshade, cogon, bermuda grass, hemarthria compressa, and groundsel, etc.

(2) Chinese Fan Palm (Form *Livistona chinensis* (Jacq.) R. Br.)

The Chinese fan palms are evenly distributed as clusters, with average height of 2-3m, and coverage of about 90%. Chinese fan palm is the constructive specy, accompanied with multiflora rose (Rosa L.), rubus setchuenensis, paper mulberry, and coriaria nepalensis, etc. The herb include elderflower (Sambucus williamsii), Caulis Akebiae, shepherd's purse(Capsella bursa-pastoris), green foxtail(Setaria viridis (L.) Beauv.), dandelion(Taraxacum mongolicum Hand.-Mazz), and so on.

(3) Multiflora Rose (Form *Rosa L.*)

Multiflora rose is widely distributed and one of the main vegetation types in the evaluation area. It's the dominant specy of the community, with a height of about 0.4m and clustered distribution, accompanied with small-leaf bramble (*Rubus parvifolius* L.) and euonymus (*Euonymus japonicus* L.), etc.

IV. Scrub-grassland

There are mainly 4 kinds of scrub-grassland, including green foxtail (Setaria viridis (L.) Beauv.), annual fleabane (*Erigeron annuus*(L.) Pers. (*Aster an-nuus* L.)), caulis akebiae, and Chinese fever vine (*Paederia scandens* (Lour.) Merr.), among which green foxtail, caulis akebiae and Chinese fever vine are native species, and annual fleabane is a invasive specy.

3.4.1.5 Terrestrial animals

Based on the documents review and the site survey, there are Provincial-level key protected animal includes 3 species of amphibian, which are Bufo gargarizans, Rata guentheri, Rata limnocharis; 1 specy of reptile, which is Zaocys dhumnades; and 5 species of aves which are Streptopelia O. orbentalis, Hirundo rustica Guttrualis, Cyanopica cyana Swinhoei, pica pica.sericea, C. macrohynchus Colonorum.

I. Amphibian

According to *Atlas of Key Protected Wild Animals of Hubei Province, Illustrated Handbook of Amphibians of China,* and *A Complete Volume on Vertebrates of China,* combined with field investigation, there are amphibians belong to 3 species in 2 families of 1 order in the evaluation area, which are all provincial level protected animals. The list of the amphibians is shown in Table 3-14.

Table 3-14 List of the Amphibians of the Evaluation Area

Family	Specy	Living Environment	Fauna	Amount	Protection class
1. ANURA					
a. Bufonidae	1.*Bufo gargarizans*	It inhabits on land near water or in grassland that is dark and with a certain humidity.	Cosmopolitan	+++	Provincial-level
b. Ranidae	2.*Rata guentheri*	It often inhabits in pond, ditch, river or the grassland nearby. Spawning season is March to June.	Oriental	++	Provincial-level
	3.*Rata limnocharis*	It inhabits in pond, paddy field and field and damp environment nearby.	Oriental	++	Provincial-level

According to the living environments of amphibians, the ecological distribution of the amphibians in the evaluation area is divided into the following two categories:

1) Land-inhabited type: includes bufo gargarizans and rata limnocharis, they mainly live on the land near water, being closely related to human activities.

2) Static-water type: *Rata guentheri,* mainly lives in ponds and lakes, being closely related to human activities

II. Reptile

There are reptiles of 8 species in 7 families of 2 orders in the evaluation area, among which there is provincial protected animal black-tail snake (*Zaocys dhumnades*), no national key protected animal. The list is as shown in Table 3-15.

According to ecological habits of reptiles, the eight kinds of reptiles of the evaluation area are divided into the following three ecotypes:

1) Brushwood-Type: Eumeces chinensis, lygosoma indicum, agkistrodon blomhoffii, dienagkistrodon acutus and zaocys dhumnades. They mainly live in brushwoods of the evaluation area, and are closely related to human activities.
2) Residence-Type: Gekko japonicus, they live in the houses of residents.
3) Water-inhabited-Type (reptiles living and foraging in water): includes Chinemys reevesii and Pelodiscus sinensis. They have a certain distribution in water bodies.

Table 3-15 The status of Reptiles of the evaluation area

Family	Specy	Living Environment	Fauna	Amount	Protection class
I.TESTUDINES					
i. Bataguridae	1. Chinemys reevesii	It inhabits in lake, pond, stream and wet grass on the bank.	C	+	Not involved
ii. Trionychidae Trionychidae	2. Trionyx sinensis *Pelodiscus sinensis*	It mostly inhabits in pond, ditch, and rice field.	C	+	Not involved
II. SQUAMATA					
iii. Gekkonidae	3.*Gekko japonicus*	It inhabits in residence and around.	O	+++	Not involved
iv. Scincida	4.*Eumeces chinensis*	It inhabits in farmland, residence and scrub grass nearby.	O	++	Not involved
v. Lacertidae	5. *Lygosoma indicum*	It inhabits on slope and in stones of roadbed.	O	++	Not involved
VI. Viperidae	6.*Agkistrodon blomhoffii*	It is often found in grass slope, brush, field, and cottage.	C	++	Not involved
	7. Dienagkistrodon acutus	It inhabits in plain, mountain, or hill near ditch, and often appears near residence.	C	++	Not involved
vii Colubridae	8.*Zaocys dhumnades*	It inhabits in plain, hill and mountain, and is often found in field, forest, river bank, stream side, brushwood, and meadows, also found around residence.	O	+++	Provincial-level

Notes: The classification system refered to *The Check List of Amphibians and Reptiles of China* (Zhao Ermi, Zhang Wenxue, 2000). In the Column of Fauna, “o” represents Oriental, “c” represents Cosmopolitan.

III. Mammalia

There are mammalias of 8 species in 5 families of 4 orders in the evaluation area, with details as shown in Table 2.4-4, among which, the species of rodentia is most, up to 4, occupying 50.0%. There is one provincial protected animal badger, no national key protected animal. The list of mammalias is as shown in Table 3-16.

According to ecological habits of mammalias, the species mentioned above can be divided into the following 2 ecotypes:

1) ***Half underground living type*** (It's cave inhabited, mainly acts and finds food on ground, and dodgs enemies in cave, sometimes finds food underground): Including erinaceus europaeus, mus musculus, rattus flavipectus, rattus novegicus, mustela sibirica), mainly distrbuted in forests.

2) ***Grotto inhabiting type:*** (small mammalias inhabiting in grotto upside down) including *Pipistrellus pipistrellus.* There are some distributions in dense residential area.

Table 3-16 The Status of Mammalias

Family	Specy	Living Environment	Fauna	Amount	Protection class
INSECTIVORA					
i. Erinaceidae	*Erinaceus europaeus*	It inhabits in various environments, making nest in root, fallen log, stone gap, and brushwood.	P	++	Not involved
CHIROPTERA					
ii. Vespertilionidae	Pipistr, ellus abramus	It inhabits in eave, and gap of door and window, and often acts over lake, pond and paddy field near residence.	C	+++	Not involved
RODENTIA					
iii. Muridae	Mus musculus	It likes to inhabit in residence, warehouse, field, forest land and so on.	C	++	Not involved
	Rattus flavipectus	It mostly digs caves in residence and warehouse.	O	++	Not involved
	Rattus novegicus	It inhabits in various environments, mostly closed to human, such as warehouse, kitchen, and wild field.	O	+++	Not involved
CANIVORA					
vi. Mustelelidae	*Mustela sibirica*	It inhabits in various environments, such as forest margins, brushwood, swamp, river valley, hill, and plain.	C	++	Not involved

Notes: The classification system is refered to *A Complete Volume on Vertebrates of China* (Liu Mingyu, Xie Yuhao, Ji Damin, etc,, 2000). In the Column of Fauna, "p"represents palaearctic, "o" represents Oriental, "c" represents Cosmopolitan.

IV. Birds

According to data and investigations, there are 10 species of birds, belonging to 6 families of 3 orders, among which there are 5 species of provincial key protected animal, including Streptopelia O. orbentalis, Hirundo rustica Guttrualis, Cyanopica cyana Swinhoei, pica pica.sericea, C. macrohynchus Colonorum.The list is as shown in Table 3-17.

There are 2 species of ardeidae family of ciconiiformes order, occupying 20.0%, 2 species of columbiformes order, occupying 20.0%; 6 species of passeriformes order, occupying 20.0%.

1) Land bird type: it's with hard mouth, robust feet and short wings; good at walking, uses claws to grind soil to find food. There are all species of columbidae family of columbiformes order, namely Streptopelia O. orbentalis and Streptopelia chinensis. They are distributed in woodland and edge of forest, or other areas on one side of river bank.

2) Singing bird type: It is with stubby or long and thin beak, short and thin feet, good at singing, including all the 6 species of passeriformes order. They are widely distributed, mainly living in field and brushwood beside water.

Table 3-17 the Status of Birds

Family	**Specy**	**Living Environment**	**Residential type**	**Fauna**	**Protection class**	**Family**
COLUMBIFORMES						
i.Columbidae	*Streptopelia O．orbentalis*	It inhabits in regions with many trees.	R	C	++	Not involved
	Streptopelia chinensis	It inhabits in wood on hill and mountain, countryside of plain with a lot of trees, and near farmland.	R	O	++	Provincial-level
PASSERIFORMES						
ii. Hirundinidae	*Hirundo rustica guttrualis*	It inhabits near village, often flys over field, forest, and water area.	S	P	++	Provincial-level
iii. Sturnisae	*Acridotheres c.cristatellus*	It inhabits in It inhabits in villages of plain, garden and field, and bamboo forest; often acts in group.	R	O	+	Not involved
iv. Corvidae	*Cyanopica cyana swinhoei*	It inhabits in shaw and pinewood near village.	R	P	++	Provincial-level
	Pica pica.sericea	It inhabits in forest of plain; often act in villages and fields.	R	P	++	Provincial-level
	C．macrohynchus colonorum	It inhabits in field or big trees of countryside; often act in field and by road.	R	P	++	Provincial-level
v. Ploceidae	*Passer montanus saturatus*	It mostly inhbits in buidings and trees, with wide acting scope; often act in group.	R	P	+++	Not involved

Notes: The classification system refered to *List of classification and distribution of China's birds (second edition) (Zheng Guangmei, 2011). In the column of "Residential type", W- winter visitor; S-* summer visitor, R-resident bird, T-traveler; In the column of "Fauna", "p" - palaearctic, "o" - Oriental, "c" - Cosmopolitan.

3.4.2 Aquatic organism

The investigation is combined with the data about the developing status of fishery and sampling survey, integrating relevant research results and field study.

3.4.2.1 Phytoplankton

The status of aquatic organism of the evaluation area is mainly according to analogy of data, without sampling analysis.

Aquatic plant resources include economic aquatic plant resource and non-economic aquatic plant resource. Economic aquatic plant resources are mostly emergent aquatic plants, such as lotus, lotus root, water caltrop, papyrus, and reeds, and so on. Non-economic aquatic plant resources include duckweed, water lily, water plantain, cattail and algae. The floating algae is mainly composed of chlorophyta, accompanied with a little Pyrrhophyta, chrysophyte, xanthophyta, euglenophyta, cyanophyta, bacillariophyta, and spirulina. These plants can provide fishes with habitat and food, and can purify pollutants in water. They have important significance to maintain the balance of aquatic ecosystems.

3.4.2.2 Evaluation of benthonic animal

According to analogy of data from similar stretches of river, there are 87 species of big benthonic animals; among which, there are 3 species of annelid, occupying 3.45%; 5 species of mollusk, occupying 5.75%, 76 species of aquatic insect, occupying 87.35%; 3 species of malacostraca, occupying 3.45%. The dominant species of the stretch of river in city are *Conchapelopia* sp. and *E.potthasti* of Chironomidae family of Diptera order; and the dominant species of branches are *Electrogena* sp. of heptageniidae family, ephemeroptera order; *Caenis* sp. of Caenidae family; *Choroterpes* sp. of Baetiscidae family; *Indobaetis* sp. of Baetidae family; and *Hydropsyche* sp. of Phryganeidae family, Trichoptera order, which reflect that the water quality of the moat is poor.

3.4.3 Status Quo of Tourism Facilities

At present, there are 14 A-level scenic spots in Jingzhou, including 4 4A-level scenic spots and 9 3A-level scenic spots. 50.0% of Jingzhou A-level tourism attractions are located within the Jingzhou District, thus forming the key layout of Jingzhou tourism attractions. All A-level scenic spots within Jingzhou Municipal District (Jingzhou district and Shashi district) are located in historic town, with two 4A-level scenic spots and four 3A-level scenic spots. Above-mentioned attractions see 1.372 million tourist arrivals each year annually, with 3,761 average daily tourist arrivals. 2013 witnessed 133.493 billion regional GDP in Jingzhou. To be specific, the primary industry completes 31.909 billion CNY of added value; the secondary industry completes 59.62 billion CNY of added value; the tertiary industry completes 41.964 billion CNY of added value, increasing 10.2%. The industry structure rate is 23.9: 44.7: 31.4. Total income of tourism amounts to 13.772 billion CNY (increasing 24.1%), accounting for 10% of full-year GDP.

In terms of facilities, there are 18 star hotels in total of 2,819 bedrooms within Jingzhou Municipal District (Jingzhou district and Shashi district) (including 1 5-star hotel, 2 4-star hotels, 11 3-star hotels and 4 2-star hotels). To be specific, high-star hotels are mainly concentrated in Jingzhou district with 810 bedrooms. Moreover, there are 612 non-star hotels of 12,886 bedrooms in Jinghzou district.

By the end of 2013, there are over 6,300 catering enterprises in Jinghzhou district, employing 15,000 people and hundreds of peoples in upper and lower industry chain.

3.5 Environmental baseline evaluation

The main construction activities of the proposed project include: dredging, sewage pipe network project, wetland building, revetment and water systems interconnection. So, in the design of monitoring plan, for the selection of water environment monitoring point and monitoring factors, the important intersection of water systems, bridges and other features of hydrological regime are taken into account. For the selection of atmospheric environment monitoring points, EA consultant mainly considered the effect of tail gas from relevant underground garages.

The surface water quality of evaluation is based on relevant results from Jingzhou Environment Monitoring Station (JEMS) from July 2014 and the regularly monitoring data from 2012-2014. The atmospheric, acoustic environmental quality baseline evaluation is based on the monitoring data from JEMS in the February 2015. And the sediment baseline evaluation is based on the monitoring data from JEMS in June 2014. The distribution of monitoring points is shown in Figure 3.5-1.

Figure 3.5-1 Map of the Monitoring sites

3.5.1 Surface water

The monitoring results of the water quality of water systems of the historic town show that, the water quality of all monitoring points all exceed the standard of Grade III of *Environment Quality Standard of Surface Water* (GB3838-2002) which is the objective standards. The existing monitoring data is reflected that the general water quality of the historic town is worse than Grade V. The main pollutant exceeding the standard is ammonia nitrogen, total nitrogen and total phosphorus. The water quality of Taihugang Channel is Grade V. The main exceeding pollutant is total nitrogen and total phosphorus.

The main reasons are as following: First, the direct discharge of domestic sewage and domestic garbage, and the tail water discharge of the sewage plant in south of the city affect the water quality of the water systems of the historic town. Second, with little exchange between the water system of the city and outside, the water flows slow, and self-purification ability of which is poor. The third, endogenous pollution of the sediment has released for a long time, making the water quality of the city worse and worse. The additional baseline data of surface water monitored on June 5, 2014 and June 27, 2014 is shown in the Table 3-18.

Table 3-18 Additional baseline data monitored in June, 2014

Monitoring section	Water-stage	Date	pH	COD	BOD_5	DO	SS	Ammonia nitrogen	Total nitrogen	Total phosphorus
			Dimensionless	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
East of south gate	Drought	June 5	6.87	16	5.56	3.37	8	2.77	7.24	0.372
	Rain	June 27	7.02	28.6	9.17	2.65	10	1.06	4.14	0.205
100m south of the east gate	Drought	June 5	7.4	33.8	11.1	17.85	5	0.66	5.75	0.325
	Rain	June 27	7.05	29.8	10.1	3.25	6	0.94	4.6	0.433
200m east of the new north gate	Drought	June 5	7.17	57.6	18.1	6.13	7	15.1	17.1	1.36
	Rain	June 27	7.24	32.2	10.2	1.08	10	7.06	9.54	1
Taihugang Channel entrance of the city	Drought	June 5	6.59	10.8	3.96	4.34	14	0.47	4.38	0.493
	Rain	June 27	6.95	12.7	4.12	4.03	12	0.46	2.67	0.215
Taihugang Channel exit of the ci	Drought	June 5	6.59	10.8	3.96	4.34	14	0.47	4.38	0.493
	Rain	June 27	6.95	12.7	4.12	4.03	12	0.46	2.67	0.215
Center of the North Lake	Rain	June 27	7.16	37.1	11.7	2.55	13	1.62	4.3	0.59
Center of the West Lake	Drought	June 5	6.75	63.8	20.3	2.3	19	2.88	5.55	1.36
	Rain	June 27	6.7	85.7	25.8	0.84	130	6.8	7.5	1.25
Center of the Horse Wash pond	Drought	June 5	6.69	15.6	5.34	6.53	5	0.5	2.26	0.127
	Rain	June 27	7.18	31	8.62	1.35	6	1.2	2.5	0.185
Environment Quality Standard of Surface Water		III	6~9	20	4	5	N.A.	1	1	0.2

The 2012～2014 routine monitoring data of Jiulongyuan Section of the moat, North Lake, West Lake and Horse Wash Pond in shown in the Table 3-19 below.

Table 3-19 The routine monitoring data statistics of 2012~2014

NO.	Monitoring section	Water-stage	Date	pH	COD	BOD_5	DO	Ammonia nitrogen	Total nitrogen	Total phosphorus
				Dimensionless	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
1	Jiulongyuan	low	2012-3-1	7.91	15.6	3.9	6.17	0.895	2.28	0.18
2	Jiulongyuan	normal	2012-5-4	7.93	11.5	2	7.45	0.912	2.32	0.18
3	Jiulongyuan	Wet season	2012-9-6	7.76	19	4	7.2	0.684	1.95	0.14
	Jiulongyuan	low	2013-3-6	7.22	28.7	9	3.27	13.5	18.1	1.04
	Jiulongyuan	normal	2013-5-8	7.91	33.7	9.24	5.35	9.03	32.1	0.95
	Jiulongyuan	high	2013-7-5	7.03	61.7	21.6	12.65	0.606	6.46	0.62
	Jiulongyuan	high	2013-9-4	7.03	31.3	11	12.65	3.36	6.46	0.39
	Jiulongyuan	normal	2013-11-7	7.54	30.3	10.6	4.7	2.87	/	0.43

NO.	Monitoring section	Water-stage	Date	pH	COD	BOD_5	DO	Ammonia nitrogen	Total nitrogen	Total phosphorus
				Dimensionless	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
	Jiulongyuan	low	2014-1-2	7.21	7.7	7.7	9.12	1.35	/	0.32
	Jiulongyuan	low	2014-3-4	7.79	12	12	9	9.71	/	6.77
	Jiulongyuan	normal	2014-5-6	7.79	20.8	20.8	9	8.5	/	0.92
	North Lake	high	2013-8-5	8.43	38.6	6.81	8.66	1.19	3.31	0.91
	North Lake	low	2014-12-30	7.58	37	12.9	8.34	4.34	7.05	0.4
	West Lake	high	2013-8-5	8.31	38.2	8.9	4.81	0.909	3.34	0.87
	West Lake	low	2014-12-30	6.43	23.7	8.29	0.86	5.91	7.2	0.7
	Horse Wash pond	high	2013-8-13	8.12	43.7	9.52	8.05	0.811	3.23	0.7
	Horse Wash pond	low	2014-12-30	7.48	34.9	12.2	8.11	0.42	2.62	0.2
	Environment Quality Standard of Surface Water		III	6~9	20	4	5	1	1	0.2

3.5.2 Atmospheric environment

The monitoring result indicates that, in the area of the Visitors' Center, the hour values and daily average values of SO_2, NO_2 Meet of the Type II area as specified in GB3095-2012 *Ambient Air Quality Standard.* In the northwest corner and southwest corner of the city, NH_3 and H_2S meet the requirements of TJ36-79 *Hygienic Standards for the Design of Industrial Enterprises.* The monitoring results of PM10 in the upwind and downwind direction of the Visitors' Center exceed the limiting value of the Type II area of GB3095-2012 *Ambient Air Quality Standard,* among which ,in point 1, the maximum daily average value *of* PM10 is 0.214mg/L with the over standard rate of 85.7% and the maximum concentration of standard rate of 143%; in point 2, the maximum daily average value *of* PM10 is 0.21 mg/L with the over standard rate of 85.7% and the maximum concentration of standard rate of 140%. This is caused by the impact from Chengnan Development Zone and transportation.

Monitoring Items Sulfur dioxide, nitrogen dioxide, particulate matter, ammonia, hydrogen sulfide, with a simultaneous meteorological observation of wind direction and wind speed.

Monitoring Points Layout set two monitoring points at 500m upwind and downwind direction of the proposed Visitors' Center, and four monitoring points at 500m upwind and downwind direction of the northwest and southwest of the city wall. Based on the requirement of the monitoring point layout principal, the location of the monitoring is shown in the Table 3-20, and the results of the atmospheric quality is shown in the Table 3-21.

Monitoring Frequency according to the project schedule, the monitoring is set to conduct in February 2015, continuously sampling for seven effective days; among which, taking hour average sample for 4 times of SO_2, NO_2, ammonia, and hydrogen sulfide; and taking daily average sample of SO_2, NO_2, PM10.

Table 3-20 Location of the Atmospheric monitoring

Number		Position	Direction of the site	Distance	Setup instructions
Vistors' Center	1#	Upwind	N	500m	Clean control point in upwind direction, 0 degree.
	2#	Downwind	S	500m	Control point in downwind direction, 180 degree
The yard in the northwest	3#	Upwind	N	500m	Clean control point in upwind direction, 0 degree.
	4#	Downwind	S	500m	Control point in downwind

Number		Position	Direction of the site	Distance	Setup instructions
corner					direction, 180 degree
Southwest corner	5#	Upwind	N	500m	Clean control point in upwind direction, 0 degree.
	6#	Downwind	S	500m	Control point in downwind direction, 180 degree

Table 3-21 Results of the Atmospheric monitoring

Area	Point No.	Item	Pollutant	Concentration range mg/m^3		Standard values mg/m^3	Over standard rate	The maximum concentration of standard rate	Demonstrating compliance
				Minimum value	Maximum value				
Vistors' Center	1	Hour value	SO_2	0.025	0.055	0.5	0	11%	Meet
			NO_2	0.015	0.029	0.2	0	14.5%	Meet
		Daily average value	SO_2	0.02	0.028	0.15	0	18.7%	Meet
			NO_2	0.014	0.019	0.08	0	23.75%	Meet
			PM_{10}	**0.105**	**0.214**	**0.15**	**85.7%**	**143%**	**Exceed**
	2	Hour value	SO_2	0.021	0.056	0.5	0	11.2%	Meet
			NO_2	0.013	0.026	0.2	0	13%	Meet
		Daily average value	SO_2	0.017	0.029	0.15	0	19.3%	Meet
			NO_2	0.013	0.018	0.08	0	22.5%	Meet
			PM_{10}	**0.096**	**0.21**	**0.15**	**85.7%**	**140%**	**Exceed**
The yard in the northwest corner	3	Hour value	NH_3	0.055	0.128	0.2	0	64%	Meet
			H_2S	——	0.003	0.01	0	30%	Meet
	4	Hour value	NH_3	0.046	0.106	0.2	0	53%	Meet
			H_2S	——	——	0.01	0	0	Meet
Southwest corner	5	Hour value	NH_3	0.046	0.108	0.2	0	54%	Meet
			H_2S	——	——	0.01	0	0	Meet
	6	Hour value	NH_3	0.041	0.123	0.2	0	61.5%	Meet
			H_2S	——	——	0.01	0	0	Meet

3.5.3 Acoustic environment

The monitoring results showed that, the noise environment of day and night in all the monitoring points can meet the requirements of category 2, 3, 4a of the Environmental Quality Standard for Noise (GB3096—2008) standards.

Monitoring Item Leq(A)

Monitoring Points Layout According to Environmental Quality Standard for Noise (GB3096-2008) and the principle of laying noise monitoring points in HJ2.4-2009, 16 monitoring points were set in the project area as following.

Table 3-22 Location of the Acoustic environment

Location	NO. of the points	Function	Notes
East Vistors' Center	4	Perimeter monitoring	The location of the Vistors' Center can be found in atmospheric monitoring points as a reference.

Location	NO. of the points	Function	Notes
The side facing Dongdi Street of the Catholic Church on Dongdi Street	1	Sensitive point	Area of category 2
Museum	4	Sensitive point	Perimeter area
A place proposed to pile bottom mud	5	Temporary occupy	Area of category 3
West gate	1	Occupy proposed to build a pump station	Area of category 2
Binyang Building	1	Occupy proposed to build a pump station	Area of category 2
Total	**16**		

Monitoring Frequency An one-time measurement is set to be conducted in February, 2015, monitoring the noise of day (8:00-11:00) and night (22:00 - 4:00 the next day), and recording the main noise source and the characteristic of the surrounding environment.

NO.	Monitoring points	Monitoring date	Monitoring results	
			Day dB(A)	Night dB(A)
1	North of the northeast Vistors' Center	February 12, 2015	58.4(65)	46.9(55)
2	West of the northeast Vistors' Center		59.8(65)	49.2(55)
3	South of the northeast Vistors' Center		61.3(70)	48.2(55)
4	East of the northeast Vistors' Center		57.5(65)	45.9(55)
5	The side facing Dongdi Street of the Catholic Church on Dongdi Street		55.6(60)	45.3(50)
6	North of the perimeter of Jingzhou Museum		50.8(60)	45.4(50)
7	West of the perimeter of Jingzhou Museum		52.6(60)	47.2(50)
8	South of the perimeter of Jingzhou Museum		53.1(70)	49.0(55)
9	East of the perimeter of Jingzhou Museum		53.0(70)	47.4(55)
10	Storage yard 1		56.2 (65)	43.3(55)
11	Storage yard 2		55.1 (65)	42.9(55)
12	Storage yard 3		56.8 (65)	42.1(55)
13	Storage yard 4		52.1 (65)	42.1(55)
14	Storage yard 5		51.5 (65)	41.6(55)
15	West gate		53.7 (60)	42.3 (50)
16	Binyang Building		51.6 (60)	42.0 (50)
The figures in the brackets are standard values, and those outside are measured values.				

3.5.4 Groundwater

As shown in Table 3-23, among the present situation of the groundwater well point on Minzhu Street, ammonia nitrogen and Mn exceed the standard for *ground water of* category III in *Quality Standard for Ground water* (GB/T14848-93), and other items all meet the requirements of standard for *ground water of* category III. The main reason that Ammonia nitrogen and Mn exceed standard is that the ground water in this area is related to surface water system of the city which also exceed standard.

Monitoring items According to Technical Specifications for Environmental Monitoring of Groundwater (HJ/T 164-2004), the monitoring items include: pH, total hardness, total dissolved solids, potassium permanganate index, ammonia nitrogen, nitrate, nitrite, volatile phenol, total cyanide, Fe, Mn, Pb, Cd, As, Hg, Cr^{6+}, 17 items in all.

Monitoring Frequency A one-time monitoring is conducted in February 2015 according to Technical Guidelines for *Environmental Assessment-Groundwater Environment* (HJ610-2011).

Table 3-23 The List of the standard indexes of groundwater monitoring results

Item	The Vistors' Center of the west gate	
	Measured value	Standard value
pH	7.45	6.5~8.5
Total hardness	242	≤450
Total dissolved solids	159	1000
Potassium permanganate index	1.7	3
Ammonia nitrogen	2.46	0.2
Nitrate	1.26	20
Nitrite	0.004	0.02
Volatile phenol	Not detected	0.002
Total cyanide	Not detected	0.05
Fluoride	0.306	1
Fe	0.07453	0.3
Mn	0.1198	0.1
Pb	Not detected	0.05
Cd	Not detected	0.01
As	Not detected	0.05
Hg	Not detected	0.001
Cr^{6+}	0.006	0.01

3.5.5 Sediment

Since the moat and water body within city mainly receive domestic sewage discharged directly from surrounding areas, the main pollution factor is domestic sewage, rather than industrial pollution sources. In addition, by getting the point upon distribution of dredging area of the moat and lakes within the city, the moat flows by water supply from Gangnan Canal, interval drainage from Jingsha River and water exchange with Taihu Canal through Liumen Pump Station, while the lakes within the city has poor fluidity and is independent water body. Therefore, two sediment monitoring is selected for the moat, and one sediment monitoring is for water body within the city. All sampling point is divided into three layers to sampling for analysis of sediment quality in different points and layers.

Monitoring items The analyzing items of sediment samples include: physicochemical index (PH value, moisture content), total nutrient index (total nitrogen, total phosphorus, total potassium), organic matter, heavy metal index (mercury, zinc, copper, cadmium, lead, total chromium, total selenium, nickel, arsenic); organic contamination index (fluoride, cyanide), with 17 items in all.

Monitoring points layout

Sampling Time: June 5, 2014					Weather: Cloudy	
NO.	Watercourse name	The location of sludge and mud sampling point	Color	Taste and odor	Latitude and Longitude of the sampling point	
					N	E
1#	City moat	500m east of the south gate H>0.6	Gray	Stench	30°20′59.94″	112°11′31.89″
	City moat	500m east of the south gate 0.3<H≤0.6	Gray	Stench		
	City moat	500m east of the south gate H≤0.3	Gray	Stench		
2#	City moat	100m east of the new north gate	Gray	Stench	30°21′8.67″	112°10′39.01

Sampling Time: June 5, 2014					**Weather: Cloudy**	
NO.	**Watercourse name**	**The location of sludge and mud sampling point**	**Color**	**Taste and odor**	**Latitude and Longitude of the sampling point**	
		H≤0.3				″
	City moat	100m east of the new north gate 0.3＜H≤0.6	Gray	Stench		
	City moat	100m east of the new north gate H＞0.6	Gray	Stench		
3#	City moat	Sediment of the west lake H≤0.3	Gray	Stench	30°21′11.4″	112°10′21.36 ″
	City moat	Sediment of the west lake 0.3<H≤0.6	Gray	Stench		
	City moat	Sediment of the west lake H>0.6	Gray	Stench		

Monitoring Method The monitoring method is mainly according to *The Technical Specification for Soil Environmental Monitoring* (HJ/T166—2004), *Environmental Quality Standard for Soils* (GB15618-1995), *Soil Agricultural Chemistry Analysis* (The third edition) (China Agriculture Press) and *Determination Method for Municipal Sludge in Wastewater Plant.* The analytical method is as shown in Table 3-24.

Table 3-24 Analyzing methods of pollutant in lacustrine sediment

No.	**Item**	**Measuring method**	**Detection limit (mg/kg)**
1	Ph value	Glass electrode	——
2	Moisture content	Frozen difference	——
3	Total nitrogen	Wet combustion method (Kelvin method)	——
4	Total phosphorus	NaOH molten-molybdenum antimony colorimetric method	10
5	Organic matter	Potassium dichromate volumetric method—outer addition method	——
6	Total potassium	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	0.01ppm
7	Hg	Determined with atomic fluorescence, after digestion with nitric acid-sulfuric acid-vanadium pentoxide	0.025
8	Zn	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	0.5
9	Cu	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	1.0
10	Cr	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	1.0
11	Pb	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	0.4
12	Total chromium	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	0.3
13	Total selenium	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	0.1
14	Ni	Determined with ICP-MS , after digestion with hydrochloric acid-nitric acid-hydrofluoric acid-perchloric acid	2.5
15	As	Determined with atomic fluorescence, after digestion with sulphuric acid-nitric acid-perchloric acid	0.01
16	Fluoride,	Fluorinating reagent spectrophotometric	0.05ppm
17	Cyanide	after distillation-Isonicotinic acid-pyrazolone colorimetric method	0.02ppm

Monitoring Result It is conducted that a field sampling to the sediments of each river, the monitoring results and evaluation of the sediment pollution indexes are as shown in table 2.5-12.

(1) Compliance with the Grade II of *Environmental Quality Standard for Soils (*GB15618-1995)

As shown in Table 3-25, the pH of each monitoring point is 6.5~7.5; At each monitoring point, the indexes of copper, lead, total chromium, arsenic all meet the requirements of the secondary standard in Environmental Quality Standard for Soils (GB15618-1995). Among them, the maximum pmax of copper is 51.7% (500m east of the south gate, H>0.6); the maximum pmax of lead is 31.5% (100m east of the new north gate, H＞0.6), the maximum pmax of arsenic is 8.3% (100m east of the new north gate, H＞0.6). All the pmaxes are relatively low.

In addition, mercury, zinc, cadmium, nickel exceed standard to different degree. For mercury, 8 of the 9 monitoring points exceed standard, only point 2-1 is with pmax of 94.8%; pmax of others are 111%~570%. For zinc, 9 monitoring points all exceed standard, with the pmax of 100%~139.6%. For cadmium, 5 of the 9 monitoring points exceed standard, with pmax of 121%~181.33%; and 4 of the other monitoring points are with the pmax of 62.33%~88.67%. Nickel is only detected in 3 monitoring points of 1-1~3, which are with the pmax of 77%, 95.8%, 164.8% respectively. In monitoring point 1-3, nickel is 64.8% beyond the standard limit.

Overall, in each monitoring point, mercury, zinc, cadmium, nickel exceed the secondary standard of *Environmental Quality Standard for Soils (*GB15618-1995*)*; and copper, lead, total chromium, arsenic all meet the secondary standard of *Environmental Quality Standard for Soils(*GB15618-1995*).*

(2) Compliance with *Control Standards for Pollutants in Sludges from Agricultural Use(*GB4284-84*)*

As shown in Table 3-25, in each monitoring point, the indexes of mercury, zinc, copper, cadmium, lead, total chromium, nickel, arsenic all meet the requirements of the highest allowable content in neutral and alkaline soil (pH≥6.5) of *Control Standards for Pollutants in Sludges from Agricultural Use(*GB4284-84*),* and the pmax of each pollution index is relatively low, which in the 9 monitoring point are below 50%. Among them, the highest pmax of mercury occurs in point 2-2, which is 19%; the highest pmax of of zinc occurs in point 3-3, which is 34.9%; the highest pmax of copper occurs in point 2-3, which is 37.6%; the highest pmax of cadmium occurs in point 3-2, which is 2.72%; the highest pmax of lead occurs in point 2-3, which is 9.46%; the highest pmax of total chromium occurs in point 1-2, which is 28.8%; the highest pmax of nickel occurs in point 1-3, which is 41.2%; the highest pmax of arsenic occurs in point 1-1, which is 3.32%

All the sediment monitoring indexes meet the requirements of *Control Standards for Pollutants in Sludges from Agricultural Use (*GB4284-84*), the* sediment of all dredging points can be used in farmland.

(3) Compliance with Table 6 of *Discharge Standard of Pollutants for Municipal Wastewater Plant (*GB18918-2002*).*

According to Table 3-25, the indexes of mercury, zinc, copper, cadmium, lead, total chromium, nickel, arsenic of all monitoring points meet the requirements of the highest allowable content of table 6 in *Discharge Standard of Pollutants for Municipal Wastewater Plant* (GB18918-2002).

Because the index and limiting value of this standard is similar to *Control Standards for Pollutants in Sludges from Agricultural Use (*GB4284-84*) (only* Zn is different, the former is 3000mg/kg, the latter is 1000mg/kg)*,* so we don't analyze it in detail here.

(4) Compliance with *The Disposal of Sludge from Municipal Wastewater Plant-The Quality of Sludge Used for Afforestation in Gardens or Forests* (GB/T23486-2009).

According to Table 3-25, the indexes of mercury, zinc, copper, cadmium, lead, total chromium, nickel, arsenic at all monitoring points meet the requirements of pollution index and limitation in table 4 of *The Disposal of Sludge from Municipal Wastewater Plant-The Quality of Sludge Used for Afforestation in Gardens or Forests* (GB/T23486-2009).

At the 9 monitoring points, the organic content of the sediment (the highst one is 2.58%) can't meet the requirements that the nutrient index should be ≥25% in table 2 of *The Disposal of Sludge from Municipal Wastewater Plant-The Quality of Sludge Used for Afforestation in Gardens or Forests* (GB/T23486-2009).

The content of nitrogen and phosphorus in the sediment at monitoring points 1-1 (0.37), 1-3 (0.322), 3-1 (0.375), and 3-3 (0.643) conforms to the limitation requirement for nutrients of ≥0.3% in Table 2 of the standard GB/T23486-2009, Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge Used in Gardens or Parks. At monitoring points 1-2, 2-1, 2-2, 2-3 and 3-2, the content of nitrogen and phosphorus does not conform to such limitation requirement for nutrients.

At all the monitoring points, the water content in sediment does not conform to the physical and chemical property requirement of <40% in Table 2 of the standard GB/T23486-2009, Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge Used in Gardens or Parks. The monitoring point with the lowest water content is 2-2 (72.1%). Therefore, dry the sediment at the 9 monitoring points until the water content reduces to lower than 40%, then add in an appropriate amount of organic fertilizer, and add in N, K and P in sediment at monitoring point 1-2, 2-1, 2-2, 2-3 and 3-2, and the sediment can be used for the construction and maintenance of urban green space system or suburban forest land.

(5) Compliance with standard GB/T23485-2009 Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Landfilling

As can be seen in Table 3-25, the content of heavy factors including mercury, zinc, copper, cadmium, lead, total chromium, nickel and arsenic in the sediment at all the monitoring points conforms to Table 2 Pollutant Indicators and Limitation Requirement of standard GB/T23485-2009 Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Landfilling.

At all the monitoring points, the content of cyanide in the sediment conforms to Table 2 Pollutant Indicators and Limitation Requirement of standard GB/T23485-2009 Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Landfilling. Cyanide was detected only at monitoring point 1-1 and at other monitoring points no cyanid was detected.

At all the monitoring points, the water content in sediment does not conform to the limitation requirement of <60% in Table 1 of standard GB/T23485-2009 Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Landfilling. The monitoring point with the lowest water content in sediment is 2-2 (72.1%). Therefore, dry the sediment at all the monitoring points until the water content reduces to lower than 60%, then the sediment can be transported to urban domestic garbage landfill and landfilled together with domestic garbage in a certain proportion.

(6) Analysis on complice with standard HJ350-2007 Standard of Soil Quality Assessment for Exhibition Sites (Interim)

As seen in Table 3-25, the content of heavy metals including mercury, zinc, copper, cadmium, lead, total chromium, nickel, selenium and arsenic in the sediment at all the monitoring points conform to the Pollutant Indicators and Limitation Requirements of standard HJ350-2007 Standard of Soil Quality Assessment for Exhibition Sites (Interim).

At all the monitoring points, the content of cyanide in the sediment conforms to the Pollutant Indicators and Limitation Requirements of standard HJ350-2007 Standard of Soil Quality Assessment for Exhibition Sites (Interim). Cyanide was detected only at monitoring point 1-1 and at other monitoring points no cyanid was detected. Therefore, the quality of sediment in the project area can satisfy the quality requirements for soil used for construction of wetland and revetment.

Table 3-25 Monotoring results of sediment

Indicator		pH	Water content (%)	Organic matter (%)	Cyanide (mg/kg)	Total nitrogen (%)	Total phosphorus (%)	Mercury (mg/kg)	Zinc (mg/kg)	Copper (mg/kg)	Cadmium (mg/kg)	Lead (mg/kg)	Total chromium (mg/kg)	Total selenium (mg/kg)	Nickle (mg/kg)	Arsenic (mg/kg)
1#	1-1 500m to the east of South Gate, H≤0.3	7.56	93	2.37	0.007	0.159	0.211	0.556	274	64.8	0.187	72.4	238	0.389	38.5	2.49
	1-2 500m to the east of South Gate, 0.3<H≤0.6	7.53	87.3	2.38	——	0.113	0.166	0.587	311	94.7	0.363	76.6	288	0.452	47.9	1.92
	1-3 500m to the east of South Gate, H>0.6	7.63	96.1	2.58	——	0.153	0.169	1.27	345	103.4	0.44	89	205	0.437	82.4	0.88
2#	2-1 100m to the east of New North Gate, H≤0.3	7.81	99	1.84	——	0.118	0.138	0.474	268	53.9	0.266	82.6	——	——	——	——
	2-2 100m to the east of New North Gate, 0.3＜H≤0.6	7.79	72.1	2.03	——	0.101	0.12	2.85	343	89.1	0.187	70	——	——	——	——
	2-3 100m to the east of New North Gate, H ＞0.6	7.72	91	1.75	——	0.103	0.134	0.829	332	188	0.206	94.6	——	——	——	——
3#	3-1 Sediment in West Lake H≤0.3	7.59	88.4	0.868	——	0.189	0.186	1.02	250	47.4	0.392	81.9	——	——	——	——
	3-2 Sediment in West Lake 0.3<H≤0.6	7.8	79.6	0.408	——	0.126	0.115	0.741	297	69.9	0.544	49.3	——	——	——	——
	3-3 Sediment in West Lake H>0.6	7.57	85.8	0.659	——	0.415	0.228	1.59	349	88.5	0.531	61.3	——	——	——	——
Level II standard in GB15618-1995 Environmental Quality Standard for Soils		6.5~7.5	——	——	——	——		0.5	250	200	0.3	300	300	——	50	30
GB4284-84 Control Standards for Pollutants in Sludge from Agricultural Use		≥6.5	——	——	——	——		15	1000	500	20	1000	1000	——	200	75
GB18918-2002 Pollutant Discharge Standard of Municipal Wastewater Plants		≥6.5	——	——	——	——		15	3000	1500	20	1000	1000	——	200	75
GB/T23486-2009 Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge Used in Gardens or Parks		≥6.5	40	≥25	——	≥0.3		15	4000	1500	20	1000	1000	——	200	75
GB/T23485-2009 Disposal of Sludge from Municipal Wastewater Plant – Quality of Sludge for Co-Landfilling		5~10	60	——	10	——		25	4000	1500	20	1000	1000	——	200	75
HJ350-2007 Standard of Soil Quality Assessment for Exhibition Sites (Interim)		——	——	——	8	——		50	1500	600	22	600	610	1000	2400	80

3.6 Useful public infrastructure for the project

3.6.1 Water supply engineering

Jingzhou Municipal has three water plants: Liulin, Nanhu and Yingdu. With a water supply capacity of 550,000 m^3 per day, these plants supply water for industrial production and daily use of 900,000 residences in the central urban region as well as surrounding towns and villages of Jingzhou Municipal.

All the plants use raw water from the Yangtze River, the water quality of which can reach the Class II water quality standard of the *Surface Water Quality Standard* throughout the whole year. Currently the water quality of the raw water is sound, and the comprehensive qualified rate of the supplied water is 100%.

Table 3-26 Location, area, water-intake location and water supply capacity of the current water plants

Administration	Water plant	Location	Floor area	Pressure of finished water (MPa)	Supply capacity (10,000 m^3)
Shashi	Liulin Water Plant	East of Liulinzhou	58,000 m^2	0.34	30
	Nanhu Water Plant	No. 9, Nanhu Road	85,000 m^2	0.34	15
Jingzhou	Yingdu Water Plant	Xuetangzhou	85,000 m^2	0.36	10

3.6.2 Drainage project

(1) Chengnan sewage district

The south and west area of the Jingzhou Historic Town were originally used for farming, scientific research and education. Recently, due to the development of the Chengnan Development Zone and Jingxi Industrial Park as well as urban expansion, this area enjoyed fast development. In 2009, Chengnan Sewage Plant Phase I was built to the south of Jingli Road and the west of Jiuyang Avenue. The disposal capacity is 50,000 m^3/ day. Based on the improved oxidation ditch technique, it mainly treats the sewage of the local region.

Currently Chengnan Sewage Plant remains in stable operation. In 2013 it collected waste water of 17.31 million m^3 in total. Average daily disposal is about 47,400 m^3. The quality of effluent water by Chengnan Sewage Plant is shown in the following Table 3-27.

Table 3-27 Average monthly water quality of Chengnan Sewage Plant in 2013

Month	1	2	3	4	5	6	7	8	9	10	11	12	1^{ST} Class B
COD	14.8	21.1	23.5	23.2	23.6	20.9	21.2	22.8	23.4	23.1	22.9	23.3	60
BOD	6	6	8	7.6	8.24	7.3	7.33	7.98	7.48	8.08	8.02	8.14	20
Ammonia nitrogen	0.44	1.77	3.33	0.352	1.56	0.519	0.142	0.498	1.55	2.3	1.78	0.098	8

Month	1	2	3	4	5	6	7	8	9	10	11	12	1ST Class B
TN	4.01	4.53	3.54	6.7	3.06	6.11	2.46	1.83	1.93	3.24	3.56	3.49	20
TP	0.175	0.412	0.034	0.032	0.159	0.279	0.269	0.03	0.014	0.032	0.071	0.154	1

(2) Caoshi sewage district

In 2009 Caoshi WWTP Phase 1 was built to the east of Chudu Avenue and north bank of the Taihugang Channel. The disposal capacity is 30,000 m^3/ day. Based on the improved oxidation ditch technique, it mainly treats the sewage of Jingzhou Historic Town and Wudelu District. Currently the pipe network of the Jingzhou Historic Town has established a sound capture-typed confluence sewage treatment system. The waste water from Jingzhou Historic Town converges with the waste water from the west side of Wude Road through the Jingsha Avenue sewage main pipe, and then enters Caoshi WWTP from the Caojiao Road sewage pipe through the Taihugang Channel.

Currently Caoshi WWTP remains in stable operation. In 2013 it collected sewage of 9.83 million m^3 in total. Average daily disposal is about 26,900 m^3.

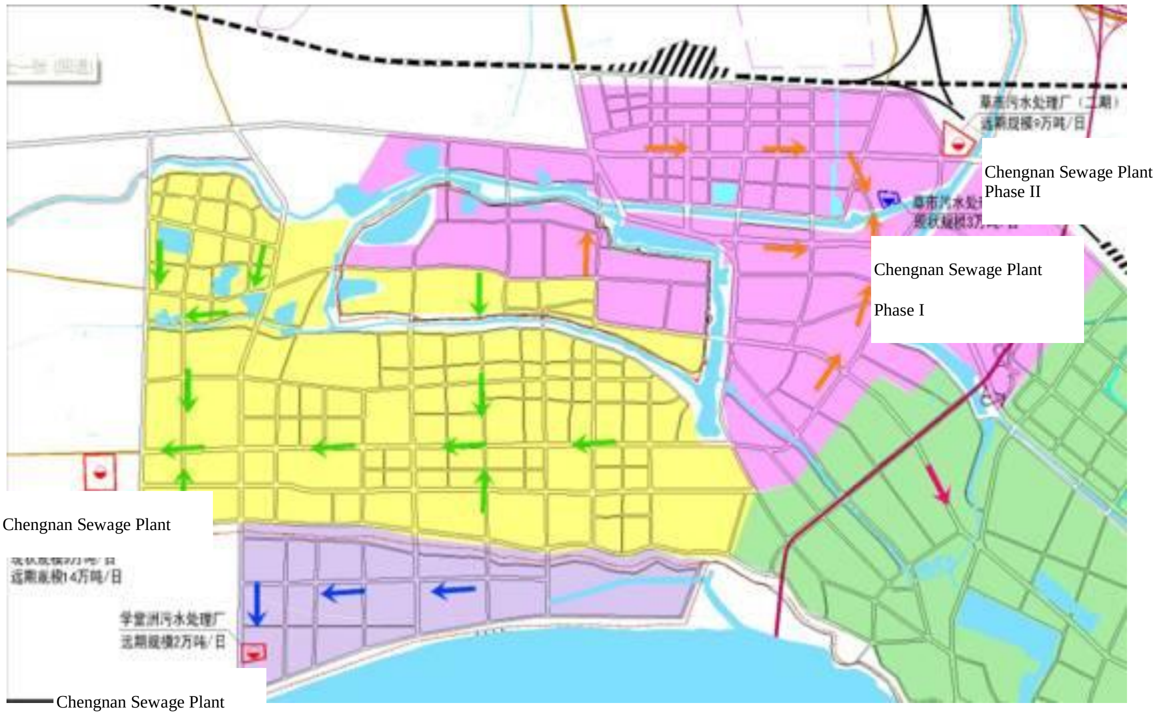


Figure 3.6-1 Map of sewage distribution in the historic town

3.6.3 Gas engineering

Except for a middle-pressure gas pipe along the Taqiao Road, there is no high-pressure or middle-pressure gas network on any other roads. Consequently, gas supply for residents and commercial users comes from multiple sources: natural gas, liquefied petroleum gas, and coal, etc.

3.6.4 Electrical power engineering

Currently there are 3 power supply sources in the historic town area: 220 KV Jinan Transformer Substation, 110KV Longtan Substation and 110KV South Gate Substation. The 10KV distribution network within the historic town district has backward structure and messy line routes, and mostly are overhead. The lines routes of the 10KV network supply electricity in a branch-like open network to the users.

3.6.5 Solid waste disposal system

Currently, the household garbage of Jingzhou Municipal is mainly disposed by the household garbage incineration project of Jimei Thermal Power Co., Ltd. This incineration project is located at the Paima Village, Jinan Town, Jingzhou Municipal (Shown in the next figure), and it is about 7km away from the historic town. The construction content includes 2 sets of 48.5t/h density-type circulating fluidized bed boiler, 1×12MW steam turbine generator unit, 1×6 MW steam turbine generator unit, gas treatment devices, landfill leachate collection, and second-class sewage treatment station. Daily disposal capacity is 1000 tons. In May 2012, the project was put into operation upon acceptance of the Hubei Provincial Environmental Protection Bureau.

Figure 3.6-2 Location of the Jimei Waste Incineration Power Generation Project (Location A)

3.6.6 Current Status of Xiongjiazhong Tomb

Xiongjiazhong Tomb is located in the Zhangyang Village, Chuandian Town, Jingzhou District, Jingzhou Municipal, Hubei Province. The major construction content includes: ancient tomb excavation (founding of archaeological workstation, investigation and exploration, excavation of pit for sacrifices and chariot and horse pit, major mound and accompanying mound), demonstration center (main entrance square, comprehensive service center, office area of museum, and burial area).

As for household garbage in the mound area, after collected by the garbage collection center, it is transferred to the Jimei Waste Incineration Power Generation Project for disposal. The earthwork excavated for archaeological studies should be flattened onsite. Currently construction of the wastewater disposal facilities and garbage collection facilities for Xiongjiazhong Tomb has not started yet.

3.6.7 Planned water diversion project

Water Transfer Project from the Yangtze River to Han River is about 67.23 km long, with 27.05 km within the territory of Jingzhou Municipal. The project within the territory of Jingzhou mainly covers five components: Longzhouyuan (water intake) project, the channel works, key crossing projects, water replenishment project of Dongjing River, Jingzhou (front) control dispatch center project. At the same time, within Jingzhou, there are also land acquisition and housing demolition project, river restoration, cultural heritage conservation, land reclamation, environmental protection, urban construction and other special compensation programs.

The canal of Water Transfer Project from the Yangtze River to Han River is designed to have water diversion flow of 350 cubic meters per second, and the maximum water flow can reach 500 cubic meters per second. The central government has approved Jingzhou Municipal to establish drainage sluice gate in Konan, giving 10 cubic meters per second water flow to compensate the local region and improve its water environment.

3.7 Major environmental problems in the project area

The main environmental problems in the project area are shown in the Table 3-28 below.

Table 3-28 Environmental condition in the Jingzhou historic town area

City	Subcomponent	Current conditions of the area	Waste water discharge condition
Jingzhou Municipal	Preservation of cultural heritage and promotion of tourism development	The overall layout of the historic town walls and gate towers is not integral and some parts are seriously damaged. The artistic value of the ancient wall architectures is not sufficiently explored and protected. The coverage rate of retaining wall in the soil city wall is low and the protection for the soil city wall is insufficient. There are abundant plants on the wall, some of which threaten the stability of the wall; there is serious conflict between land use and the population inside the historic town. The living environment inside the historic town is crowded and the traffic there is heavy. The tourist road at Xiongjiazhong Tomb is not convenient and the popularity and exhibition performance of the mound need to be enhanced. The spatial pattern of tourism is not clear and the key development area is not outstanding. The touris market needs to be explored and the key tourism systems need to be improved. The development and management of tourism of the historic town is not unified and comprehensive benefit of tourism is not significant.	Waste water discharge mainly include direct discharge of treated water from Chengnan WWTP (15.4258 million m^3/a) and direct discharge of domestic sewage (8.2466 million m^3/a)
	Improvement of ecological environment and water environment of the Historic	The discharge of a large amount of municipal domestic sewage and garbage and other pollutants has caused serious pollution of water systems. The buildings inside the historic town have led to separation and reduction of water systems. Biodiversity degree in the rivers is low and the self-cleaning capacity of ecological systems	

City	Subcomponent	Current conditions of the area	Waste water discharge condition
	Town	has been lost. The pollution from inside the sediment cause serious pollution to the water in the area. The sewage treatment ability of the existing sewate plants need to be enhanced.	
	Upgrade of transport convenience of the Historic Town	The current road layout inside the historic town is not fit for the future tourism development plan and land use layout. Some sections of the Inner Ring Road are seriously damaged. The distribution of layers of road networks in the area is not reasonable and there is a serious lack of sub-trunk road and branch. Traffic on the road networks is concentrated too much. The existing parking facilities are in serious shortage.	

The current conditions of the areas are as shown in the pictures below. The current conditions indicate that protection of environment and cultural relics demand urgent solutions.

Figure 3.7-1 Current conditions of the moat and the West Lake

Figure 3.7-2 Section of a typical wall and construction technology

Figure 3.7-3 Current conditions of pinion wall and abutment wall

Figure 3.7-4 Current conditions of vegetation on the walls

Figure 3.7-5 Sewage discharge outlets

Figure 3.7-6 Current conditions of historic blocks

Figure 3.7-7 Current conditions of Kaiyuan Taoist Temple

Figure 3.7-8 Current conditions of the museum

Figure 3.7-9 Current conditions of Xiongjiazhong Tomb

Figure 3.7-10Current conditions of the land planned for visitors’ center

Figure 3.7-11 Current conditions of the water diversion from the Yangtze River to the Han River

Figure 3.7-12 Current conditions of the surface of Inner Ring Road

Figure 3.7-13　　Dirt road section of the Inner Ring Road

Figure 3.7-14　　Car parking condition inside the historic town

Figure 3.7-15　　Traffic conditions of Jingzhou Middle Road and the East Gate

4 ALTERNATIVE ANALYSIS OF THE PROJECT

The comparison encompasses both comparisons of schemes and with/without project comparisons. The former includes: the schemes for each process of dredging (including methods for dredging, dehydration, and final outcome of sludge), water body connections, and wetland systems.

4.1 With/without project comparison

Scenario 1: with the project; Scenario 2: without the project. The results are shown in Table 4-1.

Table 4-1 With/without project comparison

	Scenario 1 (with project)	Scenario 2 (without project)
Pros	(1) Protection/development of affected cultural heritage guided by World Bank principles. (2) Environmental improvement; higher quality of life; economic development; sustainable tourism for the historic town. (3) Compliant with Jingzhou's planning for tourism & preservation. (4) Creating opportunities for the 3rd sector. (5) Supporting the new city regions' development. (6) Emphasis on social equality. Most interviewed residents are supportive. (7) Negative environmental impacts can be mitigated by protective measures.	(1) Conservative approach to maintaining the cultural heritage, avoiding destruction from inappropriate development. (2) Maintaining current state of environment & land use, avoiding negative environment impacts from construction & operation of the project.
Cons	(1) Pollutants including dusts, wastewater, noise, solid wastes, etc; impacting vegetation and landscape; water & soil loss. (2) Permanent occupation of land areas; noise from pump station operation; emission from underground carpark; other long-term impacts. (3) Tourist impacts: commercialization of local culture; impacts from inappropriate tourist behavior; environmental pressure from increase in tourists.	(1) Cultural heritage: no support for further inheritance and development. (2) Social economy: no support for social development & economic optimization; underutilization of cultural resources; lack of improvement for infrastructure. (3) Environmental quality: greater social development pressure will worsen the environmental quality.
Conclusion	The project will result in further protection of Jingzhou's cultural heritage and growth of tourism under the gujdance of WB principles, and allow the further increase of Jingzhou's international fame. The short-term impacts can be mitigated or avoided via environmental management. Scheme 1 is advised. Scheme 2 can prevent impacts caused by the project undertaking. However, in the long term, Jingzhou's deficiency in infrastructure will not benefit the preservation of cultural heritage or the improvement of society and quality of life. Scheme 2 is not advised.	

It can be seen that while the project will create some environmental impacts during construction and operation, these spatially and temporally limited impacts can be prevented or minimized, and large scale negative impacts can be avoided. In the long-term, the project can improve the sustainable tourism of the region, increasing the residents' quality of life. The residents are also supportive of the project. It can be concluded that the project will have a positive effect.

4.2 With/without project comparison

4.2.1 Comparison of dredging methods

(1) Scheme 1: wet dredging, supplemented with dry dredging

Scope of wet dredging:

K1+600~K2+516 section (Old South Gate), K5+375~K11+137 section (west gate ~east gate section), west lake;

Scope of dry dredging:

City moat pile No. K2+516 (Old South Gate) ~K5+375 (west gate) and fish pond, and water ponds in the northeast, as shown in the following Figure 4.2-1:

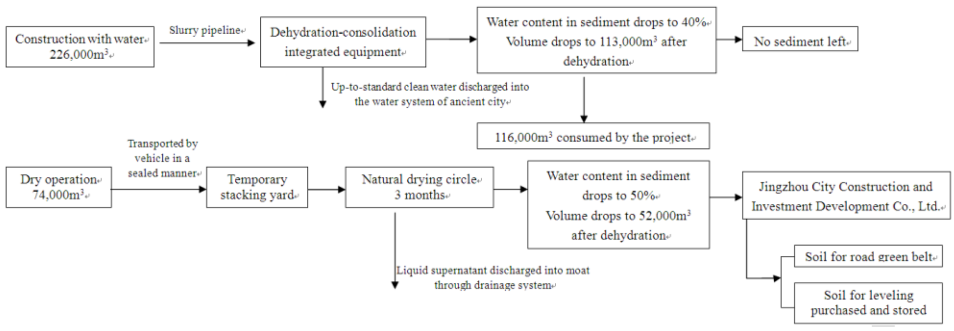


Figure 4.2-1 Dredging flow chart (Scheme 1)

(2) Scheme 2: full wet dredging, as shown in the following figure:

The proposed project adopts wet dredging method, which doesn't drain river and lakes. It adopts the ring cutter suction dredger or amphibious dredging machine (with pump head) to remove the bottom sediments. After being transmitted into the dredging tube from the pump head of dredging machine (ship), sludge can be transferred to the sediment dehydration consolidation station, northwest of No.K6+000 (Old South Gate), by relay pumping station along the way for mechanical dehydration. Water content in sediment after dehydration drops to 40%-50%, which can be used for wetland and revetment engineering of the proposed project.

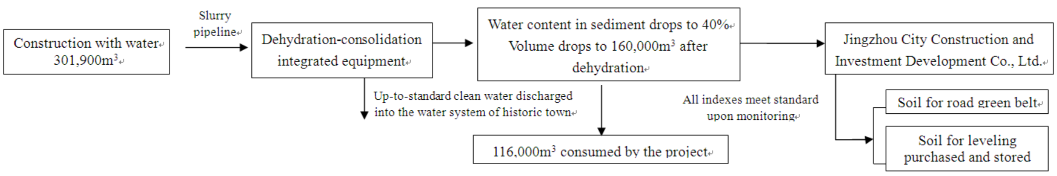


Figure 4.2-2 Dredging flow chart (Scheme 2)

A comparison is shown in Table 4-2.

Table 4-2 Comparison of dredging schemes

Scheme	Method	Pros	Conclusion
1	Wet dredging, supplemented by dry dredging	Dry dredging is inexpensive & easy to perform	Sludge can only be dehydrated by natural drying, which is time-consuming & occupying a large area; secondary pollution during transportation
2	Full wet dredging	One step completion of digging, transportation & disposal; continuous operation; multiple dehydration options better for reutilization of sludge; small environment impact using sludge tubes and pumps.	High cost

A comparison is shown in Table 4-3.

Table 4-3 Comparative analysis for environmental impact

No.	Environmental factors	Scheme 1	Scheme 2	Preferred Scheme
1	Noise	No strong noise impact	No strong noise impact	Little difference
2	Aquatic environment	Requiring the drying of rivers & lakes; relatively strong impact	Direct wet operations, some impact	Scheme 2
3	Atmospheric environment	Dusts from dry operation and large-scale natural drying, with strong impact	No strong impact from full wet operation	Scheme 2
4	Planning compliancy	Yes	Yes	Scheme 2

As shown by Tables Table 4-2 and Table 4-3, while dry dredging is inexpensive and easy to conduct, the sludge can only be dehydrated via natural drying, which occupies a large land area for a long time, with potential secondary pollution from the transportation. Wet dredging is costly but less environmentally impactful, with multiple options for sludge clearing, which makes the operation more flexible for further reutilization of the sludge. Scheme 2's combination of sludge tubes and pump stations also incur a smaller environmental impact. Scheme 2 is recommended.

4.2.2 Comparative analysis on sludge dehydration schemes

Since the sludge dredged has high moisture content, dehydration is required before disposal. Three schemes have been suggested.

(1) Scheme 1: mobile dehydration facility.

A dehydration vessel can be dragged by the dredging vessel. The former is equipped with dehydration equipment, chemical additives, slurry disposal, and dry sludge transportation. On the dehydration vessel, the sludge are diluted, flitered of large particles, lifted by a slurry pump for separation of sand and water, and delivered to the dehydration machine. The dehydrated sludge and sands are transmitted to another vessel or land vehicles, then moved to temporary stockyards for natural drying. The vessel can reduce the moisture content of sludge to as low as 60%.

(2) Scheme 2: natural drying

The sludge is moved to the temporary stockyards for natural drying with only evaporation and local permeation. Natural drying is time-costly due to the high moisture content and limited size of stockyards. Based on JIngzhou's evaporation rate from July 2013 (July being the month with highest evaporation rate in a year), 1m2 of stockyard has a total evaporation of 177.4mm (or 0.18m2). Even with all temporary stockyards occupied simultaneously (total area 50,000m2), the maximum monthly evaporation is only 10,000m2, requiring 15 months before the moisture content can be reduced to 40%. This calculation has not even taken account of other factors such as precipitation.

(3) Scheme 3: combined dehydration and solidification.

The combined dehydration and solidification technology allows a 200m3/h rate for a single processing facility, which reduces the moisture to below 40%, lowering the costs for transportation and storage. Table 4-4 shows a comparative analysis.

Table 4-4 Comparative analysis of sludge dehydration schemes

Scheme	Process	Volume Reduction	Neutralization	Stabilization	Conversion into Resources	Cost	Land Area Occupation	Adaptability
Scheme 1 (dehydration vessel)	Dehydration only	Moisture 60%, small reduction	No neutralization	Less secondary pollution than natural drying	Still requiring natural drying before utilization	High	Small	Affected by river width and depth
Scheme 2 (natural drying)	Dehydration only	High moisture, little reduction	No neutralization	Prone to secondary pollution	Difficult to reuse	Low	Large	Suitable only to unpolluted sludge; affected by weather
Scheme 3 (one-step solidification)	Dehydration & solidification	Moisture <40%, large reduction	Harmful substances are contained and neutralized	No secondary pollution	Can be used in backfill	High	Small	Suitable for various sludge; unaffected by weather

The comparison of environmental impacts is shown in Table 4-5.

Table 4-5 Comparative analysis of sludge dehydration schemes

No.	Environmental factors	Scheme 1	Scheme 2	Scheme 3	Preferred Scheme
1	Noise	Some noise from dehydration &	Little impact from natural drying	Some noise during the dehydration	Scheme 2

No.	Environmental factors	Scheme 1	Scheme 2	Scheme 3	Preferred Scheme
		transportation, small impact			
2	Aquatic environment	Little impact on aquatic environment after the treating the residual water	Little impact from natural drying	Little impact on aquatic environment after the treating the residual water	Little difference
3	Atmospheric environment	Small impact	Affected by weather during the long drying period; small impact	Small impact	Scheme 1 or 3
4	Ecological impact	Small land occupation, high moisture, some impact	Large land occupation, strong impact	Small land occupation, low moisture, small impact	Scheme 3
5	Social impact	Odor from long natural drying period has large impact on the passersby	Odor from long natural drying period has large impact on the passersby	Less impact from odor due to short drying period	Scheme 3
6	Landscaping impact	Small area occupation has little impact on landscaping	Large area occupation impacts landscaping	Small area occupation has little impact on landscaping	Scheme 3
7	Planning compliacy	Yes	Yes	Yes	Little difference

Table 4-5 shows that Scheme 3, combined dehydration and solidification incurs a greater direct cost, but has notable advantages in land occupation, requirements on work sites, management, efficiency and time, meaning the overall cost is the lowest.

Table 4-5 shows that Scheme 3 has the advantages of a slow drying period, high efficiency, solidification and neutralization, and results in directly useable sludge, without secondary pollution.

The analysis shows that Scheme 3, combined dehydration and solidification should be used.

4.2.3 Final disposal of sludge

After dehydration, the sludge is suitable for final disposal. Four methods of sanitary landfill, incineration, and dumping and land utilization will be compared in the following table.

Table 4-6 Comparative analysis on the advantages and disadvantages of sludge disposal methods

No.	Way of disposal	Advantages	Disadvantages
Scheme 1	Landfill	Technology is mature; easy, convenient, low cost, and it does not require high dehydration of the sludge, highly applicable	Landfill of leachate may pollute the groundwater, and it may produce explosive gases; it cannot ultimately avoid environmental pollution, but only delay the time of pollution
Scheme 2	Incineration	Incineration is considered as the most thorough treatment of sludge. It can carbonize all the organic matter and kill pathogens, and can minimize the volume of	Higher investment and operating costs; ashes, slag and flue generated during the incineration has great impact on the environment; unable to reuse the useful components (TN, TP) in the

No.	Way of disposal	Advantages	Disadvantages
		sludge	sludge
Scheme 3	Dumping	Easy and energy-efficient	Pollution from the dumping sites may cause global environmental problems, and this method has been prohibited
Scheme 4	Reuse	Low investment, low energy consumption, low operating costs, and the organic part can be converted into soil conditioner	Potential risks in reusing sludge for farmland; immature research in this field in China

Table 4-7 Comparative analysis on environmental impact

No.	Environmental factors	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Preferred Scheme
1	Noise	Little noise	Little noise	Little noise	Little noise	Little difference
2	Impact on aquatic environment	Certain impact of leachate on underground water and surface water	Low impact	Prone to secondary water pollution	Low impact on surface water after reutilization	Scheme 2 or 4
3	Ecological impact	Low ecological impact, as the sludge enters the landfill site	Minimizes volume of sludge, low ecological impact	Largest area occupation, serious negative ecological impact	Good disposal of sludge; low ecological impact	Scheme 2 or 4
4	Social impact	Occupation of the capacity of the landfill site	Ashes, slag and flue has large environmental impact and has some social impact	Significant negative impact	Good disposal of sludge; low social impact	Scheme 4
5	Landscaping impact	Negative impact to surrounding landscaping	Minimizes volume of sludge, low landscaping impact	Negative impact to surrounding landscaping	Low landscaping impact	Scheme 4
6	Planning compliancy	Yes	Yes	No	Yes	Scheme 4

From the perspective of environmental protection, land reutilization of sludge after treatment can minimize the sludge volume, save the cost of land utilization. On the other hand, since the quality of the sludge reaches standards, it has no significant impact on the aquatic and ecological environment.

Based on consideration for transport priority interest, urban development, construction cost and environmental impact, it is recommended to reuse the sludge.

4.3 Alternative of water system connect schemes

The FSR has proposed two schemes for connecting the water systems in the historic town (see Table 4-8), with their comparison shown in Table 4-9.

Table 4-8 Comparison of water system channeling schemes

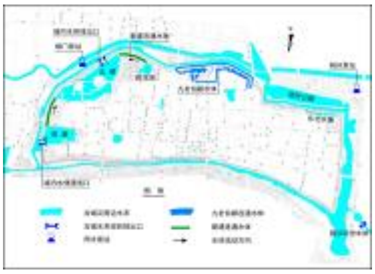
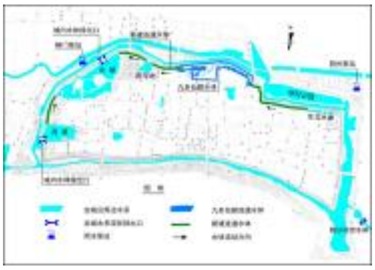
Scheme	Content	Features
Scheme 1 	Only connects major water bodies in the city such as west lake, north lake, Xima Pond, etc. The characteristic is that river connection line spares a relatively wide green belt and space, making it easier for project implementation and small project volume.	Partially connected
Scheme 2 	Connects all the river systems in the city, including west lake, north lake, Xima Pond and Jiulaoxiandu Lake in the northeast and all the ponds. Considering that the construction of Jiulaoxiandu Complex in the east of new North Gate in the historic town has integrated the surrounding river systems, it reduces the difficulty of connecting the small water bodies in the northeast.	All connected

Table 4-9 Comparative analysis of environmental impact

No.	**Environmental impact**	**Scheme 1**	**Scheme 2**	**Recommended Scheme**
1	Noise	Negative impact during construction; no impact during operation	Negative impact during construction; no impact during operation	Little difference
2	Impact on aquatic environment	According to the DHI's *Report on the Water Conservation and Water Quality Models*, Scheme 2 can better improve water quality than Scheme 1	According to the DHI's *Report on the Water Conservation and Water Quality Models*, Scheme 2 can better improve water quality than Scheme 1	Scheme 2
3	Ecological impact	By improving the water quality of west lake, north lake and horsepond, it can improve the environment for the living of aquatic organisms, and has little impact on the living of terrestrial organisms.	By improving the water quality of the entire historic town, it can improve the environment for the living of aquatic organisms, and has little impact on the living of terrestrial organisms.	Scheme 2
4	Social impact	Little social impact	Little social impact	Little difference
5	Landscaping impact	Good for landscaping	Good for landscaping	Little difference
6	Planning consistency	Consistent	Consistent	Little difference

With consideration for landscaping, construction and investment, it is recommended to adopt

Scheme 2, which is to connect all the water systems within the historic town. During construction, it has relatively less impact on the existing and planned river channels. During operation, as the ecological environment recovers, landscaping will also be improved.

From the perspective of environmental protection, during operation, both Scheme 1 and Scheme 2 have positive environmental impact, but the latter has larger positive impact. Scheme 2 is recommended.

4.4 Alternative of artificial wetland system schemes

Three schemes are proposed based on different possible types of wetlands.

Scheme 1: "West lake 1": surface flow; "north lakes2 to 4": horizontal subsurface flow; "north lake 5": aquatic habitat belt.

Scheme 2: "West lake 1": surface flow; "north lakes 2 to 4": surface flow; "north lake 5": aquatic habitat belt.

Scheme 3: "West lake 1": surface flow + vertical subsurface flow; "west lake 2 to 4": horizontal subsurface flow; "north lakes": surface flow.

The design parameters and the removal efficiency of the schemes are shown in Table 4-10 and Table 4-11

Table 4-10 Design parameters of constructed wetlands schemes of lakes and ponds within the historic town

Type	Designation	BOD_5 Load	Hydraulic Load	Hydraulic Retention Time	Area	Designed Flow rate	Remark
		kg/ha.d	m3/(m2.d)	d	10000 m2	m3/s	
Design parameters for west & north lake artificial wetlands (Scheme 1)							
Surface flow	West 1	100~150	0.1	7	5	0.10	Total water area: 60,000 m2; scenery decorations
Hor. sub. flow	North 2~4	120~200	0.4	2	3	0.10	Requiring digging a channel between No. 2&3, building a culvert bridge
Aquatic life belt	North 5	50~100	0.4	2	6	0.20	0.1m3/s from west lake & Xima Pond each
Design parameters for west & north lake artificial wetlands (Scheme 2)							
Surface flow	West 1	100~150	0.1	7	5	0.10	Total water area: 60,000 m2; scenery decorations
Surface flow	North 2~4	100~150	0.1	7	7	0.10	Requiring digging a channel between No. 2&3, building a culvert bridge
Aquatic life belt	North 5	50~100	0.4	2	6	0.20	0.1m3/s from west lake & Xima Pond each
Design parameters for west & north lake artificial wetlands (Scheme 3)							

Type	Designation	BOD5 Load	Hydraulic Load	Hydraulic Retention Time	Area	Designed Flow rate	Remark
		kg/ha.d	m3/(m2.d)	d	10000 m2	m3/s	
Design parameters for west & north lake artificial wetlands (Scheme 1)							
Hor. sub. flow	West 1	120~200	0.4	2	5	0.30	Total water area: 60,000 m2; scenery decorations
Vert. sub. flow	North 2~4	120~200	0.6	2	4	0.30	Requiring digging a channel between No. 2&3, building a culvert bridge
Aquatic life belt	North 5	50~100	0.4	2	8	0.40	0.3m3/s from west lake; 0.1m3 from Xima Pond

Table 4-11 Removal efficiency of constructed wetland of lakes and ponds of each scheme (top to bottom: Scheme 1, 2 and 3)

Scheme	BOD_5	COD_{Cr}	SS	TN	TP
Scheme 1	60	60	90	70	70
Scheme 2	50	50	85	60	60
Scheme 3	80	75	90	75	75

Based on DHI's hydrological model report for the historic town, the results of water quality improvement for the three schemes are shown in Table 4-12.

Table 4-12 Annual average water quality indicators post-wetland schemes

Scheme	Indicator	Historic town water system (incl. inner lakes) Annual average value of indicators (mg/l)					Water Quality Class
		COD_{cr}	BOD_5	NH_4-N	TN	TP	
Status Q (m^3/s)	Parameters	Comparison					
		30	6	1.5	1.5	0.3	IV
0.1 Scheme 1	Removal (%)	55	60	50	50	60	V
	Calculated Value	15.75	2.52	1.06	1.78	0.24	
	Reduction (%)	47.50	58.00	29.33	-18.67	20.00	
	Class	III	II	IV	V	IV	
0.1 Scheme 2	Removal (%)	50	55	45	45	55	
	Calculated Value	16.12	2.66	1.12	1.85	0.29	V
	Reduction (%)	46.27	55.67	25.33	-23.33	3.33	
	Class	III	II	IV	V	IV	
0.3 Scheme 3	Removal (%)	60	65	60	60	70	
	Calculated Value	13.47	2.07	0.8	1.33	0.18	IV

Scheme	Indicator	Historic town water system (incl. inner lakes) Annual average value of indicators (mg/l)					Water Quality Class
		COD_{cr}	BOD_5	NH_4-N	TN	TP	
	Reduction (%)	55.10	65.50	46.67	11.33	40.00	
	Class	II	II	III	IV	III	

Table 4-11 and Table 4-12 shows that Scheme 3 achieves the highest efficiency of pollutant removal. Given the initial condition of a Class IV water system, with only new pollution load from the tail water of Chengnan WWTP (i.e. in dry season, without any runoff pollution), the water system can reach Class IV quality with the purification of the wetlands, and all indicators except for TN are better than the Class III standard.

In order to minimize pollution load, enhance the self-cleaning capacity of the water body, it is recommended to use Scheme 3, the wetland plan with high removal efficiency.

5 ENVIRONMENTAL IMPACT ANALYSIS AND ASSESSMENT

5.1 Compliance with Industry Policies and Relevant Plannings

5.1.1 Analysis of compliance with industry policies

According to *Industrial Restructuring Guidance Catalogue* (2011) (Revised in 2013) issued by the National Development and Reform Commission of the People's Republic of China, "Dredging of rivers, lakes and reservoirs" and "Township drainage pipelines project" are encouraged projects, thus the proposed project is in compliance with related requirements of national industry policy.

5.1.2 Compliance with plannings

5.1.2.1 General Municipal Planning of Jingzhou Municipal (2011-2020)

The planning proposes to protect all the brick and earthen walls of Historic town and the moat, Sanyi Street-Desheng Street historic blocks, as well as historic blocks in South Gate Street of Historic town, CH sites of various levels and ancient architectures. In addition, the protection are classified in three levels: key protection areas, key coordination areas and ordinary coordination areas, according to the height, size, style and color of buildings in the Historic town; the protection targets in Historic town include nine traditional streets and one alley: Sanyi Street, Desheng Street, South Gate street, Zhangjuzheng Street, Fanrong Street, Binxing Street, Dongdi Street and Xidi Street, and Guandai Alley."

Component: Historic Town Preservation and Promotion of Tourism Development specifies the protection measures and schemes on the brick walls and earthen walls; the Component on water environmental improvement specifies the schemes to improve the water system of the historic town which is in line with the *General Municipal Planning of Jingzhou Municipal*.

5.1.2.2 Planning on the Protection of Jingzhou Historic town

This planning proposes to protect the structure and overall style of the historic town, style of historic blocks, CH sites, contemporary and modern architectures and industrial heritages, and national-level intangible CHs, so as to establish an integrated system to protect the Historic Town and the cultural heritages. The planning also demands careful protection of integral structure pattern of the town and the layout of streets and alleys, especially the belt-like layout of the streets and alleys of Shashi District so as to highlight its lanscape of Jingzhou as a "water city on the left side of Yangtze river".

During overall renovation and vegetation restoration of historic town, strict protection of overall structure of Historic town is carried out, and the project will focus on functional restoration of historic town water system, which is in line with the *Planning on the Protection of Jingzhou Historic Town*.

5.1.2.3 Special Regulatory Planning on the Redevelopment of Historic Town

This planning aims to achieve "functional adjustment, population decentralization, integrated protection and sound renovation", which focuses on environmental improvement and functional upgrading of Historic town, especially the urban functions of historic town as center of commerce, entertainment and tourism; functional upgrading can boost the economic development of Historic town; this planning defines historic town as" an integrated historic and cultural tourism center highlighing the ancient culture of Chu civilization and Three Kingdoms and water culture".

The proposed project supports local tourism development, which will promote urban economic development, so it is also in line with the *Special Regulatory Planning on the Redevelopment of Historic Town*.

5.1.2.4 General Planning on the Tourism Development of Jingzhou Historic Town

This planning is still approval pending. It aims to expand, optimize and increase the income of tourism of Jingzhou historic town, eventually make it a pillar in the ecological culture tourism circle in western Hubei, and a reputed and competitive cultural tourist site both at home and aborad. The development objectives are defined as: The scenic area of historic town is an industrial cluster that has great development edges and potential of the whole historic town. It will play a key role in the overall tourism development of the region. By appropriate construction and operation, the planning aims to turn the Historic town scenic area into a well-known national-level 5A tourism resort of international fame, a famous oriental cultural city as well as a famous scenic spot of world cultural heritage.

At present, the historic town is applied for listing in the Catalogue of World Cultural Heritage; the proposed project can help preserve the original style and features of Historic town, and will improve the infrastructure and surrounding environment of historic town, so it will benefits the application for listing in the Catalogue of World Cultural Heritage; therefore, the proposed project is in line with the *General Planning on the Tourism Development of Jingzhou Historic Town*.

5.1.2.5 General Planning on the Protection of Cultural Heritages of Historic Town Wall

This planning emphasizes the integration of historic town wall and the urban space of Jingzhou Municipal, as well as its relationship with surrounding environment. It proposes that the protection and display of the town wall is of equal importance. The planning proposes to improve and adjust roads and exhibition facilities based on the natural, historic and environmental layout of the wall and the moat.

The proposed project will not only protect and repair historic town wall, but also exhibit intangible CHs by use of existing resources; therefore, construction of the proposed project is in line with *General Planning on the Protection of Cultural Heritages of Historic Town Wall*

5.1.2.6 Other relevant plannings

According to Regulations on Demarcation of Surface Water Environmental Protection Functional Zones of in Jingzhou Municipal Zone (1998), Classification of Surface Water Environment Functions Zone in Hubei Province (2000) and Integrated Renovation Planning on Water Environment of Jingzhou Municipal Zone (2010-2020) (2010) issued by General Office of Hubei Provincial People's Government, planning on Historic town water system is in compliance with Surface Water Environment Quality Standard (GB3096-2002), Class III water area function.

The proposed project consists of necessary sediment dredging, living sewage interception, sewage pipeline reconstruction and other works in favor of historic town water system, thus it can significantly benefits the restoration of Historic town water system.

5.2 Environmental Impact Analysis

5.2.1 Pollution sources analysis

The pollution sources analysis and the mitigations is summary in the Table 5-1 below.

Table 5-1 Summary of pollution sources and mitigation measures

Time frame	Type	Pollution generation node	Pollution source	Main pollutant	Mitigation measures
Construction period	Waste gas	G1-1	Civil work	Flying dust during construction period, and the main pollutant is TSP.	——
		G1-2	Fuel combustion from machine	Waste gas from fuel combustion; and the main pollutants include SO_2 and NO_2.	——
		G1-3	Sediment disposal	Organic matters, as the sediment is agitated during dredging and piled up thereafter, may decompose and generate foul gas under anaerobic condition, such as ammonia and H_2S.	——
	Noise	N1-1	Noise from operation of large construction machine	The noise of a dredging pump can be as high as 104dB, of excavator 98dB, and of bulldozer 100dB.	Arrange construction time reasonably
	Waste water	W1-1	Alkali waste water from washing	Suspended matter, pH	It can be used for concrete after being treated via waste water sediment tank to standard
		W1-2	Oil-containing waste water from washing transportation vehicles	oil, slit, etc.	It is used for road cleaning after being treated with oil-separating sedimentation treatment.
		W1-3	Foundation pit wastewater	Mainly contains silt	Foundation pit waste water is treated with grade II sedimentation and reused for road cleaning.
		W1-4	Domestic wastewater from construction personnel	COD, BOD_5, ammonia nitrogen, etc.	Try to use the existing living facilities nearby.
		W1-5	Remaining water in storage yard	TP, TN, SS, etc.	Coagulant sedimentation will be used to treat the remaining water at storage

Time frame	Type	Pollution generation node	Pollution source	Main pollutant	Mitigation measures
					yard to and it will be discharged to the nearby surface water body
		D1-1	Filtrate at sludge storage yard	TP, TN, SS, etc.	Anti-seeping measures at storage yard
	Solid waste	S1-1	Construction waste and demolition waste		Reused for building construction
		S1-2	Domestic waste from construction personnel		It will be handed over to sanitation department for disposal.
		S1-3	Sediment dehydration and consolidation from dredging	Dried sludge, water content 40%	It is reused for earthwork in wetland and revetment engineering
		S1-4	Abandoned pipe material		The pipe supplier will recycle it.
		S1-5	Abandoned soil mixed with curing agent and remaining curing agent		They will be handed over to Jingzhou Museum for disposal in a uniform way.
		S1-6	Preservatives such as formalin		They will not be discharged.
	Ecology	E1-1	The main ecological environment impact during construction period includes damage to surface vegetation when cleaning up the site during construction and water and soil loss from the exposed surface by site excavation.		Try to reduce temporarily occupied area for construction and to shorten construction duration.
		E1-2	Sediment dredging influences the aquatic ecology of river or lake, and sludge treatment site affects the ecological environment in the site.		Try to reduce temporarily occupied area for construction and to shorten construction duration.
		E1-3	Soil and vegetation are damaged when excavating pipe trench		Soil will be excavated, piled and backfilled layer by layer.
Operation phase	Waste gas	G2-1	Underground parking lot in tourist center	NO_2, CO	It will be discharged from the 2.5m-high discharge outlet on the ground
	Waste water	W2-1	Domestic wastewater from visitors in tourist center	The main pollution factors include COD and NH_4-N	It will be treated to standards in the secondary sewage plant of the city and discharged to Caoshi WWTP
		W2-2	Wastewater from Xiongjiazhong Tomb visitors and employees	The main pollution factors include COD and NH_4-N	It will be treated with micro-power sewage treatment device and discharged to agricultural irrigation system.

Time frame	Type	Pollution generation node	Pollution source	Main pollutant	Mitigation measures
		W2-3	Sewage from rive and lake disturbance	The main pollution factors include COD, NH_4-N, TP and TN	——
	Noise	N2-1	Noise from cars in tourist center parking lot	Noise	——
		N2-2	Noise from running of tourist center equipment	Noise	Reduce noise by adopting foundation vibration reduction and building sound isolation
		N2-3	Noise from social life in tourist center	Noise	——
		N2-4	Pumping station	Noise	The noise reducing measures include using low noise equipment, installing sound cover and adopting double wall for plant.
	Solid waste	S2-1	Domestic waste from visitors in tourist center		It will be regularly cleared up and moved out by sanitation department
		S2-2	Domestic waste in Xiongjiazhong Tomb		It will be regularly cleared up and moved out by sanitation department
		S2-3	Sludge or sediments will be regularly generated in pumping station and box culvert during operation.		It will be regularly cleared up and moved out by sanitation department

5.2.2 Pollution sources during construction

5.2.2.1 Pollution intensity of waste gas during construction

G1-1: Dust during construction will be calculated by means of analogy analysis on monitoring data of similar projects; the dust concentration at the construction site is about 0.5~0.7mg/m^3.

G1-2: Waste gas from fuel combustion is discharged at the site in an unorganized way and the main pollutants include HC, SO_2, NO_2 and soot. According to Practical Data Manual of Environmental Protection, the concentration of pollutant discharged from diesel engine tail gas exhaust is as follows: HC＜1800mg/m^3, SO2＜270mg/m^3, NO_2＜2500mg/m^3, and soot＜250mg/m^3.

G1-3: during construction, organic matters, which are contained in the sediment of the river channel, as the sediment is agitated during dredging and piled up thereafter, may decompose and generate foul gas under anaerobic condition, such as ammonia and H_2S, which are released in an unorganized state. Foul gas will not only pollute environment and present unpleasant feeling, but also endanger human health when reaching certain concentration. Odor intensity is classified with the odor threshold into three classes (Stink Prevention Method carried out in May

1972 in Japan).

Table 5-2 Classification of odor intensity

Odor intensity	Description of felt intensity
0	None
1	Barely smelt (odor threshold)
2	Odor is weak but its nature can be identified (identification threshold)
3	Easy to feel the odor
4	Strong odor
5	Unbearable strong odor

Generally, the limit standard is equal to class 2.5-3.5 of the odor intensity; if such intensity scope is exceeded, it is regarded as foul gas pollution and corresponding measures need to be taken. The proposed project adopts analogy method to analyze the class of odor pollution intensity. According to the analysis of river dredging in the proposed project, relatively obvious odor will be generated when digging sediments; class 2 intensity will be reached within 30m, with slight odor, which is lower than the limit standard (class 2.5-3.5) of odor intensity; and there is basically no odor outside 50m. 30m at the lower wind direction of sludge storage yard the odor intensity can reach class 2, with slight odor, and there is basically no odor outside 50m.

5.2.2.2 Noise pollution intensity during construction

N1-1: noise from dredging pump, excavator, bulldozer, agitator and concrete mixer feature strong sound, large sound level and continuousness; for example, the noise of dredging pump can reach 104dB, of excavator 98dB, and of bulldozer 100dB.

5.2.2.3 Wastewater pollution intensity during construction

W1-1: reinforced concrete during all kinds of civil works will produce alkali waste water from washing that features relatively high concentration of suspended matter, and the pH value can reach 9~12.The quantity of stone blocks with cement mortar in the proposed project is about 2,947 m^3, and concrete quantity is about 8894m^3.It is known by comparing similar project that about 0.875t washing wastewater will be generated from every one cubic meter of masonry work, and about 2.5t from every one cubic meter of concrete construction, so the total washing wastewater generated will be 31,343.75t (in which wastewater from masonry work is 2,579t, and 24,814t from concrete washing).

W1-2: machine construction will dominate the work; 25 vehicles will be used mainly for transporting soil and stone materials, which need to be cleaned frequently. If 50% of them are to be washed every day, about 9m^3 oil-containing wastewater will be generated; oil and silts are the main pollutants.

W1-3: some components will set up berm area with soil bags, which may cause water seepage, waste water from excavation face and rainwater accumulated in foundation, so, frequent drainage is needed. According to estimate of similar analysis, drainage frequency from berm area will be 50m^3/h the highest. Foundation pit wastewater mainly contains silt and the silt content may be as high as 2,000mg/L.

W1-4: the main pollutants include COD, BOD_5 and ammonia nitrogen; it is expected that daily generated quantity is about $1m^3/d$.

W1-5: compared with the east lake tunnel project of Wuhan, about $2000m^3$ of tail water will be generated for every $4000m^3$ of sludge treated.About 301 $900m^3$ will be dredged in the project, and it is estimated that $50,000m^3$ tail water from dredging will be generated during the whole construction period. The treatment scale at the sludge dehydration and consolidation treatment site is 600~$1,400m^3/d$, and the tail water drainage at single sludge dehydration and consolidation treatment site is 300~$700m^3/d$.The project will set up 2 sites for sludge treatment (dehydration and consolidation). According to the project construction schedule, every sludge treatment site will not simultaneously run; at most two of them will be running together, so, the most likely drainage of remaining water from storage yard is $1,400m^3/d$, and the maximum remaining water drainage of every storage yard is $700m^3$.The pollutant concentration of other water is as follows: TP0.11mg/L, TN12.72mg/L, BOD1.82mg/L, SS14.5mg/L, pH7.9, COD34.65mg/L, ammonia nitrogen 4.62mg/L.

D1-1: after anti-seeping measures are taken at the storage yard, the sludge filtrate will have relatively small influence on underground water.

5.2.2.4 Solid waste pollution intensity during construction

S1-1: construction waste and demolition waste

Construction waste includes waste leftover material generated from all kinds of construction material. It is estimated that 300t for every 10 000 square meters of construction material will be generated; the total floor area of the project is $41647m^2$, and 1248t of construction waste will be generated and recycled.

$3316m^2$ of buildings at tourist center will be demolished. Referring to the regulations in Calculation Standards of Construction Waste of Luoyang City, if every square meter has 1.3t, the stonework generated from project demolition will be 4310.8t, which will be reused for the civil work in the proposed project.

S1-2: domestic waste will be generated from construction by 250 persons, 1kg/d/person. The construction period is 5 years, which is about 1500 days, so, 375t of domestic waste will be generated in total, 75t/year.

S1-3: About $300,000m^3$ of sludge will be dredged. The sediments will be reduced to 160,000m3 after dehydration. A total of 163,000 m3 will be used for wetland and revetment, meaning all sediments from dredging can be reused.

S1-4: the pipelines are about 12470m long in total, if 1% of them are abandoned pipe, it will be 124m, which will be recycled by the pipe supplier.

S1-5: about 100t of waste soil mixed with curing agent and the remaining curing agent will be disposed by Jingzhou Museum in a uniform way.

S1-6: preservatives such as formalin will not be discharged.

5.2.2.5 Ecological damage during construction

E1-1: The main ecological environment impact during construction period includes damage to surface vegetation when cleaning up the site during construction and water and soil loss from the exposed surface by site excavation. And the ecological impact is unfavorable but lasts only for a short period of time.

The ecological remediation engineering will have ecological protection on both sides of river channel, which can restore the aquatic ecology impacted during construction as soon as possible. The area of natural wetland remediation is about 166 00m^2, which will keep large area of natural environment for the historic town and provides good habitation and activity site for original terrestrial animals, especially birds and amphibians.

Impact by land occupation: permanent occupation (0.24hm^2) will cause loss of land use functions to some degree; project construction will disturb the original terrain and damage vegetation for 2.5hm^2. Excavation and leveling will cause damage of surface soil and exposure of parent material. The nutrient accumulation and exchange path that the original organic matters participate in the surface soil will be blocked, which will affect element absorption and accumulation of organisms. Disturbance to surface soil will increase the likelihood of soil loss and erosion, and thus negatively impact conservation of soil and water; land occupation by construction, by temporary road and by construction material storage will influence the meadow vegetation at the beach to some degree.

E1-2: Sediment dredging influences the aquatic ecology, and sludge treatment site affects the ecological environment in the site. Sediment dredging will have certain unfavorable impact on ecological environment during construction, but long-term and favorable impact from the above mentioned measures will gradually appear. Sediment dredging will fundamentally change and improve the base, reducing ecological disturbance such as impact of sludge treatment site on the ecological environment in other sites.

E1-3: the soil and vegetation within the construction scope of manual or mechanical excavation for pipeline will be disturbed and damaged, and the vegetation damage will be serious especially in the excavated pipe trench area. The pipeline outside the city is about 4.8km long, and the sewage branch pipe inside the city is about 8.4km long.

5.2.3 Analysis of pollution source during operation

5.2.3.1 Waste gas pollution intensity during operation

G2-1: Underground parking lot in tourist center. The pollution emissions from vehicles in underground parking lot mainly depend on the frequency of vehicle travelling. Most vehicles in and out of the underground parking lot are cars; the estimation assumes that all the underground stalls are occupied and every vehicle comes in and goes out twice every day and the average travelling distance every time is about 200m.

The number of stalls of the underground parking lot built at the northeast is shown in the following table. Two exits or entrances are set up; all floor heights are 3.2m; one 2.5m-high exhaust outlet is installed, running 12 hours a day for ventilation, and it is calculated as 365 days a year.

Table 5-3 Statistics of underground parking lot information

Location	Number of stalls	Floor area	Number of exits or entrances	Floor height m	Exhaust outlet height m	Designed air change rate,	Number of daily running hours of	Number of running	Hourly discharged waste gas (cubic

						times/h	ventilation	days	meter)
Northeast	390	15600	2	3.2	2.5	3	12	365	149760

The main pollutants contained in automobile exhaust are CO and NO_X. Pollutant discharge coefficient is calculated according to the class I discharge limit listed in phase IV in Limits and Measurement Methods for Emissions from Light-duty Vehicles (China phase III and IV) (GB18352.3-2005), namely, emission of single vehicle: CO 1.0g/km, and NO_X 0.08g/km.The emissions of automobile exhaust in the proposed project is shown in Table 5-4.

Table 5-4 Pollution intensity of northeast carpark

Pollutant	Emission coefficient (g/km/vehicle)	Waste gas (cubic meter)	Emission height (m)	Emission speed (kg/h)	Emission concentration (mg/Nm^3)	Standard value		Emission quantity (t/a)
						Emission speed (kg/h)	Emission concentration (mg/Nm^3)	
CO	1	149760	2.5	0.013	0.087	0.076	15	0.05692
NOx	0.08			0.00104	0.007	0.0033	0.6	0.00456

5.2.3.2 Waste water pollution intensity during operation

W2-3: Domestic wastewater from visitors in tourist center Sewage generated in the proposed project is estimated to be 80% of fresh water. According to Water Use Quota Standard, compared with the exhibition hall, the water use quota for the tourist center in the proposed project is 4.5L/m^2.d. The area of every tourist center is shown in the following Table 5-5.

Table 5-5 Basic information of tourist center and Xiongjiazhong Tomb

Location of tourist center	East tourist center
Floor area (m^2)	2451
Water use (t/d)	11.03
Water drainage (t/d)	8.82

According to the office building waste water quality recommended in the textbook EA Consultant for Social Areas compiled by the former occupational qualification training management office of the State Environmental Protection Department (SEPD), the pH value and concentrations of COD_{Cr}, BOD_5, SS and ammonia nitrogen are 7~8, 280mg/L, 140mg/L, 140mg/L, and 31.5mg/L, respectively. After pre-treatment in septic tank, the elimination rates of COD_{Cr} and ammonia nitrogen are, by referring to the parameters recommended in the Approval Register Table for Environmental Impact of Construction Project, 15% and 3%, respectively; and those of BOD_5 and SS are, following the conclusion in ***Investigation and Analysis of Septic Tank Pollutant Elimination Effect in Wuhan Residential Community*** published by Liu Yiliang, 11% and 47%, respectively. And for the drained water quality, they are 7~8, 238mg/L, 124.6mg/L, 74.2mg/L, and 30.56mg/L.

The pollutant discharge information of the tourist center in the proposed project is shown in Table 5-6.

Table 5-6 Pollutant discharge in east tourist center

Category	Item	Generated concentration mg/L	Emission concentration mg/L	Take-over standard mg/L	Generated quantity t/a	Self-reduction quantity t/a	Emission quantity t/a	Effluent from sewage plant	Final emission quantity t/a	Where to
Domestic waste water	Sewage quantity	——	——	——	3219.3	0	3219.3	——	3219.3	Caoshi WWTP
	pH	7~8	7~8	6~9	——	——	——	6~9	——	
	COD	280	238	300	0.90	0.14	0.77	60	0.19	
	BOD	140	124.6	160	0.45	0.05	0.40	20	0.06	
	SS	140	74.2	200	0.45	0.21	0.24	20	0.06	
	Ammonia nitrogen	31.5	30.555	——	0.10	0.00	0.10	8	0.02	

W2-2: domestic waste water from Xiongjiaozhong subcomponent generated in the proposed project is estimated to be 80% of fresh water. According to Water Use Quota Standard, compared with the exhibition hall, the water use quota for Xiongjiazhong Tomb in the proposed project is 4.5L/m^2.d.

Table 5-7 Basic information of Xiongjiazhong Tomb

Location of tourist center	Xiongjiazhong Tomb
Floor area (m^2)	7596
Water use (t/d)	34.20
Water drainage (t/d)	27.36

According to the office building waste water quality recommended in the textbook EA Consultant for Social Areas compiled by the former occupational qualification training management office of the State Environmental Protection Administration, the concentrations of COD_{Cr}, and ammonia nitrogen are 7~8, 280mg/L, and 31.5mg/L, respectively. After being treated with micro-power sewage treatment facility, the effluent concentration of COD and ammonia nitrogen is 100mg/L and 15mg/L, respectively, following the parameters in EA Consultant Report Form for Xiongjiazhong Tomb Archeological Excavation and Field Exhibition. The water pollutant emissions are shown in Table 5-8.

Table 5-8 Waste water pollutant discharges of Xiongjiazhong Tomb

Category	Item	Generated concentration mg/L	Emission concentration mg/L	Emission standard mg/L	Generated quantity t/a	Self-reduction quantity t/a	Emission quantity t/a	Where to
Domestic waste water	Sewage quantity	——	——	——	9986.4	0	9986.4	Agricultural irrigation system
	pH	7~8	7~8	6~9	——	——	——	
	COD	280	100	500	2.79	1.794	0.996	
	Ammonia	31.5	15	——	0.315	0.165	0.15	

Category	Item	Generated concentration	Emission concentration	Emission standard	Generated quantity	Self-reduction quantity	Emission quantity	Where to
		mg/L	mg/L	mg/L	t/a	t/a	t/a	
	nitrogen							

W2-3: connection of rivers and lakes will turn static water into flowing water, which may disturb sediments in rivers and lakes and cause re-suspension of sediments in lake and river, so, more pollutants of sediments from rivers and lakes will be released to the rivers and lakes body, and the effect of rivers and lakes water quality improvement by water supply sub-component will be negatively affected.

5.2.3.3 Noise intensity during operation

N2-1: noise from cars in tourist center parking area. In "4.1 Noise of Automobile " of Engineering Manual for Noise and Vibration Control (Ma Dayou), there is a statistical result for acceleration and stable noise sound level of typical cars in use shown in the following table. The vehicles in and out of the parking area are all small vehicles and will be driven at slow speed, about 30km/h, noise value 70~75dB(A).

N2-2: the noise mainly comes from running noise of equipment such as underground parking lot fan, water pump and outdoor unit of central AC fitted for the tourist center. Underground parking lot fan and water pump are installed underground below the building. Foundation vibration reduction is adopted and building is used for sound isolation, so, the noise is relatively small. The tourist center has three sets of central AC system of multiple variable refrigerant flow, and so, 9 outdoor units are needed. The outdoor units are air-cooled unit, arranged at the top of every building respectively; the running noise of single outdoor unit is about 65-70dB(A).

N2-3: noise from social life such as noise caused by increasing visitors at the tourist center that will reach 60dB(A) and above after the project is completed.

N2.4: After the project is completed, pumping house established in the control engineering such as pumping station will generate relatively high noise and the noise level is about 90~99dB.

5.2.3.4 Solid waste intensity during operation

S2-1: domestic waste from visitors in tourist center. If there are about 500 visitors in the tourist center every day and the domestic waste generation coefficient is 1kg/person.d, the annually generated domestic waste will be 182.5t/a.

S2-2: domestic waste from visitors in Xiongjiazhong Tomb. If there are about 100 visitors in the tourist center every day and the domestic waste generation coefficient is 1kg/person.d, the annually generated domestic waste will be 36.5t/a.

S2-3: silts or sediments regularly generated in pumping station and box culvert, about 4.7t/a.

5.2.4 Summary of pollutants in operation phase

Table 5-9 Summary of generation and discharge of main pollutants from project

Type	Pollution factor	Generated quantity t/a	Self-reduction quantity	Final emission	Note

				quantity t/a	
Waste water	Quantity of waste water	13205.7	13205.7	13205.7	Sewage from tourist center goes into the secondary sewage plant of the city for treatment; that from Xiongjiazhong Tomb will be treated with its own micro-power sewage treatment station before being directly discharged.
	COD	3.56	1.934	1.186	
	NH_4-N	0.415	0.165	0.17	
Waste gas	NOx	0.00456	——	0.00456	Directly discharged
Solid waste	Domestic waste	223.7	223.7	0	Treated by sanitation department

5.2.5 Positive environmental impact

After the proposed project is implemented, the water system of the historic town of Jingzhou will become inter-connected with related natural water bodies, and such connection is a kind of systematic and dynamic. Improving river connection has great ecological significance. The implementation of the proposed project will produce significant benefit for ecological environment, which is mainly manifested as follows:

(1) Improving the complexity, stability and resilience of water body system

Healthy and stable water ecosystem will take shape by channeling rivers and lakes. In terms of system level and landscape pattern, structure composition and function of every water body will be increased and expanded, and complexity and stability of water body system will be increased and the system will have relatively high resilience under the environmental pressure generated by human activities.

(2) Effectively removing endogenous pollution of water course

Dredging and disposing the sediments in rivers and lakes will get rid of some pollutants, especially plenty of organic matter and pollutants of nitrogen and phosphate, reduce endogenous pollution of water course and improve ecological environment of river and lake.

About 301,900 m^3 sediments in the water system of the historic town will be dredged and totally 193.22t of TP and TN will be eliminated, which can effectively reduce the endogenous pollution of water system in the historic town. Therefore, dredging will play an active role in improving the water quality and ecological environment of the river and lake.

(3) Ecological restoration

In order to restore the original ecological landscape of the watershed of the historic town and further improve the self-cleaning ability of water body, ecological restoration projects, such as ecological revetment and artificial wetland, will be carried out, implementing the principle of ecological priority of revetment engineering.

(4) Environmental benefits from interceptor pipe engineering

The water system of the historic town is an important landscape water source of Jingzhou, but its quality has severely degraded due to aggravation of natural environment and pollution of domestic sewage as economy develops in recent years. Therefore, sewage intercepting project will be implemented to collect the sewage in this area with sewage pipe network and send it to sewage plant for treatment to meets the requirements of related standards. This avoids the direct discharge of untreated sewage into the water system, which can effectively reduce pollution of the water system. According to estimation, under the condition of full-load running of sewage plant after the outside sewage interception main pipe project is put into operation, 470.54t of COD, 41.34t of NH4-N, 84.15t of TN and 5.88t of TP that would have been discharged in river will be reduced. After the branch sewer is put into operation inside the city, the sewage collection scope in the historic town will be increased by 90%.

(5) Environment benefit from water supply engineering

The water supply engineering is not the component of the proposed project, but it can contribute to improving the water quality of the water system of the historic town. From DHI water quality model results, it can be seen that after the entire water environment remediation project is carried out, the overall water quality of the water system of the historic town will be maintained at type IV; where the water quality is type III critical value, about $5m^3/s$ of water needs to be supplied, where it is type II, $3m^3/s$ of water needs to be supplied.

(6) Improving ecological landscape with historic town wall restoration and vegetation upgrading

The west city wall protection and city wall vegetation upgrading will greatly improve the city wall landscape and ecological environment, and also create conditions for surrounding residents to feel the city or and its water environment landscape closely. After ecological remediation, the historic town will become an urban ecological landscape belt integrated with water conservancy, ecology, culture, relaxation and sightseeing, and also a hot spot for urban construction and development. A good tourist environment and place for relaxation will be provided to the citizens.

5.2.6 Environmental impact analysis

5.2.6.1 Ecological environment impact

The project will comprehensively improve the environment on the existing rivers and lakes and embankment with multiple means such as sediment dredging and ecological remediation (including the construction of artificial wetland), aiming at improving the moat water environment and ecological environment. Seen from the project content, every component is for the purpose of improving or protecting river water quality and ecological environment; however, unfavorable short impact will be produced on the surrounding ecological environment during the project construction, which is unavoidable; but, as the project is completed, favorable long-term impact of the project on ecological environment will gradually appear.

5.2.6.2 Terrestrial plant

(1) Impact of land occupation on vegetation

The project will have permanent land occupation and temporary land occupation. Permanent land occupation has long-term and unrecoverable damage to the natural vegetation in the assessment area, and temporary land occupation has temporary impact on the natural vegetation that can be gradually restored after construction is finished.

According to the field investigation, only soil city wall grows some vegetation in the assessment area, and there is little vegetation distribution in other areas due to urban construction and human activity. The directly affected areas of the project include waters (river), residential place, beach and construction land. Seen from the distribution pattern of vegetation in the assessment area, secondary natural vegetation dominates the area, along the city walls mostly are artificial or secondary vegetation (mainly artificial vegetation), relatively centralized. According to the status survey, vegetation affected in the construction area of the project is mainly vegetation along the city walls and natural vegetation along the river course pipeline, etc. The constructions including dredging, revetment construction, pipe network construction, vegetation upgrading and wetland rebuilding will have impact on quantities of organisms, distribution pattern and bio-diversity to some degree. It is known from the status survey that the area directly affected by the project has not stretches of woodland, so, the vegetation area destroyed by the project will be relatively small. For the permanently occupied area, artificial landscape greening and ecological revetment can be implemented after the project is completed to make up for the influence on the vegetation in this area. For temporary land occupation, the project can rely on the existing road for construction access; only temporary soil dump site and sludge dehydration and consolidation site are needed, and the vegetation there will be gradually restored after the project is completed. Therefore, the project construction has relatively small impact on the vegetation in the area.

(2) Impact on protected species

There are some cedar-woods in the assessment area, but the proposed project will carry out vegetation upgrading based on correct identification and will not cut off trees of large area, therefore, the project construction has relatively small impact on the cedar-woods in the area.

5.2.6.3 Aquatic ecology

(1) Planktons

Dredging operation, remaining water at storage yard, river channeling and revetment construction will make suspended matter at operation area and around discharge outlet increase dramatically, the water body quality will become turbid and the translucency of water body will be greatly reduced, and thus the photosynthesis of planktons will be affected, consequently, species and quantity of planktons will be reduced. And zooplanktons feed on phytoplanktons will be correspondingly reduced because their composition and distribution are related to the phytoplanktons as baits. These changes will indirectly influence the aquatic ecological system of the river in the construction section. But the construction is carried out section by section, so, such influence is temporary and limited to small scope. When dredging, remaining water at storage yard and revetment work are completed, the concentration of suspended water in the water body will soon restore to background values. Taking into account the self-restoration ability of ecological system and continuous supplement of organism from branches, the species of planktons will soon be restored after the project is completed.

(2) Benthic animals

The main impact on benthic animals during construction is from dredging. While dredging sediments in river, some benthic animals that are troglobic and filter feeding and move slow will be cleared out of the water body. So, dredging will pose great threat to the existence of benthic animals in the river bottom. Besides, benthic animals are relatively quick and easy to perceive the reaction of sedimentary environment because sediments extensively and profoundly affect them in terms of living base material, feeding way, feeding target and feeding mechanism. The structure of benthic animals will change and the impact may be long term and will take a long period of time to be restored due to re-sedimentation of suspended matter by dredging.

The benthic animals may be restored to some degree after dredging according to the river restoration project, but the restoration will be very slow.

(3) Fishes

The project area is not important place for aquatic organisms to natural spawning, feeding, and hibernating or migration route. The status survey indicates that there are few fishes in the project scope. Dredging, remaining water at storage yard, berm construction and demolition during construction will affect quantity of organisms as baits for local planktons and benthic animals, and the original conditions of surviving, growing and reproduction for fishes will be changed. But for the entire water system, this impact is relatively small. The fishes in these places will move to other places. Besides, man-made sabotage of construction personnel, such as fishing, will also cause unfavorable impact on fish resources.

After the project is completed, heavy metal and poisonous matter in the sediments will be eliminated by dredging to cut their migration and gathering in food chain and thus increase the economic value of fishes; besides, phytoplankton and zooplanktons will be gradually restored in the water, so there is great potential for baiting; therefore, it will be very favorable for natural growth of fishes such as chub and crucian in zooplanktons and those feed on algae.

5.2.6.4 Ecological integrity

According to the investigation, there are no protected wild plants of rare or endangered species within the construction scope in the project. After the project is completed, an inhabiting living environment for birds will be provided due to formation of green belt, revetment and wetland.

During project operation, river will flow more smoothly and the base matter in riverbed will change to different degrees as the pollution base matter will be eliminated and new base matter will be gradually restored from upper reaches, which is more suitable for surviving of multiple aquatic organism; as the water quality gets better, the species of pollution tolerant organisms will be gradually reduced and the species that are not tolerant to pollution will be increased.

At present, the historic town area of Jingzhou is a built-up city area. The original ecological situation has been changed by the urban development construction, which has caused obvious damage to the ecological environment on both sides of the river. The principle of ecology will be used for vegetation restoration by combining artificial greening and natural restoration for ecological restoration. Vegetation removed for city walls is mainly vines that are parasitic, and also there are a few arbors that have relatively large damage on city wall. Vegetation by artificial planting is mainly indigenous vegetation that is widely distributed and able to be adapted to the ecological environment of the area. Natural restoration can be conduced by fully utilizing the natural vegetation and ecological environment combining the rules and characteristics of secondary succession of plant community. As the revetment and revetment on both banks of the river are established, the vegetation and ecological system in the project area will be gradually improved and reinforced, which not only has the effect of beautifying, but also is favorable to adjustment of local small climate.

Disturbance to water course during project construction will reduce quantity of organisms in the area, but the vegetation will be restored and even more after project completion. Therefore, the overall effect of the project on environment is positive. The project has great realistic significance for protecting and improving the overall ecological structure of water system. The production ability of natural system in the project area is at relatively high level and has the ability to restore to some degree after being disturbed; so the impact of the project on the stability of natural ecological system is acceptable as the impact is small.

5.2.6.5 Revetment construction

According to the embankment design specification, the type of embankment project should be adapted to the local conditions and use local materials and also be determined according to the principle of combining urban construction with ecology. The project area is a built-up urban area. There are a lot of stone suppliers in Jingzhou who have a lot of stored stone materials with good quality, but there are not many soil materials; therefore, for the revetment construction of the proposed project, mainly planting concrete interlocking blocks and ecological gabion revetment are adopted. For revetment construction at local steep river sections and buildings, masonry stone or box-type planting concrete block retaining wall is adopted. Flood control and landscape will be combined. The flowing speed of some water course is relatively slow, soft soil banks such as vegetation protective carpet that has great ecological effect will be adopted.

The impact of ecological revetment ecology is focused on water permeability, air permeability, flexibility and comprehensive ecological effect of revetment; its comprehensive ecological effect will be relatively good correspondingly if its water permeability, air permeability and flexibili1ty is relatively good.

The impact of revetment construction is similar to that of general dredging of river course. Water and soil loss during construction will cause increase of SS concentration and affect the living environment of aquatic organism; therefore, the largest impact of revetment engineering should come from the Operation phase after the project is implemented.

Whatever revetment method is used, the air permeability, water permeability and exchange of water and soil element and organism exchange from it will not be comparable to natural bank slope. Due to damage to natural bank, only a method similar to ecology is used for restoring it. The restored bank can only minimize the ecological impact after the project is carried out under the circumstance that it is feasible economically and technically.

Gabion box/pannier is focused on projected river bank and preventing over-erosion, so it has less water cleaning function, and thus the water body in the construction section can hardly be cleaned through revetment. Cleaning after revetment implementation mainly relies on revetment plant. The greening cycle is long, vegetation growing space is small and nutrients can hardly be kept; the greening coverage does not exceed 10%; the anti-erosion property of vegetation root system is low, therefore, the cleaning function of revetment plants is not ideal.

Therefore, the ecological impact of ecological revetment is mainly that it will reduce the function of cleaning water body, and the exchange function of liquid phase and solid phase for organisms. The revetment section is only a small part of the whole river, so, the implementation of revetment basically does not affect the cleaning of water body by the entire river basin; only some river sections are compromised in terms of cleaning function.

5.2.6.6 Landscape environment

(1) Current impact on landscape

Currently, visual landscape has been severely impacted by the exposed discharge of sewage directly from the west of the historic town, water and soil loss, water course blocking, sludge, ridges and debris. As it were, “city wall is still here, but clear waters are gone”.

(2) Impact on landscape during construction

The negative impact of the project on visual environment is mainly embodied in construction period. Negative impact will be produced on landscape and visual environment by a lot of excavation at construction site and arrangement of all kinds of construction machines as well. Therefore, construction management must be reinforced and construction operation scope must be strictly controlled. The construction materials stored on site must be covered up and construction waste and domestic waste from construction personnel must be timely cleared up and moved away to avoid visual pollution.

(3) Impact after construction and during operation

the proposed project repair and modify the bank slopes along the river by means of combining natural revetment with hard revetment, which can increase the benefit of visual landscape on both sides of the river to a large degree for clearing up water course garbage and regional greening. Meanwhile, construction of artificial wetland will increase surrounding green land area and may even attract animals such as waterfowl to inhabit, and so, the benefit natural landscape of the moat will be increased.

5.2.6.7 Analysis of construction roads impacts

For main construction roads are built on the existing roads without occupying new roads; subsidiary roads are built on the enlisted temporary storage yard and temporary storage yards in consolidation of dehydration plant, the distribution of construction roads has little impacts on ecological environment.

5.2.7 Atmospheric environment

The impact of the project on air is focused in construction period, in which the waste gas such as dust from construction (secondary dust on working plane), waste gas from machine fuel (including transportation vehicle), and odorous gas at sludge disposal site will be generated. During operation, there is basically no impact on the external environment, but the underground parking lot will have tail gas from automobiles.

5.2.7.1 Construction phase

(1) Analysis of impact of dust from construction

Usually station mixing is adopted for concrete mixing during road construction, which refers to mixing line and soil at the mixing station as per designed ratio. The mixed concrete will be moved to the construction road section with truck. Concrete mixing operation will cause TSP pollution on construction site under the action of wind. According to actual investigation on similar completed project, 8.80mg/m^3 of dust will be caused at 50m lower wind direction, 1.65mg/m^3 at 100m lower wind direction, and 0.3mg/m^3 at 150m lower wind direction, which complies with grade II standard average daily value in Ambient Air Quality Standard (GB3095-2012).

During construction, transportation and unloading of powder material will bring TSP pollution to the area along the route. According to field monitoring result of dust caused by truck transportation at similar construction site, 11.625mg/m^3 of dust will be caused at 50m lower wind direction, 9.694mg/m^3 at 100m lower wind direction and 5.093mg/m^3 at 150m lower wind direction, which exceeds grade II standard in Ambient Air Quality Standard (GB3095-2012). The dust caused by construction transportation vehicles will have relatively serious pollution to the area along the route.

It can be known from the above mentioned analysis that the dust pollution caused by construction activities cannot be ignored, which may have impact on the air environment at sensitive points adjacent to the working plane. Corresponding measures should be taken in engineering design and during construction to alleviate its impact on surrounding air environment.

(2) Waste gas from machine fuel

According to the monitoring result of similar project, the impact scope of main pollutants in the waste gas from excavator fuel is 0.016mg/m^3 ~ 0.18mg/m^3 at 15m~18m lower wind direction. According to the construction organization design, only a few machines are used in the proposed project and the emission height is limited; besides, the impact scope is limited to the construction site and very limited scope, featuring small pollution scope and short time; therefore, the waste gas discharged by construction machine will have relatively small impact on surrounding environment and will not obviously aggravate air pollution in the area, but may cause unfavorable impact on residents adjacent to construction operation area and along the transportation route; therefore, necessary protective measures should be taken to minimize the unfavorable impact on the residents along the transportation route by the waste gas from fuel discharged in construction activity.

(3) Odorous gas at sludge disposal site

The proposed project adopts analogy method to analyze the class of odor pollution intensity. According to the analysis of river dredging type, relatively obvious odor will be generated when digging sediments; class 2 intensity will be reached within 30m, with slight odor, which is lower than the limit standard (class 2.5-3.5) of odor intensity; and there is basically no odor outside 50m. 30m at the lower wind direction of sludge storage yard the odor intensity can reach class 2, with slight odor, and there is basically no odor outside 50m.

Sludge dehydration and consolidation will be conducted from the beginning of winter to the end of spring, so the weather is quite cold and not favorable for odor to disappear. The sludge dehydration and consolidation site is temporary structure and the nearest distance to the ambient air sensitive point is Fanrong street, which is close to the 2# site; while other storage yard are more than 40m away from other sensitive goals. Therefore, the odor generated in sludge disposal will have limited impact on sensitive points around and keep 30m safety distance away from the sludge storage yard to reduce the impacts of odorous gas.

5.2.7.2 Operation phase

Detailed forecasting models are in the appendixes; this section only describes the results.

Hourly highest concentration of NO_2 from tail gas in parking lot 5000m leeward is 3.86E-06mg/m^3, which is lower than 0.2mg/m^3 the grade II standard in GB3095-2012 Ambient Air Quality Standard, and that of CO is 4.82E-05mg/m^3, which is lower than 10mg/m^3 the grade II standard in GB3095-2012 Ambient Air Quality Standard; taking into account the highest concentration obtained from the status monitoring and addition of NO_2 and CO background ratio to standard concentration in residential point of the historic town, the final ratio of NO_2 to standard concentration is 14.5%.Therefore, the sensitive points near to the historic town can meet the requirement of grade II standard limit in GB3095-2012 Ambient Air Quality Standard, and the underground parking lot will have relatively small impact on surrounding environment after being put into operation.

5.2.8 Surface water

After the project is completed and put into operation, it will be favorable to improving the water environment quality of the water system of historic town. The impact of the project on water environment is focused in construction period, including impact on water environment by construction waste water, foundation pit waste water, and domestic waste water and dredging process. The main source intensity in operation is disturbance of endogenous pollution by domestic waste water from every tourist center and Xiongjiazhong Tomb and water system channeling.

5.2.8.1 Construction phase

Impact of dredging on water environment Destination of remaining water from stockyards

(1) Estimation of remaining water drainage

According to the engineering analysis data, the most likely daily drainage of remaining water at project storage yard is about 1400m^3/d, and the largest drainage from single storage yard is about 700m^3/d.

(2) Analysis on where the drained remaining water from storage yard goes

The project is located in the service scope of Jingzhou Municipal Chengnan wastewater treatment plant (WWTP) and Jingzhou Municipal Caoshi WWTP. But the sewage interception pipe network is not complete at the place where the project is, it is not realistic to have the tail water from the project discharged into the urban sewage plant. In the later period of the project, the remaining water from storage yard will go through coagulating sedimentation to meet the grade A standard in GB18918-2002 Discharge Standard of Pollutants for Municipal Sewage Plant and discharged to into the moat nearby.

(3) Impact prediction

When remaining water at No.1 storage yard is normally discharged, the COD, ammonia nitrogen, TP and TN downstream 1500m river section all fail to meet the requirement of grade III in Surface Water Environment Quality Standard (GB3838-2002). The main reason is that the concentration of background value is too high. As a matter of fact, the contribution of COD, ammonia nitrogen, TP and TN is not high; at 1500m, the concentrations both of COD and of TP are lower than background concentration while the contribution of ammonia nitrogen and TN contribution is less than 5% of the background concentration. Therefore, on the whole, after remaining water from No.41 storage yard is mixed in the river, its pollution contribution is relatively small; taking into account the endogenous pollution eliminated during dredging, the impact from normal discharging of No.41 storage yard remaining water on surface water quality is relatively small.

When remaining water at No.1 storage yard is discharged at abnormal condition, the COD, ammonia nitrogen, TP and TN downstream 1500m river section all fail to meet the requirement of grade III in Surface Water Environment Quality Standard (GB3838-2002). The main reason is that the concentration of background value is too high. As a matter of fact, the contribution of COD, ammonia nitrogen, TP and TN is not high; at 1500m, the contribution of COD is lower than background concentration while the contributions of ammonia nitrogen, of TP and of TN are less than 10% of the background concentration. Therefore, on the whole, after remaining water from No.1 storage yard is mixed in the river, its pollution contribution is relatively small; taking into account the endogenous pollution eliminated during dredging, the impact from abnormal discharging of No.1 storage yard remaining water on surface water quality is relatively small. However, in order to minimize the impact of remaining water on regional water environment, the normal draining of dredging dehydration should be guaranteed and abnormal discharging should be eliminated.

Analysis of impact of dredging on river water environment the proposed project adopts the method of dredging with water.

During construction, with the method of dredging with water, the dredging equipment will disturb sediments in the river, and a layer of semi-suspended particle-like sludge matter will be attached at the water body interface between water body and sediment; this matter has high water content, high nutrients and high organic matter content, and is extremely easy to dissolve and re-suspend. During dredging, such layer of matter and sediment will be disturbed and dispersed in water body and release pollutants that are easy to cause secondary pollution to water environment. According to the inland river dredging experience in China, environmental-friendly cutter suction dredger (namely, the dredging equipment of the proposed project) will be used to move the sludge to designated storage site with pipeline, which can effectively control the dredging scope and depth so that no position will be missed, and neither under-digging nor over-digging will occur. The powerful suction pipe of the dredger will generate negative pressure to suck away the semi-suspended pollutants at the sediment surface, and thus reduce secondary pollution in construction. Practice indicates that the SS diffusion scope is 15m after the water body is disturbed by common cutter used in the cutter suction and dredging in the West Lake. Beaver-type environment-friendly cutter imported from Netherlands will be used to keep the diffusion scope to 5m, and will have relatively small impact on the surrounding water environment.

(4) Construction wastewater

Concrete placing will be needed for the reinforced concrete engineering in the project, so, some cement wastewater will be generated from placing concrete and washing material tank, and the main pollution factors in the wastewater is SS and pH (usually 9-12); the discharging is intermittent and dispersible. Cement wastewater will be neutralized before sedimentation treatment to the standard in Standard of Water for Concrete (JGJ63-2000), and then be reused to mixing concrete, so it has no impact on water environment.

Wastewater from washing trucks and machines in construction site mainly contains SS and oils; the SS concentration will be 300mg/L, and oils concentration 20mg/L. Oil-containing wastewater will be treated with oil separation and sedimentation to grade I standard in Table 1 of GB8978-1996 Integrated Wastewater Discharge Standard and reused for washing road, so will have no impact on water environment.

Some components will set up berm area with soil bags, which may cause water seepage, waste water from excavation face and rainwater accumulated in foundation, so, frequent drainage is needed. According to analysis and estimation of similar project, the maximum discharge rate from the berm will be 150m3/h; and water pump is used to drain out of the berm. Wastewater in foundation pit mainly contains silt, and the silt content may be as high as 2000mg/L. The assessment requires that such wastewater can be used for reducing dust on road after being treated with sedimentation to the grade I standard in Table 1 of Integrated Wastewater Discharge Standard.

(5) Domestic wastewater

Construction personnel work at different places and they should try to use the existing living facilities around the work site. Based on strictly implementing the above domestic wastewater treatment facilities, the domestic wastewater from project construction personnel will not have impact on the water system or water body of the historic town.

(6) Others

a) When the berm is built and demolished, some soil and sand will drop into the river, causing disturbance to water body, but the impact is temporary and will disappear after the berm is built and demolished.
b) Pollution caused by fuel or engine oil spill from construction machine will increase water indexes such as oils in water environment and cause aggravation of water body quality.
c) When the construction is conducted in rainy season, silt and dust may be mixed into the adjacent water body with rainwater and cause unfavorable impact. Corresponding measures should be taken during later period of construction to reinforce management and effectively prevent the construction materials from dropping into water body so that the construction process will have minimized impact on the surrounding waters.

5.2.8.2 Operation phase

Wastewater pollution mainly comes from the domestic wastewater from east tourist center and Xiongjiazhong Tomb. Besides, rive-lake channeling also causes disturbance and releases sediment.

(1) Domestic wastewater of tourists

Wastewater in operation of the proposed project mainly comes from domestic wastewater from the east tourist center. The domestic wastewater at the east tourist center will be pre-treated in septic tank and discharged into Jingzhou Municipal Caoshi WWTP for treatment. According to "Analysis of water pollution source in Operation phase", the emission concentration of pH, COD, BOD_5, SS and ammonia nitrogen in the water discharged from the proposed project is 7~8, 238mg/L, 124.6mg/L, 74.2mg/L and 30.56mg/l, respectively, which meet the standard receiving concentration of Caoshi WWTP (COD 300mg/L, BOD_5 160mg/L, SS 200mg/L).

Caoshi WWTP is located at the north of Jingzhou Municipal, the northwest of Jingsha Avenue and Wude Road, east of Caojiao Road and in Group I, Yuexin village. Its serving area covers 1712hm^2 including the area of Jingzhong road of Jingzhou historic town and north of Jingnan road, the route from east of Nanhu to Wude road, west of Taqiaobei road and south of high-speed railway. In 2010, phase I of Caoshi WWTP is put into operation and its capacity is 300 000m^3/d.

Table 5-10 Overview of the sewage plant

Name	Scale (10 000 m^3/d)	Location	Main process	Fitted pipe network construction	Serving area	Treatment depth	Receiving water body
Jingzhou Caoshi WWTP	3	East of Chudu avenue, north of Taihu port	Modified oxidation ditch	Fitted pipe network has been basically completed; only some branch pipes need to be completed	Sewage from historic town at north of Jingzhong road and Wude district	Secondary treatment	Taihu port

At present, the sewage pipe network of the east tourist center has been put into operation; therefore, the sewage there can be connected to the sewage plant for treatment.

The sewage quantity to be treated in Caoshi WWTP is about 8.82m^3/d, which is about 0.029% of the treatment capacity of the plant. Therefore, it is feasible for Caoshi WWTP to treat sewage in the proposed project. The discharged water quality of the proposed project meets the receiving standard of Caoshi WWTP. The project sewage will not be directly discharged into surface water system, and therefore needs reinforced management and monitoring; and septic tank should be cleaned up on a regular basis. The sewage that the proposed project generates will have relatively small impact on surrounding environment.

(2) Domestic wastewater impact in Xiongjiazhong Tomb

As the Xiongjiazhong Tomb are implemented, it is estimated to add 27.36m^3/d of domestic wastewater, and the generated amount of pollutants will be COD 0.996t/a and ammonia nitrogen 0.15t/a. The discharged concentration COD 100mg/L and ammonia nitrogen 15mg/l meet the requirement of the grade I discharge standard in Table 4 of the national ***Integrated Wastewater Discharge Standard GB8978-1996***.

However, for the uncompleted construction of sewage treatment facilities as supporting project in the first phase, EA Consultant requires the implementation of sewage treatment supporting facilities to meet the needs of sewage treatment.

Impact of rive-lake channeling on water environment

The main impact on water environment after the implementation of river-lake channeling is sediment disturbance caused by change of hydrologic state, and thus the effect of river lake water quality improvement by water supply dispatching will be negatively affected. During water supply, the hydrologic situation of lake will be turned from static water state into flowing water state, which may cause sediment disturbance and lead to release of pollutants to lake water body and thus affect river lake water quality. Lake sediment disturbance mainly depends on water body flow velocity, so, most rive-lake sediments has relatively small disturbance, and the disturbance scope is mainly distributed at the inlet and outlet of the connecting channel. At the beginning of water supply, the sudden change of hydrologic situation of lake will cause reconfiguration of sediments of local area that have been accumulated for many years as the flowing state changes; after a period of time, the sediments of the eroded part will gradually reduce and reach fluvial equilibrium state; and then the sediment disturbance will not be significant; besides, the dredging engineering has already significantly reduced endogenous pollutants in river and lake, therefore, the water system communication of the proposed project will have relatively small impact on the quality of water environment.

(3) Intercepted sewage load

It is known from DHI yearly water equilibrium diagram of historic town water system, the directly discharged quantity of domestic water is 8.2466 million m^3/a, about 22 593m^3/d. However, the remaining treatment capacity of Chengnan WWTP is 2600m^3/d, and that of Caoshi WWTP is about 3100m^3/d, so, the total treatment quantity is only 5700m^3/d; therefore, the present sewage treatment scale cannot meet the requirement after the sewage interception pipe network is put into operation. After the proposed project is completed, even if all the domestic wastewater of the historic town is sent to be treated in the two sewage plants, still 16893m^3/d of sewage treatment capacity is needed.

According to the long-term plan of the two sewage plants, in future, Chengnan WWTP may have a capacity of 140 000m^3/d and Caoshi WWTP 120,000m^3/d. According to the special plan of Jingzhou drainage project, the treatment capacity of the two sewage plants will be increased and put into operation before the sewage interception pipe network of the proposed project is put into operation. Therefore, the intercepted sewage can be treated to the standards in the two plants and drained away; this has environmental feasibility.

In order to avoid restriction of sewage plant project to the proposed project, it is suggested to set up a special leader team to supervise the expansion project of the two sewage plants so that the expansion project of the two plants can be managed to be put into operation before the sewage treatment pipe network is put into operation.

5.2.9 Acoustic environment

Acoustic environment impact by the proposed project mainly comes from noises of large construction machines such as dredging pump, excavator, bulldozer, agitator and concrete mixer in construction period and noises from underground parking lot vehicles, equipment running in tourist center, crowd in tourist center and pump running.

5.2.9.1 Construction phase

The scope of noise impact during construction is relatively large and the affected areas are different in different time; on the whole, it is not regular and the intensity is large. However, during some period of time and in certain area, the transiency of impact is outstanding, which makes it difficult to be managed during construction; besides, the noise source is mobile, so it is not easy to take engineering measures for noise reduction. The project can reasonably arrange construction time and progress by enhancing construction organization and management during construction and develop effective temporary noise-reducing measures to local conditions; nighttime construction should be forbidden at the construction side where there is residential community around.

According to the prediction result, under the circumstance of only considering noise from construction vehicles, the noise is 64dB at 20m and 60dB at 50m in the daytime, which has relatively small impact on surrounding environment. The noise is 51dB at 300m at night. Noise from transportation vehicle will have certain impact on nighttime environment; but the transportation is mobile, and as this section is completed, the construction noise will disappear; so the overall impact is relatively small but the impact intensity in a short period of time is relatively large.

5.2.9.2 Operation phase

Noise during operation mainly comes from underground parking lot vehicles, tourist center equipment running, tourist center crowd and pump station running.

Noise impact of equipment running at tourist center

According to engineering analysis, noise from public equipment of the proposed project comes from underground parking lot fan, water pump and outdoor unit of central AC.

In order to reduce the noise generated from equipment running, low-noise equipment will be selected for underground parking lot fan, water pump and outdoor unit of central AC. Underground arrangement is set up for parking lot fan and water pump, which are covered by 1.5m-high soil or above; foundation vibration reducer damper is used for equipment installation. Hoses and flexible joints are used for connection between equipment and pipeline. Pipeline support adopts elastic supports. Compensators are installed at both inlet and outlet of pipeline, and all the places where pipelines passing through wall contact walls should be wrapped with elastic material; all kinds of pumps and underground parking lot fans should be installed in separate equipment room. The abovementioned measures may reduce equipment noise of the proposed project for 30~40dB(A). Therefore, public equipment noise will have relatively small impact on surrounding environment.

Noise impact of tourist center crowd

Noise from social life such as noise caused by increasing visitors at the tourist center that will reach 60dB(A) and above after the project is completed. The noise level generated from tourist center meets the requirement of category 4 limit of 70dB(A) in GB22337-2008 Emission Standard for Community Noise because the functional zone where every tourist center is in is basically category 4 area. When superposed with background value, it can still meet the requirement of functional zone limit, so the acoustic environment impact on surrounding sensitive goals is relatively small.

5.2.10 Impact of underground water environment

5.2.10.1 Impact of sewage facilities

The aquifer group of the research zone is mainly divided into 3 layers: pore phreatic quifer group, upper pore confined aquifer and lower fracture confined aquifer group. Pore phreatic water is mainly buried in the Holocene series of quaternary system, and the main water-bearing media include sandy loam and silt, and sand gravel layer in some sections. The upper pore confined water is mainly buried in the upper Pleistocene series and the main water-bearing media include sand, and sandy gravel layer; there is a lot of water with stable upper confining bed; lithologically, there are clay, mild clay, silty clay, and sludge locally; the upper confining bed changes a lot in thickness; from the west to the east and the north to the south the buried depth of upper confining bed gradually increases; the buried depth is usually 0.5~5m, and 10m the deepest. The rules of aquifer group bottom are; highest buried depth in the middle, raised from the middle to the edge, having stable aquiclude with lower fracture pore confined aquifer group. The lower fracture pore confined aquifer group shows the shape of lens and the water-bearing media are very different vertically and horizontally; and lithologically, there are silt, argillaceous silt and fine sand, generally containing sludge.

The proposed project adopts Concrete Modularized Septic Tank 08SS704 No.13 septic tank, which is 18~50m^3 for effective volume and 0.4m deep; the foundation design elevation is 81.66~81.75m.The first rock (soil) layer below the foundation of septic tank and oil separator is sand or sand gravel.

The main pollution factors of domestic wastewater from the proposed project are COD and ammonia nitrogen, which will be filtered, intercepted and settled by soil and go through soil adsorption and vegetation absorption should they be leaked and drained; besides, a lot of micro-organisms existing in soil will also have relatively strong degradation function on the pollutants. Experimental data indicate that the surface soil and the soil layer of aeration belt 0.5m below will eliminate 85% of COD and 90% of ammonia nitrogen. However, long-term accumulation of pollutants will still cause pollution to underground water.

Therefore, in order to protect the underground water environment of this area, the bottom of septic tank and oil separator will be compacted with at least 0.3m high clay with 250-300mm thick concrete structure covered on top; and on the concrete structure 2 layers of SBS (modified bituminous sheet material) impermeable layer; the first layer is 4mm thick and the second 3mm, so that the permeability coefficient of the impermeable layer $\leq 10^{-7}$cm/s.

Prefabricated concrete used for sewage pipe and concrete for pipe seat must comply with relevant regulations. Concrete pipes should be free from fracture, pores, collapse and severe corrosion; impervious concrete should be used to treat the internal side of inspection well. Regular maintenance of septic tank and sewage pipe should be carried out on a regular basis to ensure their anti-seeping effect. After the above mentioned anti-seeping measures and strict job management measures are taken, the probability of underground water pollution accident in the proposed project is very small, and the impact on the underground water environment in the project area is also very small.

5.2.10.2 Impact of sediment storage yard

Filtrate generated from temporary storage yard of sludge may cause secondary pollution to the underground water in the storage area by the organism such as nitrogen and phosphate that it contains due to rainwater erosion and seepage if no anti-seeping measures are taken.

According to the dredging implementation program, every sludge storage yard will take anti-seeping measures. The specific anti-seeping design is as follows:

1) Anti-seeping measures must be taken on the foundation; the impervious layer should be at least 1m-thick clay (permeability coefficient$\leq 10^{-7}$cm/s) or 2mm-thick HDPE, or at least 2mm-thick other artificial material, and permeability coefficient$\leq 10^{-10}$cm/s.
2) The height of stored sludge should be determined according to the ground bearing capacity;
3) Liner should be placed at one foundation of base;
4) Liner should be able to cover the scope that bottom sludge or its dissolved matter may extend to;
5) Liner material should be compatible with the stored sludge;
6) Design and build leachate collecting and eliminating system;
7) The stored sludge should be kept from wind, rain and sunshine;
8) Incompatible dangerous wastes should not be placed together.

Based on implementing the abovementioned anti-seeping measures, the filtrates of sludge storage yard will have relatively small impact in terms of secondary pollution on underground water.

5.2.10.3 Impact of solid waste

5.2.10.4 Construction phase

(1) Sediments from dredging

About 301,900m^3 of sludge will be dredged in total; which will be reduced to about 160,000m^3 after dehydration, which shall meet the requirement of corresponding standard limits in Standard of Soil Quality Assessment for Exhibition Sites (provisional) (HJ350-2007) and GB/T23486-2009 Disposal of Sludge from Municipal Wastewater Treatment. 163,000m^3 of sediments can be backfilled into wetland and revetment components: 54,000m^3 for the moat wetland, 49,000 m^3 for the east lake wetland, 48,000 m^3 for the north lake wetland, 9,000m^3 for Xima pond, 3,000m^3 for the northeast pond. All sediments can thus be reused, with minimal environmental impact.

Two sludge disposal sites are set up in the project. The sludge disposal site of every river course is selected at low-lying area within the blue-green line of river; besides meeting the demand of dredging, sensitive points around should be avoided as possible, the nearest sensitive point from the storage yard is about 40m. For the Fanrong Street is close to the storage yard, Fanrong Community will be affected to some degree when sludge is under temporary disposal. Therefore, 30m safe distance away from the storage yard is required by EA Consultant. The other sludge disposal site will not have impact on sensitive points. Therefore, during dredging, the use of the sludge storage site near to the Fanrong community should be minimized.

(2) Construction waste

During civil work construction, a small amount of construction garbage including waste and demolition waste will impact the city landscape, traffic and ambient air quality if they are not cleared away in time. Construction waste such as damaged bricks, stones, ceramics and cement waste will be generated during construction, most of these wastes are inorganic and will have little direct impact on water and ambient air quality, but may occupy land and cause secondary pollution. Therefore, construction waste should be handled in time. Try to recycle it in construction or use it in backfilling in pits and depressions.

Domestic waste and abandoned pipe material the proposed project is mainly centralized at the historic town and its surrounding areas and construction personnel mostly live outside the city; they will work in the daytime and go back to their home at night. The construction personnel will go home after get off work and go to the construction site in the morning, so, most of their domestic waste can directly go to the urban sanitation system and be treated in a centralized way by the sanitation department. Abandoned pipe materials generated when pipeline is laid will be recycled by the supplier.

(3) Abandoned soil mixed with curing agent and the remaining curing agent

The impact of archeological excavation on environment is mainly embodied in hardening protection on the foundation pit of historic tombs in later period. The curing agent to be used will be mixed on site and sprayed to the pit wall; the seepage will be little. After excavation is finished, soil layer seeped with curing agent on the pit wall surface and the remaining curing agent will be sent to Jingzhou Museum for bio-safety disposal. Therefore, the soil mixed with curing agent and the remaining curing agent will have relatively small impact on the surrounding environment.

5.2.10.5 Operation phase

According to analysis of the project pollution source, after the project is completed and put into operation, solid waste mostly comes from domestic waste of tourist and regularly generated sludge and sediments during pump station running and in pipe culvert, which will be cleared up and treated by the municipal sanitation department in a centralized way. So, no unfavorable impact will be caused to the environment. The specific solid wastes and the way to treat them are as follows:

1) S2-1: Domestic waste from visitors in tourist center. The east tourist center will generate domestic waste 182.5t/a every year.
2) S2-2: Domestic waste in Xiongjiazhong Tomb. 36.5t/a of domestic waste will be generated every year.
3) S2-3: silts or sediments regularly generated in pumping station and box culvert, about 4.7t/a.

5.2.11 Cumulative impacts

5.2.11.1 Introduction

The cumulative environmental impact refers to the environmental impacts exerted by cumulative effect that because of superimposed impacts of an activity of its past, present and foreseeable future. It is produced from the following circumstances: (1) the environmental impacts of one project co-ordinate with that of another project; (2) impacts from several projects on environmental system are frequently and densely populated in time and space so that the impacts of each individual project can’t be disposed. The cumulative environmental impacts are superimposed environmental impacts of same nature or different nature activities in time or space. Whatever the way of development and construction, it objectively exists in cumulative environmental effect.

The cumulative environmental impact is the process to systematically analyze and evaluate cumulative environmental impacts which considers the changes of districts or even greater scopes to analyze the cumulative environmental effect in time or space. Through the analysis and research, the relationship between the development and the environment can be coordinated in a wider range of time and space thus the EA Consultant can be a more effective mean of implementing sustainable development strategy. The cumulative environmental impact both includes the development activities of past, present and future into the assessment scope, and evaluates from point of view of impacted natural environment, ecological system and social environment. What’s more, the cumulative environmental impact emphasizes on the research of adduct, synergistic and antagonistic effects that accumulated by environmental impacts and it put forwards classification analysis techniques of cumulative impact source, cumulative impact pathway and cumulative effect. When a large number of projects are developed contemporarily, it is inevitable that some projects will affect the environmental system because of frequency in time and denseness in space, so that the impacts of each individual project can’t be disposed timely. On account of complexity and diversity of development and construction project, the possible impacts of cumulative environmental impacts are various. Generally, the analysis of cumulative impacts is over the causal process of cumulative impacts which contains cumulative impact source (reason), cumulative impact pathway (mean) and cumulative effect (result).

5.2.11.2 Analysis methods

Effective analysis mean and method must be taken to objectively and comprehensively analyze cumulative impacts. Refer to national *Technical Guideline of Planning EA Consultant* and *Good Practice Handbook—Cumulative Impact Assessment, IFC.* The major methods of cumulative impacts:

1) Expert consultation: Combining scientific technical opinions of experts and past experience (previous studies and their findings) both for VEC determination and impact assessment and management (different experts can be involved for different types of VECs and impacts). Scenarios can be established based on past experience and expert opinion for evaluation of the impacts and reasonably foreseeable projects.

2) Checklist: List the environmental factors that could be impacted by planning and possible impacted natures, and then make a qualitative or semi-quantitative assessment about checked environmental impacts.

3) Matrix: Matrix takes the planning goals, indicators, planning scheme (proposed economic activity) and environmental factors as matrix's row and column and fills in Symbols, numbers, or words at corresponding position which shows casual relationship between behaviors and environmental factors.

4) Map Overlays: Overlay thematic maps evaluating regional characteristics including natural conditions, social background and economic situation so as to form a map comprehensively reflecting the spatial characteristics of the environmental impact;

5) Network: Network diagram can be used to show the environmental impact of these activities and casual relations between various impacts;

6) System Flow Chart: Environmental system can be described as an interrelated component. We can recognize the secondary, tertiary and more levels of environmental impact through relations between environmental components. It is a very useful approach to describing and recognizing direct and indirect impacts.

7) Scenario Analysis: Scenario analysis is a way of describing environmental conditions of the implementation of plans in different time and conditions in chronological order.

8) Environmental Mathematical Model: Using mathematical quantitative form shows spatial-temporal changes and variation law of environmental system of environmental elements, which is frequently used for describing transport and transformation rules of pollutants in space in the air or the water;

9) Environmental Carrying Capacity Analysis: Environmental carrying capacity refers to the threshold of the support capability of a regional environment to human social and economic activities in a certain period of time.

5.2.11.3 Impact screening

The proposed project adopts expert consultation and matrix to identify the cumulative environmental impacts. Main construction projects includes restoration and preservation of Historic Town wall, environmental remediation and utilization of Kaiyuan Taoist Temple, upgrade of museum treasures, restoration and reutilization of historic buildings, second phase construction of National Archaeological Park in Xiongjiazhong Tomb, river dredging, sewage collection pipe network, wetland projects, engineering machine of water system connectivity for upgrade of transport convenience of the Historic Town and so on. The recognition of environmental impacts for each subcomponent can be found in Chapter 1.6.1 in details, mainly involving traffic congestion caused by tourism in construction and operation periods; short noise, solid waste, wastewater, dusts, stink and safety; improvement of water environment quality; cultural heritage preservation and so on. According to experts' advice, after the implementation of the proposed project, the following projects will produce cumulative environmental impact in this region: improvement of ecological environment and water environment of Historic Town including dredging, laying of sewage pipe network, water system connectivity and so on. Therefore, this analysis of cumulative impacts mainly analyzes the environmental benefits brought forth by the water environmental improvement projects and overlays the environmental impacts of water environmental improvement projects in Jingzhou so as to further identify the effect of COD and ammonia emissions of the proposed project.

5.2.11.4 Analysis of Evaluation Results

The cumulative impacts analysis is based on the each item associated the water system in the Historic Town selected by EA Consultant, and calculated on superposed amount of COD, ammonia and nitrogen.

The sewage interception component has the most obvious positive benefit, which can reduce 470.54t of COD, 52.68t of ammonia nitrogen, 133.97t of TN and 10.04t of TP. Besides, water supply component and wetland engineering also have relatively large benefit. The water supply component will absorb 105.12t of COD and 41.34t of ammonia nitrogen every year. The wetland engineering will absorb 27.51t of COD and 1.55t of ammonia nitrogen very year.

Table 5-11 List of component of assessed cumulative impact on water environment

S.N.	Item	What impact	Impact type
1	Dredging	Reduce endogenous pollution by eliminating sediment	Positive profit
2	Remaining water discharge	Pollutants in the remaining water will increase pollution load in water environment	Negative profit
3	Domestic wastewater in tourist center	Pollutants in the domestic wastewater will increase pollution load in water environment	Negative profit
4	Wetland engineering	Self-cleaning ability of water body will be increased	Positive profit
5	Water system channeling and water supply engineering	Water amount will be added, and volume will be increased	Positive profit
6	Sewage interception engineering	Directly discharge sewage will be intercepted to reduce pollution load	Positive profit

Table 5-12 Superposed calculation of environmental impact, unit: t/a

Pollution factor	Dredging	Remaining water	Domestic waste water	Wetland engineering	Water system channeling and water supply engineering	Sewage interception engineering	Subtotal
COD	/	+5.2	+0.19	-27.51	-105.12	-470.54	-597.78
Ammonia nitrogen	/	+0.69	+0.02	-1.55	-10.5	-41.34	-52.68
TN	-37.1	+1.908	/	-4.13	-10.5	-84.15	-133.97
TP	-1.7	+0.0165	/	-0.38	-2.1	-5.88	-10.04

Note: water quality purification of wetland engineering will be calculated as 1% of the total pollutants discharged in the water system of the historic town according to the current situation. Water supply engineering will supply water 730 hours a year, $8m^3/s$ of water every second will be supplied.

5.2.11.5 Emission Reduction in Regional Water Environment

The emission reduction has achieved great success in Jingzhou during Eleventh Five-Year period. The amount of COD has reduced 9200t, nearly 15.16% in total emission reduction; the amount of SO_2 has reduced 3700t, nearly 8.2% of the total amount of emission reduction. It has successfully complete the emission reduction targets set in the early Eleventh Five-Year period (COD emission reduction to 7.8%, SO_2 emission reduction to 8%), with COD emission reduction exceeding 7.36%.

During the 12th Five-Year Plan, there are 132 emission reduction projects, including the planning and implementation of structural adjustment, management in engineering, urban sewage treatment, and management in agricultural pollution. There are 44 urban sewage treatment emission reduction projects, including 40 new township sewage plants, 2 expansions of urban sewage plants, 38 km expansions of pollutant pipelines, which increase sewage treatment capacity of 395,000 tons / day. There are 54 pollution sources control projects in livestock farms (cell), including ancillary construction in solid waste and sewage treatment facilities, which adopts dry collection to achieve farming wastes for fertilizer and methane treatment and other measures, and closing an aquaculture farm. Except for the new additional pollution, it will reduce 11680 tons emission reduction in COD, and 740t emission reduction in ammonia nitrogen.

5.2.11.6 Cumulative impact in Water Environment

According to the plan of emission reduction amount in Jingzhou in the 12th Five-Year Plan, the base quantity, additional quantity, reduction quantity, reduction rate in the emission amount can be seen in Table 5-13. From the table below, the amount of COD and ammonia nitrogen produced in the proposed project accounts for 5.11% and 7.12% in the emission reduction plan in Jingzhou. It has produced some environmental benefits to the repairing of water system in ancient town, which also promotes the improvement of water system.

Table 5-13 Statistics of COD and ammonia nitrogen emission reduction in Jingzhou

Item	Unit	COD	Ammonia Nitrogen
Reduction amounts in the 11h Five-Year Plan	Ten thousand tons	0.92	/

Reduction amounts in the 12h Five-Year Plan	Ten thousand tons	1.168	0.074
Reduction amounts in the proposed project	Ten thousand tons	0.05978	0.00527
Rate of Reduction amounts in the proposed project accounts in the Jingzhou in the 12th Five-Year Plan	%	5.11	7.12

5.2.12 Analysis of Impact on Associated Area

Based on the project analysis, the assessment scope should be appropriately expanded because the proposed project involves in extensive areas. This assessment will cover the associated areas upstream and downstream involved in the proposed project. The following content and scope are added for assessment.

Table 5-14 List of project assessment scope of associated area

Assessment target	Assessment content	Assessment scope	Assessment timeframe	Reasons for being part of assessment scope
Surface water	Tail water impact of Chengnan WWTP and Caoshi WWTP	Gangnan Canal and Taihugang Channel	Operation phase	Wastewater during the project operation will be discharged to Chengnan WWTP and Caoshi WWTP
	Impact of water supply sub-component on water system of historic town	Water system of historic town	Operation phase	The water supply sub-component is not in the scope of the proposed project but is directly related to the proposed project.
Solid waste disposal	Waste incineration project relying on feasibility	——	Operation phase	Domestic waste

5.2.13 Analysis of impact on surface water

5.2.13.1 Analysis of impact of Chengnan WWTP

(1). Introduction to environmental protection formality of Chengnan WWTP

The Chengnan WWTP project was approved by municipal bureau of environmental protection in Nov 16, 2007. It is projected to have the capacity for 140,000m^3/d (with 50,000m^3/d completed as of present). The plant utilizes the technology of reinforced secondary treatment of nitrogen and phosphorus removal + modified oxidation ditch + concrete + sand leach + advanced treatment and disinfection process, which can meet the requirement of water quality for discharging of incoming water and can greatly reduce regional discharge quantity.

At present, Chengnan WWTP runs stably and has received sewage 1.731 million m^3 in total in 2014. Its daily treatment capacity is about 47400 m^3. The actual discharged water quality from Chengnan WWTP is shown in the following Table 5-15.

Table 5-15 List of discharged water quality form Chennan sewage plant in 2013, unit: mg/L

Factor	COD	Ammonia nitrogen	TN	TP
Average value of incoming water	103	10.7	6.99	2.51

Average value of discharged water	21.98	1.19	3.71	0.14

(2). Environmental impact analysis of tail water of Chengnan WWTP

It can be seen that phase I of Chengnan WWTP has relatively small impact on sewage receiving water body under the circumstance of normal discharging, and relatively large impact under the circumstance of non-normal discharging.

5.2.13.2 Impact analysis of Caoshi WWTP

(1). Introduction to environmental protection formalities of Caoshi WWTP

Caoshi treatment plant was approved by the Jingzhou Bureau of Environmental Protection in Nov 16, 2007. It has the capacity for 120,000m3/d. The project utilizes the technology of reinforced secondary treatment of nitrogen and phosphorus removal + modified oxidation ditch + concrete + sand leach + advanced treatment and disinfection process, which can meet the requirement of water quality for discharging.

At present, Caoshi WWTP runs stably, receiving sewage 9.83 million m^3 in total in 2013. Its daily treatment capacity is about 26,900 m^3.

Table 5-16 List of discharge water quality of Caoshi WWTP in 2013, unit: mg/L

Factor	COD	Ammonia nitrogen	TN	TP
Average value of incoming water	210.7	30.7	21.2	10.69
Average value of discharged water	41.98	4.2	10.7	2.1

(2). Analysis of water environment in drainage from Caoshi WWTP of Jingzhou Municipal

This chapter only introduces the final results, while the calculating process of prediction is enclosed in the appendix.

If the discharge is normal, drainage from Caoshi WWTP of Jingzhou Municipal Phase 1 has fewer impacts on pollutant-holding water body; if not, it has greater impacts on pollutant-holding water body.

5.2.14 Impact of water supply engineering on water system of historic town

The Project of Water Diversion from Yangtze River to Han River is one of the components for improving upper and middle reaches of Han River in the middle route phase I of South-to-North Water Diversion project. The task of the component is to meet the conditions for ecology, irrigation, water supply and navigation in the lower river section of Xinglong of Han River which is the biggest tributary of the Yangtze River and provide irrigation water source to the Dongjing river irrigation area so that the impact of the middle route project of South-to-North Water Diversion on the ecological environment and social economy at the middle and lower reaches of Han River will be alleviated.

As an important source for improving water environment of the proposed project, the water supply subcomponent plays an important role. According to the impact of the water supply sub-component on the water quality of the historic town water system, the EA Consultant Report of Water Diversion from Yangtze River to Han River of Middle Route Phase I of South-to-North Water Diversion Project compiled by our institute and the DHI Sub-report of Hydrologic Water Quality Model Study of Historic town of Jingzhou are taken as references.

5.2.14.1 Environmental protection procedures of the Water Diversion from Yangtze River to Han River Project

In order to analyze the impact of Water Diversion from Yangtze River to Han River, the Hubei Construction and Administration Bureau of South-to-North Water Diversion Middle Route Project entrusted us to compose the Environmental Impact Report of Water Diversion from Yangtze River to Han River Project as the Phase I of South-to-North Water Diversion Middle Route Project. After accepting the task, we immediately sent relevant technological personnel to the areas along the Water Diversion from Yangtze River to Han River Project and the areas along the middle and lower reaches of Han River to conduct field investigations. Based on sufficient studies on the current status of ecological environment in the region, we composed the EA Consultant Outline for Water Diversion from Yangtze River to Han River Project as the Phase I of South-to-North Water Diversion Middle Route Project. On February 12 -14, 2004, the Appraisal Center for Environment and Engineering of the State Environmental Protection Administration held a technical assessment meeting for the EA Consultant Outline for Water Diversion from Yangtze River to Han River Project as the Phase I of South-to-North Water Diversion Middle Route Project (hereinafter referred to as the EA Consultant Outline) in Wuhan City, Hubei Province. After the meeting, the assessment organization carefully modified the EA Consultant Outline according to the Assessment Opinions for EA Consultant Outline for Water Diversion from Yangtze River to Han River Project as the Phase I of South-to-North Water Diversion Middle Route Project, and conducted environmental status monitoring, pollution source investigation, groundwater resource investigation, and investigation into the outbreak of schistosomiasis, and on the basis of which, the EA consultant composed the Environmental Impact Report of Water Diversion from Yangtze River to Han River Project as the Phase I of South-to-North Water Diversion Middle Route Project (hereinafter referred to as the Report). On March 18 to 20, 2005, the General Institute of Hydropower and Water Resource Planning and Design of the Ministry of Water Resources hold a technical appraisal meeting for the Report in Wuhan City. On March 22, 2006, entrusted by the State Environmental Protection Administration, Hubei Environmental Protection Bureau held the appraisal meeting for the Report.

5.2.14.2 Analysis of environmental impact on Gangnan Canal

Under the condition of guaranteeing 90% of monthly average flow, there is not must difference in water environment quality for the three scenarios: the scenario prior to water diversion, the scenario in which diverted water does not go into Han River and that in which the diverted water goes into Han River. The middle scenario will have slightly lower concentration of potassium permanganate while the latter one will improve the water environment quality of Han River to some degree. Under the condition of the lowest flow for 30 days in a row, the flow is relatively small and the water environment quality is relatively poor due to limited adjusting capacity of Danjiangkou reservoir. But the adjusting capacity of Danjiangkou reservoir will be increased by building more dams and water diversion, which will make flow increase and improvement of water environment quality to some degree compared with the situation before water diversion. After the water is diverted from Yangtze River to Han River, due to the water supply function, the lowest flow at Xiantao station can be kept at 500m3/s and above, and therefore, the water environment quality of Han River will be improved to a large degree. Based on the condition that all the industrial pollution sources will be treated to full standards before being discharged, the river section below Gaoshibei will be kept as type III water body when domestic water is not treated to standards; and this river section will be kept as type II water body when it is treated to standards.

Calculated according to the average 10-day flow of February and March, under the current condition, the guarantee rate of 500m^3/s sectional flow of Han River at Xiantao diachronically will be 87%. After the middle route project of the south-to-north water conversion is implemented, if the project of water conversion from Yangtze River to Han River is not taken into consideration, the guarantee rate of 500m^3/s sectional flow of Han River at Xiantao City diachronically will be only 44%; and if taken into consideration, the rate will be 95%, which can make sure that “water bloom” will not occur in Han River under normal circumstance. After the middle route project of south-to-north water diversion is carried out, under the condition of average flow of years in dry season, if Xinglong pivot project is the only project to be built a the middle and lower reaches of Han River, there is great chance that the growth rate of algae at the lower reaches of Han River will increase and it is very likely to have “water bloom” occurrence from Hanchuan to Wuhan section of Han River; such impact, however, will be greated reduced by the function of water supply from Yangtze River to Hanjaing river, and the impact factor has dropped to 20~30%; so occurrence of “water bloom” at the lower reaches of Han River can be under good control. After considering the change of hydrologic situation of Yangtze River after the Three Gorges project, the middle route project of south-to-north water diversion and the project of diverting water from Yangtze River to Han River, under the most unfavorable condition, the probability that the flow of Han River is less than 0.3m/s under the backwater effect of five-year-return high water level of Yangtze River; therefore, the construction of water diversion from Yangtze River to Han River will play an extremely important role in improving the water environment quality of the lower reaches of Han River, controlling and diminishing the impact of “water bloom” on the water body of Han River.

When the channel of water diversion from Yangtze River to Han River passes Changhu lake, some lake branches will be barred, and so, the exchange between lake branches and the main lake will be reduced. Compared with the scenario when no channel is built, the potassium permanganate index of Changhu lake water quality around the main ditch increases from 7mg/L to 9mg/L in the scenario of channel being built, so, unfavorable impact will be produced on the water environment quality of Changhu lake.Hougang, one of the largest area of the lake branches, will basically solve the problem of local concentration increment caused by the barrier through increasing lake water flowing with water supply 1m3/s from the Changjaing river; meanwhile, considering that comprehensive control will be carried out on the industrial pollution sources around the Changhu lake, the phenomenon of Changhu water body being polluted will be thoroughly eliminated.

After the water diversion from Yangtze River to Han River is carried out, it will be level cross with Shiqiao river, which will have some backwater effect on the water of Shiqiao river. If it over passes the river, the effect of backwater can be eliminated.

The project will supply water to Dongjing river, which will increase the flow of Dongjing river, the irrigation guarantee rate in the irrigation area of Dongjing river, and the irrigation water quantity and subsiding water quantity of Dongjing river irrigation area. Calculation indicates that the concentration of nitrogen and phosphate in Dongjing river will increase if it is compared with the current situation.

5.2.14.3 Impact analysis of Gangnan Canal water supply

According to the Planning of River-Lake Channeling Engineering for Jingzhou Downtown (2013), water supply to the water system of the historic town all comes from the water supply system of Yangtze River; the water is supply to the moat from Taihugang Channel and Gangnan Canal through Juzhang River and the channel of water diversion from Yangtze River to Han River. On the one hand, the water supply sub-component will supplement the ecological use for the water system of the historic town; on the other hand, it can provide power source necessary for the moat. Water supply from Taihugang Channel is one of the main sources of water supply to the water system of the historic town recently, which is mainly realized by the Liumen pump station, and the water quality is between type III and IV. In the long run, the water will come from the channel of water diversion from Yangtze River to Han River, and the water quality of Yangtze River can reach type II.

The model of water supply engineering program is that the water level of city moat keeps at 29.5m, the normal water level, under the condition of precipitation evaporation and pollution load in the current condition of the typical year 2013; for the boundary conditions, direct discharging of surface run-off, pipe network leak, direct discharging of tail water from sewage plant (domestic wastewater from the west and south of the city and south of the port is put into the main sewage interception pipeline and discharged into Gangnan Canal after being treated in Chengnan WWTP) and Gangnan Canal water supply (the actual water supply flow in 2013 is replaced with the flow of the water supply sub-component) are considered; the initial field setup of water quality is type IV water critical value; in terms of compliance, release of endogenous sludge (after dredging project is carried out) is also considered. The water supply by Gangnan Canal is $3m^3/s$, $5m^3/d$, $8m^3/s$ and $10m^3/s$; the supplied water quality is type III or type II water quality critical value.

The calculation result of the working condition of every water supply can be known from the following Table 5-17. The water supply quantity and the water quality of supplied water have significant impact on the water quality of the water system of the historic town. The overall water quality level should be kept at type IV; when the supplied water quality is at type III critical value, $5m^3/s$ of water needs to be supplied; and when it is type II, $3m^3/s$ needs to be supplied. The overall water quality level should be kept at type III. When the supplied water quality is type II critical value, $8m^3/s$ of water needs to be supplied. On the whole, the water supply sub-component has significant effect on improving the water system of the historic town.

Table 5-17 Statistics of yearly average concentration of overall water quality indexes of historic town water system by the water supply program

Water supply program comparing index			Yearly average concentration of water quality indexes of historic town water system					Overall water quality rating
			COD	BOD	NH4-N	TN	TP	
Water supply flow	Water quality type	Comparing target	30	6	1.5	1.5	0.3	IV
3	III	Calculation value	25.54	4.32	1.29	1.65	0.34	V
		Drop ratio %	14.87	28	14	-10	-13.33	

Water supply program comparing index			Yearly average concentration of water quality indexes of historic town water system					Overall water quality rating
			COD	BOD	NH4-N	TN	TP	
		Index level	IV	IV	IV	V	V	
	II	Calculation value	22.24	3.79	0.99	1.34	0.26	IV
		Drop ratio %	25.87	36.83	34	10.67	13.33	
		Index level	IV	III	III	IV	IV	
5	III	Calculation value	24.11	4.23	1.19	1.46	0.29	IV
		Drop ratio %	19.63	29.5	20.67	2.67	3.33	
		Index level	IV	IV	IV	IV	IV	
	II	Calculation value	20.38	3.61	0.84	1.11	0.21	IV
		Drop ratio %	32.07	39.83	44	26	30	
		Index level	IV	III	III	IV	IV	
8	III	Calculation value	23.09	4.17	1.12	1.32	0.27	IV
		Drop ratio %	23.03	30.5	25.33	12	10	
		Index level	IV	IV	IV	IV	IV	
	II	Calculation value	19.07	3.47	0.75	0.94	0.18	III
		Drop ratio %	36.43	42.17	50	37.33	40	
		Index level	III	III	III	III	III	
10	III	Calculation value	22.7	4.15	1.09	1.27	0.26	IV
		Drop ratio %	24.33	30.83	27.33	15.33	13.33	
		Index level	IV	IV	IV	IV	IV	
	II	Calculation value	18.75	3.42	0.71	0.88	0.17	III
		Drop ratio %	37.5	43	52.67	41.33	43.33	

5.2.15 Impact analysis of solid waste incineration

Garbage generated by the project will be sent to Jimei Incineration-based Waste-to-Energy Project, the following solid waste incineration plant for the impact analysis.

5.2.15.1 Summary

Jingzhou Municipal Jimei solid waste incinerator project is located in Paima village, Jinan town, Jingzhou Municipal, about 7km away from the historic town. Its construction content includes 2 sets of 48.5t/h different-SG circulating fluidized bed boiler, 1*12MW steam turbine generator unit and 1*6MW steam turbine generator unit, complete with environmental protection facilities such as flue gas treatment, garbage leach collection treatment and secondary domestic wastewater treatment station, and daily treatment scale is 1000t. The former Environmental Protection Bureau of Hubei Province has replied (EHH[2006] No.140) to the EA Consultant of the proposed project in April 2006. The project started construction in September 2009 and completed in June 2011. It was approved by Jingzhou environmental protection bureau in July 2011 before being put into trial production. In May 2012, it was officially put into operation after being accepted by the department of environmental protection of Hubei province.

5.2.15.2 Technological process

The technological production process of the domestic solid waste incinerator project of Jingzhou Jimei thermal power Co., Ltd. is shown in Figure 5.2-1.

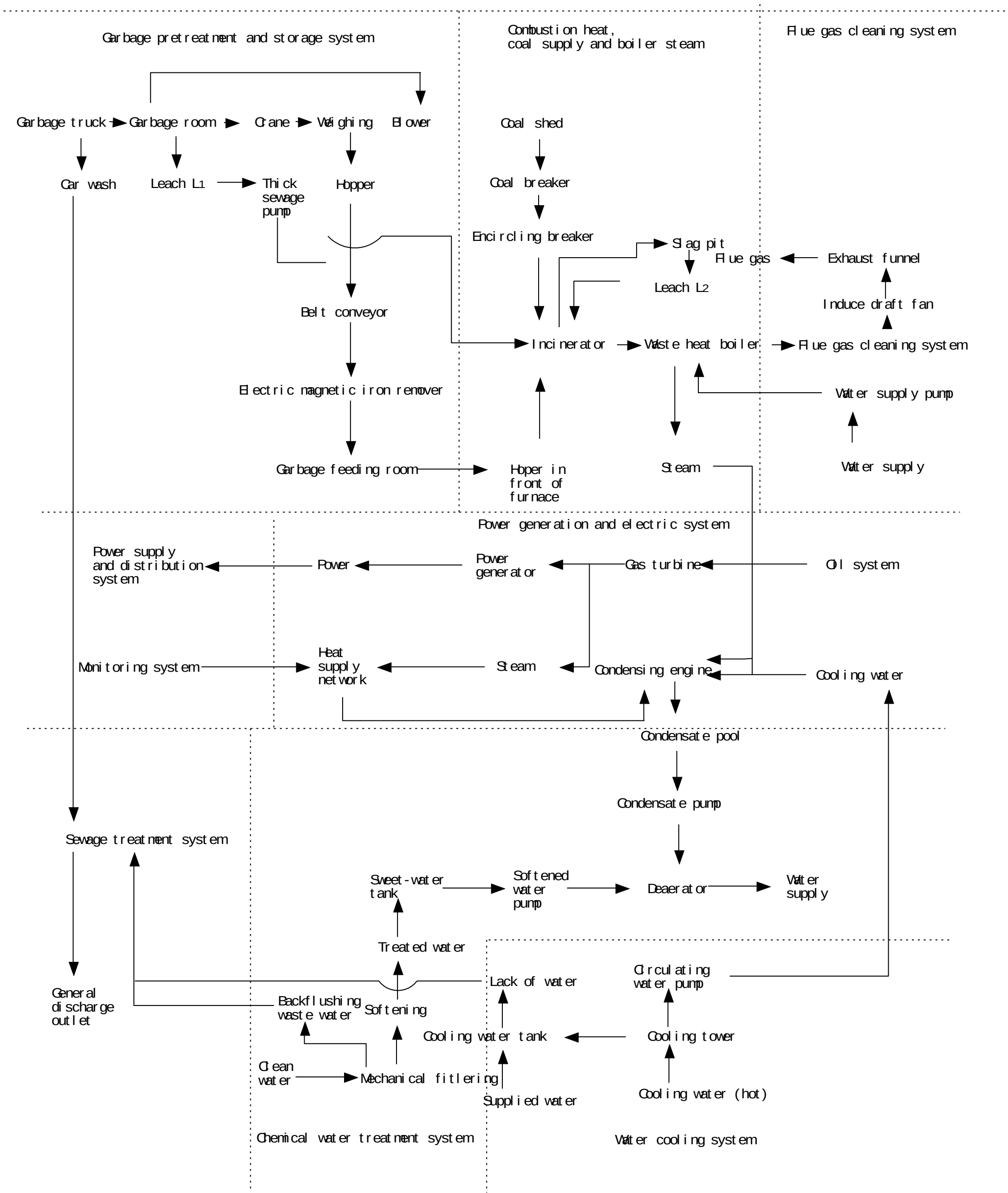


Figure 5.2-1 Flowchart of production process

5.2.15.3 Main mitigation measures

The main measures in the garbage power generation works are:

(1). Countermeasures of ambient air pollution prevention and protection

1) Acid gas prevention and protection measures: semi-dry washing tower is used to get rid of acid gases such as HCL and SO2 in the flue. The eliminating rate of chlorides and SO2 by semi-dry washing tower can reach 91.00% and above, and 80.00% and above, respectively; after the treatment, both chlorides and SO2 can meet the standard and be discharged.
2) Preventive and protective measures against heavy metal, smoke and TCDD: active carbon adsorption is adopted to eliminate substance such as heavy metal in smoke and TCDD and furan in incineration system. Meanwhile, the proposed project will use advanced process and strict running control technology to make the temperature in incinerator＞850℃ and the smoke staying time ＞2s; Fuel will be sprayed in when the machine is started to keep complete incineration inside the incinerator. Methods such as smoke quenching will be used to effectively control generation of TCDD and furan and secondary synthesis to reduce their generation. The effect is good as the eliminating rate of smoke, HF, HCL and TCDD reach 98.00%, 71.97%, 88.44% and 98.94%, respectively, all of which can reach standard before being discharged.
3) Preventive measures against smoke pollutants from incineration: the proposed project adopts high temperature bag-type dust remover and the dust-removing rate is 97.07% and above, so the smoke can meet the standards and be discharged.
4) Control measures against odorous gas during operation: working sections that generate odor such as garbage unloading hall, garbage storage pit and incineration unit all adopt airtight negative pressure system; air curtain is installed at the entrance and exit of garbage unloading hall; automatic dump gate is set up between garbage slot and garbage pit, which keeps enclosed state at ordinary times to reduce escaped dust and odor. There are three incinerators for the proposed project, two of which will be kept running to keep the garbage unloading hall and garbage storage pit at negative pressure state for a long period of time to keep odor from escaping.
5) Coal-fired boiler smoke treatment also adopts absorptive wetting and semi-dry circulating fluidized bed reaction tower and mechanical dust removal plus bag-type dust removing system; the dust-removing rate is above 98.00% and the desulfurization efficiency is above 80.00%.
6) After the proposed project is completed and put into operation, the running process control should be enhanced so that the temperature inside furnace between 850℃ and 1100℃ can be kept and the smoke stay time longer than 2s to ensure normal running of pollution treatment facilities and prevent occurrence of abnormal discharging of pollutants.
7) This assessment requires that Chengnan thermal power company should design a 100m-high chimney with a diameter of 2.60m to meet the discharging requirement.
8) Designate a 300m-long sanitation protection distance around the project location; the residents in the project location and in the sanitation protection zone should be relocated and the area should be planted with 10m-wide greening belt.

(2). Preventive measures against solid waste

1) Measures against flying ash: it is recommended to adopt cement solidification method for ashes in the proposed project, namely, add cement to some ratio in ash and mix them with water to solidify it. This method has low investment cost. After toxicity test (GB5085.3-1996) is carried out for verification to confirm that the heavy metal leaching concentration does not exceed the standard, the solidified ashes will be moved to garbage dump to be safely buried in the hazardous waste burying area.
2) Treatment measures against slag and pre-treated inorganic substance: slag and pre-treated inorganic substance are not hazardous waste and can be used as brick material or foundation material for road pavement. Chengnan thermal power company can contact Jingzhou building material plant and relevant department for comprehensive utilization of slags.
3) Metal treatment: large chunk of waste metal in the residue from garbage incineration can be conveniently separated manually; small waste metal in fine slags will be automatically separated by magnetic separator and stored at a fixed storage area of the slag gallery before being sent to steel plant for recycling.

(3). Preventive measures against water pollution

1) Measures of separating polluted water by grades and cycling use of water: after the proposed project is built and put into operation; polluted water will be separated from less polluted water or clean water for discharging; equipment cooling water will be reused after being treated with cooling tower; wastewater that contains high concentration of pollutants will be categorized for treatment or reused.
2) Garbage leaching water treatment measures: under the condition of high calorific value of garbage and allowable furnace temperature, the leaching water will be incinerated in the incinerator after filtration. The proposed project is provided with garbage leaching water high temperature concentration back spray incineration device.
3) Measures for water from cooling system: all the water from cooling system will be recycled as water for cleaning shop and equipment and for cooling water of slag separator water seal, and so, will not be directly discharged into pollutant receptor water body.
4) Comprehensive treatment measures against discharged wastewater from plant area: discharged wastewater from plant area includes wastewater from cleaning conveyor, garbage truck, garbage feeding room; wastewater from cooling slag extractor, back-flushing wastewater for boiler water supply filter, regenerated wastewater from ion exchanger back flushing; condensate wastewater from plant area heating, other wastewater from cleaning and domestic wastewater. Physic-chemical method and contact oxidation method will be used for treatment; the designed treatment capacity is 750m3/d and the actual treatment capacity is 601.950m^3/d; after being treated at sewage treatment station, COD, NH_4-N, SS, sulfide and TL will be eliminated 75.00%, 60.00%, 88.00%, 70.00% and 60.45%, respectively. The treated wastewater will be discharged in the water area of Changhu Lake and Miaohu Lake through Longhui River.

5.2.15.4 Environmental impact analysis

The assessment is conducted according to the Environmental Protection Acceptance Monitoring Report of the Jimei Incineration-based Waste-to-Energy project of Jingzhou Jimei Thermal Power Co., Ltd. provided by the environmental monitoring center of Hubei province. It can be known from the documents review and field investigation that the Jimei garbage incineration power generation project has no unfavorable impact on surrounding environment and the enterprise has taken effective preventive measures against generation and discharge of pollutants as required by environmental protection.

(1). Waste gas

Organized waste gas emission All the largest emission concentrations of smoke, SO_2, NOx, CO, H_2S, Hg, Cd, Pb and TCDD in the flue gas of incinerator meet the requirement in Table 3 of Standard for Pollution Control on the Municipal Solid Waste Incineration (GB18485-2001).

Unorganized waste gas emission Unorganized emission of particles at factory boundary meets the grade II standard in Integrated Emission Standards of Air Pollutants; H2S, ammonia and odor concentration meets the requirement of grade II standard in Emission Standards for Odor Pollutants (GB14554-93).

(2). Waste water

Domestic wastewater treatment facility water quality monitoring result The largest values of average daily concentration of pH, COD, BOD, suspended matter, ammonia nitrogen, phosphate and cationic surfactant at the outlet of domestic wastewater treatment facility meet the requirement of grade I in Table 4 in *Integrated Wastewater Discharge Standard* (GB8978-1996).

Monitoring result of acid-alkali wastewater The pH value of acid-alkali wastewater is between 7.58~8.66, which meets the requirement of grade I in Table 4 in *Integrated Wastewater Discharge Standard* (GB8978-1996).

(3). Solid waste

The contents of Cu, Zn, Cd, Pb, Hg, total Cr, Cr VI, As and Ni in the slag sample are all lower than the corresponding limit value specified in *Identification Standards for Hazardous Wastes - Identification for Extraction Toxicity* (GB5085.3-2007).

All the heavy metals, TCDD content and water content in the solidified flying ash meet the corresponding standard requirement in *Standard for Pollution Control on the Landfill Site of Municipal Solid Waste* (GB16889-2008).

6 ANALYSIS OF IMPACTS ON SOCIAL ENVIRONMENT

6.1 Social impacts of sub-components

Considering that the social impacts of the project are relatively big, the PMO has consigned Involuntary Resettlement Research Center of Wuhan University to formulate the *Social Impact Assessment of World Bank Financed Hubei Jingzhou Historic Town Conservation Project* (hereinafter referred to as SA). The conclusion of social impacts in the EIA mainly refers to SA.

Jingzhou Historic Town Conservation Project, planned by Jingzhou Urban Construction & Investment Co., Ltd. and applying for the loan of the World Bank, consists of 18 sub-components in 4 components. Details are as follows:

Component I: Cultural Heritage Conservation and Tourism Promotion, including 6 sub-components, i.e. Restoration and Preservation of Historic Town Wall, Environment Improvement and Utilization of Jingzhou Kaiyuan Taoist Temple, Upgrade of Display of Jingzhou Museum Treasure Hall Cultural Objects, Restoration and Reutilization of Historic Buildings, Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park, Support to Tourism Development.

Component II: Improving the Water Environment of the Historic Town, including 4 sub-components, i.e. Dredging of the Moat and Lakes within the Historic town, Sewage Pipe Network, Expansion of Wetlands within the Moat and Larger Lakes, as well as Water Resources Inter connectivity Improvements and Possible Increased Water Transfer between Water Bodies.

Component III: Improving Accessibility of the Historic Town, including 5 sub-components, i.e. Road Traffic System, Non-motorized Traffic System, Public Transit System, Traffic Sinage System and Technical Support

Component IV: Consultancy Service of Design Review and Project Management, including 4 sub-components, i.e. Consultancy Service of Design Review, Project Management and Monitoring Evaluation, Procurement of Office Facilities for PMO and Implementing Agencies, Training and study tour, and Subject research, management system.

The objective of project development (PDO) is to protect Jingzhou cultural heritage, promote tourism development (upgrade of tourism facilities and service), and improve the living environment of surrounding residents. In combination with project contents, the chapter details the impacts of the project on social environment, further analyzes resettlement plan and tourism crime and puts forward pertinent measures.

6.1.1 Sensitive receptors

Jingzhou Historic Town was attached to Jingzhou District in Jingzhou Municipal. Jingzhou Historic Town is 3.75 km long from east to west, 1.2 km wide from north to south, and 9 m high. Its circumference is 11.28 km long. Total area of the Jingzhou Historic Town reaches 4.5 square kilometers. The Historic Town is surrounded by moat.

Residents inside the Jingzhou Historic Town are mainly from the West Town Street and the East Town Street. Renmin Road separates the West Town Street from the East Town Street. To the west is the West Town Street, and to the east is East Town Street. Half land of residents committee of both north door and west door for the West Town Street is outside Historic Town, and the remaining parts are inside. East Town Street is inside Historic Town except Caoshi, Dongqiao, Dongsheng, Anxinqiao Towns.

The West Town Street has jurisdiction over six community residents committees, Jingcheng Village as well as Hongzhuan fishery. It is very rich in cultural and tourism resources, some tourist attractions like famous Jingzhou Museum, Iron Maiden Temple, and Guanggong Temple are located there. Various types of medium and large institutions and hospitals are intensive. Urban infrastructure facilities are sufficient. The East Town Street has jurisdiction over ten community residents committees, and there are 98 avenues and alleys, 318 administration units, and enterprises and public institutions at district, municipal, provincial or national level.

Based on the statistics of population in *Social Impact Assessment of World Bank Financed Hubei Jingzhou Historic Town Conservation Project*, the objects affected are sensitive receptors directly affected by waste water, waste gas, noise, and waste slag produced by construction. See Chapter1.4.2 for details. Objects indirectly affected by the project and those benefiting from the project cover residents, schools and organizations inside Historic Town. See Table 6-1 List of Sensitive Receptors in the Area Affected by Project for the administrative zoning of affected objects.

Table 6-1 List of Sensitive Receptors in the Area Affected by Project

Area	Name of sensitive receptor	Population
Xicheng Sub-district Office (inside Historic Town)	Tonghuiqiao Neighborhood Committee	12936
	Minzhu Street Neighborhood Committee	7638
	Sanyi Street Neighborhood Committee	6614
	North Gate Neighborhood Committee	7423
	Yingdu Road Neighborhood Committee	11355
	West Gate Neighborhood Committee	4087
	Jingzhou West Gate Middle School	/
	Jingzhou Yingdu Primary & Middle School	/
	Yangtze University College of Arts and Science	/
	Jiangling Middle School	/
	Jingzhou Primary School	/
	Hubei Province Jingzhou Middle School	/
Xicheng Sub-district Office (outside Historic Town)	Jingcheng Neighborhood Committee	732
	Fanrong Street Neighborhood Committee	3725
	Hongzhuan Community	489
Dongcheng Sub-district Office (inside Historic Town)	South Gate Neighborhood Committee	7819
	Yingbin Neighborhood Committee	4931
	Jingdong Neighborhood Committee	7451
	East Gate Neighborhood Committee	6008
	Jiefang Neighborhood Committee	8309
	Xiangyang Neighborhood Committee	8002
	Huangjintang Neighborhood Committee	11117
	Xuanmiaoguan Neighborhood Committee	8923
	Jingzhou South Gate Middle School	/
	Jingzhou Experimental Primary School	/
	Jingzhou Institute of Technology	/
	Jingzhou East Gate Primary School	/
	Jingzhou Radio and Television University	/
Dongcheng Sub-district Office (outside Historic	Caoshi Neighborhood Committee	8007
	Dongqiao Neighborhood Committee	1606
	Dongsheng Neighborhood Committee	5387

Area	Name of sensitive receptor	Population
Town)	Anxinqiao Neighborhood Committee	14758
Note: population of schools is incorporated into neighborhood.		

6.1.2 Social impacts of restoration of Historic Town wall and associated buildings

6.1.2.1 Status quo analysis

Jingzhou's fortified city wall is known as the core carrier of the historical and cultural city of Jingzhou. The Historic Town wall, together with the towers, has a very high historical value in the aspects of its scale of shape, the pattern, the functional structure, history and culture, and the reservation conditions, etc. The existing city wall above the ground is of Ming and Qing architectural relics, which has undergone many ups and downs of hundreds of years and the impacts and hazards of wars, natural and human factors. The main parts of the bricks, the earth walls are damaged seriously. The cultural relics in the project area are generally in poor condition. Some sections of Historic Town wall, brick pavement and important wood components have suffered varying degrees of damage. Some ancient wooden members are in serious adverse state. A large number of historic buildings cracked, and some sections of Historic Town wall has become dangerous rock body. Some outdoor stone pavement is in a serious damage state. Other problems widely exist in various cultural heritage sites, and the situation is very serious in some places. For example, the disappearance of a large number of ancient buildings in historic blocks commonly exists in the surrounding streets of the Historic Town wall. The quality of water system around the Historic Town wall has severely deteriorated, and some river sections have even dried up. Apart from effective control of building height, the protection of ancient buildings in the Historic Town area has lagged far behind. It has been an important task for local government to carry out the renovation of the Historic Town.

6.1.2.2 Analysis of project implementation impacts

The main problems to be resolved in the Restoration and Preservation of Historic Town Wall are as follows: Firstly, the tilt, collapsed walls caused by mixed masonry of bricks and earth, and the uneven pressure in the walls; Secondly, the weathering, loosening and peeling off of the walls bricks as the result of destruction of natural factors such as long ages, exposed to the weather and the erosion of the rains; Thirdly, removal of the unknown or unspecified trees and weeds; Lastly, restoration of the badly damaged walls, gates, tower platform, tower and the hideouts.

Environment improvement and utilization of Jingzhou Kaiyuan Taoist Temple includes road and Greening Environment Work, Scenic Spot Construction Work, Preservation and Exhibition of other Removable Cultural Objects. Upgrade of Exhibition of Jingzhou Museum Treasure Hall Cultural Objects includes Comprehensive Reconstruction of Treasure Hall Buildings, Treasure Hall Exhibition Work, Installation Work of Treasure Hall, Environmental landscape and ancillary works, and Restoration and Reutilization of Historic Buildings. Phase II Construction of Xiongjiazhong Tomb National Archaeological Relics Park includes Landscape and Infrastructure Work, Relics Noumenon Exhibition Work, Work of Unearthed Cultural Relics Exhibition Hall, Work of Park Area Identification and Guide- to- Visitors System, and Park Area Management System Work. Tourism Development supports includes Visitors' Center, Construction and Improvement of Greenbelt such as Parks and Gardens, Historic Town Tourism Sinage and Guide to Visitors Information Service System.

The abovementioned works may pose negative impacts in short term. However, in the long run, such works can improve the tourism quality of Historic Town and do better in preserving the historic relics in the area.

Negative impacts: Noise and air pollution will be caused during construction, and large transportation vehicles will also cause pollution. The project construction will occupy public space around the city walls and some roads may be closed to traffic, and thus cause inconvenience to the pedestrians and residents. Besides, the construction will disturb the life of neighborhood and may have potential safety risk and cause inconvenience for entering and exiting the city gate. What's more, the business of the stores and merchants in the neighborhood will also be affected during operation. However, many jobs will be provided to local residents because a lot of labors, such as construction workers and loaders, will be needed during the construction. Technicians are workers are also needed during project operation, which means more job opportunities to some degree. The biggest impact to the residents inside and outside the Historic Town during the restoration is the inconvenience that it may cause for the city gate traffic because it is already inconvenient at present due to huge traffic flow. Unavoidably, the city gate will be restored as well when the city walls are restored; and thus the traffic pressure at the city gate will be aggravated.

Positive Impacts: More work should be done to enhance attraction of Jingzhou Historic Town walls to tourists if the city is compared with other similar cities in terms of the absolute number of tourists. The restoration of the Historic Town walls will attract more tourists to the Historic Town and thus promote the economic development of the city. Besides, successful restoration of the city walls also plays an active role of demonstration for restoration of other ancient architectures, and a valuable experience for the relics management office.

The restoration of Jingzhou Historic Town walls will undoubtedly drive the economic and social development of the Historic Town, bring new appearance to the Historic Town, and inject powerful momentum to the social and economic development of the eastern and western city streets.

6.1.3 Social impacts of improving water environment in and around the Historic Town

6.1.3.1 Status quo analysis

The outside and inside of ancient circumvallation in Jinzhou city possess complete drainage system, which connects the Tai Lake in the west and the Long Lake in the east historically.

The perimeter of the moat outside the city is about 12.2 kilometers .The moat is 5 meters from the nearest angle of the brick city wall and 30 meters from the furthest angle of the brick city wall, and generally is 10 meters. The width of the moat is 10-50 meters, reaching 100 meters in local area, with the depth to be 3-4 meters, the normal water level to be 28.71 meters (elevation of the Yellow Sea), flood level to be 30.21m, the water area to be 0.6 square kilometers, the accommodated drainage area to be about 34 square kilometers, and the depth of mud to be 0.5-1.0 meter. There is water flowing in the river throughout the year, which forms the natural cover for defence of the outside ancient circumvallation, together making up the Historic Town system with typical style of Yangtze River Delta.

The moat is a water city gate in ancient, connecting with the Yangtze River, located in the Small East Gate which is also named as the Gong An Gate in the southeast direction, which totally relies on ships in and out, as there is no land route connecting to the outside world. Then as the

Yangtze River changes its course, in case of flood control, the moat is cut off with the Yangtze River water. The scholar of Jinzhou, Pu Shipei, has recorded in his book *Jinzhou Stories* that in Qianlong fifty-three years (1788 AD), the Wan City dike section of Jinzhou dike mostly appears dyke breaches, which leads to one of the rare big flood in Jinzhou history, with 1,763 people drowned and 40,815 houses collapsed at that time in the city.

Through many years of treatment, the water quality of the moat in Jinzhou Historic Town and the internal and external drainage system has been improved, such as the eastern city wall section of the moat. However, the water pollution is still serious in most of the river sections, as the pollution source has not been cut off effectively.

For many years, as the rapid population growth and disordered construction in the Historic Town, the drainage system has been eroded constantly, most of the internal river water being obstructed, sever deposition appearing in the existing water surface, having losing the basic capability of flood drainage function. Both the North Lake and the West Lake are the internal drainage system of the Historic Town, which connects to the moat outside the city, and the water quality of which is quite poor except part of the water body, the revetment construction of which has lagged behind, with serious deposition.

According to the planning of the Jinzhou Historic Town, the internal city shall be the combined system, while the external city shall be the separate system. Up to now, 6500 meters of sewage interception pipe has been constructed in the internal Jinzhou Historic Town; 15000 meters of sewage pipe has been constructed in the south of the city, which is the separate system. However, as there is still 5600 meters of sewage pipe still not being constructed, the rain sewage diversion cannot be implemented completely, which results in the fact that there is still a large number of sewage water flowing into the moat directly. That the source of pollution has not been cut off utterly leads to the effect of the pollution treatment being not obvious.

6.1.3.2 Analysis of project implementation impacts

The management goal of internal and external water system in Historic Town: to finally make the water quality reaches the standard of the third type water of national surface water through completion of sewage interception to the internal and external circuit of the moat, dig-out of mud in the moat bottom, ecological revetment construction and cultivation of aquatic plants and animals; to make the internal and external drainage connect with each other, increasing the self cleaning capacity of water body. The project includes the construction of moat dredging, management of the internal and external drainage system in Historic Town, sewage interception of moat and so on.

The implementation of abovementioned works may produce negative effects, such as noises, dust, odor, and inconvenience for traffic. However, in the long run, such works can improve the water quality in Historic Town and upgrade the ecological environmental, which could further enrich the tourism environment. For a long time, authorities at all levels pay a lot of attention to the water treatment inside and outside Historic Town and have made effort on exploring better ways to solve the water problem of moat. However, water treatment has suffered a lot of failure. Though some technical measures have been taken at some river sections, the results are not obvious. In the meantime, successful experience has been accumulated at East Gate Section. Currently, the biggest problem in water treatment is deficiency of fund. Once the project is accepted by the World Bank, water treatment works can be further enhanced to completely improve the water quality inside and outside Historic Town.

6.1.4 Social impacts of transportation facilities improvement

6.1.4.1 Status quo analysis

Due to high population density and incomplete infrastructure, Jingzhou Historic Town, covering an area of 4.5 km^2, has no longer been able to bear the residences and traffics of population inside the town. For protecting it, besides decentralisation of population, there are various problems to be solved lied in other aspects, including inner and outer traffic and landscape of the Historic Town. The project contents comprise: the protection and maintenance for inner and outer ring roads of City Wall, the protection and maintenance for outer ring road of moat, and traffic dredging work for the interior and exterior of the Historic town.

6.1.4.2 Analysis of project implementation impacts

In order to improve the traffic inside Historic Town and facilitate the transportation, the main work of the protection and maintenance inner and outer ring roads of City Wall includes: environmental protection work within the area of 50m of dyke toe inside the City Wall (comprising supporting construction works such as waste transfer stations, public toilets, management rooms and greening) landscape lamp lighting work for 10.28 km of inner ring, building elevation reconstruction work of inner ring, restoration and promotion work for footpath of outer ring.

Tour bus route between Historic Town and Xiongjiazhong Tomb starts at East Gate Visitor's Center, stretching to Xiongjiazhong Tomb passing Jingzhou Avenue, North Ring Road, and Jingying Road. The whole length of the route is 40km, taking a 1.5h bus ride. 2 stations are provided along the route, i.e. East Gate Visitors' Center Station and Xiongjiazhong Tomb Station. It is expected that the two-way passenger flow volume on Historic Town – Xiongjiazhong Tomb Special Line could reach 2,306 persons/day, requiring 10 hybrid tour coaches. See Figure 6.1-1 for the traffic map.

Seen from the cooperating scenic spot development and promoting tourism, there is relatively good social impact. Seen from the east gate scenic area that is provided with relatively good tourist infrastructures, the ancient city has small area and is lack of parking lot; tourist vehicles (buses and private cars) are usually parked along the inner ring road, which has caused bigger traffic pressure to the inner ring road that is already crowded. Demolition involved in parking lot and visitors' center is not much, which is mainly at the north of Mingyue Park.

Figure 6.1-1 Map of Xiongjiazhong Tomb Bus Route

6.1.5 Social impacts of resettlement caused by the project implementation

6.1.5.1 Overview of land requisition and demolition

According to the statistics of physical goods investigation carried out by PMO and Involuntary Resettlement Research Center of Wuhan University, in the project, the area of state-owned land requisitioned is 17.94mu, all of which is construction land. Temporary land occupation is 566.50mu, among which 317 mu belongs to Jingzhou Municipal Forest Bureau, 249.50mu collectively owned by Jingcheng Village. Areas affected by land requisition and resettlement are within Xicheng Sub-district. Land use involves Jingcheng Village and municipal forest bureau; resettlement involves North Gate Neighborhood Committee at Xicheng Sub-district.

Demolition covers an area of 8,180m^2, and involves households of 38, population of 125. Private houses demolished cover an area of 3,980m^2. Two public institutions are affected with a demolition area of 4,200m^2. A total of 13 stores are affected, involving 38 employees.

6.1.5.2 Analysis of resettlement impacts on society

Seen from negative impacts, the implementation of project exerts very limited impacts on poor people. The impacts rest on the recovery of demolished house after resettlement. Therefore, PMO and Jingzhou Municipal government formulate special aid measures for vulnerable population, ensuring that they are provided with better housing conditions than before resettlement.

Seen from positive aspects, the implementation of the project will improve the living environment of people residing in Historic Town and transportation and tourism development of Historic Town, which creates good environment for the development of Historic Town, stimulates tourism, transportation, commercial services. In the end, the project could bring jobs to the poor population and improve their living and travel conditions.

6.1.6 Health management

Most of the construction workers and staffs are from different places, they will take other diseases to the area. Common health problems of these groups are: sexually transmitted infections (STIs), HIV/AIDS, tuberculosis, respiratory infections, diarrhea, parasites, and vector-borne diseases such as malaria, alcoholism, drug abuse, zoonotic diseases, schistosomiasis, leptospirosis and so on. Contractors need to take the following measures, to ensure the making of sufficient health plan of the project:

1) Screen workers in annual recruitment;
2) -Implementation of a comprehensive vaccination program in accordance with the local regulations;
3) -Implementation of Malaria prevention measures in existing conditions in the camp, and setting up of facilities for early diagnosis and treatment of patients;
4) -Storage of enough drugs to treat malaria;
5) -Collection and detection of saliva of individuals at risk of tuberculosis (TB) infection;
6) -Storage of antibiotics to treat respiratory tract infections;
7) -Storage of drugs and infusions in treatment of food poisoning and diarrhea;
8) Solutions for mass outbreaks of food poisoning;
9) -Regular monitoring of the camp's common kitchen;
10) -Storage and distribution of insect repellent for/to the workers;
11) Management measures of diseases control and pest control during the building of construction camp;
12) -Free supply of condoms to camp workers;

6.1.7 Security of residential area

6.1.7.1 Water Level of Lake and River

The Contractor shall send prior notice to the Department of environmental protection and local authorities in at least 30 days about planning and construction activities that might lead to rising of water level in rivers and lakes, or cause stranding or drowning of residents.

6.1.7.2 Traffic safety

The Contractor shall work with the local community and community leaders to jointly execute the community transportation and security plans. Its aim is to minimize risks associated with transportation during the construction. The traffic safety program will include the following:

1) -Provide the maximum speed allowed for the old town area;
2) Construction of safe sighting distance in the construction sites and the construction camps;
3) Set legend in the construction area, in order to facilitate traffic; provide guidance for each part of the work, and provide safety recommendations and warnings.
4) All identities need to be of Chinese language, and made according to Chinese types;
5) Under the consent of environmental officials, use the selected route to the project site, and size of the vehicle should meet the road grade of the area, and strictly control its cargo load to prevent damage to local roads and bridges;
6) Assume responsibility for damage to the local road and bridge caused by overloading transportation and repairing of the damage is required;
7) Don't use vehicles with excessive emissions or undesired noise. In built-up areas, the Contractor shall use test equipment to ensure that the noise silencers are installed and are running in good condition;
8) Need to maintain an appropriate traffic control throughout the contract period;
9) Clearly and cautiously mark the safe passage for pedestrians;
10) If there are school children nearby, traffic safety officer is needed in directing after the school is over;
11) Ensure the supply of traffic signs (including paints, easels, sign materials, etc.), road marking, fencing wire, in order to maintain pedestrian safety during construction.

6.1.8 Mitigation measures of social environmental impacts

6.1.8.1 Project control and management measures

Negative social impacts of the project mainly exist in construction period. In order to control such negative impacts and guarantee the effect of treatment, maintenance and management during operation period shall be strengthened. Specifically, following shall be achieved:

1) Uniform disposition and planning of transportation route in a proper manner is required before commencement of project construction; for the section of road subject to jam that is unable to meet transportation requirements, prior communication with relevant traffic management authority is required to prevent transport vehicles from being stranded on the way.
2) Eye-catching billboard should be erected at construction site, indicating the content of construction, working hours and off-duty time of construction, time for completion, liaison and complaint hot-line, as well as statement asking for public understanding with inconvenient travel due to the construction.
3) Construction progress shall be accelerated to shorten construction period and mitigate adverse impact on traffic.
4) Proper demolition and resettlement of local residents are required strictly according to recommendations and requirements of *Plan on Resettlement of Affected Residents by Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project*, so as to minimize the environmental impact from resettlement of affected residents.
5) Sanitary and clean drinking water in work area shall be guaranteed, complying with sanitation standard for drinking water, strengthening food sanitation management, avoiding serving of unhealthful food to avoid outbreak of epidemic diseases such as hepatitis, diarrhea and the like. Sanitation condition of sufficient and functional systems, toilet facility and waste management should be made available at dorm and

kitchen facilities in the quarters of construction personnel.

6) Apart from treatment, management in the long run shall be paid attention as well. Establish a specially-assigned environment maintenance team for the moat; develop regulations and systems to eradicate pollution discharge or littering so as to maintain the environmental sustainability of the moat.

6.1.8.2 Compensation measures for resident relocation and resettlement

(1) Compensation for house demolition and resettlement

The demolition of the project is at East Gate Visitor's Center, involving 38 households in a total.

For compensation, monetary compensation and property swap are provided, from which the Relocated resident can selected. For households who chose monetary compensation, compensation fund will be directly provided by PMO and Jingzhou Land Requisition and Compensation Office. Currently, Jingzhou Urban Construction & Investment Co., Ltd. are carrying out the renovation of old city and construction of new urban area according to the plan of Jingzhou municipal government. Resettlement buildings are being constructed at several sections. If the 38 households at East Gate Visitor's Center chose property swap, they can easily be incorporated into resettlement building plan.

(2) Compensation for population affected by temporary land occupation

Dredging of moat and lakes inside Historic Town and wetland work requires temporary land occupation of 566.50mu, among which 421 mu is for dredging lakes. Therefore, aquaculture could be affected. The rest 145.50 mu is used for stacking sediments from moat and lakes. According to progress schedule, the dredging of moat and lakes are to be completed within one year, including sediment treatment. Therefore, temporary land occupation will not last over two years. Furthermore, the ponds where sediment treatment locates are deeply polluted, which greatly affects the aquaculture. The dredging works could greatly improve aquaculture environment and increase productivity.

During implementation of the project, PMO will provide compensation for temporary land occupation to property owner of water surface as per young crops loss. Compensation is 2,970 Yuan/mu/year. Compensation duration depends on actual construction. Any period less than one year will be counted as one year. The contract between Jingcheng Village, Three-kingdom Park and their contractors remain unchanged. Contractors will be exempted from cost during construction period. Details shall be up to the negotiation between Jingcheng Village, Three-kingdom Park and their contractors. The amount of compensation for contractors for each year will be the average net income of contractor in first three years. When aquaculture is available after environment treatment, the contractors will resume their operation as agreed before the project.

(3) Resettlement and restoration of affected organizations and stores

The buildings to be demolished at East Gate Visitor's Center include 13 stores along streets, which covers an operation area of 1,015m^2 and involves operation personnel of 38.

Upon negotiation, following resettlement are carried out for such stores: 1) for licensed operation area, monetary compensation and store resettlement can be selected from by relocated persons; 2) for stores changed from residential house on state-owned land, residential area will be compensated as per residential house appraisal price, commercial area as per 70% of commercial house price appraised by appointed institutions. For stores which are not along streets, house resettlement or compensation and compensation for certain economic loss will be provided after appraisal by appointed institutions. Proper compensation will be provided for loss caused by termination of contract. 3) Allowance for close-up and unemployment will be granted in the amount of 5% of appraisal price of requisitioned stores every year. 4) Relocation grant will be 10 Yuan/m^2 for requisitioned housed.

6.1.8.3 Control of tourism-related crime

Controlling tourism-related crime field should manifest the integrity to systematically align and combine various control paths on the whole, cut off the activating chain between tourism-related crime field and potential criminals, inhibit the field effect of tourism-related crime field, and thus prevent this background factor from promoting tourism-related crime. Control of tourism-related crime field should modify the structure of tourism-related crime field dynamically to interfere in the generation and communication of tourism-related crime field information and potential criminal's utilization, generation, control and feedback of the crime field information, which is such a dynamic process, and thus destroy the information feedback function of background factors on tourism-related crime. Therefore, control of any element of crime field may be effective in controlling crime, but the best tourism-related crime control effect can be generated by adjusting the paths and ways of controlling tourism-related crime field at the height of integrity and dynamics of tourism-related crime field.

To summarize, the number of tourists in the Jingzhou historic town will increase after the restoration project is completed, but the regional crime rate can be kept in a controllable scope if the control of security during the time period when and at the place where crime occurs frequently can be enhanced, safety guidance can be given to tourists during their travel and accountability regulations is carried out to the department responsible for security management.

6.2 Impact of construction on commercial and economic convenience

6.2.1 Impact of construction on economic activities

Impact analysis: construction activities will produce some noise and dust, which will affect the people's enthusiasm for business and economic activities. Moreover, in the construction process some temporary road and bridge facilities will inevitably be built, and digging holes will have some effect on economic activities of nearby residents. But the end of construction will also mean the end of that impact.

Mitigation measures: shorten the construction time as far as possible.

6.2.2 Impacts of water environmental works on economic returns of lotus ponds and fish ponds

The impact on the commercial and economic activities by water environmental restoration project is primarily from profit lost in dredging and sediment piling which will temporarily occupy the lotus pond and fish pond. According to the Migration Report, the condition of land occupation is as follows. During dredging process of the construction, land in the following table will be occupied, and compensation shall be made in accordance with the requests contained in Immigration Report: the proposed project shall not occupy land of Jingcheng Village, but shall only provide crop compensation for temporary land use. According to government documents of

Hubei province, the crop compensation for the affected area is 2,700 Yuan per year per mu. Besides, revisions of compensation coefficients for land of different types are made. The compensation coefficient for intensive water surface is 1.1. Thereafter, the crop compensation price is 2,970 Yuan per mu in areas of Jingcheng Village. No.1 stockyard and the north lake waters are state-owned aquaculture water, belonging to Three Kingdoms Park of Municipal Forestry Administration. For aquaculture losses caused by dredging, compensation shall be made according to temporary compensation standard of collective land of Jingcheng Village. Compensation standard is higher than normal output value of aquaculture and lotus roots.

Thickness of the dredging is between 0.4~0.8m, the aim of which is to remove incompact surface silt. Dredging will not have significantly impact on the aquaculture and the lotus root.

In addition, after the end of the project, land for temporary use will restore its original function. As the compensation for temporary land use will be implemented and the water function of the land shall be restored after the construction is over, the water environment impact on aquaculture and lotus root of Jingcheng Village brought by construction is slight on the whole, and in the short-term, the negative impact is offset by government subsidies.

Table 1.1-1 Water surface affected by sediment dredging

Location of water surface	Area (square meters)	Ownership	Utilization status
The West Lake	71000	Jingcheng Village	Planting of lotus root
Northeast pond	9600		
Moat	572708		
Total	653308		

Table 1.1-2 Temporary yard for stacking dry sediment

Number of stacking yard	Location	Area (square meters)	Ownership
1	Moat, between K5+550~K5+800	21,750	Jingcheng Village
2	Moat, between K6+100~K6+700	26,450	Fanrong Street
Total	-	**48,200**	

6.2.3 The impact of construction on tourism revenue

During wall restoration, phase II construction for the Xiongiazhong project, and renovation of historical blocks, the museums and Kaiyuan Taoist Temple, exhibitions in these project areas will be suspended. However, this construction will not largely affect tourism at these scenic spots as the construction is relatively light.

Only the “Treasure Hall” of the museum will go through renovation. During renovation, the “Treasure Hall” will be closed, while the museum’s other exhibition facilities will operate as usual. So the museum’s renovation will have few effects on tourist convenience and on the museum’s revenue.

The wall restoration project focuses on the west side of the wall. In addition, retaining wall will be added to the historic town walls of the city wall and vegetation will be planted. With regard to the project, restoration of the west city wall will impede tourists from gaining a panorama view of the city wall, while the retaining wall and vegetation projects will affect sightseeing and comfort. Generally, the restoration of city walls will reduce the ancient city’s tourism revenue. However, after construction is completed, the ancient city’s wall will look much better, which will attract more tourists. As tourists increase, the ancient city’s tourism revenue will increase, which can make up for the loss in tourism revenue from construction. In the short term, construction has a bigger effect on the ancient city's tourism and commercial activities. But in the long term, this is a choice that has been made to boost the ancient city's attractiveness.

There is no commercial activity in the historical block project, so there will be no impact on business during the restoration of 13 buildings in the historical block.

The Kaiguanyuan renovation project focuses on renovating roads, greening, reconstructing the walls in the city's southwest corner, and maintaining stele. None of these projects involve restoration of the cultural relic itself, but they will affect sightseeing and the comfort of tourists. In addition, if necessary, the construction site will be sealed up. But as the whole renovation project is relatively light, it will not have a big effect on tourism revenue.

The second-phrase of Xiongjia Tomb is expansion and system transformation based on the first-phase of the project. The content of the project is light overall, and during the second-phase of the construction, the tourist can still complete the whole travel of the first phrase. The location of exhibition hall of the second-phase of the project is 382m away from the core cemetery of first- phase, therefore, the second-phase construction of Xiongjia tomb is of little effect on the business income of the scenic area.

6.3 Impact of the Project on Evacuation

After consultation with PMO and Jingzhou municipal government, and reference with Overall Planning of Jingzhou Municipal, Jingzhou municipal government is carrying out evacuation for people of Jingzhou historic town:

1) Attract large numbers of people by transferring some schools and hospitals to the outside of the historic town, so as to reduce population pressure inside the historic town.
2) Move some government buildings to reduce the burden of the population within the historic town. But the plan was stranded due to policy of prohibiting construction of new government buildings in 2013.
3) Rebuild shanty areas, the residents of which shall be relocated to a new living houses outside the historic town.

Up to now, there is no subproject of under the "Protection and Repairing of the Jingzhou historic town by World Bank Loan "project that involves evacuation of the population, and the Government has no sufficient funds for evacuation of the population. Therefore, the proposed project does not require further analysis.

6.4 Induced Impact of the Project

6.4.1 Visitor's impact on the local culture of Jingzhou

Accompanied by tourism activities, large influx of foreign workers also brings a lot of new things and foreign cultures. It is a gradual perspective broadening process that local people who were once against it now fully accept it, and even accept the culture of tourists. Thus, the tolerance and acceptance capacity for foreign culture from mental perspective is gradually increased. "Globalization" has become an irreversible trend today, we cannot hold a simply mind that once traditional culture meets the globalization, it will lose its own characteristics. According to the principle of bilateral influence between globalization and national culture, each ethnic group is not passively accepting foreign culture, instead, they are going globe through the accepting process. A higher degree of international integration is good for the nation's development, and its culture will be able to get more space for survival and development.

Therefore, accompanying the implementation of Jingzhou historic town project by World Bank loan, more foreign tourists will come to Jingzhou , thus promoting a culture exchange of Jingzhou and the world. Therefore, their vision will be broadened, and Jingzhou people will be fully prepared in the mental perspective, thus taking a more proactive stance in the globalization process and seizing more opportunities.

6.4.2 Impact of New Visitors on Food Reception Capacity of Jingzhou

Currently there are 6,000 restaurants in Jingzhou, and during the high tourist season around 1 million visitors could be received per day, while during the tourist season the number of visitors is fewer than 90,000, which is within the receiving capacity of Jingzhou catering industry. Besides, as to Jingzhou (historic town) food catering establishment, its main features are as follows: (a). the number gap for facilities is not obvious. (b). Accompanying the increasing of tourist population, demand for catering will also increase. New restaurants will gradually open, and balance between demand and supply will be achieved through market regulation.

6.4.3 Impact of Tourism Development on Local Economic Development in Jingzhou

The variation of tourist consumption structure can have its impact on economic growth by affecting the total consumption. Analysis of impact of economic growth on domestic tourism consumption shows: from 1994 to 2013, the impact coefficient of domestic tourism consumption on economic growth is 0.0316, namely, for every 100 million Yuan increase of domestic tourism consumption, the GDP increase will be 3.16 million Yuan. Analysis of impact coefficient of domestic tourism consumption in 2013 shows: for every 1% increase of non-fundamental travel consumption by urban and rural residents, the domestic tourism consumption will increase by 0.26 and 0.29%. Therefore, according to the impact of domestic non-fundamental travel consumption of urban and rural residents on total travel consumption in 2013 and the average impact coefficient of 0.0316, which is domestic tourism consumption to economic consumption from 1994 to 2013, we can roughly calculate the impact of non-fundamental travel consumption of urban and rural residents on total travel consumption in 2013. Compared with 2008, in 2013, the non-fundamental travel consumption of urban and rural residents has increased by 5.6% and 27% respectively; therefore, domestic travel consumption will increase by 6.6% and 7.8%, which is, a 9.47 billion Yuan and 11.89 billion Yuan increase of domestic travel consumption respectively. According to the relationship between domestic tourism consumption and economic growth from 2000 to 2013, that is, when domestic tourism consumption increases by 100 million Yuan on average, the GDP will increase by 3.16 million Yuan, we can make the calculation that in 2013 non-fundamental travel consumption of urban and rural residents will cause a GDP increase of 299 million Yuan and 354 million Yuan respectively. Compared with 2008, the non-fundamental travel consumption of urban and rural residents in 2013 has increased by 65.72 billion Yuan and 41.46 billion Yuan respectively. In terms of comparison between urban and rural, in 2013, non-fundamental travel consumption of rural residents is growing faster, and it shares larger proportion, accounting for 66% of domestic tourism consumption of rural residents. The non-fundamental travel consumption of rural residents is almost the same with that of urban residents. Therefore, from the estimated figure, non-fundamental travel consumption of rural residents has more impact on economic growth.

The impact of travel consumption on economic growth is influenced not only by fluctuation velocity of consumption structure but also by total consumption. As the total domestic travel consumption is limited and shares little proportion of GDP, and the non-fundamental travel consumption is even less, therefore, in such conditions, even there is big variation in the travel consumption, its influence on economic growth is comparatively weak.

In recent years, the non-basic consumption in domestic tourism consumption of urban and rural residents weighs more and more. The development of consumption structure becomes increasingly rational. Though the abovementioned facts, the proportion of non-basic consumption in China is smaller than that in developed countries in which the proportion is around 70%. The consumption structure can affect the economic growth in two ways: i.e. by exerting influence on total consumption, and by promoting the adjustment of industrial structure. Currently, the non-basic consumption, which possesses good economic benefits, weighs a little in the domestic tourism consumption of urban and rural residents, which is further complicated by hardly changing consumption structure and limited total consumption. Therefore, the change in micro consumption structure can hardly exert any influence on that in macro total consumption and macro consumption structure. As a result, economy can be hardly pushed up by the change in domestic tourism consumption structure.

Based on the above analysis, it can be inferred that, the influence of the project on the economic development of Jingzhou could be very small, though the number of visitors will increase, and tourism can be developed further after the implementation of the project.

6.4.4 Impacts of increased visitors on traffic congestion

This section refers to relevant contents in *Feasibility Study Report of Hubei Jingzhou Historic Town Conservation Project – Special Report of Analysis of Traffic and Technical Proposal*. Whether the planned road network and slow traffic system can meet traffic and travel demand is comprehensively analyzed by considering the travel demand of both residents in the Historic Town and visitors during planned years. The project includes the component of improving accessibility. This component aims to mitigate the traffic congestion in the Historic Town.

(1) Motorized vehicle traffic

During planned years, visitors to Historic Town mainly travel by buses, shuttle buses and taxis. According to the aforesaid precast and analysis, bus demand of visitors is 404 persons/hr, which have small effect on the normal bus system in the Historic Town; shuttle bus demand 1155 persons/hr, which requires large passenger flow capacity; taxi demand 404 persons/hr, which produces a traffic flow of 200 taxis/hr. Therefore, the traffic flow of motorized vehicles caused by visitors is low, exerting a little influence on the travel demand of residents in the Historic Town.

(2) Non-motorized vehicle traffic

The non-motor vehicle demand of visitor in planned years is 867 persons/hr, which has great effect on the traffic in the Historic Town. Complicated by the non-motor vehicle demand of residents, traffic on non-motor vehicle lane of Jingzhou Road Middle reaches 80% of the total capacity of the lane.

(3) Pedestrian traffic

The pedestrian traffic demand of visitors during planned years is 2887 persons/hr. Walking is the main travel mode of visitors, which puts a challenge to the comfort and accessibility of the pedestrian system of the Historic Town.

In short, the traffic system of the Historic Town will suffer certain pressure after the implementation of the project. Regarding that, a scheme of partial anti-clockwise one-way traffic and partial two-way traffic on Inner Ring road will be adopted. In addition, some motor vehicle lane and sidewalk will be reconstructed so as to separate pedestrians from vehicles and improve transport efficiency. Pedestrians crossing facilities will be provided at key traffic nodes, which could guarantee the safety of pedestrians and improve the transport efficiency of vehicles.

6.4.5 Additional pressure of increased visitors on environmental facilities

6.4.5.1 Calculation of sewage load from increased visitors in the Historic Town

According to *Feasibility Study Report of Hubei Jingzhou Historic Town Conservation Project – Special Report of Tourism in Jingzhou Historic Town,* the number of visitors to Jingzhou Historic Town will reach 1,808,000 in 2016 and 3,166,000 in 2020. However, this number could reach 1,934,000 in 2016 and 4,011,000 in 2020 after the World Bank financed project. As so far, this number is around 1,300,000.

In 2020, the increased number of visitors to the Historic Town will be 2,711,000. Considering that visitors are not permanent population, 0.02m^3/person of sewage output will be taken in calculation in light of other similar projects. Then, the increased sewage in 2020 will amount to 54,220m^3/year. According to the *Reply on Issues in Relation to Water Quality in Chengnan and Caoshi WWTP and Moat* issued by Jingzhou Municipal Commission of Housing & Urban-Rural Development, Phase II construction of Caoshi WWTP and Chengnan WWTP will commence in 2015 and be completed within one year. Upon completion, an additional sewage treatment capacity of 180,000m^3/d is provided, which can sufficiently handle the increased domestic sewage produced by increased visitors. In addition, the EIA of the two Sewage Plants have been approved by Jingzhou Municipal Environmental Protection Bureau.

6.4.5.2 Analysis of impacts on Xiongjiazhong Tomb water environment

According to *Feasibility Study Report of Hubei Jingzhou Historic Town Conservation Project – Special Report of Tourism in Jingzhou Historic Town,* the number of visitors to Xiongjiazhong Tomb will be 2.6 times the current number in 2020. Currently, sewage output is 10% of total sewage treatment capacity. Therefore, existing sewage treatment facilities can still sufficiently handle the increased sewage output in Xiongjiazhong Tomb in 2020.

However, the sewage treatment system of Xiongjiazhong Tomb phase I has not been constructed yet. EA consultant requires that, the employer shall add the sewage treatment system as soon as possible as per the requirements of Phase I project to meet sewage treatment needs.

6.4.5.3 Impacts of increased visitors on domestic waste

Additional domestic waste will be produced by visitors in the Historic Town and Xiongjiazhong Tomb. Such waste will be incinerated by Jimei Thermal Power Plant. The feasibility study of existing facilities can be conducted. According to the aforesaid, the increased number of visitors to the Historic Town will be 2,710,000 in 2020. The factor of 1kg domestic waste /person is taken in calculation, then, it can be inferred that 2,710t additional waste will be produced in 2020.

Jimei Thermal Power Plant has a redundant waste treatment capacity of 30,000t/a. Therefore, increased waste in 2010 is still in the capacity of Jimei Thermal Power Plant.

6.4.6 Impacts of excavation on ground water

The water system in the Historic Town is well developed. Surface water and ground water are well connected. Ground water level ranges from 0.5 to 5m. Therefore, pipe network excavation could easily expose underground aquifer and affect the quality and volume of ground water. However, the diameter of most pipes ranges from 0.4 to 0.6m, which will not greatly affect the hydrogeological conditions. Therefore, pipe network works will not cause the subsidence of city wall foundation.

During implementation of the project, except the excavation required by the project, any other excavation shall be minimized. Small machinery is recommended during construction.

7 PHYSICAL CULTURAL RESOURCES MANAGEMENT PLAN

As the project involves many national, provincial and city-level Cultural Heritage (CHs), a core objective of the proposed project is cultural heritage preservation. The project investment in cultural heritage preservation and tourism promotion accounts for over 50% of the total investment. Cultural heritage preservation is particularly important during project construction. The information on cultural heritage identification, current situation of damages to cultural heritage, targets of preservation and renovation and other related information on the cultural heritage required in the project are provided by the local cultural affairs and tourism departments.

7.1 Major PCRs involved in the project

7.1.1 Summary of major CHs in the project area

There are 595 CHs in total in Jingzhou Municipal, in which 15 are national key CHs, 52 are Hubei's provincial CHs, and 527 are city (county) level key CHs. Many of them are CHs. Details have been given in Section 2.2.2.

Main targets of analysis of impact on cultural heritage are the sensitive receptors involved in the project. Based on field survey and related information obtained, and with the confirmation of local cultural heritage preservation bureau, the CHs involved in the impact assessment are as shown in Table 7-1. The other CHs listed in the environment overview are not within the project area and are not subject to the impact of the project.

Table 7-1 List of sensitive receptors in the project area

No.	Name	Age dating	Location	Level of preservation
1.1	Jingzhou Historic Town Wall	Ming Dynasty, Qing Dynasty	Jingzhou Historic Town	National level (4th group in 1996)
1.2	Kaiyuan Taoist Temple	Ming Dynasty, Ming-Qing	West of the Jingzhou Museum	National level (6th group in 2006)
1.3	Xiongjiazhong Tomb	Chu	45km north of Jingzhou downtown area	Provincial level (2nd group in 1981)
1.4	Jingzhou Museum		North of Jingzhou Middle Road	4A level scenic spot (2000)
1.5	Historic blocks	Qing Dynasty	Sanyi Street-Desheng Street, South Gate of Jingzhou Historic Town, West Section of Shengli Street, Zhongshan Road-Chongwen Street	Historic and cultural blocks
1.6	Historic Buildings	Qing Dynasty	13 historic buildings along the Esat Dike Streent and South Gate Street	No. 18 and No. 10 residential buildings in East Dike Street and No. 46 residential building in South gate Street are provincial CHs, the others are ordinary CHs or traditional residential buildings.

7.1.2 Introductions to major CHs and scope and requirements of preservation

7.1.2.1 Jingzhou Historic Town Wall

(1) Introduction to the cultural heritage

Jingzhou Historic Town Wall is located in Jingzhou District, Jingzhou Municipal, Hubei Province. It is 5km away from the ancient capital of Chu Jinan Historic Town in the north, 20km away from the Baling Mountain Ancient Tombs in the northwest, close to the intersection of National Highway 318 and National Highway 207, and adjacent to the central urban district Shashi District in the southeast.

Jingzhou Historic Town Wall was listed as one of the National Key Cultural Relics Preservation Sites in 1996.

The geographical coordinates of the center of Jingzhou Historic Town Wall are 112°11′40″ E, 30°21′18″ N. The geographical coordinates of the four corners of Jingzhou Historic Town Wall are as follows:

Southeast corner (Zhongxuan Tower): 112°11′40″ E, 30°21′18″ N

Southwest corner (No. 23 Battlement): 112°10′12″ E, 30°20′59″ N

Northwest corner (Gongji Gate): 112°10′54″ E, 30°21′47″ N

Northeast corner (Mingyue Tower): 112°12′38″ E, 30°21′21″ N

The satellite image of Jingzhou Historic Town Wall is as shown in Figure 8.1.2-1.

Figure 7.1-1 Satellite image of Jingzhou Historic Town Wall

(2) Conservation zone

In the documents Overall Urban Plan of Jingzhou Municipal, Preservation Plan of Jingzhou as a Famous Historic and Cultural City, and Overall Plan for Cultural Relics Preservation of Jingzhou Historic Town Wall, the conservation zone of Jingzhou Historic Town Wall and construction control zone are specified differently. Details are as shown in Table 7-2.

Table 7-2 Definition of the conservation zone of Jingzhou Historic Town Wall and construction control zone in the documents

No.	Document name	Conservation zone	Construction control zone	Coordination area	Heritage area	Buffer area
1	Overall urban plan of Jingzhou Municipal	Brick Wall, earth Wall and moat of Jingzhou Historic Town Wall	Grade I: 25~50 m outward from the conservation zone of Historic Town Wall, including the surrounding water bodies, green open space, etc.	-	-	-
			Grade II: about 25m from the construction control zone Grade I;			
			Grade III: about 50m from the construction control zone Grade II			
2	Preservation Plan of Jingzhou Famous Historic and Cultural City	Historic Town Wall and moat, internal Wall base, moat river bank	Grade I: 25m~50m from internal Wall base, 25m outward from moat river bank, including the surrounding water bodies, green open space, etc.	The area extending from the construction control zone to the boundary of Jingzhou Historic Town area. The building height limit in the coordination area extending about 100m from the construction control zone Grade III is 15m, and building height limit in the rest area is 23m.	-	-
			Grade II: about 25m from the construction control zone Grade I;			
			Grade III: about 50m from the construction control zone Grade II			
3	Overall Plan for Cultural Relics Preservation of Jingzhou Historic Town Wall	Historic Town Wall and moat; the area between 50m from internal Wall base and 50m from moat river bank, including other cultural heritage sites surrounding the Historic Town Wall, such as Xuanmiao Temple, Kaiyuan Taoist Temple, Tienv Temple, Confucian Temple, Quan Cong Temple, Sanyi Street, Zhangjuzheng Street, Xiejiashan Guanyu Temple,	Grade I (290 hectares): Inside the Historic Town Wall: extend from the east of Quyuan Road to the end of Jingdong Road in the east, from the south of Minzhu Street and Binxing Street to the junction of Aimin Lane and Jingzhou Middle Road in the south, the west of Yingdu Road in the west, and the entire area in the north of Jingzhou North Road. Outside the Historic Town Wall: extend 100m outward the Eastern Ring Road in the east, to Tonghui Bridge and Wencui Fang in the south, to Fanrong Street in the west and Taihu Port in the north.	-		
			Grade II (570 hectares):			

No.	Document name	Conservation zone	Construction control zone	Coordination area	Heritage area	Buffer area
		Zhijiashan and Songjiashan, Sanguanbi, Taihui Temple and Desheng Street (277 hectares)	Inside the Historic Town Wall: all the area inside the ancient Wall excluding conservation zone and the construction control zone Grade I. Outside the Historic Town Wall: extend to Northern Ring Road in the north, to Zhangjia Temple, Southern Ring Road, Meijia Pond, Zhaojiatai in the south, to 200m in the south of Southern Ring Road, to Western Ring Road in the west, and to 200m outward the Eastern Ring Road in the east.			
4	Cultural heritage application documents of Jingzhou Historic Town Wall	Historic Town Wall and moat	Grade I (290 hectares): Inside the Historic Town Wall: extend from the east of Quyuan Road to the end of Jingdong Road in the east, from the south of Minzhu Street and Binxing Street to the junction of Aimin Lane and Jingzhou Middle Road in the south, the west of Yingdu Road in the west, and the entire area in the north of Jingzhou North Road. Outside the Historic Town Wall: extend 100m outward the Eastern Ring Road in the east, to Tonghui Bridge and Wencui Fang in the south, to Fanrong Street in the west and Taihu Port in the north.	-	Equivalent to conservation zone (277 hectares)	Construction control zone Grade I and Grade II (860 hectares)
		Key conservation zone: the area between 50m from the internal Wall base to 200m outside the Wall; General conservation zone: 200m~600m outside the ancient Wall	Grade II (570 hectares): Inside the Historic Town Wall: all the area inside the ancient Wall excluding conservation zone and the construction control zone Grade I. Outside the Historic Town Wall: extend to Northern Ring Road in the north, to Zhangjia Temple, Southern Ring Road, Meijia Pond, Zhaojiatai in the south, to 200m in the south of Southern Ring Road, to Western Ring Road in the west, and to 200m outward the Eastern Ring Road in the east.			

7.1.2.2 Kaiyuan Taoist Temple

(1) Introduction to the cultural heritage

Kaiyuan Taoist Temple, together with Taihui Temple and Xuanmiao Temple, are called the "Three Temples" of Jingzhou. The three temples are all located in the urban area of Jingzhou, with ancient buildings built in the Tang and Song Dynasty. The existing buildings of the "Three Temples" of Jingzhou show the architectural features of Song, Yuan, Ming and Qing Dynasties, and have provided significant physical basis for research into the architectural arts of temples in the Jinghan Plain or even in the whole South China.

Kaiyuan Taoist Temple is located in the west of the Jinghzou Historic Town in Jingzhou District. It is adjacent to Jingzhou Middle Road in the south, about 300m away from the West Gate of Jingzhou Historic Town, and is close to the Jingzhou Museum. The area of the temple is approximately 8,305 square meters.

Kaiyuan Taoist Temple was first built in the Kaiyuan years in Tang Dynasty (AD 713-741), with a history of 1293 years. According to the Notes on Jiangling written by Kong Zilai in the Shunzhi years, Emperor Xuanzong once dreamt of a giant saying that he is going to build a temple; after that, a magnificent temple was built in Jingzhou with an iron sculpture of Tianzun, the Taoist god. Kaiyuan Taoist Temple was also recorded in a poem of Chaozao, who lived in the Song Dynasty. It was once prosperous in the Song Dynasty, and was renovated for several times after that. The existing buildings such as the Front gate, Thundergod Hall, Sanqing Hall, Heaven Gate, and the Patriarch Hall are well preserved. In 2006 Kaiyuan Taoist Temple was listed in the sixth group of National Key Cultural Heritages.

A stone tablet which writes "Repartee of Sengjia from Chengtian Temple" is an important cultural relic in the Kaiyuan Taoist Temple, the article on which was written by the famous litterateur Huang Tingjian in Song Dynasty; in the temple there are also five iron bells cast respectively in the end of Yuan Dynasty, in the seventh year of Tianshun's Reign in Ming Dynasty, in the thirteenth year of Wanli years in Ming Dynasty, in the twenty-first year and the twenty-eighth of Kangxi's Reign in Qing Dynasty. Figure 7.1-2 shows the images of Kaiyuan Taoist Temple.

Figure 7.1-2 Front gate (left) and Patriarch Hall (right) in Kaiyuan Taoist Temple

(2) Conservation zone

The Conservation Zone of the Kaiyuan Taoist Temple is the area 30m away from the central axis in the east and west (the geological coordinates of the Front gate of Kaiyuan Taoist Temple are

112°10′12.6″ E, 30°21′18.0″ N), 30m from the stylobate of the Patriarch Hall in the north (the geological coordinates of the northeast corner are 112°10′24.7″ E, 30°21′23.0″ N, and the geological coordinates of the northwest corner are 112°10′22.4″ E, 30°21′23.0″ N), and from the stylobate of the Front gate to the side of Jingzhou Middle Road in the south (the geological coordinates of the southeast corner are 112°10′24.7″ E, 30°21′17.5″ N, and the geological coordinates of the southwest corner are 112°10′22.5″ E, 30°21′17.6″ N).

The construction control zone of the Kaiyuan Taoist Temple is 20m outward of the conservation zone.

The conservation zone and construction control zone of the Kaiyuan Taoist Temple are as shown in Figure 7.1-3.

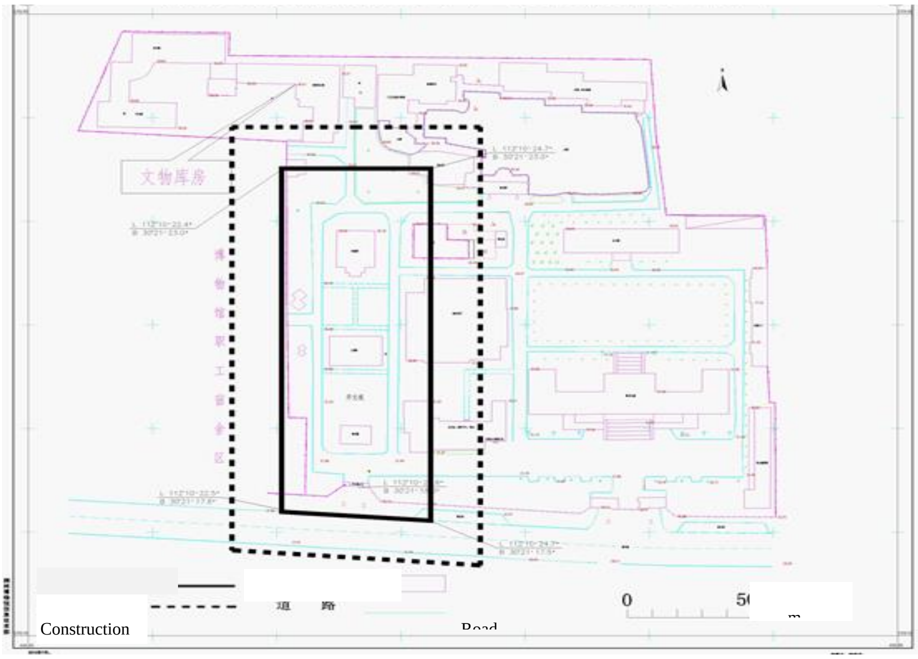


Figure 7.1-3 Conservation zone and construction control zone of the Kaiyuan Taoist Temple

7.1.2.3 Xiongjiazhong Tomb

(1) Introduction to the cultural heritage

Xiongjiazhong Tomb is located at the junction area of Zhangchang Village and Zongbei Village of Chuandian Town, Jingzhou District, Jingzhou Municipal and Xinghuo Village of Herong Town, Dangyang City; it is 26km away from the ancient capital of Chu Jinan Historic Town in the southeast, 34km away from Jingzhou Historic Town, 14km away from Jishan Ancient Tombs in the east, 20km away from the Balingshan Ancient Tombs in the south, and 4.5km away from Juzhang River and Zhaojiahu Ancient Tombs in the northwest. The existing Xiongjiazhong Tomb has an area of about 150,000 square meters. The geological coordinates of the its center (main tomb) is 112°00′37″ E, 30°37′12″ N, and the height above the Yellow Sea is 58.6 ~ 68.2 meters.

The existing Xiongjiazhong Tomb mainly consists of the following:

Main Tomb. The main tomb is the core of the Xiongjiazhong Tomb and is the tomb of the master (king). In the 1960s and 1970s, the main tomb was seriously damaged in the construction of canals; at that time, the mausoleum was only 4-5 meters high above the ground and the diameter of the mausoleum was about 70 meters. It is found in archaeological exploration and excavation that the main tomb is a shaft earth pit tomb with multiple benches. The entry to the tomb is about 67 meters long. The top of the outer coffin is 14 meters deep from the entry. The tomb chamber has an area of about 400 square meters. There is a ramp tomb passage is the west which is about 33 meters long, 6 meters wide at the east end and 30 meters wide at the west end. In 2011, preservation measures were taken for the main tomb and the canals were filled with earth to protect the tomb. At present, the main tomb is about 16 meters high above the ground and grass has grown on the surface of it.

Figure 7.1-4 Overhead image of Xiongjiazhong Tomb

Figure 7.1-5 Main tomb and sacrificial tombs of the main tomb of Xiongjiazhong Tomb

Auxiary Tombs Joint tomb is the tomb of the mater's wife (queen). In the 1960s and 1970s, the mound of the joint tomb was completed undermined and some part of the mound was exposed. It is found in archaeological exploration and excavation that the joint tomb is a shaft earth pit tomb with multiple benches. The size of the joint tomb is about half of the main tomb. The entry to the tomb is about 33 meters long, with a ramp tomb passage of about 10 meters long in the east. In 2011, preservation measures were taken for the joint tomb and the canals were filled with earth to protect the tomb. At present, the joint tomb is about 8 meters high above the ground and grass has grown on the surface of it.

Chariot-and-Horse Pits The chariot pit is close to the west of the main tomb and consists of a large chariot pits and 39 small chariot pits. The large chariot pit is 132.6 meters long from north to south, 11-12 meters wide, and about 2 meter deep. The southwest part of the chariot pit has been damaged in irrigation works. The small chariot pits are mainly distributed in the west of the large chariot pit in roughly two rows. 43 chariots and 164 horses have been found in the large chariot pit; most of the chariots are four-horse-drawn chariots, some are two-horse-drawn chariots, and 3 chariots are six-horse-drawn chariots, making it one of the largest chariot pits that have ever been found in China so far. At present the chariot pits have been protected and reinforced and the construction of the protective building (namely the chariot pits Display hall) has been completed.

Human Victim Burials Tombs Sacrificial tombs are divided into sacrificial tombs of main tomb sacrificial tombs and joint tomb sacrificial tombs. Main tomb sacrificial tombs are in the south of the main tomb; it has been found in explorations that there are 92 sacrificial tombs arranged orderly. Generally four sacrificial tombs form a row and there are 24 rows in total. The 16th row has only three tombs and the 24th row has only one tomb found at present. Joint tomb sacrificial tombs are in the north of the joint tomb; 35 sacrificial tombs have been found by explorations. 36 main tomb sacrificial tombs have been cleaned; these tombs are generally of equal size, about 4.7 meters long, 3.3 meters wide and 4.7 meters deep; the tombs are east-west facing; most of the tombs face to the east and only two tombs face to the west. The tombs are all shaft earth pit tombs. Except for a few tombs that have an outer coffin, most of them only has a single coffin. Most of the sacrificial tombs in the south of the 16th row are found with copper sword in the coffin, while the sacrificial tombs in the north are mainly found with jade. In the No. 72 sacrificial tomb a dog is found in a separate coffin. More than a thousand of cultural relics have been unearthed in the 36 sacrificial tombs, most of them are jade. Joint tomb sacrificial tombs have not been unearthed at present.

Sacrificial Pits Over 190 sacrificial pits have been found within the scope of the Mausoleum, which are distributed mainly in the south of the main tomb and between the main tomb and the joint tomb, and slightly in the north of the chariot pits. Five of the sacrificial pits have been cleaned in archaeological works. The entries of these sacrificial pits are square or round. The pits are 6-8 meters deep. Generally each sacrificial pit has one jade disc buried in the bottom of the pit.


Figure 1.1-1 Chariot Pits Site in Xiongjiazhong Tomb

(2). Conservation zone and management requirements

Preservation Plan of Xiongjiazhong Tomb in Jingzhou Municipal, Hubei Province (B.B.H. [2009] 58) approved by China State Administration of Cultural Heritage in 2009 defines the conservation zone and construction control zone as follows.

The conservation zone of the mausoleum is determined as per the tomb area of Xiongjiazhong Tomb defined by archaeological survey and exploration, which includes main tomb, joint tomb, sacrificial tombs, chariot pits and sacrificial pits. Meanwhile, in consideration of the geographic features of the mausoleum, the conservation zone is extended in the south-north direction to the two ends of Xishan Hummock for about 700 meters and to the edge of the paddy field in the west for about 300 meters, with a total area of 40.85 hectares.

Within the conservation zone of Xiongjiazhong Tomb, no above-ground or underground buildings not related to preservation of the cultural heritage are allowed, and no blasting or earth borrowing is allowed. Excepting for archeological works approved in strict accordance with laws, no entities or individuals shall perform any drilling or excavation works. The land within the enclosure of the mausoleum (294 meters wide in the east-west direction and 677 meters long in the north-south direction, with total area of 15.52 hectares) in the conservation zone is determined as land for cultural heritage preservation instead of agricultural land, so farming on the land shall be stopped. Drainage of the conservation zone should be kept in good condition to prevent soil loss. Places such as canals which have caused damages to the mausoleum should be backfilled to protect the surface. For the tombs and chariot pits that have been unearthed, measures should be taken to protect against rain and prevent collapse so as to ensure the safety of the heritage. The conservation zone can be afforested properly and infrastructures in the zone shall be built away from the cultural relics. Infrastructures not related to preservation of the cultural heritage such as road, car park and square shall be restricted. The necessary preservation facilities should be of succinct model and should be designed for the safety of the cultural relics.

The scattered residential houses within the conservation zone should be relocated and the land should no longer be used for construction. Construction of mausoleum medium and related preservation facilities should be subject to the strict procedures of proposal and approval. Design and implementation of preservation project should be completed by qualified professional entities.

The construction control zone of the mausoleum is the humpy ground outward of the conservation zone, where there are a dozen or so of medium-size tombs (not unearthed archaeologically and no details available). The east boundary of the construction control zone is a through road (about 550 meters east of the mausoleum); the west of the zone is extended to Tangjiawan for archaeological reason (about 2,200 meters west of the mausoleum); the north of the zone is extended for about 650 meters to Jiexi Temple; the south of the zone is extended for about 350 meters to Wangjiawan. The construction control zone is delimited with road at all the four sides, with a total area of 458.50 hectares.

The geographic features and idyllic landscape in the construction control zone of the mausoleum should be retained. No additional residential quarter should be built in the zone. After relocation, the residential land in the zone should be transformed to land for cultural heritage preservation or farmland. The size of the residential quarters in the zone should be controlled and the amount of utilized land should not be extended. Buildings in the residential quarters should have no more than one storey. Buildings in the newly planned tourist service area in the construction control zone should be no higher than 7 meters, and the volume of buildings should not be too large. The total building width should not be over 30 meters. The appearance and color of the buildings should match the surroundings and the exterior wall should not be clad with large ceramic tiles. Archaeological exploration should be performed before each construction activity; if any important relics are found, it should be reported to the cultural relics administration authority; when necessary, the construction plan may be modified and the scope of conservation zone may be adjusted. The existing geographic features and hydrological characteristics of the region should be remained. Earth borrowing that will change the geographic features and activities that will damage the water environment are forbidden. The squares and car parks should be of ecotype.

The conservation zone and construction control zone of Xiongjiazhong Tomb are as shown in Figure 7.1-6.

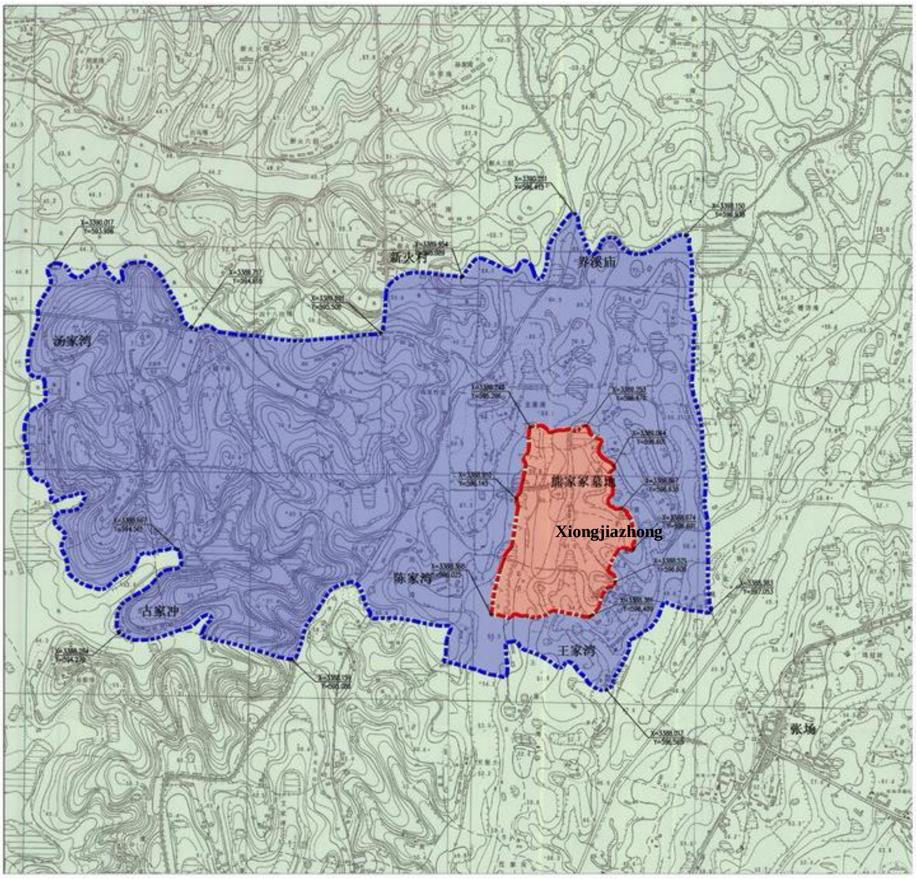


Figure 7.1-6 Conservation zone and construction control zone of Xiongjiazhong Tomb

7.1.2.4 Treasures Hall of Jingzhou Museum

Jingzhou Museum is located at No. 166 Jingzhou Middle Road inside the Jingzhou Historic Town, with Three Kingdoms Park on its north, Jingzhou Middle Road on its south, and West Gate of Jingzhou Historic Town not far away to its west.

Jingzhou Museum, formally the Jingzhou Branch of Hubei Research Institute of Culture and History founded in the early 1950s, was renamed Jingzhou Prefecture Museum in October, 1958, and was administered by Jiangling County and renamed Jiangling County Museum since October, 1969; In October, 1971, it came back under administration of Jingzhou Cultural Affairs Bureau and was renamed Jingzhou Prefecture Museum; In December, 1994, Jingzhou and Shashi were merged and the museum was renamed Jingzhou Museum. There are a great number of unique cultural relics in the museum. The museum has a professional staff of archaeological workers and Display workers and a Display and communication platform with multiple functions that is open to tourists all the year round. Since the establishment of Jingzhou Museum, it has received 8 national awards and 17 provincial awards. In 2000, China National Tourism Administration rated Jingzhou Museum as an AAAA scenic spot. In 2008, Jingzhou Museum was appraised as a National Class I Museum in the first museum grading and assessment implemented by China State Administration of Cultural Heritage. Jingzhou Museum is the only prefecture-level museum in Hubei Province except for Hubei Provincial Museum and Wuhan Museum.

The Treasures Hall is located in the north of Jingzhou Museum and is close to Three Kingdoms Park.

In order to place the precious cultural relics housed at the museum together for Display and to highlight the unique value and status of Jingzhou Museum, the museum had been raising money for the Treasures Hall from 1987 to 1991. In 1990 the Treasures Hall was officially opened to the public, with Display of mummies in West Han Dynasty unearthed in the Jingzhou Phoenix Mountain No. 168 Han Tomb, Display of Chu and Han textiles and embroideries, and Display of ancient wood lacquerware. Jingzhou Museum raised the fund for the hall through government investment and bank loan. Besides the Treasures Hall that exhibits precious cultural relics, the museum has also built the Chuyue Palace where traditional Chu singing and dancing performances are held, which, together with the other two Display halls, surround the lake and form a water garden. The building area of Chuyue Palace is 393.48 square meters, the building area of the No. 168 Han Tomb Hall is 950.74 square meters, and the building area of Chu and Han Textiles and Embroideries Hall is 1,839.9 square meters. The total building area including the entrance hall is 3,281.62 square meters. The Treasures Hall was designed by the former Hubei Jingzhou Prefecture Architectural Survey and Design Institute in 1988 and was completed in December, 1989. The hall has been put into use for 25 years and is now one of the main buildings for basic Displays of Jingzhou Museum.

7.1.2.5 Historic Blocks

(1) Introduction to the historic blocks

The Preservation Plan of Jingzhou as a Famous Historic and Cultural City specifies two historic blocks in Jingzhou and two in Shashi as the core components of the historic urban districts, which are Sanyi Street-Desheng Street Historic and Cultural Block, Jingzhou Historic Town South Gate Historic and Cultural Block, Desheng Street West Section Historic and Cultural Block and Zhongshan Road-Chongwen Street Historic and Cultural Block.

In the South Gate Historic and Cultural Blocks stand various buildings, including provincial key CHs, city-level CHs, and ordinary CHs, excellent historic buildings, early modern buildings and contemporary buildings.

After meticulous field investigation, based on the practical situations of the historic blocks and the above principles, two typical historic blocks which contain 13 historic buildings and plots are selected in the FSR as the demonstration sites for historic building renovation and reutilization in the Jingzhou Historic Town Preservation Project.

Table 7-3 Historic buildings and plots

No.	Target of preservation	Location	Class of cultural heritage	Type of building	Land area (m^2)
01	Space at No. 8 East Dike Street	No. 8 East Dike Street south	-	-	230
02	Residential building at No. 10 East Dike Street	No. 10 and 12 East Dike Street south	Provincial cultural heritage	Ancient building (residential building)	496.
03	Residential buildings at No. 14 and No. 16 East Dike Street	No. 14 and 16 East Dike Street south	-	Traditional residential building	261

No.	Target of preservation	Location	Class of cultural heritage	Type of building	Land area (m^2)
04	Residential building at No. 18 East Dike Street	No. 40-1-2 East Dike Street south	Provincial cultural heritage	Ancient building (residential building)	376.
05	Residential building at No. 11 East Dike Street	No. 11 East Dike Street north	-	Traditional residential building	244
06	No. 15 and 17 East Dike Street	No. 15 and 17 East Dike Street north	-	Modern one-storey building	162
07	No. 19 and 21 East Dike Street	No. 19 and 21 East Dike Street north	-	Modern one-storey building	348
08	Residential building at No. 27 East Dike Street	No. 13 East Dike Street north	Cultural heritage	Ancient building (residential building)	181
09	Residential building at No. 37 East Dike Street	No. 23 East Dike Street north	Cultural heritage	Ancient building (residential building)	236
10	Residential building at No. 41 East Dike Street	No. 25 and 27 East Dike Street south	Cultural heritage	Ancient building (residential building)	207
11	Residential building at No. 46 South Gate Street	No. 33-4 South Gate Street	Provincial cultural heritage	Ancient building (residential building)	829
12	Residential building at No. 30 South Gate Street	No. 53 South Gate Street south	Cultural heritage	Ancient building (residential building)	315
13	Residential building at No. 34 South Gate Street	No. 51 Inner ring South Road, South Gate Street	Cultural heritage	Ancient building (residential building)	397

(2) Conservation zone and preservation requirements

Table 7-4 Scope of conservation zone of the historic and cultural blocks

Name of blocks	Land area of core conservation zone (hm^2)	Land area of construction control zone (hm^2)	Total land area (hm^2)
Sanyi Street-Desheng Street Historic and Cultural Block	3.8	21.6	25.4
Jingzhou Historic Town South Gate Historic and Cultural Block	5.6	8.8	14.4
Desheng Street West Section Historic and Cultural Block	6.1	8.1	14.2
Zhongshan Road-Chongwen Street Historic and Cultural Block	7.0	8.8	15.8
Total	**22.5**	**47.3**	**69.8**

Detailed specifications for preservation of the historic blocks are made in the Plan, mainly as follows:

1) The buildings, structures and other historic and cultural resources in the blocks shall be categorized and documented and should be taken as the major targets for preservation of historic and cultural blocks;
2) Conspicuous signboards or markers shall be provided at appropriate positions of the historic and cultural blocks to indicate the main specifications such as the boundary of the conservation zone and preservation requirements;

3) No entities or individuals shall build new structures or expand existing structures in the core conservation zone of the historic and cultural blocks except for the construction and expansion of necessary infrastructures and public service facilities;
4) Renovation of historic buildings within the core conservation zone of the historic and cultural blocks shall not change their original height, volume, appearance and color;
5) New buildings and structures in the construction control zone of the historic and cultural buildings shall have appearance that reflects the spirit of the time, shall adopt new materials and new techniques, and shall not imitate the appearance of ancient buildings but shall have height, volume, style, color and material quality that match historic environment;
6) The historic environment elements in the historic and cultural blocks such as ancient and rare trees, ancient bridges and wells, and scattered ancient artifacts shall be well preserved and the ecological environment, street floors, street interface, traditional courtyard space and environmental facilities in the surrounding areas should be renovated so as to combine the natural, historic or cultural elements with the blocks that meet the needs of modern life, and to make the historic and cultural blocks environmentally friendly urban areas with strong historical and cultural atmosphere;
7) Outdoor advertising shall be strictly controlled in the historic and cultural blocks, store signboards, garbage bins and other above-ground environmental facilities and municipal facilities shall be planned and designed uniformly and the size, appearance, color, material, and style of the various facilities shall reflect the features of the historic and cultural blocks.

As for Jingzhou Historic Town South Gate Historic and Cultural Block, special instructions are given as follows:

"The main objectives of preservation of Jingzhou Historic Town South Gate Historic and Cultural Block should be preservation and renovation of the traditional residents' courtyards and early modern buildings as well as the renovation of the spatial environment of the landscaped streets such as Binxing Street, Guandai Alley, Pancake Alley, South Gate Street, East Dike Street, and West Dike Streent, including renovation of historic buildings such as Jingzhou Historic Town Wall, South Gate-Nanji Gate, Temple of Guanyu, South Gate Cathedral and the Abbey and treatment of the surrounding environment."

7.2 Cultural Heritages Preservation Mitigations

7.2.1 Introduction of local Cultural Heritages preservation

Since the first batch of Cultural Heritages were designated in 1961, the national, provincial, city and county governments have identified the Cultural Heritages in the project area and specified the protection level of these Cultural Heritages. All Cultural Heritages involved are under strict protection of state laws. The Jingzhou Historic Town Wall in the proposed project is a focus of the protection. In particular, the Jingzhou Historic Town Wall and Kaiyuan Taoist Temple were included in the national key Cultural Heritages in 1996 and 2006 respectively, under the protection of the relevant laws and regulations.

In terms of planning, the local government and Cultural Heritages department have formulated a number of preservation plans, taking full account of planning needs of Cultural Heritages preservation in the overall urban planning and other specialized planning, and developed strict management measures for urban development and building height control in protected areas.

In terms of attention paid to Cultural Heritages preservation, the Historic Town Wall had undergone many restorations in the Qing Dynasty. In the early years since the founding of new China, the Historic Town Wall was not restored for a long time. After 1980, the national and local governments paid attention to it and carried out a series of restoration activities. From 1985 to 2011, the Historic Town Wall has undergone a total of five restorations. The restoration scope includes Historic Town Wall restoration and City Gate construction, etc.

In terms of capital investment, specialized protection agency and professional technicians have been assigned to carry out necessary restorations on the Jingzhou Historic Town Wall since 1979. From 1979 to 2012, the Jingzhou historic town walls, gates, towers and soldiers-hiding holes have undergone multiple restorations under the support of special funds allocated by national and provincial governments and local self-raised funds, totaling 6.8723 million CNY. Now, the length of restored Historic Town Wall has reached 6,783m.

7.2.2 Status quo in Cultural Heritages preservation

Status quo of main Cultural Heritages preservation is as following:

7.2.2.1 Jingzhou Historic Town Wall

(1) Brick town wall

Trees and bushes bred on top brick joints and surfaces of the west town wall. Although excrescent trees were cut down in 2010, thick roots remain in walls and continue to grow. As a result, a plurality of gaps of varying sizes are now caused by dislocated, loose, shedding and crooked bricks, bulged and inclined and partially collapsed walls at 5 m height above the west wall section. Due to natural catastrophes, environmental pollution, combined with long years out of restoration, the surfaces of the west town wall have been stripping seriously suffered from weathering and most of the bricks have been flaked, in powder form, residue bricks and empty holes everywhere on the wall.

(2) Piled brick wall

The main questions of the piled brick walls of the west town wall, with length of 2196 meters, are the inclined piled walls, cracks, ragged brickworks and full trees and bushes partially.

(3) Wall top footpath

The top footpath has not been restored for many years with the result that it suffered from serious demolished by humans in the fifties to sixties of the 20th century so that most wall bricks were excavated and stolen; the cave-in earthen town wall partially buried by soil, a few residual bricks and stripping wall bricks suffering from weathering cause local ponding, which damages the brick walls consequently.

(4) Earthen town wall

Due to long years of settlement and water and soil loss of the earthen town walls, the top of the west town wall is uneven. The top elevation of the earthen town wall is normally approximate 35~45 cm lower than discharging outlet of the piled walls, causing impeded drainage in rainy seasons and serious ponding, damaging the walls greatly consequently. According to on-site survey and analysis of related data, it is shown that long years out of restoration, water and soil loss and earth borrowing artificially lead to bumpy, rough and ragged earthen town walls of the west town wall nowadays.

7.2.2.2 Kaiyuan Taoist Temple

Nowadays, the Kaiyuan Taoist Temple is still in static protection state without utilization. The main structure is under restoration, at present, in the south of the west walls, Stone Stele group scattered in the open air; in the middle, two Double-Pavilions with Stone Manger, Iron Pan and Bell and other CHs exhibited inside; in the northwest corner, stone components of Jinshi Memorial Archway scattered. There are no more enclosing walls in the north and east, so the temple is adjacent directly to the Jingzhou Museum.

Environment inside Kaiyuan Taoist Temple: the disordered tree pieces, overcrowded vegetation and tufty bushes have a bad effect on the whole environment inside the Kaiyuan Taoist Temple, no radiance and charm to the classic and elegant historic architectural complex inside and loss of unwordly atmosphere.

Walls out of restoration: there are only remained partial south walls of historic sites and west walls built in 1965 by Jingzhou Museum, while the north and east original walls has been dismantled during the Cultural Revolution. The existing walls are ragged because of damaged and stripping tile pieces and weathered wall bodies due to years out of restoration. There are no more enclosing walls in the north and east, which is insecure and adverse to Cultural Heritages Preservation and Management. Therefore, the original enclosing walls need repair and restoration. According to surveying and mapping, the residue enclosing wall is 180 m in length and 2.83 m in height and the enclosing wall to be restored is 200 m in length and 2.83 m in height.

Preservation of Stone Steles and Carvings: there are about 69 Stone Steles stored near to the west enclosing walls, horizontal or vertical against to the walls, most of important historic CHs. Due to exposure to sun and rain they are damaged and the inscriptions become increasingly illegible, which is badly in need of preservation. Jingzhou Cultural Heritages Preservation Center has been entrusted to prepare the pre-arranged planning of the Stone Steles and Carvings and intended to carry out the protective restoration.

Restoration of Jinshi Memorial Archway: as one of the collected valuable CHs, Jinshi Memorial Archway is now scattered in the northwest along the enclosing wall inside the Kaiyuan Taoist Temple. Its main stone components remain, exquisitely sculptured, but unfortunately incomplete with components scattered on the ground. Actually, it shall be restored, utilized and exhibited in proper position for study and view.

Restoration and utilization of Historic Well: there are two historic wells inside the Kaiyuan Taoist Temple, dilapidated, respectively located to the north of the Front Gate and the east of the Thundergod Hall, tufty grass in the well, old rope mark along the mouth of the well, no hexagonal fences on the periphery at present but metal protective fences on the head. As the important natural and historic CHs, it shall be cleared and restored, combined with the landscape design inside the temple, becoming a highlight landscape in the Kaiyuan Taoist Temple.

Preservation and Display of Other Removable Cultural Heritages: the existing 69 Stone Steles and Carvings, exposed to sun and rain, adverse to preservation, shall be preserved and exhibited as quickly as possible. As the space of the three main halls is limited, it has been confirmed that precious Taoist Cultural Heritages are exhibited inside the halls while all the valuable Stone Steles and Carvings are protected in outer space.

7.2.2.3 Xiongjiazhong Tomb

Preservation Planning of Hubei Jingzhou Xiongjiazhong Tomb has been approved by State Administration of Cultural Heritage in principle in 2009.The Construction Work Project Phase I is broke ground officially on 18th, September, 2011, substantially completed on 25th, June, 2013 and the park went into normal operation stage after on 17th, December, 2013.

The completed Construction Work Project Phase I includes partial Infrastructure Work and Park Area Landscape Work, Construction Work of Horse & Chariot Pit Relics Preservation Display Hall, landscape and Decoration Work, Display Work of Main Tomb and Joint Tomb Sites, Visitors Service Facility Construction Work and Environment Regulation Work.

With the implementation of Construction Work Project Phase I of National Archaeological Park of Xiongjiazhong Tomb, the infrastructures and Display halls have been initially established, the two-year trial operation has achieved some benefits driving the Jingzhou Cultural Heritage Tourism and the economic and social development in Jingzhou. But there is still a long way to go to become the leading Jingzhou Tourism and the existing problems are to be improved and solved through Project Phase II.

7.2.2.4 Cultural Relics Displays at Jingzhou Museum Treasures Hall

The Cultural Relics Displays at Jingzhou Museum Treasures Hall are made up of the Main Display Building and Treasure Hall which is the main Display of Jingzhou Museum, displaying nearly a thousand relics of three themes, including *Phoenix Mountain No.168 Han Tom Display*, *Ancient Lacquer Woodware Boutique Display* and *Chu-Han Embroidery Display,* occupying a total floor area of 2000 ㎡.

With the rapid development of museum cause and increasing improvement of Cultural Heritage Display level, the current Display equipment and methods appear very backward in Treasure Hall in four aspects, 1) outdated equipment and passing methods, in which the current Display is held in 1997, with most shabby and passing showcases and lighting sets; 2) serious lack of high-tech Display, even without mere touch-based navigation chart and other electronic facilities, much less sound, light, electricity and other high-tech display facilities; 3) lack of system maintenance, because of poorly constructed buildings for some halls, leaky roofs, walls for seepage and frequent short-circuit line; 4) aging showcases and glass lamps, in need of reconstruction; 5) outdated display forms, obviously lagging behind the times compared with the museums of medium size or above in surrounding area with non-matching showpieces.

Nowadays, the general trend of exhibit art design of museum is diversification, individuation, human nature, integration and globalization and many domestic museums have made efforts for this by high investment, quality and level. At present, the current exhibit space and capital investment at home are divided into three grades: high end, 20,000-30,000 CNY per square meters; medium end, 15,000 CNY per square meters; low end, five to 10,000 CNY per square meters. Assumption of this standard, the current exhibit level of the Treasure Hall even doesn’t reach the lowest. Noticeable, the display forms of the existing Cultural Heritages Display in Treasure Hall is in urgent need of update and improvement.

7.2.2.5 Historic Blocks and Historic Buildings

The Historic Buildings included in the range of study, all dated from Qing Dynasty, have been damaged to different extents up to now. The comprehensive and direct evaluation has been divided into severe, moderate and mild damage in according with the architectural styles, overall preservation conditions, landscape integrity, structural safety and other aspects of these buildings.

On the whole, the preservation conditions of the Cultural Buildings (of the provincial Cultural Heritages preservation) are relatively good while that of general traditional dwellings are poor. Also, the newly-built modern architectural styles bring large destruction to the Historic Blocks.

7.2.3 Existing problems of Cultural Heritages preservation

(1) Lagging management of Cultural Heritages

The CHs protection sites in the project area have generally failed to provide satisfactory preservation to CHs, and the situation is very serious in some cultural heritage sites. The CHs preservation involves investment in CHs preservation, selection of preservation technology, maintenance of heritage authenticity, management and development methods, etc. It is obviously necessary to conduct in-depth review from the strategic preservation framework to specific technical details.

The materials for restoring some historic buildings in the project area are blindly selected, and many supporting facilities are lagging behind. Some historic buildings have not been restored for many years, suffered from weathering, moth-eaten damage or serious natural disasters, decaying beams, deformed purlins and rafters, broken and cracking walls, crooked beam frames and final collapse.

(2) Arbitrary transformation of Historic and Cultural Blocks

Due to the lack of unified planning for the Historic Blocks, residents arbitrarily restore the Historic Buildings or build new buildings. Some Blocks has lost their ancient styles.

(3) Residents' weak awareness of Cultural Heritages preservation

Most local residents don't know much about the laws and regulations for CHs preservation and have weak awareness of CHs preservation.

7.3 Impacts and Mitigations of Cultural Heritage

7.3.1 Impacts and Mitigations on Historic Town Wall

(1) Impact analysis

In spite of restoration of sensitive objects, the project focuses on the restoration of damaged brick town walls, construction of retaining walls with water and soil loss and removal of parasitic plants harm native vegetation, therefore, the project itself does no negative impacts to the Historic Town Wall and its vegetation.

(2) Protection measures

Table 7-5 Protection measures during restoration and construction of town walls

No.	Project name	Status quo	Length (m)	Restoration measures	Environmental Protection Regulations
1	Brick town walls	Restored	798	Maintenance	Conduct under guidance of CH preservation experts
		Local loosening	960	Crack repair	Supervision under supervision company with professional background
		Severe damage	84	Repairing and strengthening	Supervision under supervision company with professional background
		Local empty holes, gaps, dislocation and bulge	354	Removal and reconstruction	Strict distinction of protected and removed objects and conduct under guidance of design units during construction
2	Piled brick walls	Restored	526	Maintenance	Conduct under guidance of CH preservation experts
		Local loosening	527	Crack repair	Supervision under supervision company with professional background
		Severe damage	567	Repairing and strengthening	Supervision under supervision company with professional background
		Local empty holes, gaps, dislocation and bulge	576	Removal and reconstruction	Strict distinction of protected and removed objects and conduct under guidance of design units during construction
3	Wall top footpath	Restored	340	Clean up and dredge	Supervision under supervision company with professional background
		Local loosening	651	Crack repair	Supervision under supervision company with professional background
		Cave-in and severe damage of bricks	1205	Bedding and paving	Supervision under supervision company with professional background
		Cave-in and severe damage of brick basement layer	1205	Backfill of loess area	Supervision under supervision company with professional background
4	Earthen town walls	Mild damage	1490	Maintenance	Supervision under supervision company with professional background
		Moderate damage	473	Backfill consolidation local along ground	Supervision under supervision company with professional background

7.3.2 Impacts and Mitigations on Xiongjiazhong Tomb

(1) Impact analysis

Most Works of Land Requisition and House demolition, Civil Engineering and Afforestation of Xiongjiazhong Tomb Phase I has been completed, so based on the Phase I, the makeshift roads of Phase II can be constructed depending on the current roads in the Park. Meanwhile, main focus on the improvement of service levels of supporting facilities, the construction of Phase II has a few impacts on the Xiongjiazhong Tomb itself on the whole.

(2) Protection measures

Table 7-6 Protection measures of Xiongjiazhong Tomb Phase II Works

No.	Project name	Component name	Environmental Protection Regulations
1	Landscape and Infrastructure Work	(1) Chu Yulin Landscape Work (2) Farmland Clear-up Work (3) Phase II Parking Lot Construction Work (4) Parking Lot and Main Ring Road Asphalt Pavement Work (5) Academic Exchange Center Rebuilding Work (6) Outdoor Greening Spray System Construction Work (7) Visitors Service Facility Construction Work	Utilize the current park area roads as transport roads of construction vehicles to reduce temporary occupation land beyond construction roads as much as possible; in case of Civil Engineering Work, conduct archaeological excavation first and then carry out construction operation after confirmation of no buried Cultural Heritages.
2	Relics Noumenon Display Work	(8) Work of Horse & Chariot Pit Relics Preservation Display Hall (9) Work of Junshi Grave Sacrificial Pit Preservation Display	Collect waste fluid produced during excavation unit and entrust Jingzhou Museum for uniform treatment. For Civil Engineering Construction Work, conduct archaeological excavation first and then carry out construction operation after confirmation of no buried Cultural Heritages.
3	Work of Unearthed Cultural Relics Display Hall	(10) Cultural Relics Display Hall construction work (11) Cultural Relics Display Hall and Surrounding Landscape Work (12) Cultural Relics Display Work (13) Multifunctional Hall Equipment Procurement	For Civil Engineering Construction Work, conduct archaeological excavation first and then carry out construction operation after confirmation of no buried Cultural Heritages.
4	Work of Park Area Identification and Guide- to- Visitors System	(14) Logo System Work (15) Guide-to-Visitors System Work (16) On-line Museum Construction Project	——

No.	Project name	Component name	Environmental Protection Regulations
5	Park Area Management System Work	(17) Public Management System Construction Project (18) Security and Protection Management System Construction Project	——

7.3.3 Impacts and Mitigations on Jingzhou Museum

(1) Impact analysis

Jingzhou Museum is only a sensitive object exhibited instead of a cultural relic, therefore, the proposed project has no impact on the Cultural Heritages Preservation Sites of Jingzhou Museum due to properly keeping exhibited CHs during renovation construction of Treasure Hall.

(2) Protection measures

Table 1.1-3 Protection measures of Jingzhou Museum Works

No.	Project name	Scale/area (m²)	Environmental Protection Regulations
I	**Comprehensive Reconstruction of Treasure Hall Buildings**	□	□
1	Partial Building Removal	404	The Jingzhou government has agreed not to demolish the Historic Buildings.
2	Partial New Building Construction	438	Arrange properly the temporary storage points in conformity with standard requirements for Cultural Heritages and engage specialized persons in charge of inventory and delivery of Cultural Heritages.
3	Building Transformation of Earthquake Fortification and Strengthening (including Inner Wall Reconstruction)	2800	Place temporary shelter on the pool during building construction to prevent construction waste fluid into it.
4	Remoulding of Heat Preservation and Energy-Saving of Buildings (including dampproofing Transformation)	2800	Place temporary shelter on the pool during building construction to prevent construction waste fluid into it.
5	Building Facades Reconstruction (including Doors and Windows Update)	2800	Make full use of original building materials
6	Building Waterproofing Roof Layer and Downpipe Reconstruction	2014	Make full use of original building materials
II	**Treasure Hall Display Work**	□	□
1	Interior Decoration Work	3200	Arrange properly the temporary storage points in conformity with standard requirements for Cultural Heritages and engage specialized persons in charge of
2	Showcase Replicas and Handcrafts and Props Making	1900	

No.	Project name	Scale/area (㎡)	Environmental Protection Regulations
3	Professional Showcase and Lighting	1900	inventory and delivery of Cultural Heritages.
4	Copy Display	1900	
5	Multi-media Equipment and Software Engineering	1900	
III	**Installation Work of Treasure Hall**	□	□
1	Monitor System Modification	1 set	——
2	Fire Alarm System Modification As Well As Automatic Spraying (Auxiliary Gas Fire Extinguishing System)	1 set	——
3	Central Air Conditioning System	3200	——
4	Elevator	1 set	——

7.3.4 Impacts and Mitigations on Kaiyuan Taoist Temple Improvement Project

(1) Impact analysis

The main construction objects of the Management Project of Kaiyuan Taoist Temple focus on roads, enclosing walls and Preservation Works to Stone Steles, Carvings and other CHs. In other word, the project itself does not involved in the construction of the CHs , therefore, it has a few impacts on the CHs in Kaiyuan Taoist Temple.

(2) Protection measures

The main protection measures on the Kaiyuan Taoist Temple is shown below:

1) Following the principles of CHs building preservation, do no damage to the buildings and preserve the Historic Buildings and architectural styles of the surrounding environmental.

2) Make full use of the current resources and apply the existing buildings, featured landscapes and plants into the environment renovation.

3) Strictly preserve the Stone Steles and Carvings and other CHs.

Figure 7.3-1 Proper arrange and protection to existing Stone Steles and Carvings

4) Select construction teams with CHs preservation experiences for removal and construction of enclosing walls.

7.3.5 Environmental Protection Regulations of Historic Blocks

(1) Impact analysis of Historic Blocks Project

During the restoration of Historic Blocks, in the form of closing construction of Historic Buildings, the construction materials will be piled temporarily on the roads along the East Dike Street and South Gate Street, which may occupy the streets influencing the local residents' going out. However, the project belongs to Restoration Works of Cultural Heritages, and it has no negative impact on the Historic Buildings themselves.

(2) Environmental and Protection Regulations in implementation phase

Piling points shall be designated for construction materials on-demand and the piling time shall not exceed half a day. Reduce occupation of the roads as much as possible during restoration of buildings along the East Dike Street. Besides, the proportion of temporary occupation land and road for normal traffic shall be about 1 to 2. The construction time shall avoid the rest periods of the nearby residents and prohibit night time construction.

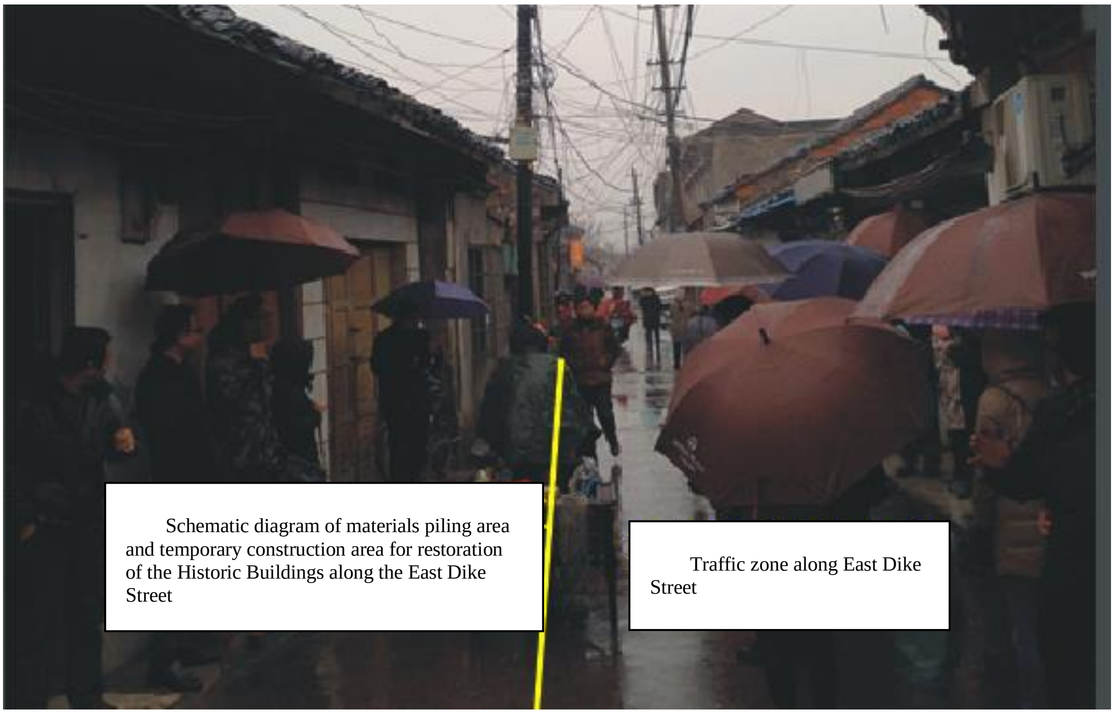


Figure 7.3-2 Schematic diagram of occupated land areas for restoration of Historic Buildings

7.4 Impacts of Construction Vibration on Cultural Heritages

The activities with machinery and vehicles entry into the Historic Town Wall during construction, such as trench excavation and building demolishing, will product vibration, which may impact the CHs. Therefore, it is recommended to use small construction machinery and equipment for various construction activities and to conduct stability monitoring to the CHs at the same time. Stop construction when the unstable value is approached. In addition, it is suggested to adopt total manual operation in particularly sensitive area and mechanical construction is prohibited.

7.5 Conclusion of Impact Assessment on Cultural Heritages and Environment

Under the premise of fully protecting historic and cultural heritage of the Jingzhou historic town, the proposed project will restore and protect the damaged city wall and historic buildings, renovate infrastructure in the region, build supporting facilities for the historic site, and continue in-depth study on cultural heritage of the Jingzhou historic town. Since the entire construction period will produce certain impacts, it is necessary to prevent any pollution and ensure normal life of management staff and residents in the ancient city. Upon completion of infrastructure improvements, no significant impact will be produced on the environment, and all sources of pollution will be effectively controlled. The quality of the environment will be greatly improved compared with that before the project. Therefore, the proposed project is necessary and feasible based on the status quo of the Jingzhou historic town, support provided by national policy and need of environmental protection.

8 MITIGATION MEASURES AND TOTAL DISCHARGE CONTROL

Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project will contribute greatly to improving scenic environment and water quality of local water system, however, emission of pollutants during construction period and operation period of the project might cause certain adverse effect on the environment, thus measures need to be taken to prevent and control environmental hazard.

8.1 Ecological Environmental Mitigations

8.1.1 Vegetation

Given the potential environmental impact and loss during project construction, it's planned to take following environmental mitigation measures and countermeasures to minimize environmental impact from project construction and recover the environment as soon as reasonably possible.

Before commencement of construction, construction contractor must demarcate protection lines, identify protection objects, define the scope of protection, coordinate anything in connection with construction site, and minimize occupation and destruction of vegetation areas such as bottomland and the like as possible.

Construction contractor shall, in its construction organization design, reasonably arrange construction general layout, to the extent that existing streets and roads of the historic town are made full use to reduce temporary land area for construction work.

For unavoidable use of construction temporary land, construction wastes should be cleared upon completion of construction in a timely manner to recover original vegetation. In addition, vegetation should also be timely recovered for permanent structures and water surface within the range of construction permanent land to original condition as possible.

In order to prevent mass water and soil loss due to laying of sewage interception pipelines, cut-off ditch and drainage canal should be built according to applicable requirements set forth in the Report on Project Related Water & Soil Conservation Plan to prevent runoff from flowing in the moat; baffle plate should be erected and sedimentation tank be constructed to reduce soil loss and runoff; construction and processing of materials are restricted during rain and strong wind; fully cut slope, embankment and other work areas apt to erosion should be stabilized; temporary sludge dump should be sheltered by covering with clean tarpaulin waterproof, and sprinkled with water under dry, windy weather condition; all earthwork disturbed areas should be maintained in stable condition; upon completion of construction work, the site should be recovered to original condition, and temporary land use should be recovered with original plant landscape.

8.1.2 Aquatic Life

In order to mitigate project related impact, strengthened management is required during construction period. Before entry and commencement of construction, fish experts from local fishery department should be engaged to organize construction personnel to study applicable national laws and regulations, conduct science popularization among them regarding protection of rare protected aquatic animals, so that they understand the significance for water environmental protection, and enhance their awareness of water environmental protection.

Construction personnel are banned fishing during construction period. Above activities should be under joint supervision management by fishery department and environmental protection authority. The cost incurred by such supervision management is paid by the employer.

In order to reduce the harm of project construction to fish, fishery department should be consulted for approval before commencement of construction, and fish expert or local experienced fisherman should be engaged for giving instructions on the spot; before entry, technical means such as ultrasonic fish frightening and the like should be adopted, and fish frightening operation should be carried out in construction area and adjacent water area, especially deep pond and backwater area where fish distribution is dense to scare away fish from construction area. In addition, construction area may be separated from other areas with net to prevent fish from entering in construction area.

In order to mitigate the impact of construction on aquatic ecosystem, extra care should be exercised to reduce dispersal of gravels in the process of construction. Dredging should be operated by sections to make for migration of benthonic animals.

In design stage of final works, further study is required with regard to dredging depth and range, dredging depth should be controlled strictly to avoid major damage to the root systems of benthonic life and submerged plants in bottom sludge, and construction by sections are advisable for this purpose.

Due to a few swimming birds, wading birds and amphibious reptiles move around the river, various hygienic managements (Such as physical sanitation, soil and domestic sewage) should be strengthened with construction personnel, construction wastewater should be treated with existing Sewage Plant before discharging, construction materials should be stacked in the place far from the source of water, particularly powder materials and hazardous materials, extra care should be exercised to prevent materials from washing away into water by rainstorm or strong wind during transportation of materials, so as to avoid contaminate the environment where these animals inhabit.

Fishery administration should strictly execute closed fishing season system, strictly prohibit fishing of fish resource in any manner in the water system of the historic town, and strengthen protection of fish resource.

8.1.3 Water and Soil Erosion

This section is excerpted from the Report on Water & Soil Conservation Plan of World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project.

The dredged sediment, stripped topsoil from excavation of visitors' center, underground parking, sewage interception pipe network, branch sewer and other works should be handled to deposit at temporary storage yard nearby, and temporary protective measures should be taken. The mud soil cleared is amount to 300000m^3, depositing at 2 temporary storage yards, the final borrow fill of revetment and wetlands, barrow earth for planting and etc may use up this part of topsoil.

(1). Requirement for Earth Depositing

In order to avoid water and soil loss as a result of improper temporary earth depositing, earth should be carefully deposited at temporary storage yard appointed in the design without unapproved dumping along the route, river or ditch.

The spoil depositing amount and level vary at various temporary storage yards; to ensure stable spoil mound, spoil depositing procedures should be strictly controlled during construction by compacting surface layer and watering, if necessary.

The stability of temporary storage yard should be maintained to the maximum extent by stable dead-load of earth; given our practical experience in completed projects, 1:2 slope of temporary earth depositing is recommended.

(2). Measures for Recovering Storage yard

Due to the site is a pound, at the end of earth depositing, the occupied part of pound should be resumed aquiculture.

(3). Temporary Measures

Temporary Barriers Temporary storage yard is 3.1hm^2 in land area; average level of temporary earth depositing is 2.5m, enclosed by retaining wall of bagged earth; full length of temporary retaining wall is 751m; retaining wall is 1m in top width, 1.5m in bottom width, 2m in height, 1m heap from the top at 1:2 slope; temporary retaining wall should be removed after refill of topsoil.

Temporary Interception and Drainage Before temporary earth depositing, earth drainage ditch should be set around temporary storage yard; earth drainage ditch is 30cm×30cm trapezoidal section, at 1:1 slope ratio; ditch wall should be tamped; longitudinal slope should be designed by topographical construction to collect runoff within the construction site; temporary grit chamber should be set at the outlet of drainage ditch; inner dimension of grit chamber is 1.5m×1.2m×1m(L×W×D); side wall and bottom slab are 30cm thick, upright wall is designed; inlet and outlet of grit chamber are trapezoidal section, bottom width is 30cm, height is 30cm; inlet and outlet are not aligned; with M7.5 mortar rubble masonry, inner side is finished with M10 mortar; function of grit chamber is sedimentation of sludge in water flow; then, water flow is discharged into downstream ditch nearby after sludge sedimentation.

Temporary Covering centralized topsoil deposit is protected by temporary covering with plastic film to prevent topsoil loss.

Quantity 0.21hm^2 rehabilitation, planting of 8,400 trees, 0.03hm^2 greening, 124m long temporary retaining wall, 350m long temporary drainage ditch, 6 grit chambers, 0.16hm^2 temporary covering.

8.2 Water environmental Pollution Mitigations

8.2.1 Selection of Construction Method

Secondary pollution during dredging construction is mainly represented by release and diffusion of pollutants sediment in local area agitated by dredger cutter, of which release arte of nitrogen and phosphorus pollutants contained in sediment is multiple times to that in static state, leading to secondary pollution in water area. To avoid water area from secondary pollution, non-polluting dredger cutter with anti-diffusion device is used to remove polluting sediment of the river during dredging.

Design of non-polluting dredger cutter is as shown in Figure 9.3-1. the assembly of dredger cutter is driven to rotate by hydraulic drive; the arm of assembly of dredger cutter first contacts sediment, the blade on the cutter arm loosens clay and collect the clay in cutter cavity with rotating dredger cutter; screw conveyer in the assembly of dredger cutter conveys clay collected in feeding cavity from spiral face to the outlet of mud suction pipe; under suction of dredge pump, dredging clay is conveyed via mud suction pipe and mud discharge pipe to mud dumping area. Non-polluting dredger cutter has following features: (1) adjustable angle of dredger cutter bit ensures cutting contour of dredger cutter fully matching polluting sediment all the time for higher dredging precision; (2) mechanical cutting of clay, formation of clay-water mixture suitable for hydraulic conveying via mud suction pipe; (3) prevention of whirling current in dredger cutter cavity from diffusion into water area out of the protective shield under the effect of centrifugal force that could cause secondary pollution, and help increasing suction concentration, decreasing turbidity of water area, thus dredger cutter meets technical requirements of non-polluting dredging operation.

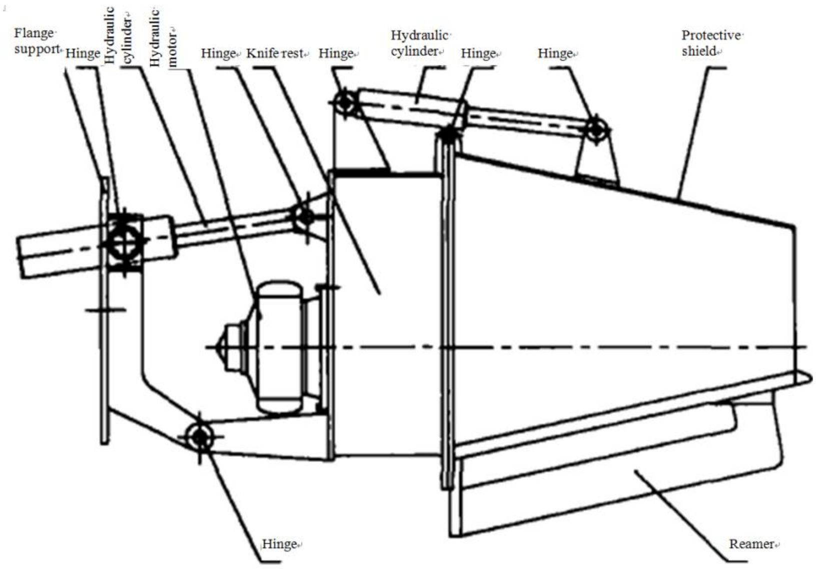


Figure 8.2-1 Schematic Diagram of Non-polluting Dredger Cutter

Practice shows that SS diffusion range of water area agitated by the cutter used for West Lake cutter suction and dredging is 15m; beaver-type non-polluting dredger cutter imported from Holland is used to control diffusion range within 5m, which has manor impact on surrounding water environment. Therefore, environmental impact evaluation concludes that it’s feasible for dredging construction of the historic town with non-polluting dredging cutter.

Besides, after the dredged sediment goes into the sludge pipes under negative pressure, the connecting pump station sends the sediment to the dehydration and solidification plant. The dried sediment will then be sent to the temporary stacking filed for storage and will be used afterwards. The whole dredging process does not involve operation of large dredging machines or cofferdam water discharge for rivers or lakes. Therefore, the dredging scheme of the proposed project has only small impacts on environment.

8.2.2 Construction Wastewater

(1)Storage yard residual water

Storage yard residual water mainly consists of filtrate from dewatering and solidification and supernatant in spill pit during sludge dewatering and solidification. Coagulating sedimentation is applied for treatment of storage yard residual water.

Technical principle: under the effect of coagulant, colloid and fine SS in wastewater are coagulated into floccules before removal by water separation treatment. Coagulation-flocculation is widely used in feed-water and wastewater treatment for reducing apparent indicators of raw water such as turbidity, color and etc as well as removing many types of venomous and deleterious pollutants. Treatment effect of pollutants in water with various flocculating agents is as listed in Table 8-1.

Table 8-1 Treatment Effect of Pollutants with Various Flocculating Agents

Control & analysis item	Basic aluminum chloride (BAC)	Ferric sulfate	Aluminum chloride	Ferrous sulfate	Aluminum potassium sulfate	Aluminum potassium sulfate + polyacrylamide
pH	7	8	7	7.5～8	7	7
Supernatant CODcr/(mg·L^{-1})	6201	6854	6038	7262	6527	2366
CODCr removal rate/％	56.3	51.7	57.5	48.9	54.0	83.3
Supernatant turbidity /NTU	32.48	4.8	34.99	30.91	94.2	25.8
Turbidity removal rate/％	70.9	95.7	68.7	72.2	0.1	76.9
Note: indicators of raw water quality are CODcr14191mg/L, turbidity 111.62NTU and pH7						

It's obvious from Table 8-1 that, aluminum potassium sulfate and polyacrylamide used as flocculating agent achieve 83.3% COD removal rate and 76.9% turbidity removal rate of supernatant, which are better in effect than other flocculating agents including basic aluminum chloride (BAC), ferric sulfate, aluminum chloride, ferrous sulfate, aluminum potassium sulfate and etc. The flocculating agent made of aluminum potassium sulfate and polyacrylamide is used to mitigate the impact of moat by storage yard residual water. Base on the concentration of pollutants in residual water from dewatering and solidification dewatering and solidification works of Wuhan Donghu Tunnel Construction Project, the concentration of pollutants discharged after treatment of storage yard residual water of the proposed project meets Grade-A standard. Treatment process of storage yard residual water is shown in Figure 8.2-2.

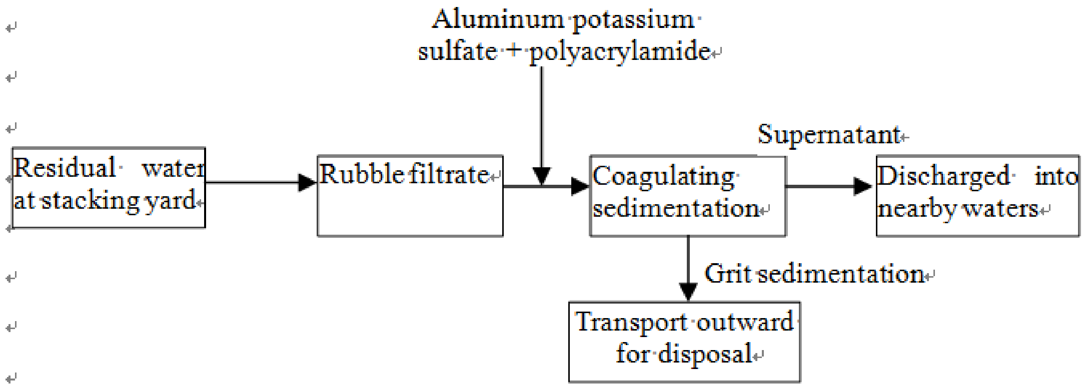


Figure 8.2-2 Treatment Process of Storage yard Residual Water

In addition, hydraulic staying time of sludge in the water should be prolonged as possible in the process of dewatering and solidification to reduce concentration of original SS in storage yard residual water.

To ensure standard quality of residual water from dredging the moat and in the historic town, residual water quality at the discharging outlet of sedimentation tank must be monitored strictly according to environment monitoring plan based on the report of environmental impact evaluation. Once substandard residual water quality is found, engineering measures must be taken immediately, together with adjustment of chemical dosage and additional staying time of residual water, so as to ensure standard quality of discharged residual water.

(2) Basic Washing Wastewater

It's known according to Studies on Recycling Waste Sludge of Ready-mixed Concrete (By Zhang Yi, 2010) and test results (Table 9.3-2) of pH value, soluble matter, insoluble matter, chlorides, sulfate radical and alkali content in clarified liquor of basic washing wastewater, that all indicators of clarified liquor meet the requirements of Standard of Water for Concrete (JGJ63-2000). Therefore, for basic washing wastewater produced by mixing concrete for the project, wastewater sedimentation tanks should be set up in various construction areas, and wastewater after standard treatment should be used as water for concrete.

Table 8-2 Analytical Results of Compositions in Clarified Liquor of Wastewater

Test item		pH value	Soluble matter (mg/L)	Insoluble matter (mg/L)	Chlorides	Sulfate radical	Alkali content
Quality indicator		>4	<10000	<5000	<3500	<2700	<1500
Results	1	12.6	1850	55	35.0	34.5	205.5
	2	13.5	1900	Clear, nil	29.0	2.9	266.6
	3	13.8	1650	155	16.5	30.5	305.1
	4	10.6	2050	160	22.0	16.5	199.5
Comments on test			Qualified	Qualified	Qualified	Qualified	Qualified

Test item pH value	Soluble matter (mg/L)	Insoluble matter (mg/L)	Chlorides	Sulfate radical	Alkali content
results					

Treatment process of basic washing wastewater:

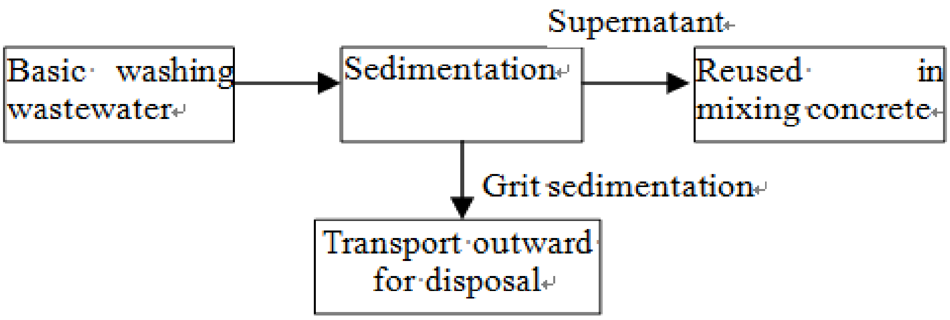


Figure 8.2-3 Technical Treatment Process of Sludge Wastewater (English version to be added)

(3)Foundation Pit Wastewater

Bagged soil cofferdam is adopted for part of project construction, which would produce seepage inside cofferdam, cut surface wastewater and foundation pit wastewater after rainfall, thus drainage is required on a regular basis. Main inclusion of foundation pit wastewater is sludge, with content up to 2000mg/L. for treatment of foundation pit wastewater, secondary sedimentation is applied by following technical process:

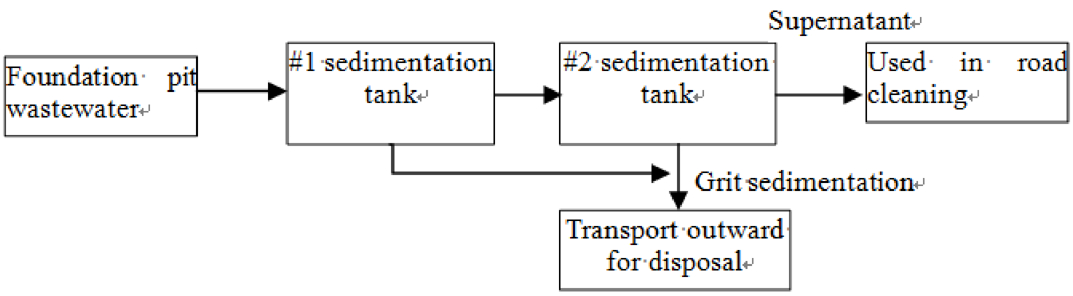


Figure 8.2-4 Technical Treatment Process of Foundation Pit Wastewater

(4) Construction Vehicles & Machinery Washing Wastewater

To prevent environmental pollution in construction area by construction machinery maintenance and washing wastewater, catch drain is designed in repair and replacement yard of construction machinery to collect oily wastewater from washing and maintenance. Parallel plate-type oil separation and sedimentation tank is set up in construction area for treatment of oily wastewater; treatment efficiency of floating oil is 70%~80%, and oily wastewater after treatment is sued for washing road. Technical treatment process of construction vehicles and machinery washing wastewater is as follows:

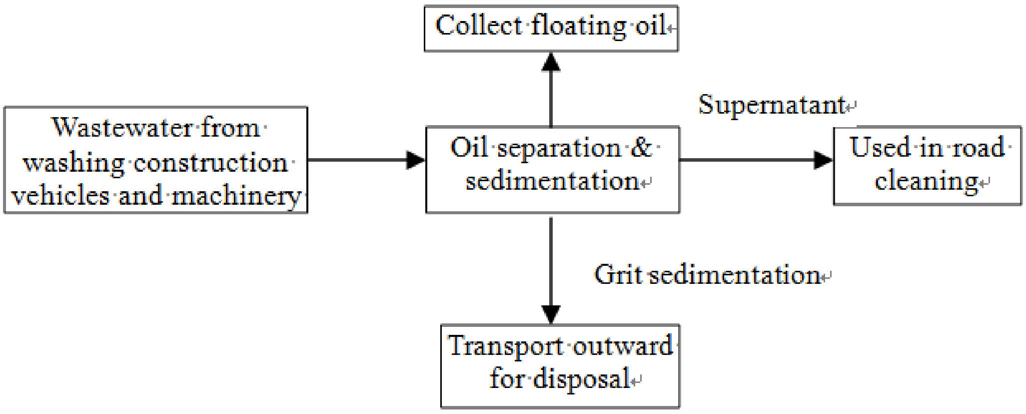


Figure 8.2-5 Technical Treatment Process of Construction Vehicles and Machinery Washing Wastewater

(5) Construction Living Sewage

Discharging of living sewage from construction site should be under strict control. For linearly distributed construction process, construction personnel are dispersive, so existing living utility near construction site should be used as possible. Discharging of living sewage at construction site is prohibited.

(6) Control of Other Pollutions during Construction Period

Strict management of construction machinery and vehicles, prohibition of oil leakage and unapproved dumping of used oil to avoid soil and water environmental pollution; solid waste for cleaning oil-tainted articles should not be littered after use but for concentrated landfill along with waste oil residue. Sewage and waste are prohibited from throwing in surrounding water area.

When bulk powder materials such as gravel and cement are stacked at construction site, storage yard should be in the side far from water and covered with tarpaulin to avoid from carrying away by surface runoff in the water after rainstorm in rainy season that could degrade surrounding water quality.

8.2.3 Control of Water Environmental Pollution during Operation period

Upon completion of the project, visitors' center and the exhibition hall will periodically produce tourist living sewage; living sewage from visitors' center is discharged to Sewage Plant after standard treatment in cesspool according to handover standard of Caoshi WWTP, sewage is collected before passing through coarse sewage grid at Caoshi WWTP, then it passes through fine grid and grit chamber for removing float and coarse sand; grits separated by spiral separator are carried away; outgoing water from grit chamber flows by gravity into modified oxidation ditch, where sewage after biochemical treatment flows into 2# sedimentation tank for subsequent treatment, and tail water is discharged after measurement. Design treatment capacity of Caoshi WWTP is 120,000m^3/d, and actual treatment capacity at present is 30000m^3/d. considering visitors' center in the east belongs to handover range of sewage treatment pipelines of Caoshi WWTP, thus living sewage from visitors' center in the east is discharged to Caoshi WWTP for treatment, estimated load of sewage from visitors' center in the east is about 8.82t/d.

Upon completion of the project, Xiongjiazhong Tomb will produce 27.36t/d additional sewage. The additional sewage will be treated by planned integrated wastewater treatment equipment.

(1) Wastewater Treatment Technology

Particular technical process of wastewater treatment adopted by Caoshi WWTP is as shown in Figure 9.3-6.

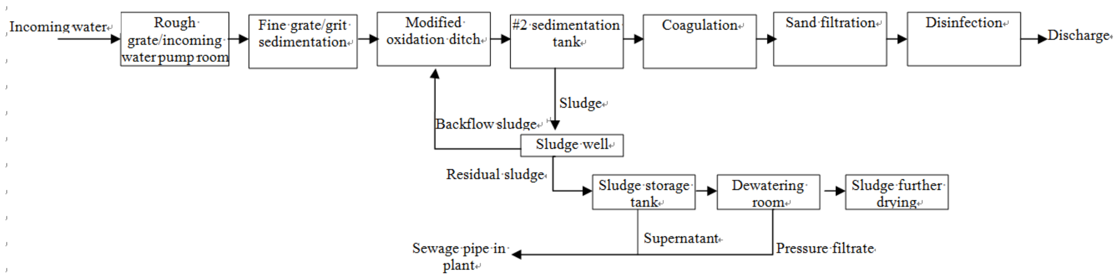


Figure 1.1-2 Technical Process of Wastewater Treatment

Summary of wastewater treatment technology:

In view of overall efficiency of biological nitrogen and phosphorus removal, AAO technology is combined with oxidation ditch to form modified oxidation ditch; additional anaerobic tank is set up in upstream oxidation ditch; sewage after primary treatment or pretreatment, and backflow of phosphorus-contained sludge discharged from secondary sedimentation tank flow into anaerobic tank, where phosphorus accumulating bacteria releases phosphorus with fast degraded organic matters as carbon source; also, anaerobic tank functions to suppress filamentous bacteria growth and overcome expansion of active sludge. There's only one backflow process in the whole biological treatment system, i.e. backflow of sludge from 2# sedimentation tank to anaerobic tank, thus oxidation ditch is equivalent to AAO technology in terms of features and efficiency. Moreover, one backflow system is saved; with this technology, tail water quality after appropriate coagulation-sedimentation and sand filtration will meet the requirement of Discharge Standard of Pollutants for Municipal Sewage Plant (GB18918-2002), Grade-1-B, and finally, tail water is discharged after disinfection with chlorine dioxide.

(2) Feasibility Analysis of Sewage Meeting Standard

Municipal Sewage Plant functions to treat with municipal living sewage and industrial wastewater in small amount, treatment effect of various treatment units are listed in Table 8-3.

Table 8-3 Schedule of Main Treatment Units of Municipal Sewage Plant and Respective Treatment Efficiency

Pollutant Treatment unit		COD_{Cr}	NH_4-N	TN	TP	SS
Grid mg/L		271.57	35.19	50.64	4.89	291.69
Oxidation ditch	Incoming sewage, mg/L	271.57	35.19	50.64	4.89	291.69
	Outgoing sewage, mg/L	38.65	7.03	21.42	0.78	18.27
	Removal rate, %	85.77	80.78	56.30	83.41	93.74
Coagulation-sedimentation	Incoming sewage, mg/L	38.65	7.03	21.42	0.78	18.27
	Outgoing sewage, mg/L	26.92	7.03	21.42	0.52	11.27
	Removal rate, %	30.34	0	0	33.33	38.29
Sand filtration + disinfection	Incoming water, mg/L	26.92	7.03	21.42	0.52	11.27
	Outgoing sewage, mg/L	23.99	5.47	15.30	0.39	5.76
	Removal rate, %	10.91	22.18	28.58	25.00	48.90
Final outgoing sewage, mg/L		23.99	5.47	15.30	0.39	5.76
Final removal rate, %		91.17	84.45	69.78	92.02	98.03
Grade 1-B standard, mg/L		60	8	20	1	20
Incoming sewage quality of municipal Sewage Plant, mg/L		193.44	18.78	20.73	1.41	197.22

Table 8-3shows that, municipal wastewater after wastewater treatment station is discharged according to Discharge Standard of Pollutants for Municipal Sewage Plant (GB18918-2002), Grade 1-B.

According to actual operation condition of Caoshi WWTP, the quality of municipal incoming sewage is lower than that of sewage filtering by grid as listed in Table 9.3-3, indicating that treatment solution of oxidation ditch + coagulation-sedimentation + sand filtration will lead to desirable treatment effect of living sewage in regional city like Jingzhou historic town.

According to the data on water quality with Caoshi WWTP in 2013, the quality of outgoing sewage from Caoshi WWTP meet the requirements of Discharge Standard of Pollutants for Municipal Sewage Plant (GB18918-2002), Grade 1-B.

(3)Time Schedule Linkage

To date, Caoshi WWTP is put into operation; upon operation and official production of the project, it can be connected to Caoshi WWTP for wastewater treatment.

The Xiongjiazhong Tomb Integrated Sewage Treatment Device should be completed and put into use simultaneously with Phase I project. Since the Integrated Sewage Treatment Device is not built, it is not feasible in terms of time schedule to depend on the device for the treatment of wastewater in the Phase I project and Phase II project. The environmental impact assessment institution suggests that the existing sewage treatment facilities in Xiongjiazhong Tomb should be put into use as soon as possible and before that, Xiongjiazhong Tomb Phase II project should not be allowed to be put into operation.

(4) Feasibility of Wastewater Treatment Capacity

The load of living sewage produced by east visitors' center is about 8.82m^3/d; near-term design capacity of Caoshi WWTP is 30000m^3/d, actual treatment capacity of this Sewage Plant is about 26900m^3/d, so Caoshi WWTP has 3100m^3/d spare capacity, and it's feasible for this Sewage Plant to accommodate wastewater of the project in terms of capacity.

Additional load of living sewage produced by Xiongjiazhong Tomb is about 27.36m^3/d; design capacity of auxiliary wastewater treatment facility in Xiongjiazhong Tomb is 1050m^3/d, so the additional living sewage can be treated with wastewater treatment facility, and it's feasible for planned wastewater treatment facility to accommodate additional wastewater of the project in terms of capacity.

(5) Feasibility of Interconnecting Drainage Pipelines

Based on the layout of drainage pipelines in the project area, wastewater produced by planned project will be treated at Caoshi WWTP; base on the findings of site survey, sewage produced by east visitors' center can be interconnected with existing sewage pipelines.

Additional sewage produced by Xiongjiazhong Tomb can be discharged to agricultural irrigation channel via Phase I drain pipe.

(6) Feasibility of Water Quality after Treatment

According to treatment technology adopted by wastewater treatment station, living sewage of the project will meet the requirement of incoming sewage by Sewage Plant after treatment in the cesspool, the sewage after treatment at Sewage Plant will meet Discharge Standard of Pollutants for Municipal Sewage Plant (GB18918—2002), Grade 1-B before discharging to Taihu Port canal. To cum up, it's feasible for interconnection of living sewage from visitors' center to Caoshi WWTP.

According to current EA report, Grade-1 standard sewage is achievable with integrated wastewater treatment equipment in Xiongjiazhong Tomb, so it's feasible to interconnect additional living sewage from Xiongjiazhong Tomb to auxiliary wastewater treatment facility.

(7) Analysis of Other Relevant Measures

The project will improve sewage collecting permeation (85% after redevelopment) in the historic town, sewage interception pipes in residential areas out of the moat can be interconnected with Sewage Plant to avoid direct discharge without treatment; thus, with initiation and operation of the project, water environment with water system in historic town will be improved to some extent.

8.3 Control of Noise Pollution Mitigations

8.3.1 Noise Pollution mitigations on Construction Stage

The impact of the project on acoustic environment mainly occurs during construction period; in order to minimize environment impact by construction machinery emitted noise, it's recommended to take following measures for prevention and control of noise during construction period:

(1) Local Disposition

Rational arrangement of construction site: avoid mobilization of large number of power mechanical equipments at the same location to prevent excessive local noise level; for stationary mechanical equipments, such equipments should be operated from operation room when operation in work shed is allowed.

(2) Management of Mechanical Equipments

Use of equipments and technology at low noise level can help reducing noise source intensity. By using transport vehicles at low noise level, noise level during drive is 10~15dB (A) less than that of other vehicles of the same type; the difference of noise level can be 5dB (A) with different types of excavator and blender.

Strengthen inspection, servicing and maintenance of mechanical equipments, maintain regular lubrication, and tighten various parts to reduce operation vibration noise; firmly install whole equipment, maintain full contact with the ground, and use shockproof base if possible, so as to reduce noise.

(3) Construction Plan

Proper arrangement of construction time, avoid construction work with noise pollution during 22:00 p.m.~6:00a.m. and lunch break as possible; if urgent construction at nighttime is unavoidable, it should be declared to local environmental protection administration, construction at nighttime should not be preceded until and unless approval is obtained, and local residents should be informed of construction period at nighttime.

Reduction of construction traffic noise: due to major environmental impact by traffic and transportation during construction period, traffic load should be reduced as possible, speed of heavy-duty trucks should be limited, speed limit should be implemented for vehicles entering in residential area, regular servicing and maintenance of transport vehicles should be performed, horning should be reduced or banned, and transport route should be arranged in a reasonable manner.

(4) Other

The employer should instruct construction contractor set up billboard at construction site, indicating construction statement and complaint hot-line, the employer should contact local environmental protection administration immediately upon receiving any complaint to allow timely treatment of various environment related disputes.

At acoustic environment sensitive points (Residents in new houses or those for resettlement) within 50m from construction site, temporary noise barrier or baffle plate should be erected; strengthen management, call for civilized construction, control artificial noise management system, minimize artificial hullabaloo as possible, enhance consciousness of all construction personnel for prevention of noise disturbing surrounding residents; management measures should be available for noise from artificial activities, artificial noise by knocking, clamoring, forceful loading/unloading and etc should be banned to minimize noise disturbance to local residents.

Meanwhile, in the process of project construction, continuous communication with existing and planned residential communities surrounding project area is required to seek maximal understanding and support by surrounding residents.

8.3.2 Noise Pollution mitigations on Operation Stage

(1) Garage Noise

In order to reduce noise from operation of utility, underground garage ventilator, water pump and like equipments in low noise level should be used; garage ventilator and water pump should be installed in underground area covered with 1.5m soil overburden as a minimum; foundation absorber should be used in installing equipment; hose and flexible connector should be used to connect equipment and pipeline; elastic suspender should be sued for pipeline support; feed pipe and discharge pipe should be equipped with compensator; wall penetration pipe should be enwrapped with elastic material at the point in contact with the wall; various pumps and underground garage ventilator should be installed in separate equipment room; by taking above-mentioned measures, equipment noise can be attenuated by about 30dB (A).

(2) Equipment Noise

Variable refrigerant flow multi-split central air conditioning should be sued at visitors' center; VRF central air conditioning should be used. Outdoor air conditioner of air cooling unit with operation noise of 65-70dB(A) should be used; all outdoor air conditioners should be mounted on the roof, and foundation shockproof measures should be taken; to conclude, noise environmental impact on surrounding area is minor.

(3) Noise Control at Pump Station

Noise impact from pump station of the project is within permissible range; to further mitigate acoustic environmental impact during operation period, control of noise source should be implemented, namely, equipments at low noise level should be used. Mechanical equipment isolation damper is adopted at pump station, additional acoustic shield is installed; double-wall is adopted for the hearing; auxiliary indoor sound absorption materials are installed; sound insulation greenbelt may be planted in outdoor area.

8.4 Air Environmental Pollution Mitigations

8.4.1 Air environmental Pollution Mitigations on construction Stage

(1) Construction Fugitive Dust

Main sources of construction related dust are earthwork excavation, mixing of ash and earth during construction of visitors' center, wetland construction, construction of river-way revetment work, demolition of buildings within the boundary of land expropriation, temporary stacking of powder materials, transportation and other processes. To mitigate the impact of dust on the environment, following measures should be taken to suppress construction related dust:

Maintain permissible humidity at construction site, sprinkling and cleaning system musts be established for storage area of powder materials, dedicated person should be appointed for sprinkling and cleaning at construction site, the frequency of sprinkling should be adjusted in terms of weather dryness degree.

Effective and clean construction enclosure should be erected around construction site.

Construction material should be stored in the shed as possible; Construction material storing in outdoor area should be shielded with tarpaulin; powder construction materials like cement and lime should be transported as bulk materials by tank car; storage bunker of powder material should be kept far from residential community as possible.

Materials such as earth, gravel and the like should be covered with tarpaulin during handling; overloaded transport is prohibited for fear of secondary pollution as a result of spillage, leakage and overflow along the way,

Wheel cleaning equipment should be installed at the exit of construction site; dedicated cleaner should be assigned for cleaning wheels and sweeping entry/exit at site; vehicles with mud-carrying wheels are banned for transportation.

Under weather condition of strong wind, construction operation producing dust is banned within 200m from sensitive points such as residential area, school, kindergarten, hospital and the like.

From the perspective of protecting human health, operators should be provided with dustproof respirator.

(2) Fuel Exhaust

Excavator, bulldozer, transport vehicles and the like used during construction of the project will produce fuel exhaust during operation. To mitigate such environmental impact, following protective measures against fuel exhaust are taken for the project:

1) Standard fuel should be used for transport vehicles and fuel-fired construction machinery, low-grade fuel is prohibited for use; in addition, driving route of transport vehicles should be arranged reasonably to ensure driving at a safe speed and reduce idle time, so as to reduce emission of exhaust gas by motor vehicle.
2) Strengthen servicing and maintenance of fuel-fired mechanical equipment, and maintain equipment operation under normal and good condition; furthermore, fuel-fired machinery should be installed with exhaust gas emission purifier to ensure emission of standard exhaust gas.

(3) Stinking Storage yard Mitigation

At present, the employer determines construction sludge dredging to be conducted in dry season (winter and spring) to avoid construction in summer, and sludge dump is far from surrounding residential area. Presently, mitigation measures against stinking storage yard are rational and feasible. These measures should also be taken during final stage of construction, and no further requirements and suggestions are proposed herein. Regular air quality monitoring is required construction period of the project to confirm whether applicable emission and ambient air quality standards are complied with.

8.4.2 Ambient air pollution mitigation during operation period

During operation period of the project, measures for prevention and control of air pollution are as follows:

1) Forced ventilation is adopted for underground parking, exhaust fan will operate 12h per day,exhaust port should be 2.5m above the ground; exhaust port should be installed at a ventilated position in combination of ground greenbelt, and exhaust gas has minor impact on the surroundings.
2) Planting coverage is 30% within land area of the project, and three-dimensional

afforesting is envisaged in conditioned space. Construction of shelter forest barrier is required surrounding project area for purifying the air and mitigating environmental impact from project related traffic noise.

8.5 Control of Pollution by Solid Waste

8.5.1 Disposal of Construction Solid Waste

Proper disposal of dewatered sediment is required during construction period; during construction period, the employer and sludge dewatering and solidification contractor should contact Jingzhou Project Headquarters in advance according to dredging, dewatering and solidification plan, report potential quantity of dried slit in near future to allow Jingzhou Project Headquarters arranging final disposal of sludge.

Construction scraps produced during project construction should be carried away in a timely manner; construction site should be cleaned at the end of construction; piling or littering of construction scraps that could deface urban aesthetics and environmental health is prohibited.

Temporary waste dump should be set up at construction site; domestic waste produced during construction period should be dumped together before carrying away in a timely manner.

8.5.2 Feasibility Analysis of Outlet for Dredged Sediment

According to feasibility study report of the project submitted by T.Y. Lin International, dredged sediment in project area will be disposed by local reuse, following is feasibility analysis thereof.

(1) Analysis of Conformity with Standard of Soil Quality Assessment for Exhibition Sites (Provisional) (HJ350-2007)

In sediments at all monitoring points, contents and limits of all heavy metal pollutants, including Hg, Zn, Cu, Cd, Pb, total Cr, Ni, Se, As and others, are in conformity with Standard of Soil Quality Assessment for Exhibition Sites (Provisional)(HJ350-2007). Therefore, on the basis of dewatering and solidification of dredged sediment, analysis is made with sludge composition of dredged sediment, and it's feasible to reuse dredged sediment for wetland fill and revetment construction.

(2) Analysis of Conformity with Disposal of Sludge from Municipal Sewage Plant-The Quality of Sludge Used in Gardens or Parks (GB/T23486-2009)

Water content of sediment at all monitoring points fails to meet the requirements of physical and chemical properties listed in Table 2 (＜40%) of Disposal of Sludge from Municipal Sewage Plant-The Quality of Sludge Used in Gardens or Parks (GB/T23486-2009). Minimum water content is 2-2(72.1%). Therefore, water content of sediments at 9 monitoring points is reduced to less than 40% after drying disposal, appropriate quantity of organic fertilizer is added, by adding of appropriate quantity of N, K and P at monitoring points 1-2, 2-1, 2-2, 2-3 and 3-2, the sediment can be used as construction and curing soil for municipal greenbelt system or suburb woodland.

(3) Analysis of Land Demand

According to feasibility study report of the project submitted by T.Y. Lin International, dredged sediment of the project is about 301,900m^3, the volume of which is 160,000m^3 after drying.

Dredged sediment after dewatering can be reused in other components. Considering construction schedule, 2 temporary yards are proposed for stacking dry sediment to be reused. The volume of dredged sediments after dewatering is 160,000m^3, while backfilling wetland and revetments needs 163,000m^3: specifically, 54,000m^3 for artificial wetland at moat, 49,000m^3 for wetland at West Lake, 48,000m^3 for artificial wetland at North Lake, 9,000m^3 for Horse Wash Pond and 3,000 for Northeast Pond. This is to say that all the sediment produced in dredging can be all recycled

8.5.3 Disposal of Solid Waste during Operation Period

Main sources of solid waste are domestic waste and common wastes produced during operation of visitors' center, Xiongjiazhong Tomb scenic area, lift pump station and box culvert; solid waste produced during operation period can be dumped together according to dumping requirement of domestic waste and then cleaned and picked up regularly by workers of municipal sanitation department. Outlet of various types of solid waste should be clear and rational. Reducing and non-polluting disposal of solid waste is required. No environmental harm should be caused by disposal of solid waste. Output of solid waste and disposal method during operation period are listed in Table 9.6-1.

Table 8-4 Output of Main Solid Wastes

Source of solid waste	Number of solid waste	Type of solid waste	Output, t/a	Outlet
Waste from visitors' center	S2-1	domestic waste	182.5	Regular cleaning and pick-up by workers from municipal sanitation department
Waste from regional play center	S2-2	domestic waste	36.5	
Sludge from lift pump station and box culvert	S2-5	Common solid waste	4.7	
Total			**223.7**	

8.6 Summary of the Mitigations

Mitigations for the proposed project are summarized in the Table 8-5 below.

Table 8-5 Summary of the Mitigations

Period of time	No.	Type	Location	Pollutant name	Equipment name	Size	QTY	Remark
Construction period	1	Noise	Heavy-duty construction machinery running noise		——	——	——	Proper construction timing
	2	Wastewater	Construction of civil works	Basic washing wastewater	Sedimentation tank	20m^3/d	13 sets	——
				Transport machinery and vehicles oily washing wastewater	Oil separator + sedimentation tank	40m^3/d	9 sets	——
				foundation pit	Primary &	200m^3/d	17	——

Period of time	No.	Type	Location	Pollutant name	Equipment name	Size	QTY	Remark
				wastewater	secondary sedimentation tanks		sets	——
				storage yard residual water	Coagulation-sedimentation system	1400m^3/d	2 sets	——
				Sludge and storage yard percolate	Anti-seepage of storage yard	——	——	——
	3	Solid waste	Construction works and demolition	Construction scraps and demolition waste	——	5558.8t		Reuse for civil work of the project
				Construction personnel's domestic waste	——	375t		Rely on sanitation facility
			Dredging	Dredged sludge, water content 80%	Dewatering and solidification equipment	400000m^3	2 sets	Water content reduced to 40%
			Surveying	Pit wall solidifier	Send to Jingzhou Museum	100t	——	——
	4	Ecology	Impact on river aquatic ecosystem by temporary land use, water and soil loss and sediment dredging, and soil and vegetation damage by channel excavation		——	——		Minimize construction temporary land area; shorten construction duration as possible
Operation period	1	Exhaust gas	Underground garage	Vehicle exhaust gas	Forced ventilation	12h/d	1 set	2.5m high exhaust funnel
	2	Wastewater	Visitors' center	Living sewage	Cesspool	80m^3/d	1 set	——
	3	Noise	Pump station	Noise	Buried	2 points	——	Additional acoustic shield
	4	Solid waste	Visitors' center	Domestic waste	Trash bin	——	7 sets	Collection and handover to sanitation department for centralized disposal
			Xiongjiazhong Tomb	domestic waste	Trash bin			
			Lift pump station and box culvert	sludge	Collection of sediment			

8.7 Total Discharge Control

8.7.1 Total discharge control factors

Total pollutants emission control is necessary for sustainability strategy as well as effective means for controlling pollution and maintaining continuous and steady national economy. According to Notice of the State Council on Issuing the *Work Plan for Greenhouse Gas Emission Control during the 12th Five-Year Plan Period* (GUO FA NO. [2011]26) and *Notice of the People's Government of Hubei Province on Issuing the Work Plan for Greenhouse Gas Emission Control during the 12th Five-Year Plan Period* (E ZHENG FA NO. [2012]35), particular provisions are defined for stringent control of additional pollution by construction project, with more demanding requirements for environmental capacity and total pollutants emission control.

According to the requirements for total pollutants emission control, and in view of the pollution characteristics of the project, following total pollutants emission control factors are identified for this feasibility study:

Exhaust gas: NOx

Wastewater: COD, ammonia-nitrogen

8.7.2 Total discharge control indicators

According to analytic outcome of the project as well as measures, countermeasures and suggestions for prevention and control of pollution, upon completion and production of the project, keys pollutants will be NOx, COD, and ammonia-nitrogen and etc. Due to part of project related wastewater is sent to municipal Sewage Plant, thus pollution emission indicators with living sewage outgoing from discharge port at visitors' center and Xiongjiazhong Tomb are used as assessment indicators. With final emission from Caoshi WWTP be used as control indicators, total discharge control indicators of pollutants for proposed project are defined as shown in Table 8-6 below.

Table 8-6 Emission of various pollutants of the proposed works

Total Discharge control factor		Proposed works, t/a	Total demand, t/a	Remark
COD	Assessment indicator	1.626	——	Wastewater from visitors' center to be disposed at Caoshi WWTP; wastewater from Xiongjiazhong Tomb to be disposed by proposed auxiliary wastewater treatment facility
	Control indicator	1.186	1.186	
Ammonia-nitrogen	Assessment indicator	0.25	——	
	Control indicator	0.17	0.17	
NOx	Control indicator	0.00456	0.00456	

8.7.3 Source of total discharge control indicators

(1). Policy Requirements for Total Discharge Control Indicators

The Outline of the Twelfth Five-Year Plan for National Economic and Social Development of the People's Republic of China sets forth binding indicators of 10% reduction of total discharge of main pollutants (SO_2; COD) for the period of the Twelfth Five-Year Plan. Also, Resolution of the People's Government of Hubei Province on Implementation of the Scientific Outlook on Development and strengthening of Environmental Protection assumes the objective for cutting total discharge of main pollutants for the period of the Twelfth Five-Year Plan. Control of pollutants emission and indicators of the project should be incorporated in the general objective of Hubei Province to ensure achievement of provincial objective of cutting total pollutants emission control indicators as scheduled.

(2). Source of Total Discharge Control Indicators

The quota for total discharge of the project is1.186t/a total COD, 0.17t/a ammonia-nitrogen and NOx0.00456t/a, total discharge indicators is subject to reassignment and distribution by Jingzhou Environmental Protection Bureau and final validation by Department of Environmental Protection of Hubei Province.

9 INFORMATION DISCLOSURE AND PUBLIC CONSULTATION

Public consultation is a two-way communication between construction organization, evaluation agency and the affected people, which plays an important role in environmental impact assessment of the construction projects. Public consultation enables us to understand the environmental issues the public really concern, so as to assist relevant departments to formulate feasible and practical measures of environmental protection, ensuring the project to achieve expected social and economic benefits.

According to the requirements of The Provisional Measure of Public Consultation in Environmental Assessment issued by State Environmental Protection Administration, Law of the Peoples Republic of China on Environmental Assessment, World Bank's Policy on Environmental Assessment (OP4.01), World Bank Operation Manual-BP17.50 Policy on Information Publicity and other related documents, information publicity and public consultation in environmental impact assessment are required for the project. The purpose of information publicity and public consultation in environmental impact assessment for the project is to allow local residents timely and accurately to understand the significance of project construction, favorable and unfavorable, direct and indirect impact of project construction on their life, and understand their attitude and major concerns with regard to construction of the project, collectively find the solution from the perspective of public interest to achieve perfect and impartial environmental impact assessment, ensure smooth construction of the project, and avoid any pollution dispute arising from project construction and operation.

9.1 Purpose and Meaning of Public Consultation

Enable the public to understand the component, scale, construction location, all-round potential impacts on the area along the line during and after the construction of the project, and the measures and countermeasures to be taken; solicit opinions about the project from the public, in order to obtain understanding, support and cooperation from the public.

The inquiring results on residents' hands-on experience and perceptual intuition about the environment where they reside and live for long, can help to analyze the characteristic of polluted environment and status of quality of each environmental element, so to reflect the degree of objectivity of the environmental evaluation, and protect the vital interests of the public.

As the public are more familiar with the natural ecology, economic development, living material value and other resources which are involved in the environmental impact evaluation, public consultation is a way to invite them to participate in the confirmation of the mitigation measures and get to know their requirements, which can make the mitigation measures raised in this evaluation more feasible and more effective.

Enable the public to participate in decision-making about whether the construction of the project is feasible or not.

9.2 Information Disclosure

First Round Information Disclosure After the environmental screening and preparation of draft EIA TOR, the EA Consultant publicized the project on official website of Department of Environmental Protection of Hubei Province on Sept. 26, 2014 (Webpage http://www.hbepb.gov.cn/wsbs/gsgg/hpgs/hpdwhp/201409/t20140926_72710.html) for public opinions and suggestions on the project and environmental impact assessment thereof. The EIA TOR hard copy is also available in the local communalities for the affected people to review.

Second Round Information Disclosure When the drafting of EA report prepared, the second information disclosure was made on official website of Department of Environmental Protection of Hubei Province (http://www.hbepb.gov.cn/wsbs/gsgg/hpgs/hpdwhp/201503/t20150324_76021.html) on March 24, 2015 , and the official website of Department of Environmental Protection of Hubei Province (http://www.jingzhou.gov.cn/article/zxgg/138612.html) on March 26, 2015. In order to let the more affected people know the information of the project, the PMO disclosure the project EIA information on Jingzhou Daily on March 26, 2015. The full EIA report is available on the local government website and in the local communalities for the affected people to review.

Furthermore, the English Version of the EA Documents including the EAR, ESMP, and EAS are disclosed on the World Bank's website (http://www.worldbank.org/projects/P148523?lang=en).

Table 9-1 Environmental Information Publicity

Stage	Time	Place	Content
First Round	2014.9.26	Billboard and internet publicity of affected areas by the project	Project title and construction content; the employer's contact; appointed EIA agent and EIA agent's contact; main tasks of EIA; method for submitting public opinion http://www.hbepb.gov.cn/wsbs/gsgg/hpgs/hpdwhp/201409/t20140926_72710.html
Second Round	2015.3.24	Governmental and internet publicity of affected areas by the project	Project title and construction content; summary of potential environmental impact with construction project; key points of EIA put forth in environmental impact assessment report; particular method for consulting public opinion http://www.hbepb.gov.cn/wsbs/gsgg/hpgs/hpdwhp/201503/t20150324_76021.html
	2015.3.26	Publicity by **Jingzhou Daily**, billboard and official website of Jingzhou Municipal People's Government	Draft EA Report and ESMP are available on the website below: http://www.jingzhou.gov.cn/article/zxgg/138612.html
	2015. 5.1	World Bank's website	The English Version of the EA Report, ESMP, EAS are available on the World Bank's website below: http://www.worldbank.org/projects/P148523?lang=en

Figure 9.2-1 First Round Information Disclosure Online

Figure 9.2-2 Second Round Information Disclosure on Hubei EPB Website

Figure 9.2-3 Second Round Information Disclosure on Local Government Website

Figure 9.2-4 Posting Announcement

荆州日报

《湖北荆州古城修复与保护》项目环境影响评价公众参与信息公告

为保护荆州古城其文化遗产，促进旅游发展，提升旅游设施及服务，改善古城周边居民的生活环境，荆州市拟利用世行贷款，建设湖北荆州古城修复与保护项目。现将该项目的环境影响评价信息公告如下：

【工程概况】本项目总投资约为11.27亿元人民币，其中世行贷款1亿美元(约6.15亿元)，内配资金约为5.12亿元，施工期为2015年–2020年。

拟建项目位于湖北省荆州市荆州区，项目属于环境综合治理类，共分3个子项，分别为文化遗产保护与促进旅游业发展项目、改善古城生态环境及水环境项目、提升古城交通便利度项目。文化遗产保护与促进旅游业发展子项目包括西城墙保护工程、古城墙挡土墙修建工程、古城墙植物保护及修复、博物馆展示提升、熊家冢保护与展示、游客接待中心、古城旅游标识与导览信息服务系统、历史建筑修复与再利用、开元观景观提升工程。改善古城生态环境及水环境子项主要包括护城河及古城内湖泊疏浚清淤工程、污水管网工程、护城河和湖泊湿地工程、护岸工程、水岸湖连通改善及河湖生态构建。提升古城交通便利度子项包括内环路改造工程、古城内关键节点改善、荆州大道/荆南路节点改善、交通组织优化、停车系统、接驳巴士系统、静态交通标识系统、动态交通标识系统。

【环境影响简介】本项目对环境的影响利大于弊，其生态、环境效益显著，不利环境影响是局部的、短期的和可逆的，影响相对较小，并可通过采取相应的环境保护措施及改善手段减缓。

项目对环境的不利影响主要为游客接待中心、疏浚清淤工程、污水管网工程的建设，从时间序列上分为施工期和运营期；从空间概念上看，对环境的影响主要来自游客接待中心、地下停车场、清淤工程的建设。施工期的土建施工、运输土方及道路改造等容易造成交通阻塞，产生噪声及扬尘等环境污染，不可避免地对周围环境造成影响，同时清淤及建筑拆除产生的大量弃土(渣)，如果处理不当，将造成水土流失、土壤破坏等环境问题。本工程投入运营后，可完善整个古城路网系统，促进古城旅游业发展。但随着人口及车辆的增加，游客中心配套建设的停车场环境噪声和汽车尾气将增加，对地下停车场附近的居民生活有一定的影响；项目运行中产生的污水量较小，且水质单一，最终排入市政管网进入草市污水厂及城南污水厂，对水环境影响程度较低。

【说明】根据《中华人民共和国环境保护法》和《中华人民共和国环境影响评价法》的规定，建设项目在环境影响评价中应征求项目所在地单位和居民的意见。为了使该工程更好地为沿线公众服务、减少对沿线公众带来负面的环境影响，我们真诚地希望您能为保护工程沿线及周边环境提出宝贵意见，我们将在环境影响报告书中真实记录您的意见和建议，将您的宝贵意见、建议向项目的建设单位、设计单位反映。

您还可以通过信件、E-mail、电话的形式给我们提供宝贵意见建议，我们的联系方式是：

项目管理单位：荆州市世界银行贷款项目管理办公室
通讯地址：荆州市北京西路440号，荆州市政务服务中心院内西2栋
联系人：种莅侯　联系电话：0716—4081878
E-mail：jingzhoupmo@163.com
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(上接1版)

Figure 9.2-5 EIA Information Disclosure on Jingzhou Daily

9.3 Public Consultation

The content of the inquiry of public consultation mainly include:

1) Awareness of the project;
2) The public's recognition of the status of environmental quality.
3) Identify the adverse impact on the affected people during construction period and operation period.
4) The public's attitude on the construction of the project from the perspective of environmental protection.

5) The opinion and suggestion of the public on the mitigation measures to be taken in the project.
6) Other opinions and suggestions of the public on the construction of the project.

9.3.1 First-round Public Consultation

9.3.1.1 Public Consultation methods

The inquiry methods of public consultation mainly include on-line publicity, posting announcement, symposium, interview and handing out questionnaire, and the process of inquiry was under active cooperation of all parties and the construction organization. Hubei Academy of Environmental Sciences organized special staffs for twice to investigate in the form of public opinion questionnaire along the line of World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project. The staffs of the investigation group introduced to the respondents in detail about the basic situation of the planned project firstly, including overview, scale, meaning of the project as well as positive and adverse impact of the construction of the project on the area. Then the respondents filled in the *Public consultation Questionnaire of Environmental Impact Evaluation of World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project.* Finally, the questionnaires are analyzed through integration and summarizing. The questionnaire is as follows:

9.3.1.2 Process of the Public Consultation

In November of 2014 (After the first round information disclosure was completed), the EA Consultant, Hubei Academy of Environmental Sciences, assistant the PMO organized special staffs to go to the area of the project to conduct the first round of public consultation inquiry, mainly in forms of on-line publicity, posting announcement, symposium, interview and handing out questionnaires. The respondents mainly consist of the residents in the project construction area and the surrounding area, including the residents along the line of Xicheng Street, Dongcheng Street, Fanrong Street, Dongdi Street and Siji Road. The specific process of inquiry is as following.

In the inquiry of public consultation, firstly, announcement was posted to tell the public about the construction content, the main environmental impact, and the mitigation measures to be taken; secondly, the residents in the project construction area and the surrounding area are called together to attend symposium in corresponding residents' committees, to explain in detail to them about the construction content, scale and construction period, the impact of the project during construction period and operation period, the mitigation measures to be taken toward the adverse impact and its effect, and solicit their opinions about the construction of the project. Additionally, staffs of Hubei Academy of Environmental Sciences went to some households to interview and hand out public consultation questionnaire to solicit their opinions. For illiterate people or people who don’t understand the content of the questionnaire, the staffs would explain to them item by item, until they understand it completely, then they could make decisions on their own and the questionnaire would be filled in according to their opinions.

Figure 1.1-3 Posted announcement

Figure 1.1-4 Photo of the field of symposium

9.3.1.3 Questionnaire survey on individuals

The respondents of the individual inquiry mainly consist of the residents involved in the construction and impact area of the project, who are the residents from the surrounding sub-districts and communities and staffs from surrounding companies of World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project. The composition of the respondents is as following.

Table 9-2 Summary sheet of the basic information of the respondents

Item	Category	Number	Proportion (%)
Age	30 and below	6	9.23%
	31-40	10	15.38%
	41-50	25	38.46%
	51-60	15	23.08%
	60 and above	7	10.77%
	Unknown	2	3.08%
Type of the organization the respondent belonging to	Enterprise	12	18.46%
	Public institution	12	18.46%
	Commerce	12	18.46%
	Government agency	2	3.08%
	Unknown	27	41.54%
Degree of education	Primary school and below	1	1.54%
	Junior high school	15	23.08%
	High school/technical secondary school	29	44.62%

Item	Category	Number	Proportion (%)
	Junior college and above	17	26.15%
	Unknown	3	4.62%

From the sheet we can see that, the people involved in the inquiry include groups of different ages, degrees of education and professions from all sub-districts along the line of World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project, who are representative and typical, and the results is dependable. The specific information of the individuals is as following:

(1) Results of individual questionnaire

See the table below for the questionnaire survey results of first-round public consultation.

Table 9-3 Sumary of Public Opinion

No.	Items	Opinion	Number (person)	Propotion (%)
1	From which way do you know the information about that World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project is to be constructed?	Website	0	0.00%
		Newspaper	15	23.08%
		TV	10	15.38%
		This questionnaire	35	53.85%
		Others	5	7.69%
2	Are you satisfied with the environmental condition of the location where you live or work at present?	Satisfied	7	10.77%
		Relatively satisfied	38	58.46%
		Not satisfied	20	30.77%
		Indifferent	0	0.00%
3	3. The impact of the water quality of the moat on you is	Serious	25	38.46%
		Not serious	11	16.92%
		General	29	44.62%
4	The construction of the project may cause environmental pollution or interference to your life. What do you think will be the main impact?	Noise	16	24.62%
		Vibration	2	3.08%
		Raise dust	32	49.23%
		Sewage mud	11	16.92%
		Ecological damage	3	4.62%
		Others	1	1.54%
5	The operation of the project may cause environmental pollution or interference to your life. What do you think will be the main impact?	Noise	35	53.85%
		Automobile exhaust	24	36.92%
		Others	6	9.23%
6	Which area do you think the environmental quality must be guaranteed?	Regional environment	27	41.54%
		The whole living environment	38	58.46%
		The bedroom	0	0.00%
7	Which do you think are the mitigation measures that should be taken during the operation period?	Sewage intercepting pipes	27	41.54%
		Sound proof window	1	1.54%
		Relocation	5	7.69%
		Greening	12	18.46%
		Planning and control	17	26.15%
8	If the construction of the project brings impact on your living environment, how do you expect to solve the problem?	Economic compensation	7	10.77%
		Require to be treated to meet standards	48	73.85%
		Relocation	9	13.85%
		In different	0	0.00%
9	What is your attitude toward the temporary impact during the construction period?	Forgivable and understandable	39	60.00%
		Forgivable and understandable, but mitigation measures should be taken	25	38.46%

No.	Items	Opinion	Number (person)	Propotion (%)
		Complaining	1	1.54%
10	Which way do you think is more effective for solving the environmental problems caused by the project?	Making a complaint to environmental protection departments	46	70.77%
		Through legal procedure	13	20.00%
		Prevent the construction and operation of the project	6	9.23%
11	After the implementation of the project, which aspect among the following do you think will be improved?	Economic development	23	35.38%
		Better traffic	11	16.92%
		Living environment	33	50.77%
		No impact	0	0.00%
12	What's your attitude toward the construction of the proposed project?	Support	63	96.92%
		Conditional support	2	3.08%
		Not support	0	0.00%
13	Other opinions	The project has no effect on our work and lives except the abovementioned. We hope the construction would start in a short time, and city wall could be restored. In fear of inconvenient traffic Be practical, I support the project for the good of Jingzhou The project hardly affects my life, and I have no comment. I support the construction of the project. I support the construction of projects. Demolish shanty town to improve the condition of South Gate. The project greatly helps the development of Jingzhou. I hope the project will not be left unfinished due to some reasons.		

(2) Analysis of the individual questionnaire

According to statistics, the results are as follows:

Public attitude and knowledge of the project 96.92% interviewees fully support the project construction; 3.08% hold conditional support. No objection to the project construction is heard from interviewees.

All interviewees have certain knowledge of the project; some of them say they'll keep an eye on the project and hope that they can be informed of the project progress.

Public understanding of environment in the project area As for public opinion towards the environment in project area, 10.77% show satisfaction, 58.46% relative satisfaction, 30.77% dissatisfaction and 0% disinterest. In addition, 38.46% interviewees believe the moat is seriously polluted; 16.92% don't believe the moat is seriously polluted, and 44.62% believe the pollution in moat is at average level. These results suggest that local people are conscious of environmental protection and have certain knowledge of environmental pollution. However, such knowledge are not thorough, thus it's necessary to strengthen public education to enhance their notion of environmental protection.

Public attitude towards the impact of historic town restoration The majority of the public believe that, the undesirable impacts of the project are noise and dust during construction. About 24.62% of them worry about noise pollution, and 49.23% about dust pollution. The most unfavorable impact upon completion of the project is noise pollution and car exhaust gas. About 53.85% of them worry about noise pollution, 36.92% about exhaust gas pollution, and 9.23% about other nuisance. Noise will further increase upon the completion of the project. 41.54% and 58.46% most expect to ensure the regional environment and overall residential environment respectively. 41.54%, 1.54%, 7.69%, 18.46% and 26.15% tend to take mitigation measures such as sewage interception, low-noise road, sound insulation window, relocation, and planning control respectively. 16.92% interviewees believe project construction will lead to better traffic situation; 35.38% interviewees believe it will boost the local economic development; 50.77% interviewees believe it will help improving the living environment.

9.3.1.4 Questionnaire on organizations

(1) Results of organizations questionnaire

A total of 8 questionnaires were distributed to sub-district offices and government sectors in project area. Basic information of these responding organizations is as follows:

Table 9-4 Statistics of Organizations

Name of Organization	Filled by	Nature of Organization	Tel. No.	Attitude
Social Welfare Home of Jingzhou District, Jingzhou Municipal	Yao Ying	Public institution	8434465	Active support
Jingzhou Municipal Women and Children's Hospital				Support
Jingzhou No.2 Nuring Home for Military Veteran Carders,				Support
Jingzhou Museum	Ma Jian	Public institution	8494808	Active support
Jingzhou Land Resources Bureau	Zhang Ji	Administrative organs	8271081	Active support
Jingzhou Municipal Heritage Tourism Board	Dai Xiongwei	Administrative organs	13797371 450	Active support
Jingzhou Water Conservancy Bureau				Support
Urban & Rural Planning Bureau of Jingzhou District, Jingzhou Municipal		Public institution	8432480	Support

(2) Analysis of the organization questionnaire

Statistics of survey results are as follows:

Table 9-5 Summary of Organizations' Opinions

Name	Option	Nr.	Proportion (%)
1. From which way does your organization know the information about that World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project is to be constructed	Media	4	50.00%
	This questionnaire	3	37.50%
	Others	1	12.50%
2. Are you satisfied with the environmental condition of the location where you live or work at present?	Satisfied	3	37.50%
	Relatively satisfied	4	50.00%
	Not satisfied	1	12.50%
	Indifferent	0	0.00%
3. What does your organization think will be the main impact of the project during the construction period?	Raise dust	3	37.50%
	Noise	3	37.50%
	Vibration	1	12.50%
	Sewage mud	2	25.00%
	Traffic interference	6	75.00%
	Land expropriation and house demolition	1	12.50%
	Others	0	0.00%
4. What is your organization's attitude toward the temporary impact during the construction period?	Forgivable and understandable	3	37.50%
	Forgivable and understandable, but mitigation measures should be taken	5	62.50%
	No comments	0	0.00%
5. What does your organization	Automobile noise	2	25.00%

Name	Option	Nr.	Proportion (%)
think will be the main impact of the project during the operation period?	Automobile exhaust	1	12.50%
	Landscape	1	12.50%
	Others	5	62.50%
6. If the impact of the construction of the project on the working environment of your organization exceeds standards, which way does your organization expect to solve the problem?	Economic compensation	0	0.00%
	Require to be treated to meet standards	8	100.00%
	Relocation	0	0.00%
	Indifferent	0	0.00%
7. What's your organization's attitude toward the construction of the proposed project?	Support actively	4	50.00%
	Support	4	50.00%
	Not support	0	0.00%
8. According to the situation of the project, combining with the reality of your organization, please put forward precious opinions and suggestions of your organization for environmental protection.	1. In the hope of that effective measure will be taken as required in report of risk evaluation of geological disasters, safeguarding the safety of project construction. Unnecessary pollution to groundwater and soil is not expected during construction. 2. The project is proposed by municipal government after meticulous planning and repeated demonstration, in hope of improving the livelihood of Jingzhou. The project covering components such as cultural heritage conservation and display, improving the environment around Historic Town, tourism promotion, etc., will exert positive effect on the cultural heritage protection and Historic town tourism development as well as working and living environment of residents and organizations in Jingzhou. Inevitably, noise, dust, slurry and traffic congestion will be caused by the project construction. But, the outcome of the project completion is far-reaching. After completion, the project will not greatly affect the water quality, air, etc. It is safe to say that the long-term interests of the project overweigh its short-term negative effects. Therefore, we actively support the project and hope that the construction could accelerate. 3. The construction period of the project is relatively long. Various technical means shall be employed to reduce the noise, dust, automobile exhaust produced during construction and operation period.		

Survey results have shown that, surrounding sub-district offices and governmental agencies have better knowledge of the proposed project. These organizations believe that construction of proposed project is consistent with local development planning, and that construction of proposed project will bring positive impact on existing local environment. All responding organizations support the project construction. In addition, 1 of them is not happy with the existing environmental quality because domestic sewage is discharged into the moat without standard treatment or proper regulation. Ecological environment is poor. Flood hazard exists in flood season. Other organizations also put forth respective requirements and suggestions to the project: they hope that, effective measure will be taken as required in report of risk evaluation of geological disasters, safeguarding the safety of project construction; in the meantime, unnecessary pollution to groundwater and soil is not expected during construction. Various technical means shall be employed to reduce the noise, dust, automobile exhaust produced during construction and operation period.

9.3.1.5 Investigation Results of Social Assessment Consultant Team

During Mar. to Oct. 2014, Center for Involuntary Resettlement Research, Wuhan University conducted a questionnaire survey on the public consultation and opinion of affected residents in the course of social impact assessment. 447 questionnaires were collected. Public opinion and suggestions on project design, project construction and resettlement are learnt. Such opinion and suggestions provide basis for the design optimization and relevant policy-making of the project.

The project places priority on the most urgent challenges facing Jingzhou Historic Town, i.e. environment improvement of water systems in and around the Historic Town, restoration of Historic Town wall, and improving accessibility of Historic Town, which are reflected in public opinion, so as to accommodate citizens' demand for protection and sustainable development of Historic Town.

From the statistics of public opinion on sub-components, the project receives huge support from local residents. Improvement of water systems in and around the Historic Town is the sub-component receiving the most support, even the sub-component receiving the least support garners a support ratio of 87%. The survey finds that, the objection are not against the project itself, but the negative impacts produced during project implementation. Regarding people's doubts on negative impacts, PMO and design institute will take relevant measures to address such problems during proposal optimization and implementation.

Figure 9.3-1 Soliciting Opinion and Suggestions from Affected Population at Fanrong Street, West Gate

9.3.1.6 Interviewing of institutions

Related issues have been asked to residents and government departments in the project area. The table below is the details.

Table 9-6 The first-round public consultation

	Time	Place	Executor	Participant disclosers	Policy basis
Symposium	Nov.29,2014	Jingzhou historic town and its surroundings	EA Consultant	Project Management Office, T.Y.LIN International, The Ministry of Culture and Tourism(MCT),	World Bank policy on heritage preservation (OP4.11)

	Time	Place	Executor	Participant disclosers	Policy basis
				Construction and Management Center	

Main contents and responses	
Summary of questions	Responses
EA Consultant is preparing to set cultural relics protection section in the report, which mainly involves an evaluation of the historic town wall, museum, and cultural heritage of the project	Response of MCT: current research has not yet been finalized, so more detailed objectives and environmental mitigation plan has to be set out according cultural heritage projection unit involved
EA Consultant has preliminary identified the impact of culture heritage preservation: environmental impact brought by archaeological excavation of the project, impact on the city brought by construction work, impact on heritage and its surroundings brought by the museum project	Response of MCT: evaluation agent can carry out evaluation work based on the preliminary identified characteristic factors of culture heritage preservation
The social impact of the project is mainly construction impact on residents and security	Response of construction center: EA Consultant could carry out the evaluation of social impact, but the content of the impact should be detailed in every aspect.
After the project is completed, it will greatly improve local tourism industry, therefore, the EA Consultant is prepared to carry out assessment on the impact on capacity of economic development in Jingzhou and impact on traffic congestion brought by tourism development in Jingzhou	Response of MCT: inducible impact analysis can be carried out according to the thought
Setting of sensitive target, as the construction of the project doesn't carry on at night, so there will be little impact on its residents, therefore, only schools are chosen as sensitive target for analysis	Response of Construction Center: the impact on residents brought by construction will be generally analyzed, but for schools and other sensitive targets selective analysis should be carried out
Identification of the EA report on related ecological survey	Response of Feasibility Study Unit: basically agree, existence of protected species should be confirmed

9.3.1.7 Problems and countermeasures

Key participants and policy basis, public concern and countermeasures during the first round of public participation could be seen in the following table.

Table 9-7 Participants and policy basis in the first-round public consultation

	Time	Place	Executor	Participant disclosers	Policy basis
Migration survey	Sept.2014 to Oct.2014	Jingzhou historic town and its surroundings	Immigration Unit	Project management office, T.Y. Lin International, Land Expropriation Compensation Office of Jingzhou District, Xicheng Street Office for resettlement of affected residents, affected enterprises and institutions, affected village cooperatives, affected population, Wuhan University	World Bank's involuntary resettlement policy (OP4.12)

	Time	Place	Executor	Participant disclosers	Policy basis
The first-round public consultation	Nov 10 to 28, 2014	Surrounding communities affected by restoration construction of Jingzhou historic town, relevant regulatory and administrative institutions	EA Consultant and project management office	Individuals: Affected residents in project area; Groups: Jingzhou Environmental Protection Bureau; Jingzhou Cultural Tourism Bureau, Jingzhou Bureau of Land and Resources; Jingzhou Water Conservancy Bureau; Jingzhou Water Conservancy Bureau and etc	Law of the Peoples Republic of China on Environmental Assessment; The Provisional Measure of Public Participating in Environmental Assessment; World Bank's Policy on Environmental Assessment, Environmental impact policy of World Bank (OP4.01),World Bank Operational Manual-BP17.50 Information Publicity Policy

Table 9-8 Problems and countermeasures of public concern in the first-round public consultation

Order	Main problems	Countermeasures
The first-round public consultation	Alternative options should be available for river-way dredging, ecological restoration, restoration of inner ring and etc; dredged sludge and domestic waste disposal plan should be optimized, especially definite plan with respect to dredging quantity and outlet of sludge.	Figure 1.1-3 Design institute of the project has designed alternative plans for various subagent; in addition, outlet of dredged sediment is defined in project design plan.
	Blacktopping of road, prioritized protection of birds' habitat, orderly planting of trees; strengthen protection and exhibition of CHs; maintain original bluestone pavement.	Road blacktopping work is required for the road connecting to inner ring and Xiongjiazhong Tomb; removal of bluestone pavement in original plan is revised to restoration by current plan.
	During dredging of West Lake, construction notice should be made to ensure municipal sewage be discharged to Sewage Plant for treatment.	During construction period of West Lake dredging, construction duration will be shortened as possible; municipal sewage will be discharged to south Sewage Plant and Caoshi WWTP for treatment.
	Departments at All levels should strengthen publicity of environmental protection to enhance citizens' awareness of environmental protection.	Strengthen publicity of environmental protection is also an important concept of the project to be communicated to the citizens.
	Work did not get prior permission, leading to inextricability of social and environmental issues in certain activities	After the end of the pre-assessment, other related issues shall be resolved
	Incomplete data of EA report	Reinforce according to depth of the feasibility study
	Land exportation led to increased unemployment; therefore, employment opportunities should be provided to the affected population.	The new hires prioritize affected personnel
	Minimize the use of explosion.	No blast in construction process
	Health and hygiene problems	Take reasonable precautions during project construction

Order	Main problems	Countermeasures
	Reduce construction debris falling in the vicinity	Periodic cleaning of construction waste
	Whether theft of construction workers will occur	Casual inspection of the construction site, and compensation for loss caused by construction
	EA Consultant is preparing to set cultural relics protection section in the report, which mainly involves an evaluation of the historic town wall, museum, and cultural heritage of the project. EA Consultant has preliminary identified the impact of culture heritage preservation: environmental impact brought by archaeological excavation of the project, impact on the city brought by construction work, impact on heritage and its surroundings brought by the museum project.	Currently the feasibility research has not yet been finalized, more detailed objectives of heritage preservation and environmental mitigation plan should be established according to heritage preservation agent involved. Evaluation agent can carry out evaluation work based on the preliminary identified characteristic factors of culture heritage preservation
Survey of migration division	(1) Some residents request nearby resettlement; (2) If empty operation of North Lake is adopted for sediment dredging, it'll cause fishery loss and unfavorable environmental impact; (3) It's likely to cause pollution and reduce aquatic breeding area in Jingcheng Village; (4) Smooth channel for hearing opinions and suggestions by affected population	(1) Project management office will provide affected residents for their option of Dongsheng apartment resettlement community in the east of Jingzhou Municipal and resettlement community in former Jiangling Cigarette Factory; (2) Dredging with water will be adopted on the principle of technical feasibility; (3) Several existing pounds will be used as temporary sludge dump, cleaning of the pounds at the time of treatment; temporary land compensation for the water area occupied; (4) Establish opinion complaint and feedback channel, for instance, installation of compliant hot-line, opinion box and etc; establish consultation system; regular symposium attended by representatives from project management office, street-level social management offices, villagers' committee and affected residents for collective consultation for countermeasures of solution; strengthen external monitoring

9.3.2 Second-round Public Consultation

9.3.2.1 Public Consultation Methods

The second-round public consultation, under the recommendation of the World Bank, is mainly conducted by household survey and door-to-door interview, combined with symposium. The second round of public participation uses questionnaires, symposium, household surveys, interviews, etc. as survey method. The survey time were Sept.9, 2014~Oct.1, 2014, Nov.10, 2014-Nov.28, 2014, Mar.21, 2015-Mar.27, 2015, and surveying objects of the area are residents and related departments in Jingzhou historic town and sub-project area.

9.3.2.2 Process of the Public Consultation

(1) Group Meeting

For better understanding of public opinion to project construction, in addition to residents' interviewing and inquiry of groups, group interviewing by public symposium should be conducted with all street-level social management offices in Jingzhou region affected by project construction; two symposiums with public participation were held on Nov 28, 2014 and Mar 27, 2015 respectively; more than 20 participants attended at each symposium, and officials from local government and governmental authorities were in presence. Major agenda of the symposium is discussion about the problems arising from project EIA, to allow the public understanding potential impact during project construction, finding of best solution by selection from comparison of technologies, project site and etc, finalize bluestone pavement renovation plan, cause of degraded water quality of the moat, diversion and convergence system of sewage from inside and outside of historic town, outlet of sewage and road surface blacktopping plan, and public support of project construction is gained by discussion. The symposium of the second-round public consultation is illustrated in Figure below. The symposium of the first-round public consultation focused on briefing of project overview and content of EA report; and the symposium of the second-round public consultation was to answer the questions of public concern, as well as to communicate matters about project change.

Figure 9.3-2 The symposium of the second-round public consultation

(2) Family interview

For better understanding of the opinion of project construction by direct stakeholders most affected by the project, during public inquiry of such residents, family visit was conducted with the public of direct interest with project construction; time of inquiry was Mar 24~27, 2015; key objects of inquiry are residents from Sanyi Street, Dongdi Street and existing residents from east visitors' center during site selection of the project. Major questions of inquiry are: the approach for acquainting with the project; the degree of satisfaction to existing living environment; identification of major environmental disturbance during construction period; attitude toward environmental disturbance during construction period of the project; attitude toward the project, and etc.

Generally speaking, all residents inquired are able to understand the environmental impact during construction period of the project, highly praise construction contents in the aspect of project related water environment control, expect relevant governmental departments to manage the project properly and benefit Jingzhou historic town in the near future. All residents inquired support project construction and understand potential environmental impact during construction period. Figure 10.3-3 shows the work of inquiry by family visit.

Figure 9.3-3 Household survey

(3) Institutions Interview

For further understanding of the opinions by the units and departments form project area, institutions of direct interest affected by project construction were interviewed during public inquiry; major objects of interviewing are Jingzhou Statistic Bureau, neighborhood committee of Beimen Street, Jingzhou District, Handicapped Association of Jingzhou District, Cultural Travel Bureau, and Feasibility Study Agency; time of inquiry: Mar 24~27, 2015.

All units interviewed understand the project, they pay much attention to improvement of water environment of the moat upon completion of the project, wish project construction to be “once and for all success”, make efforts to have living sewage, the pollution source to the moat, under control, so representatives from units interviewed express their hope for construction of sewage interception pipe network of the project to be commenced and completed as soon as reasonably possible. Besides, responding evaluate ideas has been drawn according to the newest feasibility plan. Interviews with local authorities have been held, and the specific content of the hearing is as below.

Figure 9.3-4 Interviewing of Institutions

Table 9-9 The interview of the second-round public consultation

	Time	Place	Executor	Participant disclosers	Policy basis
Symposium and interview	Mar.27,2015,Jun. 28,2015	Jingzhou historic town and its surroundings	EA Consultants	Project Management Office, T.Y.LIN International, The Ministry of Culture and Tourism(MCT),World Bank	World Bank policy on heritage preservation (OP4.11)
Main content and responses of EA Consultants					

<table>
<tr><th></th><th>Time</th><th>Place</th><th>Executor</th><th>Participant disclosers</th><th>Policy basis</th></tr>
<tr><td colspan="2">Problem summary</td><td colspan="4">Responses</td></tr>
<tr><td colspan="2">The project involves following five cultural heritage preservation agencies: Jingzhou Ancient Walls, Kaiyuan Taoist Temple,Xiongjiazhong Tomb, Jingzhou Museum, and historic architectures. Specific evaluation: (1) Impact on the cultural relics and external environment during process of heritage restoration and protection; (2) Impact on external environment and cultural relics brought by construction activities; and (3) During its operation, impact on cultural relics brought by floating population and local residents.</td><td colspan="4">Response of MCT: Agree with EA Consultant's identification of the evaluation target of heritage preservation. Please complete evaluation content as soon as possible.</td></tr>
<tr><td colspan="2">Whether sediment dredging will affect the stability of Jingzhou Ancient Walls and produce a settlement and lower its groundwater level.</td><td colspan="4">Response of World Bank experts: Sediment dredging itself is only for cleanup of loose surface sediment, and dredging with water method is used. Therefore, dredging activities will not cause ground vibrations of historic buildings, and it will not result in reduction of groundwater.</td></tr>
<tr><td colspan="2">VEC identification of cumulative impact is considering quality of water environment as evaluation target.</td><td colspan="4">World Bank: Based on the total reductions of water environment, a quantitative calculation will be made to the impact of water environment brought by the project.</td></tr>
</table>

9.3.2.3 Problems and countermeasures

The main participants, policy basis and the problems people concern in second-round public consultation, as well as the countermeasures are as following:

Table 9-10 Participants and policy basis of the second-round public consultation

	Time	Location	Executor	Participant disclosers	Policy basis
The second-round public consultation	2015.3.21~27	The surrounding communities involved in Jingzhou Historic Town Restoration Project, relevant responsible organizations and management organizations	EA Consultant, PMO	The public, local government, and staffs of competent departments of the area involved in the construction of the project	*The Environment Impact Assessment Act of China*, *The Provisional Measure of Public Consultation in Environmental Assessment*, *World Bank's Policy on Environmental Assessment (OP4.01)*, *World Bank Operation Manual-BP17.50 Policy on Information Publicity*

Table 9-11 Main problems and countermeasures of the second-round public consultation

The second-round public consultation	**The construction waste has great impact on the inner ring road.**	**It will be suggested to the government that special construction waste storage yard should be built.**
	Improvement of the water quality of the moat.	The domestic sewage interception around the moat will be regarded as an important part of the project.
	The residents' houses in the historic	For repair of houses with the value of cultural

The second-round public consultation	**The construction waste has great impact on the inner ring road.**	**It will be suggested to the government that special construction waste storage yard should be built.**
	town need fund to repair and improve.	heritage, 13 pilot projects of will be implemented firstly.
	Organize villagers to participate in training of the World Bank financed project.	Carry on various projects of public consultations, ensure the information to be open.
	Compensation standard for people with house demolished.	It will be implemented according to the latest standards of Hubei Province

In the second-round public consultation, as the residents and organizations become more familiar about the project, and the content of all sub-projects has been determined after adjustment, the problems people concern become more definite, focused and targeted. Nearly all the problems the stakeholders in the area of the project concern are responded in this public consultation.

9.3.2.4 Collection of public consultation outcome

Collection outcome is listed in Table 9-12.

Table 9-12 Collection of Public Consultation Outcome

	Time	Place	Executor	Participant disclosers	Policy basis	Major problem	Countermeasure	Reply
Resettlement investigation	Sep to Oct 2014	Surroundings of Jingzhou historic town	Resettlement department	Project management office, T.Y. Lin International, Land Expropriation Compensation Office of Jingzhou District, Xicheng Street Office for resettlement of affected residents, affected enterprises and institutions, affected village cooperatives, affected population, Wuhan University	World Bank's involuntary resettlement policy (OP4.12)	(1) Some residents request nearby resettlement; (2) If empty operation of North Lake is adopted for sediment dredging, it'll cause fishery loss and unfavorable environmental impact; (3) It's likely to cause pollution and reduce aquatic breeding area in Jingcheng Village; (4) Smooth channel for hearing opinions and suggestions by affected population	(1) Project management office will provide affected residents for their option of Dongsheng apartment resettlement community in the east of Jingzhou Municipal and resettlement community in former Jiangling Cigarette Factory; (2) Dredging with water will be adopted on the principle of technical feasibility; (3) Several existing pounds will be used as temporary sludge dump,cleaning of the pounds at the time of treatment; temporary land compensation for the water area occupied; (4) Establish opinion complaint and feedback channel, for instance, installation of compliant hot-line, opinion box and etc; establish consultation system; regular symposium attended by representatives from project management office, street-level social management offices, villagers' committee and	Public opinions and suggestions should be reported sincerely to relevant governmental authorities; project design feedback is required, the public should be informed of feedback outcome and cause; for public concern, consideration should be given in the public position, effective measures should be taken according to applicable national policy and specifications to eliminate public concern; public interest should be kept in mind in the whole process of project design, project construction and project operation.

	Time	Place	Executor	Participant disclosers	Policy basis	Major problem	Countermeasure	Reply
							affected residents for collective consultation for countermeasures of solution; strengthen external monitoring	
First EIA with public participation	Nov 10 to 28, 2014	Surrounding communities affected by restoration construction of Jingzhou historic town, relevant regulatory and administrative institutions	EIA agent and project management office	Individuals: Affected residents in project area; Groups: Jingzhou Environmental Protection Bureau; Jingzhou Cultural Tourism Bureau, Jingzhou Bureau of Land and Resources; Jingzhou Water Conservancy Bureau; Jingzhou Water Conservancy Bureau and etc	Law of the Peoples Republic of China on Environmental Assessment; The Provisional Measure of Public Participating in Environmental Assessment; World Bank's Policy on Environmental Assessment (OP4.01); World Bank Operation Manual-BP17.50 Policy on Information Publicity	(1) Alternative options should be available for river-way dredging, ecological restoration, restoration of inner ring and etc; dredged sludge and domestic waste disposal plan should be optimized, especially definite plan with respect to dredging quantity and outlet of sludge; (2) Blacktopping of road, prioritized protection of birds' habitat, orderly planting of trees; strengthen protection and exhibition of CHs; maintain original bluestone pavement; (3) During dredging of West Lake, construction notice should be made to ensure municipal sewage be discharged to Sewage Plant for treatment; (4) All levels of departments should strengthen publicity of environmental protection to enhance citizens' awareness of environmental protection.	(1) Design institute of the project has designed alternative plans for various components; in addition, outlet of dredged sediment is defined in project design plan; (2) Road blacktopping work is required for the road connecting to inner ring and Xiongjiazhong Tomb; removal of bluestone pavement in original plan is revised to restoration by current plan. (3) During construction period of West Lake dredging, construction duration will be shortened as possible; municipal sewage will be discharged to south Sewage Plant and Caoshi WWTP for treatment. (4) Strengthen publicity of environmental protection is also an important concept of the project to be	

	Time	Place	Executor	Participant disclosers	Policy basis	Major problem	Countermeasure	Reply
							communicated to the citizens.	
Second EIA with public participation	Mar 21 to 27, 2015	Surrounding communities affected by restoration construction of Jingzhou historic town, relevant regulatory and administrative institutions	EIA agent and project management office	The public in affected area of project construction, officials from local government and authorities		Construction waste has major impact on inner ring; improvement of water quality of the moat should be included in the agenda; funds need to be allocated for maintenance and renovation of houses of the residents in historic town	Local government will be advised to build special construction waste dumping ground; living sewage interception in surrounding areas of the moat will be considered as key construction work of the project; for renovation houses of heritage value in historic town, 13 sites are tentatively included in the project.	

9.4 Conclusion on Public Consultation and Disclosure

To sum up, all public participating in EIA questionnaire and symposium support and uphold the project; all opinions of public institutions will be adopted by the employer expressly. Proposed project construction will be carried out strictly on the "people oriented" principle; strict construction quality control, implementation of related mitigation measures recommended in EA report, and strict execution of "three- simultaneous" system will be complied with to minimize environmental impact by environment project. Besides the employer will do its best to provide local residents with jobs and employment as possible to drive local economic development.

10 ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

In order to protect the environment of the project area, ensure effective control and mitigation of various hazardous environmental impacts of construction, strict and scientific follow-up management as well as environmental management and monitoring must be implemented throughout construction.

10.1 Environment management and supervisory organizations

10.1.1 Institutional arrangements

The Jingzhou World Bank Financed Project Management Office (PMO) affiliated to Jingzhou Municipal Construction Investment Corporation is responsible for environmental management of the project, including development of environmental protection plan, coordination among various regulatory authorities and the employer, instruction to the employer for execution of various management measures, environmental activities and environmental management during construction and design period, organization for feasibility study of project construction. Jingzhou Municipal Construction Investment Corporation, Jingzhou State-owned Assets Supervision and Administration Commission, Jingzhou Cultural Tourism Bureau, Jingzhou Traffic Management Bureau, Jingzhou Water Conservancy Bureau, Jingzhou Bureau of Land and Resources and Jingzhou World Bank Financed Project Management Office (PMO) are responsible for implementation and management of mitigation measures during operation period.

10.1.2 Supervisory organization

The environment supervisory organizations of the project are Department of Environmental Protection of Hubei Province and Jingzhou Environmental Protection Bureau. Supervisory organizations have different responsibilities at different stages:

Feasibility Study Stage Department of Environmental Protection of Hubei Province, World Bank, Jingzhou Environmental Protection Bureau and Jingzhou Municipal People's Government are responsible. Department of Environmental Protection of Hubei Province is responsible for general environmental management of the project, including review of environmental impact program, approval of environmental impact assessment report, instruction to Jingzhou Environmental Protection Bureau for enforcement of various applicable laws, as well as completion acceptance of environmental protection installations; Jingzhou Environmental Protection Bureau is responsible for supervision and management of the project related environmental protection works, including organization and coordination of relevant organizations to serve the environmental protection works, supervision of implementation of environmental action plan, completion acceptance of environmental protection installations, instruction to local environmental protection bureau in charge of the components regarding environmental supervision and management during construction period and operation period.

Design Stage Environmental protection administration of project management office (PMO) affiliated to Jingzhou Municipal Construction Investment Corporation is responsible; Jingzhou Municipal Construction Investment Corporation is responsible for supervision and approval during collective review of project preliminary design.

Construction Stage Environmental protection administration of project management office (PMO) affiliated to Jingzhou Municipal Construction Investment Corporation and Department of Environmental Protection of Hubei Province are responsible. Jingzhou Environmental Protection

Bureau, under the guidance of Department of Environmental Protection of Hubei Province, is responsible for supervision of the employer for implementation of environmental action plan, enforcement of applicable laws and standards of environmental management; coordination of various departments; and inspection, supervision and management of project construction, completion acceptance, operation of environmental protection installations, with following particular responsibilities:

a) Formulate targeted environmental protection management measures and detailed environmental protection management plan according to applicable national construction management bylaws and operation specifications and taking into consideration of measures for pollution prevention and control put forward in specific construction plan and this EA report for the proposed project, especially development and execution of environmental knowledge and environmental monitoring training program for construction contractor and environmental protection supervision engineer.
b) Regular inspection of construction site; supervision of execution of environmental protection management measures by construction contractor, timely suspension and rectification of construction activity violating management measures;
c) Inspection and treatment of problems about disturbance to local residents or environmental pollution occurring in the process of construction;
d) Submission of environmental management stage report to local environmental protection administrative department;

Operation Stage Department of Environmental Protection of Hubei Province, Jingzhou Environmental Protection Bureau and the local competent authority of engineering having jurisdiction to the components are responsible. Authority having jurisdiction to component is responsible for implementation and enforcement of laws and standards for environmental protection, including establishment and supervision for execution of environmental protection bylaws, mastering project related environmental condition, establishment of environmental quality control objectives suitable for assessment, putting forward environmental control measures and submission to superior environmental protection department and industrial authority, organization of environmental protection personnel for exam of qualified assignment and personnel training, technical communication and scientific study relating to environmental protection.

Jingzhou Environmental Monitoring Station is responsible for execution of environmental monitoring during construction period and operation period. Environmental supervision task should be implemented by environmental supervisory unit in Jingzhou Municipal. Upon completion of various components, respective environmental protection departments will be set up, and full-time staff will be appointed to take charge of environmental protection work of the project.

10.1.3 Environmental Management Procedures

Environmental protection management procedures of the project are illustrated in Table 10-1.

Table 10-1 Environmental Protection Management Procedures

Project Cycle	Project documents	Tasks

Project Cycle	Project documents	Tasks
Identification	Project Proposal	EIA Screening, EAR TOR
Preparation	Draft Feasibility Study Report	Draft EA report
Pre-Appraisal	Final Feasibility Study Report	Revised EA Report, ESMP
Appraisal	Draft Preliminary Design Report	Finale EA Report, ESMP, EAS
Negotiation	Tendering documents	ESMP implementation
Approval by executive Board	Project implementation plan	Supervision of action plan of mitigation measures
Effectiveness	Project Implementation, Construction supervision	Environmental Monitoring Report on the implementation of the mitigation measures and acceptance of environmental protection installations
	Delivery for operation	

10.1.4 Content of Environment Management

During construction period of the project, for effective control of environmental pollution, not only construction quality and progress management of the project is required, but also supervision and inspection of civilized construction, implementation of environmental impact mitigation measures, as well as performance of contract terms applicable to environmental protection is necessary.

1) The employer should incorporate in the contract text mitigation measures to be taken during construction period at the time of awarding general contract of the project, and construction contractor is required to take these measures and practice incentive and punitive system.
2) Construction contractor should organize construction according to the requirements of construction contract as well as various provisions on environmental protection and environmental health enacted by local government; construction contractor should ensure civilized construction and protect the environment according to various mitigation measures and proposals recommended in EA report.
3) Qualified supervision agent should be consigned to appoint full-time environmental protection supervision engineer for supervision of implementation of mitigation measures by construction contractor during construction period.
4) Construction contractor should assign full-time (Part-time) environmental management personnel to reside in all construction sites and take charge control and management of various sources of pollution on the spot. In particular, construction time of construction equipment of high noise level and intense vibration should be under strict control.
5) Publicity of the project. Due to the limitation of technical condition and construction environment, it’s unavoidable to cause environmental pollution during construction, even if corresponding control measures are taken. Therefore, publicity to the residents along the route and affected areas is necessary to enhance their mental endurance to adverse effect, understand the situation, overcome interim hardness, and cooperate with construction contractor for successful completion of construction assignment.
6) The site for resettlement of affected residents from demolished home for the good of construction project should be selected following environment pre-assessment, scientific planning and well auxiliary establishment, so as to ensure living quality of the immigrants.

7) Construction authority and construction contractor should set up "complaints handling office" and complaint hot-line to receive public compliant, with full-time staff for settlement of dispute within a given period of time, and handle citizens' complaint in an appropriate manner.

10.1.5 Environmental Supervision Plan

Due to major difference in the contents of environmental management during construction period and operation period of the project, together with successive time limit of environmental management works, separate environmental management organizations should be set up for environmental management of proposed project by stages. Environmental supervision management plan during project implementation is shown in Table 10-2.

Table 10-2 Environmental Supervision Management Plan

Stage	Supervisory organization	Content of supervision	Purpose of supervision
Feasibility study stage	Department of Environmental Protection of Hubei Province	1.Review environmental impact assessment report	1.Ensure inclusiveness of EIA in contents, appropriate subject setting and highlighting key points 2. Ensure reflection of likely, major and/or potential problems relating to the project 3. Ensure practically feasible action plan for environmental impact mitigation measures
design stage and construction stage	Department of Environmental Protection of Hubei Province	1. Verify which environmental protection investment is paid or not	1. Ensure environmental protection input
	Department of Environmental Protection of Hubei Province; Jingzhou Environmental Protection Bureau	2.Insepct restoration of construction temporary land, restoration of vegetation and recovery of environment 3.Insepct treatment and discharge of living sewage from construction site and construction wastewater	2. Ensure no major damage and restoration of landscape and land resource at sludge storage yard 3. Ensure surface water from pollution
		4.Inspect whether the site of dust-soil mixing station is suitable	4. Ensure these sites meeting environmental protection requirements
		5.Insepct control of dust and noise pollution, determine construction time	5.Mitigate surrounding environmental impact by construction, enforce applicable environmental protection laws and standards
	Department of Environmental Protection of Hubei Province	6.Inspect "three-simultaneous" of environmental protection installations, ensure time limit for final completion	6. Ensure "three-simultaneous"
		7.Inspect whether environmental protection installations are standard	7.Inspect environmental protection installations
Operation period	Department of Environmental	1.Inspect implementation of environmental monitoring plan	1. Implement environmental monitoring plan

Stage	Supervisory organization	Content of supervision	Purpose of supervision
	Protection of Hubei Province	2.Inspect whether it's necessary to take further mitigation measures (Unexpected environmental problems may arise)	2. Protect the environment
	Department of Environmental Protection of Hubei Province; Jingzhou Environmental Protection Bureau	3.Inspect whether environmental quality in environment sensitive areas meeting corresponding quality standard	3.Strengthen environmental management, protect public health
		4.Inspect dumping/handling/landfill condition of solid wastes	

10.2 Environmental Monitoring Plan

10.2.1 Purpose of Environmental Monitoring

The project specific environmental monitoring mainly covers surrounding environmental impact to historic town area and water system during construction and operation, the purpose is to ensure implementation of mitigation measures and suggestions set forth in EA report, so as to control environmental impact from project construction within the limit of applicable national laws, regulations and standards.

10.2.2 Environmental Monitoring Organizations

The environmental monitoring during construction period and operation period of the project should be undertaken by a competent unit qualified by national environmental quality monitoring certification; environmental monitoring unit should conduct regular environmental monitoring, prepare environmental monitoring report and submit to regulatory department for supervision inspection by various levels of environmental protection administration. Any problem found during environmental monitoring should be reported in a timely manner to allow effective measures are taken timely.

10.2.3 Environmental Monitoring Plan

Base on environmental impact forecast outcome, conduct follow-up monitoring of environmental pollution during construction period and operation period of the project with pollution sensitive points used as monitoring points; noise, air environment and surface water environment of major environmental impact should be selected as monitoring contents; monitoring factors should be determined according to pollution characteristic factors of the project.

Monitoring analytic method stated in Technical Specifications for Environmental Monitoring by State Environmental Protection Administration for corresponding construction project should be applied. Applicable national assessment standard confirmed in EIA should be adopted. According to engineering characteristics of World Bank financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project, separate environmental monitoring plan for construction period and operation period will be established, as listed in Table 10-3.

Table 10-3 Environmental Monitoring Plan

Stage		Monitoring site	Monitoring item	Monitoring frequency		Monitoring duration	Implementing organization
Construction period	Ambient air	Concrete mixing station, dust-soil mixing station, Jingzhou Experimental Middle School, residential area such as Fanrong Community	TSP	Quarterly (More frequent during construction peak, if necessary) 3-4 times per quarter			Jingzhou Environmental Monitoring Station
		Various sludge storage yards	H_2S, NH_3	Once environmental monitoring before dredging work as background value; Once environmental monitoring during busy use of storage yard during dredging work			Jingzhou Environmental Monitoring Station
	Noise	Jingzhou Experimental Middle School, Fanrong Community and etc	LAeq	Quarterly 2 days 1 environmental monitoring at daytime and nighttime respectively			Jingzhou Environmental Monitoring Station
	Water environment	Residual water discharge port at various sludge storage yards	SS, TP, TN, DO	1 environmental monitoring during initial construction, construction peak and final construction respectively			Jingzhou Environmental Monitoring Station
	sediment	1 monitoring point for each dredging area of most , west lake and northeast pond	pH, TP, TN, Zn, Cu, Pb, Hg, As, Cd	1 environmental monitoring during final construction			Jingzhou Environmental Monitoring Station
	Monitoring the cultural relics in the process of construction						
Operation period	Ambient air	Jingzhou Experimental Middle School, Fanrong Community, Dongdi Street and etc	CO, NO_x	Once per year	1 day	18 (12)h continuous monitoring	Jingzhou Environmental Monitoring Station
	Noise	Jingzhou Experimental Middle School, Fanrong Community, Dongdi Street community and etc, Ximen pump station and Binyanglou pump station	LAeq	Once per year	2 days	1 environmental monitoring at daytime and nighttime respectively	Jingzhou Environmental Monitoring Station
	Water environment	East gate, ne south gate, old south gate, west gate, big north gate, new north gate, small north gate, , west lake, north lake, Ximachi, northeast pond	pH, NH_4-N, COD, BOD_5, oils and etc	Once per year			Jingzhou Environmental Monitoring Station

Stage		Monitoring site	Monitoring item	Monitoring frequency	Monitoring duration	Implementing organization
		Outgoing sewage from visitors' center	COD, BOD, ammonia-nitrogen	6 monitoring per year, namely once in Feb, April, June, Aug, Oct and Dec respectively		Jingzhou Environmental Monitoring Station

10.2.4 Monitoring Equipment & Cost

No new monitoring instruments and equipments will be acquired for the project, and monitoring unit is required to provide these for itself.

Monitoring cost during construction period is ￥100,000/year×5 years=￥500,000; Monitoring cost during first 3 years of operation period is included in WB-financed loan, monitoring cost thereafter is included in the pay-bill of project operator, monitoring cost is ￥120,000/year×3 years=￥360,000.

The monitoring unit should prepare monitoring report based on environmental monitoring outcome during construction period and operation period of the project and send to local environmental protection bureau and like regulatory department.

10.2.5 Environmental Monitoring Procedures

According to engineering characteristics of construction project, in combination with operation and management experiences for similar projects and considering the requirements of environmental management system (ISO14001), the employer should work out environmental monitoring procedures during construction period and operation period of the project. The contents of environmental monitoring procedures should include the following aspects:

(1) Set up dedicated environmental management organization, fund and ensure personnel;

(2) Establish environmental management system, make environmental monitoring plan, develop training program and determine measures for prevention and control of pollution for proposed project based on construction plan and particular contents herein;

(3) Organize training according to training program, ensure all personnel be aware of environmental protection and meeting the requirements for operation ability, including skill training with above measures for prevention and control of pollution;

(4) Clear-cut work division, assign responsibility to each staff, carry out planned routine management (Inc. site supervision inspection), and monitor environmental impact of proposed project;

(5) Establish smooth information communication channel, especially effective response approach for handling residents' complaints;

(6) Organize related monitoring units to conduct regular monitoring according to environmental monitoring plan, and report monitoring outcome to related department in a timely manner;

(7) Timely rectify recurred unlawful environmental pollution or disturbance to the residents during construction period and operation period, develop preventive measures, modify relevant management measures, if necessary, to adapt to specific need;

(8) Conduct proper management of important records in the process of environmental management, for example, monitoring report, residents' complaints, order of rectification within defined time limit and the like;

(9) Environmental management organization should regularly examine implementation of work, prepare Environmental Monitoring Report of proposed project and report to related department; make continuous improvement of management monitoring procedures according to review comments of environmental authority on Environmental Monitoring Report of proposed project and potential environment related complaints, so as to fulfill environmental management work in a better way.

10.2.6 Environmental Monitoring Report

(1) Environmental monitoring report in construction stage: construction period if about 5 years for various components, each can be divided into demolition stage, ground leveling stage, civil work stage, equipment installation stage, completion acceptance stage and etc, depending upon different contents of the project. According to applicable Chinese environmental management laws on construction project as well as the requirements of World Bank operation policy, environmental monitoring authority should prepare separate Staged Environmental Monitoring Report, and the purpose is to assure environmental protection administration that all mitigation measures are implemented according to approved environmental monitoring plan, and special protection measures are or will be taken to control adverse environmental impact unforeseeable in project plan. Staged Environmental Monitoring Report should be submitted twice per year during construction period. The content of Staged Environmental Monitoring Report should include following aspects: setup of environmental management organization, state of construction progress, content and method of main construction, consequential environmental impact and mitigation measures, implementation of these measures, and content about residents' complaints and handling result, if necessary. In addition to above-mentioned monitoring report, construction contractor should also prepare daily report and monthly report by itself before submitting to superior authorities and local environmental protection administration.

(2) Environmental monitoring report during operation period

Upon operation of proposed project, environmental monitoring unit should regularly prepare Environmental Monitoring Report (Generally once per year); main content of Environmental Monitoring Report should including following aspects: setup and change of environmental management organization, implementation of review comments of environmental protection administration on previous report, monitoring system (Inc. time, frequency, point, instruments/equipments used, applicable standards and etc), statistic and analytic results of monitoring data, further measures to be taken for prevention and control of pollution, and so on.

10.3 Environmental Supervision

Construction supervision system should be practiced for the project in terms of overall quality management according to the requirements for construction quality and environmental protection.

10.3.1 Principle for Implementation of Environmental Supervision

(1) Environmental supervision should constitute an important part of construction supervision; construction supervising unit should have specialized environmental supervision branch and environmental protection technician.

(2) Construction supervising unit should make environmental supervision plan according to environmental protection codes and standards applicable to the project, construction design drawing, design instructions and other design documents, construction contract, tendering documents and bidding documents of the project, EA report (Inc. recommended mitigation measures and environmental monitoring), environmental supervision contract, tendering documents and bidding documents relating to environmental supervision, as well as carry out construction supervision strictly according to environmental supervision plan.

(3) The objects of environmental supervision are all environmental pollution behaviors due to construction activities; environmental supervision should focus on environmental protection during construction period, ecological restoration during final construction period, and implementation of measures for prevention and control of pollution.

10.3.2 Scope and Time of Environmental Supervision

Scope of environmental supervision: project area and affected area, construction site, living quarters, construction road, auxiliary facilities and etc as well as surrounding areas of environmental pollution and ecological damage due to production and construction works within the boundary of above items; areas in which mitigation measures are taken to mitigate environmental impact by project operation.

Time of supervision service: from construction preparation stage to completion of construction.

10.3.3 Working Method and Procedure for Environmental Supervision

(1) Method for environmental supervision

Site supervision by patrol or oversee or combination of both; remind for regular water, gas and acoustic monitoring at construction site; in the case environmental supervisor discovered from inspection any problem concerning environmental protection and/or pollution, it should be notified construction contractor's site principal to take corrective action. Also, the requisition should be delivered to supervision department and the employer's representative. Upon receiving the notice from environment supervision engineer, construction contractor should rectify such problem.

(2) Supervision procedures

The environmental protection supervision procedures should be implemented as illustrated in the flow chart below:

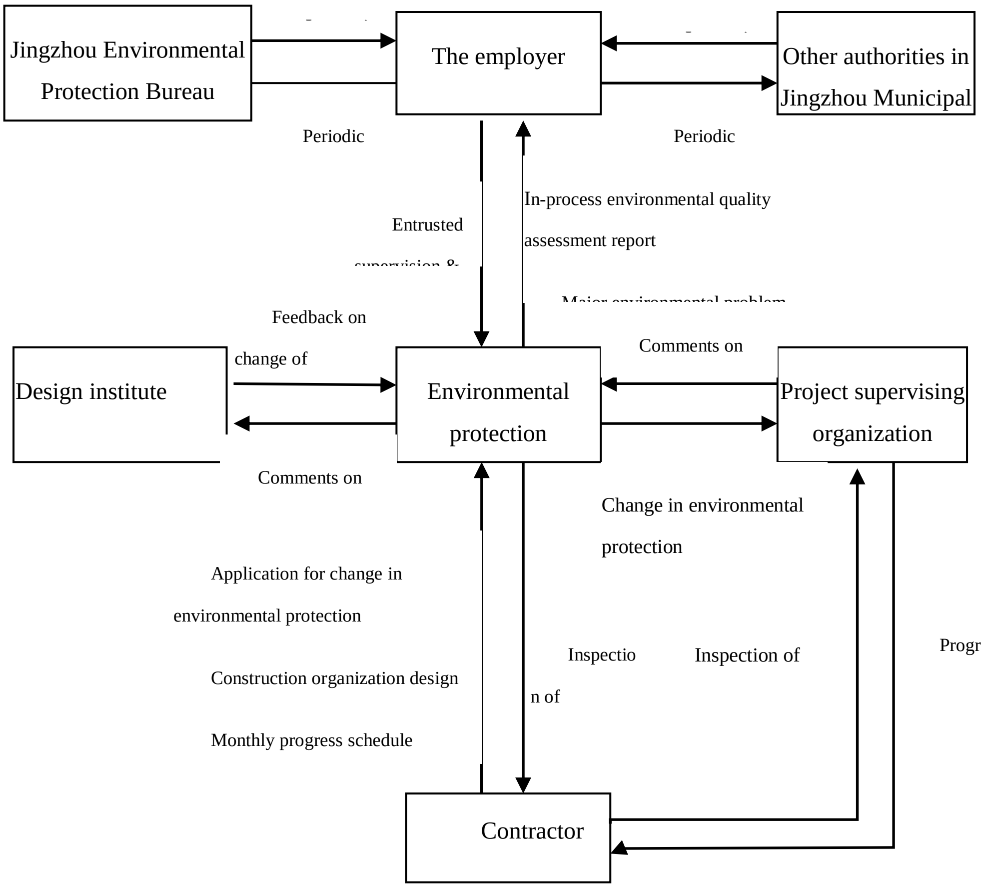

Figure 10.3-1Environmental Protection Supervision Procedures

10.3.4 Main Workload of Environmental Supervision

10.3.4.1 Environmental Supervision before Construction

As for the project, environmental management before construction mainly refers to environmental management during construction design and construction contracting in the next stage. In construction design stage, related departments in Jingzhou Municipal will directly supervise the employer and design institute to implement various mitigation measures recommended in EA report and officially approved by Department of Environmental Protection of Hubei Province; these mitigation measures will be included in investment budget and reflected in all aspects in construction design to fulfill “simultaneous design” requirement of “three-simultaneous” in environmental protection project.

In contracting of construction, the employer should regard environmental protection project as important as main construction, put forth environmental protection requirements for construction contractor's construction organization plan according to related requirements in EA report, employ construction contractor and construction group of strong awareness of environmental protection, successful performance in environmental protection project and strong ability, so as to make a solid basis for civilized construction, high quality "simultaneous construction" of mitigation measures. Before entry of construction personnel, training should be performed to learn environmental protection laws, bylaws as well as knowledge about ecological protection, prevention and control of pollution and the like.

10.3.4.2 Environmental Supervision during Construction Period

(1). Objectives of environmental supervision

Environmental protection supervision and construction supervision are correlated in some aspects but distinct in other aspects. Main objectives of environmental protection supervision are:

(1) Whether all environmental protection projects included in examined and approved EA report are implemented in all aspects during project construction;

(2) Ensure construction quality, term, ecological restoration, pollution control of all environmental protection projects complying with applicable standards and meeting the requirements of environmental protection laws and regulations through strict supervision;

(3) Feed back any event relating to failure of construction in compliance with the requirement or substandard construction quality occurred in the process of supervision construction contractor and the employer according to supervision function and power stated in the contract as well as supervision management procedures, recommend treatment measures, examine, approve, rectify or change according to specified procedures;

(4) Assist local environmental protection authority in enforcement inspection, provide scientific, full and accurate basis for settlement of environmental protection dispute;

(5) Examine and accept quantity and quality of environmental protection project; participate in completion acceptance of the project.

(2). Supervision of source of noise pollution

To prevent noise hazard, source of intense noise pollution should be controlled according to design requirements, and noise environmental quality in construction area and affected area should meet corresponding standard; environment supervision engineer should familiarize various types of source of noise pollution in construction activities, including workplace of construction machinery, construction time, traffic noise, living noise by construction personnel and etc, supervise and inspect whether noise pollution from various types of mechanical equipment is controlled according to applicable laws in the process of construction, so as to avoid noise disturbance at sensitive points such as residential area and the like.

(3). Supervision of source of ambient air pollution

Main sources of air pollution in construction area are emission of exhaust gas and dust produced during construction and production, exhaust gas from fuel combustion by construction machinery and vehicle, as well as stinking gas from dredging work. Standard emission of pollution source is compulsory, required environment quality standard should be achieved in construction area and affected area. Regular sprinkling in construction site is required in terms of climate change; clean and tidy construction site should be ensured. Ambient air quality monitoring result with ambient air sensitive point within 200m from construction site should be assessed; if exceedance is found, environmental protection supervision engineer should notify construction contractor to take precautionary measures, so as to ensure ambient air quality is within standard limit.

(4). Supervision of source of water pollution

Environment supervision engineer should focus on supervising environment quality. The source of construction wastewater and living sewage by construction personnel, emission, water quality indicators, construction process and treatment effect of treatment facilities should be supervised, inspected and monitored according to approved emission standard; supervise and inspect whether the access road at construction site is unobstructed, whether drainage system in service is under good condition, whether water-logging appears at construction site.

Vehicle washing should be carried out within construction site; vehicle washing wastewater should be reused after oil separation and sedimentation; direct discharging of construction wastewater in the moat and lakes in historic town without treatment is prohibited. Construction contractor should remove and vacate oil separator and sedimentation tank upon completion of construction.

(5). Supervision of solid waste

Supervise and inspect whether the wastes at construction site are properly disposed according to provisions; solid waste treatment includes treatment of domestic waste and construction waste, and construction site should be maintained in clean and orderly condition as possible.

(6). Management of transport vehicles

Construction contractor should strengthen management of transport vehicles; construction vehicle should be used at daytime as possible; in case of construction at nighttime, measures like slowdown and prohibition of horning should be taken to mitigate noise pollution to residents along the route. In case of more than four complaints with one noise source within one week, construction contractor should immediately review working method and construction machinery used, and effective measures should be taken to mitigate noise disturbance.

Vehicle transport should not be overloaded to control spill; construction contractor should organize cleaning of accumulate dust on entry and exit road sections of affected construction site and construction pavement, and water to suppress dust, so as to prevent environmental pollution by dust along the route.

10.3.4.3 Environmental Supervision after Construction

Implementation of environment restoration plan and operation of environmental protection treatment facilities should be supervised and managed. Ecological restoration and implementation of measures for prevention and control of pollution should be inspected. Participate in environment project acceptance activity, assist the employer to organize environmental protection training of construction personnel, take charge planning and conclusion of environmental supervision of construction project.

10.3.5 Requirement for Supervision Performance

Strengthen construction contractor's environmental supervision work to standardize construction behavior, so that ecological, landscape and environmental damage as well as pollutant emission during construction are effectively under control, facilitate environmental protection supervision management during project construction by environmental protection administration.

Responsible for control of mitigation measures critical to main construction quality, replenish, supervise and guide environmental protection in construction supervision work.

Work with environmental protection authority to implement and fulfill national, provincial and municipal environmental protection policies and laws, play the role of third-party supervision to the full extent.

10.4 Final acceptance of Environmental Facilities

Construction design should focus on prevention and control of wastewater, exhaust gas and noise according to engineering characteristics of the project to ensure standard emission of "waste gas, waste water and waste residues" upon completion and production of the project: according to applicable requirements of Management Regulations for Checking and Accepting Completed Installations of Environmental Protection of Construction Projects, the employer is required to apply with environmental protection authority for environmental protection completion acceptance, develop acceptance environmental monitoring plan, and then carry out environmental protection completion acceptance monitoring after approval.

Before completion acceptance, following documents should be prepared as a minimum: EA report, environmental protection completion acceptance monitoring report, environmental protection execution report and etc. List of major completion acceptance of environmental protection project is as shown in Table 10-4.

Table 10-4 Schedule of Environmental Protection Acceptance upon Completion of Project

No.	Sub-item	Main content of acceptance	Remark
I	Setup of organization	Corresponding EIA organization is set up according to EA report and management requirement	Supply by project employer at the time of submitting acceptance application report
II	Tendering document and bidding documents	Terms for environmental protection should be incorporated in construction contract and purchase contract of construction facilities	
III	Dynamic monitoring data	Carry out environmental monitoring and supervision during construction period as required by EA report	
IV	Environmental protection installation effect monitoring	Inspection report on environmental protection installations effect during trial operation period	
V	Mitigation measures		
Period of time	Control objects	Content of measures for prevention and control of pollution	

No.	Sub-item		Main content of acceptance	Remark
Construction period	Wastewater		Basic washing wastewater sedimentation tank to be set up within construction camp; basic washing wastewater to be reused in concrete working section; vehicle washing oily wastewater to be reused for road washing after treatment via oil separator and sedimentation tank; foundation pit wastewater to be reused for roads washing after secondary sedimentation; discharge of above wastewater in historic town water system is banned; sediment storage yard residual water to be discharged to surface water area nearby after standard coagulation-sedimentation treatment according to Discharge Standard of Pollutants for Municipal Sewage Plant (GB18918-2002), Grade 1-A	
	Exhaust gas	Fugitive dust	Equip with small tank car to sprinkle road and working face to effectively suppress dust pollution	
	Noise	Construction noise	Use low-noise equipments and machinery, strengthen maintenance and management of noise emitting equipments; set up noise reduction facility such as temporary sound insulation baffle at the location near residential area, proper arrangement of construction operation time	
	Solid waste	Domestic waste	Disposal relying on existing municipal sanitation department	
		Construction scraps and demolition waste	Reuse in civil work of the project	
		Sludge	Reuse in wetland and revetment refill after dewatering and solidification, planting in whole Jingzhou Municipal	
		Used solidifier	United disposal at Jingzhou museum	
	Ecological protection	Cleaning of construction site and impact on topsoil and vegetation	Reduce temporary land area, shorten construction operation time, sludge storage yard to be selected in wasteland as possible, land restoration and planting to be organized at the end of dredging	
		Environmental impact on the field by sludge storage yard		
Operation period	Wastewater	Living sewage	Wastewater from Visitors' center discharged to secondary Sewage Plant for treatment after sedimentation in the cesspool; wastewater from Xiongjiazhong Tomb to be treated by planned integrated wastewater treatment station	
	Noise	Visitors' center noise	Foundation absorber and damp-proof materials to be used for sound insulation and noise reduction	
		Pump station	Use low-noise equipments, install acoustic shield, double-wall workshop, buried installation	
	Solid waste	Domestic waste	Regular cleaning and picking up by municipal sanitation department	
		Common waste		
EIA suggestions			Expansion of the two Sewage Plants shall be carried out before operation of sewage interception pipe network of the project. Since the Xiongjiazhong Tomb Phase I Project has been put into operation, Xiongjiazhong Tomb Integrated Wastewater	

No.	Sub-item	Main content of acceptance	Remark
		Treatment Station should be built as soon as possible so as to meet the demand for wastewater treatment of the existing Phase I project and the subsequent Phase II project.	

10.5 Training Program

The purpose of environmental protection training is to allow all parties involved in the project to be familiar with environmental management plan, as well as other national and local environmental protection requirements on construction and operation thermal network, so as to facilitate implementation of mitigation measures.

Main objects of environmental protection training are environmental management participants and environmental supervisor, training of them is one of the components of technical support for the project. Construction contractor and workers should also be educated with training class during implementation of the project. Before commencement of project construction, all construction contractor and operation units and construction supervisors should attend compulsory environment, health and safety training. Particular training program is listed in Table 10-5.

Table 10-5 Training Program of Environmental Protection Technicians

Type	Feature	Trainee	Training content	Number of trainees	Time	Date (Year)	Cost (10,000 CNY)
Overseas	environmental management	Management staffs from related department of project coordination officer	Advanced experience and best practice for environmental management during construction period	6	10 days	2016	16
		Project management office and the employer's professionals	Technical method for environmental management during construction period	20	14 days	2017	40
Domestic	environmental protection	Construction contractor's environmental protection personnel	Basic environmental theory and monitoring method, monitoring report and job training; once training per year; environmental management plan, environmental monitoring and report, emergency response plan	10～20	4 days/class	2016-2019	8.5
	supervision	Environmental protection	Environmental protection laws,	5～10	5 days/class	2016-2019	5.5

Type	Feature	Trainee	Training content	Number of trainees	Time	Date (Year)	Cost (10,000 CNY)
		supervision engineer, construction contractor's environmental management personnel	construction planning, environmental monitoring rules and planning, ambient air monitoring and control technology, noise monitoring and control technology				
Total							**70**

11 ENVIRONMENT AND ECONOMIC PROFIT & LOSS

11.1 Budget for Environmental Protection Investment

11.1.1 Budget for Lump-sum Environmental Protection Investment

Estimated total investment of the project is 1.081 billion CNY. Environmental protection investment consists of cost and expenses for environmental protection installations, equipments, environmental monitoring during construction period and etc; base on environmental protection countermeasures and measures proposed in the EA report, initially estimated lump-sum environmental protection investment for the project is 7.88 million CNY, environmental protection investment accounts for 0.7% total investment of the project, of which 1.37 million CNY is included in the budget for project investment, additional 6.51 million CNY environmental protection investment. Composition of environmental protection investment is listed in Table 11-1.

Table 11-1 Budget for Investment in Mitigation measures

	Mitigation measures			**Treatment effect**	**QTY**	**Investment (￥10,000)**	**Remark**
	Part Ⅰ. environmental monitoring						
	Environmental monitoring during construction period			￥100,000/year	5 years	50	Added in EIA
	Environmental protection acceptance and monitoring upon completion				-	70	Added in EIA
	Part II mitigation measures						
Construction period	Wastewater	Basic washing wastewater	Reuse after sedimentation	Directly discharged in the moat is banned, has no impact on water environment	13 sets	8	Added in EIA
		washing wastewater	Reuse after oil separation and sedimentation	Directly discharged in the moat is banned, has no impact on water environment	9	8	Added in EIA
		Foundation pit wastewater	Reuse after treatment via secondary sedimentation tank	Directly discharged in the moat is banned, has no impact on water environment	17	8	Added in EIA
		Storage yard residual water	Discharge after coagulation-sedimentation	Standard treatment according to Discharge Standard of	2 storage yards	150	Added in EIA

	Mitigation measures			Treatment effect	QTY	Investment (￥10,000)	Remark
				Pollutants for Municipal Sewage Plant, Grade-1			
	Exhaust gas	Fugitive dust	Equip with small tank car to sprinkle road and working face to effectively suppress dust pollution	Suppress dust pollution	Self-made	10	Included in project investment
	Noise	Construction noise	Set up noise reduction facility such as temporary sound insulation baffle at the location near residential area	Boundary noise at corresponding limit within building construction boundary	10	16	Included in project investment
	solid waste	Construction scraps and demolition waste	Reuse in civil work	Timely cleaning and pick-up, maintain clean site	5550t	14	Included in project investment
		Domestic waste	Rely on existing municipal sanitation system	Unapproved littering is banned to prevent local environmental impact	375t	5	Included in project investment
		dredged sediment	Reuse in wetland and revetment construction after dewatering and solidification	Full reuse	300000m^3	32	Included in project investment
	Ecological protection	Restore temporary land, water & soil conservation, soil restoration		prevention and control of water and soil loss, restoration of vegetation		187	Water & soil conservation and added in EIA
	Social	Public	Media and public notice; billboard at construction site		30 points	4	Included in project investment
Operation period	Wastewater	Living sewage	Standard Grade-2 handover by Caoshi WWTP after sedimentation in the cesspool, then discharged to secondary Caoshi WWTP for further treatment	Standard discharge according to Discharge Standard of Pollutants for Municipal Sewage Plant, Grade-1	1 cesspool	4	Included in project investment
		Connection channel	Sludge cleaning		9 points	5	Included in project investment

	Mitigation measures			Treatment effect	QTY	Investment (￥10,000)	Remark
	exhaust gas	Car exhaust gas	Forced exhaust fan system	According to Integrated Emission Standard of Air Pollutants (DB11/501-2007)	1 set	15	Included in project investment
	Noise	Protection at acoustic sensitive point	Sound insulation and noise reduction at pump station	According to applicable requirements of GB3096-2008	2	12	Included in project investment
	Solid waste	domestic waste Common waste	Set up sorted trash bin, timely cleaning and pick-up	Timely cleaning and pick-up, maintain clean site		20	Included in project investment
	Part III environmental management						
	Training of environmental management participants during construction period					70	Additional from EIA
	Cost for external monitoring consultation of environmental management plan					100	Additional from EIA
	Total environmental protection investment					788	

11.1.2 Annual Operation Cost for Environmental Protection Installations

The operation cost for environmental protection installations in the first 3 years of operation period is included in WB loan; operation cost for environmental protection installations thereafter is included in the budget of project operator. Operation cost for environmental protection installations in the first 3 years is envisaged in the EA report, which is amount to 1.14 million CNY, as listed in detail in Table 12.1-2.

Table 11-2 Annual Operation Cost for Environmental Protection Installations

No.	Item	Cost (￥10000)	Remark
1	Environmental monitoring cost during operation period	12	
2	Energy consumption of equipments	2	
3	Servicing, maintenance and upgrading cost for environmental protection installations	20	living sewage treatment facilities, solid waste collecting system and etc
4	Wage and labor cost paid to serviceman	4	
Subtotal		38	
Total during operation period		**114**	**3 years**

11.2 Analysis of environmental economic profit & loss

11.2.1 Social and economic benefits

(1) Upon initiation of the project, it'll recover natural landscape of historic town water system, upgrade city image as appreciation value of historic town water system as a sight river, drive tourism development in historic town area and surrounding areas, provide local residents with more jobs by solving employment of local residents and increasing economic income of city tourism, so as to achieve better social and economic benefits.

(2) Upon initiation of the project, it'll realize redevelopment and functional restoration of the ecosystem, form unique waterfront landscape, coordinate with development construction of Jingzhou general planning, upgrade the level and quality of local construction as a whole, develop more appealing urban environment, so as to attract more investment infusion and promote economic construction in Jingzhou Municipal.

(3)World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project, in addition to environmental renovation, will supplement the content of landscape construction, to allow interaction of separate historic town water system; with water compensation of water transfer project from Yangtze River to Han River, new urban waterfront will be formed to add value with local land and housing; housing investment is inclined to waterside residence environment, which will help increase the level of housing development along the moa and even Jingzhou District as a whole.

(4) It'll drive integration of water restoration technology among polluted cities and promote the development of environmental protection industry.

Carry out technical study with ecological project as the core in Jingzhou District, develop technical plan on restoration of polluted water area in Jingzhou District through system integration, so as to achieve the goal of improving water environmental quality, redevelopment and functional restoration of ecosystem in Jingzhou; with promoted application, complete key technology and demonstration project will be spread nationwide to provide all middle-to-small cities with a sustainability model, and boost the course of water environmental control in China; if the project is completed as scheduled, it'll realize successful study on project scale, which is positively significant to validation, refinement and deepening of findings from water environment restoration, facilitates technical integration for restoration of polluted water environment, develop the group of environmental protection researchers, and ultimately drive the development of environmental protection industry. To sum up, the proposed project as an environmental protection project will bring remarkable environmental, social and economic benefits, thus project construction is practically feasible.

11.2.2 Environmental benefits

Upon initiation of the project, Jingzhou historic town water system will become an interconnected and interactive natural water environment, which is an organic and dynamic relation. Improving relation of rivers is ecologically significant; initiation of the project will bring notable environmental benefit, mainly represented by following aspects:

(1) Enhance complexity, stability and resistance capacity of water system

The project will enable more interconnected rivers and lakes and develop healthy and stable water environmental structure. With regard to system level and landscape model, structural composition and function of various water areas are added and expanded, the structure of water environment is recovered, complexity and stability of water system are increased with high anti-adversity capacity under environmental pressure by human activity.

(2) Effectively eliminate internal pollution of river-way

Dredging and disposal works of polluting sediment may eliminate part of sediment pollutants in the rivers and lakes, especially massive deposit of organic matters, nitrogen, phosphorus pollutants，so as to reduce internal pollution of river-way and improve environment of rivers and lakes.

The project includes dredging of 301900m^3 sediments from historic town water system, equivalent to removal of 193.22-ton TP and TN, which will effectively reduce internal pollution by historic town water system. Therefore, dredging plays a positive role in improving water quality and water environment of rivers and lakes.

(3) Ecological restoration

In order to restore original ecological features and improve self-purifying capacity of water area in historic town valley as possible, ecological revetment, artificial wetland and like ecological restoration works will be constructed along the route of the project, and the principle of prioritizing ecosystem of revetment construction will be put into practice.

(4) Environment benefit from sewage interception pipe construction

Historic town water system is an important sight source in Jingzhou Municipal; due to economic boom, worsening natural environment and water pollution by living sewage in recent years, water quality in historic town is deteriorated seriously. Therefore, initiation of sewage interception construction may effectively pollution of historic town water system by sewage by collecting sewage in Sewage Plant via sewage pipelines for treatment and standard discharge. Base on calculations, upon operation of the project, intercepting sewer outside the historic town, under the condition of full-load operation of Caoshi WWTP, will reduce 470.54t COD, 41.34t NH4-N, 84.15t TN and 5.88t TP emission in the rivers on a yearly basis. Upon operation of branch sewer in the historic town, the coverage of sewage collection in historic town will be increased to 90%.

(5) Environment benefit from water compensation project

Although water compensation of water transfer project from Yangtze River to Han River is not included in the scope of work of the proposed project, it'll lead to notable improvement of water quality in historic town water system. It's seen from DHI water quality modeling that, upon initiation of renovation of whole water environment project, general water quality of historic town water system will be maintained Class IV water, for water quality condition of Class III water compensation, about 5m^3/s critical value water compensation is required; for water quality condition of Class II water compensation, about 3m^3/s critical value water compensation is required.

(6) Renovation of historic town historic town wall and vegetation enhances and improve ecologic sight

Protection of west historic town wall project and historic town wall vegetation upgrading project will substantially improve historic town wall sight and environment, also, it'll create condition for residents surrounding historic town to closely view the historic town wall and water environment. After ecological renovation, historic town will form a urban ecological sight zone integrating water conservancy, ecological, cultural and sightseeing complex of interactive functions, but also a hot spot of urban construction and development, provide the citizens with a beautiful tourism and sightseeing environment as well as a destination for leisure.

11.3 Environmental loss of the project

During construction and after operation of the project, following main environmental losses will be caused:

As for land occupation by excavated materials, resettlement of affected residents, water and soil loss, environmental pollution during construction period and operation period, permanent land of the project will cause change of the mode of land use, and part of affected residents need to be resettled; both construction excavation and resettlement of affected residents might damage vegetation of fight river and cause water and soil loss; project related demolition, leveling of construction site, pavement of construction road will produce spoils and might cause water and soil loss; standing tail water on sediment storage yard, maintenance of machinery and vehicles during construction period will contaminate surface water within construction area; exhaust gas produced by fuel-fired mechanical equipments and transport vehicles, as well as dust produced during vehicle transportation and etc during construction period will degrade ambient air quality; noise emitted by construction machinery will disturb construction personnel and residents in a few environmental sensitive point near construction area. Sludge depositing will also degrade ambient air quality.

11.4 Summary of profit & loss analysis

It's found from above profit & loss analysis that, environmental and economic loss is mainly of cost for taking mitigation measures and loss of environmental quality, which is once or short-term environmental and economic loss and can be remedied by economic benefit and reducing peripheral source of pollution after initiation of the project without irreversible environmental and economic los such as construction land expropriation and the like, and the project will bring notable environmental, social and economic benefits, complying with the principle of synchronous growth of environmental benefit, social benefit and economic benefit, in conclusion, benefit of this construction project overweighs loss.

12 CONCLUSION

12.1 Project Overview

The proposed project is located in Jingzhou District, Jingzhou Municipal; it is about integrated control of environmental pollution and consists of three components, namely, (1) protection of cultural heritage and promotion of tourism development, (2) improvement of ecologic and water environments of historic town, and (3) enhancement of traffic convenience of historic town project; Component (1) consists of west historic town wall protection construction, retaining wall construction, protection and restoration of vegetation construction in the historic town, exhibition construction in Xiongjiazhong Tomb, transformation of museum exhibition, visitors' center and parking lot construction, auxiliary construction of tourism development infrastructure, renovation and reuse of heritage architecture as well as environmental renovation of Kaiyuan Taoist Temple; Component (2) consists of dredging works of moat and lakes inside historic town, construction of sewage pipelines, moat, lakes & wetland construction, waterfront revetment construction, and water resource connection and improvement as well as ecological construction of river and lakes; Component (3) consists of inner ring reconstruction, inner ring nodes renovation construction, renovation of key nodes in historic town construction, renovation of key nodes out of historic town construction, slow drive system, shuttle bus system, static traffic sign system, and dynamic traffic sign system.

Total investment is 1.081 billion CNY, including USD100 million (Approx. 615 million CNY) World Bank loan; Construction period is 2016~2020.

12.2 Findings of environmental baseline analysis

12.2.1 Ecological environment

The project site is located in urban built-up area, where human activities are active. The project area is an artificial ecosystem based on urban life; there're only a few native vegetations on earthen town wall and no large wide animals within the project area. The ecosystem is assessed to be stable and functionally integrated; due to effective human management and energy replenishment, the ecosystem will be maintained and developed stably with certain capacity of anti-interference.

12.2.2 Ambient air

SO_2 and NO_2 hour-value/day in the visitors' center meets the requirements of *Ambient Air Quality Standard* (GB3095-2012), Class II; NH_3 and H_2S values in northwest and southwest historic town meet the requirements of *Hygienic Standard for the Design of Industrial Enterprises* (TJ36-79); windward and leeward PM10 monitoring results at visitors' center exceed standard concentration value stated in *Ambient Air Quality Standard* (GB3095-2012) , Class II; 1# point PM10 daily average maximum monitoring value is 0.214mg/L, over-limit ratio is 85.7%, maximum concentration over-limit ratio is 143%; 2# point PM10 daily average maximum monitoring value is 0.21 mg/L, over-limit ratio is 85.7%, maximum concentration over-limit ratio is 140%.

12.2.3 Surface water

Water quality at all monitoring points fails to meet requirments of *Surface Water Environment Quality Standard* (GB3838-2002), Class III, mainly due to three reasons: (1) direct drainage of living sewage and domestic waste from inside and outside historic town without treatment as well as discharge of tail water from Caoshi WWTP will degrade water quality of historic town water system; (2) almost zero exchange of historic town water system and external water systems, slow water flow rate, poor self-purifying capacity of water quality; and (3) long-term release of endogenous pollution of sediment further degrades the quality of historic town water system.

12.2.4 Acoustic environment

Acoustic environment at daytime and nighttime at all monitoring points meets the requirements of *Acoustic Environment Quality Standard* (GB3096-2008), Class 2, Class 3 and Class 4a.

12.2.5 Groundwater

Status of groundwater wells in Minzhu Street, ammonia-nitrogen and Mn exceed *Groundwater Quality Standard* (GB/T14848-93), Class III, but other indicators meet the requirements of *Groundwater Quality Standard*, Class III. Main cause of excessive ammonia-nitrogen and Mn is because the regional groundwater is connected to the beyond-the-limit historic town surface water system.

12.3 Compliance with industry policies and relevant plannings

(1) Analysis of compliance with industry policies

According to *Industrial Restructuring Guidance Catalogue* (2011) (Revised in 2013) issued by the National Development and Reform Commission of the People's Republic of China, "Dredging of rivers, lakes and reservoirs" and "Township drainage pipelines project" are encouraged projects, thus the proposed project is in compliance with related requirements of national industry policy.

(2) General Municipal Planning of Jingzhou Municipal (2011-2020)

The planning proposes to protect all the brick and earthen walls of Historic town and the moat, Sanyi Street-Desheng Street historic blocks, as well as historic blocks in South Gate Street of Historic town, CH sites of various levels and ancient architectures. In addition, the protection are classified in three levels: key protection areas, key coordination areas and ordinary coordination areas, according to the height, size, style and color of buildings in the Historic town; the protection targets in Historic town include nine traditional streets and one alley: Sanyi Street, Desheng Street, South Gate street, Zhangjuzheng Street, Fanrong Street, Binxing Street, Dongdi Street and Xidi Street, and Guandai Alley."

Component: Historic Town Preservation and Promotion of Tourism Development specifies the protection measures and schemes on the brick walls and earthen walls; the Component on water environmental improvement specifies the schemes to improve the water system of the historic town which is in line with the *General Municipal Planning of Jingzhou Municipal*.

(3) Planning on the Protection of Jingzhou Historic town

This planning proposes to protect the structure and overall style of the historic town, style of historic blocks, CH sites, contemporary and modern architectures and industrial heritages, and national-level intangible CHs, so as to establish an integrated system to protect the Historic Town and the cultural heritages. The planning also demands careful protection of integral structure pattern of the town and the layout of streets and alleys, especially the belt-like layout of the streets and alleys of Shashi District so as to highlight its lanscape of Jingzhou as a "water city on the left side of Yangtze river".

During overall renovation and vegetation restoration of historic town, strict protection of overall structure of Historic town is carried out, and the project will focus on functional restoration of historic town water system, which is in line with the *Planning on the Protection of Jingzhou Historic Town*.

(4) Special Planning on the Redevelopment of Historic Town

This planning aims to achieve “functional adjustment, population decentralization, integrated protection and sound renovation”, which focuses on environmental improvement and functional upgrading of Historic town, especially the urban functions of historic town as center of commerce, entertainment and tourism; functional upgrading can boost the economic development of Historic town; this planning defines historic town as” an integrated historic and cultural tourism center highlighing the ancient culture of Chu civilization and Three Kingdoms and water culture”.

the proposed project supports local tourism development, which will promote urban economic development, so it is also in line with the *Special Planning on the Redevelopment of Historic Town*.

(5) General Planning on the Tourism Development of Jingzhou Historic Town

This planning is still approval pending. It aims to expand, optimize and increase the income of tourism of Jingzhou historic town, eventually make it a pillar in the ecological culture tourism circle in western Hubei, and a reputed and competitive cultural tourist site both at home and aborad. The development objectives are defined as: The scenic area of historic town is an industrial cluster that has great development edges and potential of the whole historic town. It will play a key role in the overall tourism development of the region. By appropriate construction and operation, the planning aims to turn the Historic town scenic area into a well-known national-level 5A tourism resort of international fame, a famous oriental cultural city as well as a famous scenic spot of world cultural heritage.

At present, the historic town is applied for listing in the Catalogue of World Cultural Heritage; the proposed project can help preserve the original style and features of Historic town, and will improve the infrastructure and surrounding environment of historic town, so it will benefits the application for listing in the Catalogue of World Cultural Heritage; therefore, the proposed project is in line with the *General Planning on the Tourism Development of Jingzhou Historic Town*.

(6) General Planning on the Protection of Cultural Heritages of Historic Town Wall

This planning emphasizes the integration of historic town wall and the urban space of Jingzhou Municipal, as well as its relationship with surrounding environment. It proposes that the protection and display of the town wall is of equal importance. The planning proposes to improve and adjust roads and exhibition facilities based on the natural, historic and environmental layout of the wall and the moat.

the proposed project will not only protect and repair historic town wall, but also exhibit intangible CHs by use of existing resources; therefore, construction of the proposed project is in line with *General Planning on the Protection of Cultural Heritages of Historic Town Wall*

(7) Other plannings

According to *Regulations on Demarcation of Surface Water Environmental Protection Functional Zones of in Jingzhou Municipal Zone (1998)*, *Classification of Surface Water Environment Functions Zone in Hubei Province (2000)* and *Integrated Renovation Planning on Water Environment of Jingzhou Municipal Zone (2010-2020)* (2010) issued by General Office of Hubei Provincial People's Government, planning on Historic town water system is in compliance with *Surface Water Environment Quality Standard* (GB3096-2002), Class III water area function.

the proposed project consists of necessary sediment dredging, living sewage interception, sewage pipeline reconstruction and other works in favor of historic town water system, thus it can significantly benefits the restoration of Historic town water system.

12.4 EA Findings

12.4.1 Ecological impact

(1) Permanent land occupation will cause irretrievable damage to natural vegetation in the assessed area; upon completion of the project, and such damage can be mitigated by greening and building up ecological revetment after project is completed. Temporary land occupation has short-term impact on natural vegetation, and the impact can be gradually removed at the end of construction. Generally, project construction has little impact on local vegetation.

(2) Project construction has certain impact on terrestrial animals such as birds and amphibians, and it'll affect structural parameters of bird flock in terms of lowering species number and diversity. Upon completion of the project, majority of terrestrial animals such as birds and amphibians will gradually recover as plants along rivers and lakes and vegetation recover.

(3) During project construction, some works will cause reduction of planktons, but such impact is only temporary and limited. Upon completion of construction, project related planktons will soon recover. As a matter of fact, number of planktons might increase due to better environmental condition of water quality. Dredging will substantially threaten habitation of benthonic life within construction area; by river renovation construction, benthonic animals will recover slowly after dredging. Upon completion of the project, recovery of benthonic life will also be relatively slow. Fishes in project area are all common local species.

(4) The project will renovate the river bank slope with combined natural revetment and hard revetment, cleaning of floating wastes in the river and area planting will substantially promote landscapes on both sides of the rivers. In addition, construction of artificial wetlands will increase greenbelt area in surrounding areas, attract waterfowls to inhabit and promote natural landscape of the moat.

(5) Route selection, general layout, construction method and functional for water & soil conservation in FSR basically meet water & soil conservation requirements; from the perspective of water & soil conservation, this project is feasible.

12.4.2 Impact on water environment

Dredging will effectively remove pollutants in rivers sediments of historic town water system; improvement of sewage collection system and sewage interception construction can ensure Grade (B) standard discharge of living sewage by residents along the moat and living sewage from visitors' center after secondary Town-level Sewage Plant instead of direct discharge in rivers, which will effectively control water sources of historic town water system.

After removal of riverbed sediment, and by construction of ecological revetment, ecological projects such as reconstruction of water plants, water clearness will be increased and water power condition improved, which is helpful for forming a healthy aquatic ecosystem. Reconstruction of water vegetation and increase of biological diversity can stabilize and improve sediment quality, increase water-borne DO, filter out surface runoff SS, absorb pollutants contained in water. Therefore, rivers water quality will be improved remarkably from this project.

Impact on groundwater mainly includes residual water discharged from sludge disposal as well as percolate from temporary storage yards; by implementation of anti-seepage measures proposed in the EA report, sediment percolate at storage yard has minor secondary pollution to groundwater.

12.4.3 Impact on acoustic environment

1. Construction period

According to forecast, generally when construction machinery is 50m from construction boundary, noise value of construction machinery can be reduced to 62-70dB (A), construction boundary noise meets daytime emission standard of *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011); when construction machinery is 110-280m from boundary, construction boundary noise meets nighttime emission standard of *Emission Standard of Environment Noise for Boundary of Construction Site* (GB12523-2011). Thus, if no any measure is taken to control noise, due to the impact of construction machinery noise at daytime, standard noise limit is reached in the area more than 50m from all construction sites; and standard noise value is reached in the area 300m from construction site at nighttime. Some institutions, enterprises and residents on both sides of construction area are within the reach of noise, their normal life, working and rest will be disturbed to some extent during Project construction, which is worse in terms of noise at nighttime.

Noise pollution varies during construction period in terms of different affected areas at different time, but they are of high intensity. However, noise pollution is more intense at a given time and in a given area, making it difficult for management during construction period, what is more, noise sources are mobile, which makes difficult to suppress construction noise. Therefore, institutional arrangements during construction period shall be strengthened, rational arrangement of construction time and progress, establishment of effective temporary noise reduction measures， and prohibition of construction at nighttime near residential areas surrounding construction area.

2. Operation period

To reduce noise during operation of public facilities, low-noise facilities should be selected, including underground garage ventilator, water pump and the like; underground setup is required for garage ventilator and water pump, with 1.5m thick overburden of earth as a minimum; foundation absorber should be set up during installation of these facilities; hose and flexible connector should be used to connect equipment and pipeline; elastic suspender should be sued for pipeline support; feed pipe and discharge pipe should be equipped with compensator; wall penetration pipe should be wrapped with elastic material at the point in contact with the wall; various pumps and underground garage ventilator should be installed in separate equipment room; by taking above-mentioned measures, equipment noise can be attenuated by about 30dB (A).

Variable refrigerant flow multi-split central air conditioning should be sued at visitors' center; VRF central air conditioning should be used. Outdoor air conditioner of air cooling unit with operation noise of 65-70dB(A) should be used; all outdoor air conditioners should be mounted on the roof, and foundation shockproof measures should be taken; to conclude, noise environmental impact on surrounding area is minor

Noise impact from pump station of the project is within permissible range; to further mitigate acoustic environmental impact during operation period, control of noise source should be implemented, namely, facilities at low noise level should be used. Mechanical equipment isolation damper is adopted at pump station, additional acoustic shield is installed; double-wall is adopted for the hearing; auxiliary indoor sound absorption materials are installed; sound insulation greenbelt may be planted in outdoor area.

12.4.4 Impact on ambient air

1. Construction period

(1) Dust

Lime-clay mixing is usually conducted at mixing station during piping and civil works. Lime-clay mixing refers to concentrated mixing of lime and clay at design lime-clay ratio at lime-clay mixing station, and the mixture is directly transported by vehicle to construction road. Concrete mixing operation will cause TSP pollution at construction site under the effect of wind force; according to site survey data of completed similar project, lime-clay mixing station leeward 50m at 8.90mg/m^3; leeward 100m at 1.65mg/m^3; leeward 150m at 0.3mg/m^3 is according to Ambient *Air Quality Standard* (GB3095-2012), Class II in terms of standard daily average value.

During construction period, transport, loading/unloading of powder materials will cause TSP pollution along the route; according to site monitoring results of dust produced by truck transport at similar construction site, spoil transport vehicles leeward 50m at 11.625mg/m^3; leeward 100m at 9.694mg/m^3; leeward 150m at 5.093mg/m^3, exceeding Ambient Air Quality Standard》(GB3095-2012), Class II; dust produced by construction transport vehicles causes serious air pollution along the route.

It's found from above analysis that, dust pollution caused by construction activity should not be neglected, for it'll cause air environmental pollution at sensitive points near working face; during project design and construction operation, corresponding measures should be taken to mitigate air environmental pollution in surrounding area.

(2) Exhaust gas from fuel-fired machinery

According to monitoring outcome of similar projects, the scope of impact with pollutant of exhaust gas from fuel-fired excavator is mainly leeward 15m~18m, with concentration within the range of 0.016mg/m^3~0.18mg/m^3; according to project construction organization design, small number of construction machinery is used, and emission height of construction machinery is limited, within scope of impact limited within construction site and in a limited range, featured by small area of pollution in short time, thus, minor environmental impact to surrounding is expected with exhaust gas emitting by construction machinery, which will not cause serious pollution of regional ambient air quality, except for certain adverse effect to the residents near construction working area and along construction transportation route. Therefore, necessary measures shall be taken to minimize adverse effect of fuel-fired exhaust gas on the residents along construction transportation route.

(3) Stink from sludge disposal yard

There are two sludge disposal yards of the project. Sludge disposal yards of all rivers are located in the low area within the scope of blue and green line of the rivers. Apart from meeting the implementation demands of dredging, the selection of location is also required to avoid the sensitive targets as far as possible. The sensitive location nearest from the yard is Fanrong Street. As the Fanrong Street is near from the yard, the Fanrong Community may be affected from the temporary disposal of the sludge. Thus, the EAR requires that, a protection distance of 30 m should be set for the storage of the sediment. The other yard won't have impact on sensitive points. Thus, in the dredging, it should be avoided to use the sludge disposal yard on Fanrong Street.

2. Operation period

During operation period of underground garage, sensitive points surrounding historic town will meet the requirement of standard limit of *Ambient Air Quality Standard* (GB3095-2012), Class II; upon completion of underground parking garage, environmental impact to surrounding area is minor in operation stage.

12.4.5 Impact of solid waste

1. Construction period

Total dredging quantity of the project is about 301,900m^3; of which the dried sludge after dewatering and solidification is 160,000 m^3 and the monitoring indicators meet the requirements of corresponding standard limit of *Standard of Soil Quality Assessment for Exhibition Sites (Provisional)* (HJ350-2007) and *The Disposal of Sludge from Municipal Sewage Plant - The Quality of Sludge Used in Gardens or Parks* (GB/T23486-2009). And the wetland of the proposed project needs to use earthworks of 163,000 m^3, the details are as following: 54,000 m^3 for backfill in the constructed wetland of the moat, 49,000 m^3 for backfill in constructed wetland of the West Lake, 48,000 m^3 for backfill in the constructed wetland of North Lake; 9,000 m^3 for backfill in Horse Wash Pond, 3,000 m^3 for backfill in Northeast Pond. All the sediment generated in the dredging can all be used for backfill, which has minor impact on the environment.

During civil engineering, small amount of construction waste, packing waste, demolition waste and the like will be produced, which might affect urban appearance, traffic and ambient air quality if they are not cleaned and carried away in a timely manner. During construction period, broken bricks, stones, tiles, cement slag and other construction wastes have little direct impact on water and ambient air quality, but they will occupy large land area and cause secondary pollution. Thus, construction waste should be disposed timely, such as being reused in construction, or reused to backfill and level up pit and depression.

Construction sites are centralized and mainly distributed in historic town and surrounding areas; most construction workers live in surrounding area instead of in the construction site. They work at construction site at daytime and go home at nighttime. For this reason, most of their domestic waste can be directly discharged to municipal sanitation treatment system, and then be treated by municipal sanitation department.

2. Operation period

Based on the analysis of project-related pollution sources, upon completion and operation of the project, solid waste will mainly come from tourists' domestic waste, as well as sludge and sediments during operation of culvert and pump station, which will be cleaned and picked up by workers from municipal sanitation department for concentrated treatment and will not cause adverse effect to the environment.

12.4.6 Impact on associated areas

South Sewage Plant and Caoshi WWTP are approved environmental impact assessment by Jingzhou Environmental Protection Bureau and put into operation, emission of tail water from both Sewage Plants will cause minor impact on water quality of sewage receptor, however, due to both Sewage Plants belong to pollutant cutting project, both Sewage Plants bring positive benefit to water environment of the historic town water system.

Although water compensation of water transfer project from Yangtze River to Han River is not included in the scope of work of the proposed project, it'll lead to significant improvement of water quality in historic town water system. It's seen from DHI water quality modeling that, upon initiation of renovation of whole water environment project, general water quality of historic town water system will be maintained Class IV water, for water quality condition of Class III water compensation, about $5m^3/s$ critical value water compensation is required; for water quality condition of Class II water compensation, about $3m^3/s$ critical value water compensation is required.

Upon completion of renovation construction of Historic town, regional number of tourists will increase, accompanied by higher regional crime rate, however, by reinforcing public security control at frequent crime time and places, proper safety instructions during the travel of tourists, implementing of public security management responsibility system by responsible public security department, regional crime rate will be within a controllable range.

It's found from acceptance conclusion and site survey that, Jimei Incineration-based Waste-to-Power project does not cause side effect to surrounding environment, and the enterprise takes effective control measures during production and emission of pollutant according to environmental protection requirements.

12.5 Mitigation measures

12.5.1 Ambient air

1. Construction period

Maintain permissible humidity at construction site, sprinkling and cleaning system musts be established for storage area of powder materials, dedicated person should be appointed for sprinkling and cleaning at construction site, the frequency of sprinkling should be adjusted in terms of weather dryness degree. Clean and neat construction baffle plate should be erected around construction site. Construction material should be stored in the shed as possible; Construction material storing in outdoor area should be shielded with tarpaulin; powder construction materials like cement and lime should be transported as bulk materials by tank car; storage bunker of powder material should be kept far from residential community as possible.

Standard fuel should be used for transport vehicles and fuel-fired construction machinery, low-grade fuel is prohibited for use; in addition, driving route of transport vehicles should be arranged reasonably to ensure driving at a safe speed and reduce idle time, so as to reduce emission of exhaust gas by motor vehicle. Strengthen servicing and maintenance of fuel-fired mechanical equipment, and maintain equipment operation under normal and good condition; furthermore, fuel-fired machinery should be installed with exhaust gas emission purifier to ensure emission of standard exhaust gas.

At present, the employer determines construction sludge dredging to be conducted in dry season (winter and spring) to avoid construction in summer, and sludge dump is far from surrounding residential area. Presently, mitigation measures against stinking storage yard are rational and feasible. These measures should also be taken during final stage of construction, and no further requirements and suggestions are proposed herein. Regular air quality monitoring is required Project construction to confirm whether applicable emission and ambient air quality standards are complied with.

2. Operation period

Forced ventilation is adopted for underground parking, exhaust fan will operate 12h per day, exhaust port should be 2.5m above the ground; exhaust port should be installed at a ventilated position in combination of ground greenbelt, and exhaust gas has minor impact on the surrounding. Planting coverage is 30% within land area of the project, and three-dimensional afforesting is envisaged in conditioned space. Construction of shelter forest barrier is required surrounding project area for purifying the air and mitigating environmental impact from project related traffic noise.

12.5.2 Water Environment

1. Construction period

Residual water in storage yard mainly consists of filtrate from dewatering and solidification and supernatant in spill pit during mud dewatering and solidification. Coagulating sedimentation is applied for treatment of storage yard residual water. Base on the concentration of pollutants in residual water from dewatering and solidification dewatering and solidification works of Wuhan Donghu Tunnel Construction Project, the concentration of pollutants discharged after treatment of storage yard residual water of the proposed project meets Grade-A standard.

2. Operation period

Visitors' center will periodically produce tourist living sewage; living sewage from visitors' center is discharged to Sewage Plant after standard treatment in cesspool according to handover standard of Caoshi WWTP, sewage is collected before passing through coarse sewage grid at Caoshi WWTP, then it passes through fine grid and grit chamber for removing float and coarse sand; grits separated by spiral separator are carried away; outgoing water from grit chamber flows by gravity into modified oxidation ditch, where sewage after biochemical treatment flows into 2# sedimentation tank for subsequent treatment, and tail water is discharged after measurement.

With this technology, tail water quality after appropriate coagulation-sedimentation and sand filtration will meet the requirement of Discharge Standard of Pollutants for Municipal Sewage Plant (GB18918-2002), Grade-1-B, and finally, tail water is discharged after disinfection with chlorine dioxide.

12.5.3 Acoustic environment

1. Construction period

Construction period: Rational arrangement of construction site: avoid mobilization of large number of power mechanical facilities at the same location to prevent excessive local noise level; for stationary mechanical facilities, such facilities should be operated from operation room when operation in work shed is allowed. Proper arrangement of construction time, avoid construction work with noise pollution during 22:00 p.m. ~ 6:00a.m. and lunch break as possible; if urgent construction at nighttime is unavoidable, it should be declared to local environmental protection administration, construction at nighttime should not be preceded until and unless approval is obtained, and local residents should be informed of construction period at nighttime

2. Operation period

In order to reduce noise from operation of utility, underground garage ventilator, water pump and like facilities in low noise level should be used; garage ventilator and water pump should be installed in underground area covered with 1.5m soil overburden as a minimum; foundation absorber should be used in installing equipment; hose and flexible connector should be used to connect equipment and pipeline; elastic suspender should be sued for pipeline support; feed pipe and discharge pipe should be equipped with compensator; wall penetration pipe should be enwrapped with elastic material at the point in contact with the wall; various pumps and underground garage ventilator should be installed in separate equipment room; by taking above-mentioned measures, equipment noise can be attenuated by about 30dB (A)

Variable refrigerant flow multi-split central air conditioning should be sued at visitors' center; VRF central air conditioning should be used. Outdoor air conditioner of air cooling unit with operation noise of 65-70dB(A) should be used; all outdoor air conditioners should be mounted on the roof, and foundation shockproof measures should be taken; to conclude, noise environmental impact on surrounding area is minor.

Noise impact from pump station of the project is within permissible range; to further mitigate acoustic environmental impact during operation period, control of noise source should be implemented, namely, facilities at low noise level should be used. Mechanical equipment isolation damper is adopted at pump station, additional acoustic shield is installed; double-wall is adopted for the hearing; auxiliary indoor sound absorption materials are installed; sound insulation greenbelt may be planted in outdoor area.

12.5.4 Solid Waste

1. Construction period

In sediments at all monitoring points, contents and limits of all heavy metal pollutants, including Hg, Zn, Cu, Cd, Pb, total Cr, Ni, Se, As and others, are in conformity with Standard of Soil Quality Assessment for Exhibition Sites (Provisional) (HJ350-2007). Therefore, on the basis of dewatering and solidification of dredged sediment, analysis is made with sludge composition of dredged sediment, and it's feasible to reuse dredged sediment for wetland fill and revetment construction.

2. Operation period

Main sources of solid waste are domestic waste and common waste from operation of visitors' center, Xiongjiazhong Tomb Chu tomb, and lift pump station and box culvert. Solid waste produced during operation period can be centralized for depositing as with domestic waste, and then cleaned and picked up by workers from municipal sanitation department.

12.5.5 Environment

Before commencement of construction, construction contractor must demarcate protection lines, identify protection objects, define the scope of protection, coordinate anything in connection with construction site, and minimize occupation and destruction of vegetation areas such as bottomland and the like as possible. Construction contractor shall, in its construction organization design, reasonably arrange construction general layout, to the extent that existing streets and roads of the historic town are made full use to reduce temporary land area for construction work.

In order to mitigate project related impact, strengthened management is required during construction period. Before entry and commencement of construction, fish experts from local fishery department should be engaged to organize construction personnel to study applicable national laws and regulations, conduct science popularization among them regarding protection of rare protected aquatic animals, so that they understand the significance for water environmental protection, and enhance their awareness of water environmental protection. Construction personnel are banned fishing during construction period. Above activities should be under joint supervision management by fishery department and environmental protection authority. The cost incurred by such supervision management is paid by the employer.In order to reduce the harm of project construction to fish, fishery department should be consulted for approval before commencement of construction, and fish expert or local experienced fisherman should be engaged for giving instructions on the spot; before entry, technical means such as ultrasonic fish frightening and the like should be adopted, and fish frightening operation should be carried out in construction area and adjacent water area, especially deep pond and backwater area where fish distribution is dense to scare away fish from construction area. In addition, construction area may be separated from other areas with net to prevent fish from entering in construction area.

In order to avoid water and soil loss as a result of improper temporary earth depositing, earth should be carefully deposited at temporary storage yard appointed in the design without unapproved dumping along the route, river or ditch. The spoil depositing amount and level vary at various temporary storage yards; to ensure stable spoil mound, spoil depositing procedures should be strictly controlled during construction by compacting surface layer and watering, if necessary.

The stability of temporary storage yard should be maintained to the maximum extent by stable dead-load of earth; given our practical experience in completed projects, 1:2 slope of temporary earth depositing is recommended. Due to the project site is located in the area of former pound and common farmland, at the end of earth depositing, occupied area of pound should be restored, and common farmland occupied should be protected by planting trees and sowing grass seeds; silver chains should be planted at a row spacing of 2×1.5m and seedling ground diameter of 1cm; Bermuda grass seeds should be sowed to planting area of 0.76 hm^2.

12.6 Public consultation

Local residents, shopkeepers, institutions and enterprises in directly affected areas of the project are consulted for opinions by means of internet information publicity, newspaper statement, hearing, interviewing, completion of public consultation questionnaire and other forms, with following outcome:

(1) Project construction authorities will work out particular, effective and feasible land expropriation, demolition and resettlement measures according to applicable national and local policies and laws to ensure full and timely land compensations to affected families as well as proper resettlement of affected residents.

(2) During construction, project construction authority and design institute should respectfully hear the opinions of affected people along the route of project area, select route rationally, make full use of existing road and field for construction, minimize damage to riverbank soil and vegetation, scientifically set up traffic channel in favor of travel of nearby residents.

(3) Construction contractor’s construction works near school or residential area will be arranged to carry out during students’ holidays or other than rest time of the residents, and fencing and safety warning sign will be erected at construction site to reduce disturbance to residents or students by construction noise.

(4) Construction contractor will use low-noise construction machinery, measure noise level of construction machinery and facilities under normal operation conditions before commencement of construction; construction machinery with noise level exceeding applicable national standard is banned for use. Regular servicing and maintenance are required for construction facilities in use to reduce disturbance to local residents by construction noise.

(5) Environmental management and environmental monitoring plan. In order to ensure project related environmental impact be controlled and mitigated effectively, standard and scientific environmental management and environmental monitoring are compulsory during construction period and operation period, in addition, environmental monitoring plan should be executed strictly during construction period and operation period, all environmental protection control measures should be implemented, and all people involved in the environmental protection project should receive environmental protection training.

12.7 Conclusion

In conclusion, the water quality and aquatic ecosystem of historic town water system can be improved and maintained if the external pollutions are intercepted and the sewage disposing network and facilities as planned in the proposed project. The environmental impacts of this project are better than harm. Moreover, the project generates significant ecological benefits, while negative impacts are limited in scope and time and they can be mitigated. For this reason, as long as the implementation of Chengnan WWTP and Caoshi WWTP expansion project precedes the operation of sewage interception pipe network and that the Xiongjiazhong Tomb integrated sewage disposal device is complemented and operated as soon as possible, the project is environmentally feasible.

ANNEX I

PREDICTION MODEL AND CALCULATION OF ENVIRONMENTAL IMPACTS

1 Prediction model and calculation of environmental impactsAnalysis of impacts on atmospheric environment during operation

(1) Prediction mode

Point source diffusion mode is selected according to the terrain conditions and pollution discharge characteristics and relevant regulations in HJ2.2-2008 *Guidelines for Environmental Impact Assessment - Atmospheric Environment*.

(2) Predictive factors and source intensity

The predicted intensity of the proposed project is shown in Table 6.2-1. Predictive factors are CO and NO_2.

Table 1.1-1 List of Source Intensity

Name of source	Wind quantity	Emission height	Temperature	Inner diameter	Emission hours	Intensity of evaluation factor	
						NO_2	CO
	m^3/h	(m)	℃	mm	h	t/a	t/a
Northeast underground garage	149760	2.5	20	600	4380	0.00456	0.05692

(3) Assessment criteria

According to the assessment of Class II standard concentration in GB3095-2012 *Ambient Air Quality Standard*, the standard values are shown in Table 6.2-2.

Table 1.1-2 Assessment Standard Value of CO and NO2

Pollutant	Average per hour
	Class II
CO	$10 mg/m^3$
NO_2	$0.2 mg/m^3$

(4) Analysis of underground garage impacts on environment during operation

The highest ground concentration is shown in Table 6.2-3, and the specific leeward concentration distribution in Table 6.2-4.

Table 1.1-3 Highest Ground Concentration and Its Distance

S.N.	Name of pollution source	Leeward distance (m)	$NO_2 (mg/m^3)$	$CO (mg/m^3)$

1	Northeast underground garage	242	3.86E-06	4.82E-05

Table 1.1-4 List of Predicted Ground Concentration of Each Parking Lot

Leeward distance from source center, m	Northeast underground garage			
	NO_2		CO	
	Leeward concentration c/(mg/m³)	Ratio to standard concentration P/%	Leeward concentration c/(mg/m³)	Ratio to standard concentration P/%
1	3.63E-11	0	4.52E-10	0
100	1.35E-06	0	1.69E-05	0
200	3.69E-06	0	4.61E-05	0
300	3.66E-06	0	4.57E-05	0
400	2.99E-06	0	3.73E-05	0
500	2.52E-06	0	3.15E-05	0
600	2.13E-06	0	2.66E-05	0
700	1.89E-06	0	2.36E-05	0
800	1.79E-06	0	2.23E-05	0
900	1.96E-06	0	2.44E-05	0
1000	2.12E-06	0	2.65E-05	0
1100	2.22E-06	0	2.77E-05	0
1200	2.32E-06	0	2.89E-05	0
1300	2.40E-06	0	2.99E-05	0
1400	2.49E-06	0	3.11E-05	0
1500	2.57E-06	0	3.21E-05	0
1600	2.64E-06	0	3.30E-05	0
1700	2.69E-06	0	3.36E-05	0
1800	2.73E-06	0	3.41E-05	0
1900	2.76E-06	0	3.45E-05	0
2000	2.78E-06	0	3.47E-05	0
2100	2.78E-06	0	3.47E-05	0
2200	2.77E-06	0	3.46E-05	0
2300	2.76E-06	0	3.44E-05	0
2400	2.74E-06	0	3.42E-05	0
2500	2.72E-06	0	3.39E-05	0
2600	2.69E-06	0	3.36E-05	0
2700	2.67E-06	0	3.33E-05	0
2800	2.64E-06	0	3.29E-05	0
2900	2.61E-06	0	3.25E-05	0
3000	2.57E-06	0	3.21E-05	0

Leeward distance from source center, m	Northeast underground garage			
	NO_2		CO	
	Leeward concentration c/(mg/m³)	Ratio to standard concentration P/%	Leeward concentration c/(mg/m³)	Ratio to standard concentration P/%
3500	2.53E-06	0	3.16E-05	0
4000	2.49E-06	0	3.10E-05	0
4500	2.42E-06	0	3.03E-05	0
5000	2.35E-06	0	2.94E-05	0

Table 1.1-5 Analysis of Concentration of Sensitive Receptors under Most Unfavorable Working Condition

Pollutant	(1) Largest contribution of northeast garage (%)	② Background value (%)	①+②(%)
NO_2	0	14.5	14.5
CO	0	——	——

Hourly highest concentration of NO_2 from tail gas in garage 5000m leeward is 3.86E-06mg/m^3, which is lower than the 0.2mg/m3 specified in Class II standard in GB3095-2012 *Ambient Air Quality Standard,* and that of CO is 4.82E-05mg/m^3, lower than the 10mg/m3 specified in Class II standard in GB3095-2012 *Ambient Air Quality Standard.* Taking into account the highest concentration obtained from the status monitoring and combining the background ratio of NO_2 and CO to standard concentration in residential point of the Historic Town with the largest contribution ratio of underground garage, it can be inferred that the final ratio of NO_2 to standard concentration is 14.5%. Therefore, the environment at sensitive receptors near to the Historic Town can meet the requirement of Class II standard in GB3095-2012 *Ambient Air Quality Standard*; and the underground garage will have relatively small impact on surrounding environment after being put into operation.

1.2 Prediction and assessment of impacts on acoustic environment

The impacts of the project on acoustic environment mainly comes from noises of large construction machines such as dredging pump, excavator, bulldozer, agitator and concrete mixer in construction period and noises from underground garage vehicles, equipment running in visitors' center, crowd in visitors' center and pump running.

1.2.1 Analysis of impacts on acoustic environment during construction

The impacts of the project on acoustic environment is highlighted in construction period, resulting from noises of large construction machines such as dredging pump, excavator, bulldozer, agitator and concrete mixer, and transportation vehicles (mainly earthwork transportation). Noise generated from large construction machines such as dredging pump, excavator, bulldozer, agitator and concrete mixer features strong sound source, large sound level and continuity; for example, the noise generated by a dredging pump can be as high as 104dB, by excavator 98dB, and by bulldozer 100dB, etc. Transportation vehicles generate noise with engine and horn, featuring strong source and mobility.

(1) Prediction mode

According to relevant requirements in HJ/T2.4-2009 *Technical Guidelines for Noise Impact Assessment*, it is planned to adopt the following prediction formula to calculate noise generated from point sources and mobile sound sources.

1) Prediction mode of point source noise source

$$L_A(r) = L_{WA} - 20\lg r - k$$

Where:

LA￿r- sound level A from sound source r(m), dB;

LWA – sound A power level, dB;

r – distance between measuring point and sound source, m;

k – attenuation correction coefficient, taken by considering the terrain characteristics of the project area.

2) Prediction mode of mobile sound source

$$L_m = 10\lg(\mathrm{N/r}) + 30\lg(\mathrm{v}/50) + 64$$

Where:

Lm – sound pressure level from the sound source r(m), dB;

N – vehicle flow, ea/h;

v – vehicle speed, km/h;

r – distance between measuring point and sound source, m.

3) Sound energy attenuation mode

$$L_{pn} = L_{wi} - TL + 10\lg\left(\frac{Q}{4\pi r^2_{ni}} - M\frac{r_{ni}}{100}\right)$$

Where:

Lpn – sound level of the nth sound receiving point, dB;

Lwi – sound level of the ith noise source, dB;

TL – sound reduction of barrier, dB;

rni – distance from the ith noise source to the nth sound receiving point, m;

Q – sound directivity factor;

M – attenuation value of sound wave in air, dB/100m.

(2) Impact analysis

(1) Point source noise

Noise from all kinds of construction machines in this project is regarded as point sound source; noise value of different types of machine at different distance is calculated according to point source mode to predict the highest intensity under the most unfavorable condition. The impact scope is shown in Table 7.4-1.

Table 1.2-1 Sound Level of Main Construction Machines at Different Distance, Unit: dB(A)

Sound source	Intensity (dB)	Predicted noise value at different distances from sound source (dB)								Daytime up-to-standard distance (m)	Nighttime up-to-standard distance (m)
		20 m	50 m	100 m	150 m	200 m	300 m	400 m	600 m		
Excavator	98	72	64	58	54	52	48	46	42	25	141
Bulldozer	100	74	66	60	56	54	50	48	44	32	178
Dredging pump	104	78	70	64	60	58	54	52	48	50	281
Concrete mixer	96	70	62	56	52	50	46	44	40	20	112
Pile driver	104	78	70	64	60	58	54	52	48	50	281

According to prediction, when the construction machine is 50m away from the boundary, the noise level of construction machine can be lowered to 60-70dB(A); the noise limit for construction site can meet the requirement of daytime emission standard in GB12523-2011 *Emission Standard of Environment Noise for Boundary of Construction Site.* When the construction machine is 110 to 280m away from the boundary, the noise level for construction site can meet the requirement of nighttime discharge standard in GB12523-2011 *Emission Standard of Environment Noise for Boundary of Construction Site*. Therefore, if there is no noise control measure to be taken, noise level at 50m in the daytime and 300m at night away from every construction site can meet the standard value. For some enterprises, public institutions and residents within the affected scope at both sides of the section, their normal lives, work and rest will be disturbed to some degree during construction, especially by noise at night.

The scope of noise impact during construction is relatively large and the affected areas are different in different time; on the whole, it is not regular and the intensity is large. However, during some period of time and in certain area, the transiency of impact is outstanding, which makes it difficult to be managed during construction; besides, the noise source is mobile, so it is not easy to take engineering measures for noise reduction. The project can reasonably arrange construction time and progress by enhancing construction organization and management during construction and develop effective temporary noise-reducing measures to local conditions; nighttime construction should be forbidden at the construction side where there is residential community around.

② Mobile noise

Mobile noise mainly comes from transportation vehicles in this project. Compared with similar projects that are already completed, it is planned that the vehicle flow in the daytime is 90 vehicles/h at the speed of 30km/h, 40 vehicles/h at the speed of 35km/h at night. The prediction result of impact scope of mobile noise is shown in Table 6.4-2.

Table 1.2-2 Prediction of Impact Scope of Mobile Noise

Time frame	Predicted noise value at different distances from sound source (dB)								
	20m	50m	100m	150m	200m	300m	400m	600m	800m
Daytime	64	60	57	55	54	52	51	49	48
Nighttime	62	58	55	54	52	51	49	48	46

According to the prediction result, under the circumstance of only considering noise from construction vehicles, the noise is 64dB at 20m and 60dB at 50m in the daytime, which has relatively small impact on surrounding environment. The noise is 51dB at 300m at night. Noise from transportation vehicle will have certain impact on nighttime environment; but the transportation is mobile, and as this section is completed, the construction noise will disappear; so the overall impact is relatively small but the impact intensity in a short period of time is relatively large.

1.2.2 Analysis of impacts on acoustic environment during operation

Noise during operation mainly comes from underground garage vehicles, visitors' center equipment running, visitors' center crowd and pump station running.

1.2.2.1 Impacts of noise from garage vehicles

According to vehicle noise source analysis, the noise from single vehicle driving is about 63.9dB(A).Considering the circumstance when three vehicles are driven together during rush hours, the noise is 71dB(A); the noise is 82dB(A) when a car is started; vehicle noise is occasional and non-continuous and its noise can reach 85dB(A) when its horn is sounded. Therefore, motor vehicles should slow down after entering the project area; the speed should be kept at 30km/h and it is strictly forbidden to sound horn when driving in the project area. After the abovementioned measures are taken, the noise from motor vehicle driving will have relatively small impact on surrounding environment.

1.2.2.2 Noise impact of equipment running at Visitors' Center

According to engineering analysis, noise from public equipment of this project comes from underground garage fan, water pump and outdoor unit of central AC.

In order to reduce the noise generated from equipment running, low-noise equipment will be selected for underground garage fan, water pump and outdoor unit of central AC. Underground arrangement is set up for garage fan and water pump, which are covered by 1.5m-high soil or above; foundation vibration reducer damper is used for equipment installation. Hoses and flexible joints are used for connection between equipment and pipeline. Pipeline support adopts elastic supports. Compensators are installed at both inlet and outlet of pipeline, and all the places where pipelines passing through wall contact walls should be wrapped with elastic material; all kinds of pumps and underground garage fans should be installed in separate equipment room. The abovementioned measures may reduce equipment noise of this project for

30~40dB(A). Therefore, public equipment noise will have relatively small impact on surrounding environment.

1.2.2.3 Noise impact of visitors' center crowd

Noise from social life such as noise caused by increasing visitors at the visitors' center that will reach 60dB(A) and above after the project is completed. The noise level generated from visitors' center meets the requirement of category 4 limit of 70dB(A) in GB22337-2008 *Emission Standard for Community Noise* because the functional zone where every visitors' center is in is basically category 4 area. When superposed with background value, it can still meet the requirement of functional zone limit, so the acoustic environment impact on surrounding sensitive goals is relatively small.

1.2.2.4 Impact analysis of pump station running noise

After the West Gate Pump Station and Binyanglou Station are built and put into operation, relatively high noise will be generated with a noise level of about 90~99dB, which will have certain impact on field operators, and will have impact on sensitive goals such as surrounding residential community if protective measures are inappropriate. This assessment adopts point source attenuation mode to have predictive analysis on pump station noise (not considering the situation of pump house wall attenuation). The result is shown in the following table.

Table 1.2-3 List of Noise Source Attenuation Value during Project Operation

Main sound source	Average sound level Db(A)	Distance (m) sound level (A) of sound source from prediction point					
		20m	50m	100m	150m	200m	300m
Pumping station	90.0	56	48	42	38.5	36	34

It can be seen from the above table that noise from pump house will meet the requirement of type 2 standard in GB3096-2008 *Acoustic Environment Quality Standard*, after natural attenuation, at 12m in the daytime and 40m at night; and the noise will be reduced to 40dB at 50m after the pump station walls isolate the noise; therefore, the noise of pump house will have relatively small impact on surrounding sensitive points if effective preventive measures are taken.

In order to further alleviate acoustic environment impact during projection operation, the control should be started from the scratch, namely, low-noise equipment should be used. The pump station will be buried type pump station and will adopt damping vibration isolation for mechanical equipment complete with sound cover; double-wall will be adopted for workshop complete with sound absorbing material indoor and sound isolation greening belt outdoor.

1.3 Prediction and analysis of residual water at sediment stacking yard

1.3.1 Whereabouts of residual water at stacking yard

(1) Estimation of residual water drainage

According to the engineering analysis data, the most likely daily drainage of residual water at project stacking yard is about 1400m^3/d, and the largest drainage from single stacking yard is about 700m^3/d.

(2) Analysis on where the drained residual water from stacking yard goes

The project is located in the service scope of Chengnan sewage treatment plant and Caoshi sewage treatment plant. But the sewage interception pipe network is not complete at the place where the project is, it is not realistic to have the tail water from the project discharged into the urban sewage treatment plant. In the later period of the project, the residual water from stacking yard will go through coagulating sedimentation to meet the grade A standard in GB18918-2002 *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant* and discharged to into the moat nearby.

1.3.2 Selection of model and parameters

(1) Determination of the length of mixing process

According to the hydrologic regime where the surface water body is near to No.1 stacking yard, the length of river mixing process section at downstream stacking yard is determined as shown in the following table.

Table 1.3-1 Calculation Result of Length of Mixing Process Section

S.N.	Name of stacking yard	Receptor of residual water	River width	Discharge outlet near-shore water side distance	Average water depth	Average flow velocity of river	Bottom slope of river	Length of mixing process section
			B (m)	a (m)	H (m)	u (m/s)	I (‰)	L (m)
1	No.4 stacking yard	City moat	10	0	1.7	0.05	0.5	133.75

(2) Determination of predictive factors

COD and ammonia nitrogen are selected in this project according to the total quantity control indexes of the state. Besides, TN and TP are added as predictive factors that are relatively high for surface water body pollutant standard indexes in the region; the four indexes are all non-permanent pollutants.

(3) Selection of prediction mode

This prediction scope is from the discharge outlet of stacking yard to 1500m downstream the surface water body. The mixing process section of the water receptor is relatively small and all the predictive factors are non-permanent; besides, the river continuously flows and the residual water discharging is assumed to be continuous and steady discharging, according to the recommendation of prediction mode by surface water guideline, prediction is conducted by using river one dimension steady state mixed mode. The calculation formula is as follows:

$$c = c_0 \exp\left(-K_1 \frac{x}{86400u}\right)$$

x- distance from calculation point to start point (discharge outlet), m

u-river flow velocity, m/s

K_1- coefficient of oxygen consumption, 1/d

C_0-pollutant concentration upstream of discharge outlet, mg/l

1.3.3 Value of parameters

c_0 - Initial concentration, mg/L, water quality measured on June 27th at 100m south of east gate is used;

c_p -Pollutant concentration in sewage, under normal condition, the pollutant concentration in the dehydration and consolidation residual water of Wuhan East Lake tunnel project is taken for calculation, namely, COD 34.65mg/L, ammonia nitrogen 4.62mg/L, TP 0.11mg/L, and TN 12.72mg/L; under abnormal conditions, the grade A standard limit value in GB18918-2002 Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant is taken, namely, COD 50mg/L, ammonia nitrogen 5mg/L, TP 0.5mg/L and TN 15mg/L.

Q_p -Sewage flow, it is calculated as 700m3/d the highest daily tail water discharge of single sediment disposal site, and 12 hours of draining per day.

Table 1.3-2 List of Background Concentration, Unit: mg/L

Name of stacking yard	COD	Ammonia nitrogen	TP	TN
No.1 stacking yard	28.3	1.06	0.205	4.14

Q_h—upstream flow of river, calculated according to river width, depth and flow velocity, m^3/s.

Table 1.3-3 Calculation Value of River Flow, unit: m3/s

S.N.	Name of stacking yard	Receptor of residual water	Average flow
1	No.1 stacking yard	Moat	0.75

K1-degradation coefficient, according to the paper Determination of Degradation Coefficient, the degradation coefficient of COD takes 0.1 (1/d), and that of NH4-N takes 0.06 (1/d); TP and TN in the area exceed the standard a lot, so the degradation coefficient of TP and TN takes 0.

1.3.4 Impact prediction

When residual water at No.1 stacking yard is normally discharged, the COD, ammonia nitrogen, TP and TN downstream 1500m river section all fail to meet the requirement of Class III in *Surface Water Environment Quality Standard* (GB3838-2002). The main reason is that the concentration of background value is too high. As a matter of fact, the contribution of COD, ammonia nitrogen, TP and TN is not high; at 1500m, the concentrations both of COD and of TP are lower than background concentration while the contribution of ammonia nitrogen and TN contribution is less than 5% of the background concentration. Therefore, on the whole, after residual water from No.41 stacking yard is mixed in the river, its pollution contribution is relatively small; taking into account the endogenous pollution eliminated during dredging, the impact from normal discharging of No.41 stacking yard residual water on surface water quality is relatively small.

When residual water at No.1 stacking yard is discharged at abnormal condition, the COD, ammonia nitrogen, TP and TN downstream 1500m river section all fail to meet the requirement of Class III in *Surface Water Environment Quality Standard* (GB3838-2002). The main reason is that the concentration of background value is too high. As a matter of fact, the contribution of COD, ammonia nitrogen, TP and TN is not high; at 1500m, the contribution of COD is lower than background concentration while the contributions of ammonia nitrogen, of TP and of TN are less than 10% of the background concentration. Therefore, on the whole, after residual water from No.1 stacking yard is mixed in the river, its pollution contribution is relatively small; taking into account the endogenous pollution eliminated during dredging, the impact from abnormal discharging of No.1 stacking yard residual water on surface water quality is relatively small. However, in order to minimize the impact of residual water on regional water environment, the normal draining of dredging dehydration should be guaranteed and abnormal discharging eliminated.

The calculation result of normal discharging and abnormal discharging is shown in Table 6.3-4 and 6.3-5.

Table 1.3-4 List of Predicted Basic Parameters of No.1 Stacking Yard Residual Water (Normal Discharge)

Predictive factor	Water from upstream		Drainage of the proposed project		Assessment criteria mg/L
	Water quantity m^3/s	Concentration mg/L	Draining quantity m^3/s	Concentration mg/L	
COD	0.75	28.3	0.016	34.65	20
NH_4-N		1.06		4.62	1
TP		0.205		0.11	0.2
TN		4.14		12.72	1

Table 1.3-5 List of Predicted Basic Parameters of No.1 Stacking Yard Residual Water (Abnormal Discharge)

Predictive factor	Water from upstream		Drainage of the proposed project		Assessment criteria mg/L
	Water quantity m^3/s	Concentration mg/L	Draining quantity m^3/s	Concentration mg/L	
COD	0.75	28.3	0.016	50	20
NH_4-N		1.06		5	1
TP		0.205		0.5	0.2
TN		4.14		15	1

Table 1.3-6 Calculated Value in Downstream Water Body after Discharging of Residual Water from No.1 Stacking Yard (Normal Discharge)

Downstream distance X(m)	COD	Ammonia nitrogen	TP	TN
	c(mg/L)	c(mg/L)	C(mg/L)	c(mg/L)
100	28.3669	1.1328	0.203	4.3192
200	28.3013	1.1312	0.203	4.3192
300	28.2359	1.1296	0.203	4.3192
400	28.1706	1.1281	0.203	4.3192
500	28.1055	1.1265	0.203	4.3192
600	28.0405	1.1249	0.203	4.3192
700	27.9756	1.1234	0.203	4.3192
800	27.911	1.1218	0.203	4.3192
900	27.8464	1.1203	0.203	4.3192
1000	27.782	1.1187	0.203	4.3192
1100	27.7178	1.1172	0.203	4.3192

Downstream distance X(m)	COD	Ammonia nitrogen	TP	TN
	c(mg/L)	c(mg/L)	C(mg/L)	c(mg/L)
1200	27.6537	1.1156	0.203	4.3192
1300	27.5898	1.1141	0.203	4.3192
1400	27.526	1.1125	0.203	4.3192
1500	27.4623	1.111	0.203	4.3192
Baseline value	28.3	1.06	0.205	4.14
Standard value	20	1	0.2	1

Table 1.3-7 Calculated Value in Downstream Water Body after Discharging of Residual Water from No.1 Stacking Yard (Abnormal Discharge)

Downstream distance X(m)	COD	Ammonia nitrogen	TP	TN
	Superposition value c(mg/L)	Superposition value c(mg/L)	Superposition value c(mg/L)	Superposition value c(mg/L)
100	28.6868	1.1407	0.2112	4.3668
200	28.6205	1.1391	0.2112	4.3668
300	28.5543	1.1375	0.2112	4.3668
400	28.4883	1.136	0.2112	4.3668
500	28.4224	1.1344	0.2112	4.3668
600	28.3567	1.1328	0.2112	4.3668
700	28.2911	1.1312	0.2112	4.3668
800	28.2257	1.1297	0.2112	4.3668
900	28.1604	1.1281	0.2112	4.3668
1000	28.0953	1.1265	0.2112	4.3668
1100	28.0304	1.125	0.2112	4.3668
1200	27.9656	1.1234	0.2112	4.3668
1300	27.9009	1.1219	0.2112	4.3668
1400	27.8364	1.1203	0.2112	4.3668
1500	27.772	1.1187	0.2112	4.3668
Background value	28.3	1.06	0.205	4.14
Standard value	20	1	0.2	1

1.4 Analysis of impact on surface water in associated area

1.4.1 Analysis of impacts of Jingzhou Chengnan Sewage Treatment Plant

1. Overview of Jingzhou Chengnan Sewage Plan

Chengnan Sewage Treatment Plant has been approved by Jingzhou Municipal Environmental Protection Bureau on November 16th 2007. It can handle 140000m3 sewage per day (50000t/d for early phase). The plant adopts the technology of reinforced secondary treatment of nitrogen and phosphorus removal + modified oxidation ditch + concrete + sand leach + advanced treatment and disinfection process, which can meet the requirement of water quality for discharge.

At present, Chengnan Sewage Treatment Plant runs stably and has received sewage 17.31 million m^3 in total in 2014. Its daily treatment capacity is about 47,400 m^3. The actual discharged water quality from Chengnan Sewage Treatment Plant is shown in the following table.

Table 1.4-1 List of Discharged Water Quality from Chengnan Sewage Treatment Plant in

2013, Unit: mg/L

Factor	COD	Ammonia nitrogen	TN	TP
Average value of incoming water	103	10.7	6.99	2.51
Average value of discharged water	21.98	1.19	3.71	0.14

2. Environmental impact analysis of tail water of Chengnan Sewage Treatment Plant

(1) Prediction mode and parameters

Discharge of Jingzhou Chengnan Sewage Treatment Plant (Phase I) at full load is shown in table 6.8-1. Normal and abnormal discharge source intensity is shown in table 6.8-2.

Table 1.4-2 Wastewater Discharge

Working condition	Discharge volume (m^3/s)	Discharge concentration (mg/L)	
		COD	Ammonia nitrogen
Normal discharging	0.58	22	1.2
Abnormal discharging	0.58	60	8

According to the recommended prediction mode in surface water guideline, one-dimensional steady-state mode is used; the calculation formula is as follows:

$$c = c_0 \exp\left(-K_1 \frac{x}{86400u}\right)$$

x- distance from calculation point to start point (discharge outlet), m

u-river flow velocity, m/s

K_1- coefficient of oxygen consumption, 1/d

C_0-pollutant concentration upstream of discharge outlet, mg/l

Hypothesis condition: ignore longitudinal discrete function, first-order kinetics reaction speed K, taking 0.1/d for COD, 0.06/d for ammonia nitrogen; no side branches to the river and the sectional area of river is a constant.

Table 1.4-3 Hydrologic Parameters of Receiving Water Body

Receiving water body	River width	Discharge outlet near-shore water side distance	Average water depth	Average flow velocity of river	Bottom slope of river
	B (m)	a (m)	H (m)	u (m/s)	I (‰)
City moat	10	0	1.7	0.05	0.5

(2) Prediction results

Table 1.4-4 List of Basic Parameters of Prediction (Normal Discharging)

Predictive factor	Water from upstream		Drainage of the proposed project		Assessment criteria
	Water quantity M^3/s	Concentration mg/L	Draining quantity m^3/s	Concentration mg/L	mg/L
COD	0.75	28.3	0.58	22	20
NH_4-N		1.06		1.2	1

Table 1.4-5 List of Basic Parameters of Prediction (Abnormal Discharging)

Predictive factor	Water from upstream		Drainage of the proposed project		Assessment criteria
	Water quantity M^3/s	Concentration mg/L	Draining quantity m^3/s	Concentration mg/L	mg/L
COD	0.75	28.3	0.58	60	20
NH_4-N		1.06		8	1

Table 1.4-6 Concentration Calculations of Downstream Water Body after Tail Water Discharge

Downstream distance X(m)	Normal discharging		Abnormal discharging	
	COD	Ammonia nitrogen	COD	Ammonia nitrogen
	c(mg/L)	c(mg/L)	c(mg/L)	c(mg/L)
100	25.7448	1.1152	41.0622	3.8694
200	25.6852	1.1137	40.9672	3.8641
300	25.6258	1.1121	40.8725	3.8587
400	25.5666	1.1106	40.778	3.8534
500	25.5075	1.1091	40.6837	3.848
600	25.4485	1.1075	40.5897	3.8427
700	25.3897	1.106	40.4958	3.8373
800	25.331	1.1044	40.4022	3.832
900	25.2724	1.1029	40.3088	3.8267
1000	25.214	1.1014	40.2156	3.8214
1100	25.1557	1.0999	40.1226	3.8161
1200	25.0975	1.0983	40.0298	3.8108
1300	25.0395	1.0968	39.9373	3.8055
1400	24.9816	1.0953	39.8449	3.8002
1500	24.9238	1.0938	39.7528	3.7949

Downstream distance X(m)	Normal discharging		Abnormal discharging	
	COD	Ammonia nitrogen	COD	Ammonia nitrogen
	c(mg/L)	c(mg/L)	c(mg/L)	c(mg/L)
Background value	28.3	1.06	28.3	1.06
Standard value	20	1	20	1

From table 6.8-4 and 6.8-6, it can be seen that phase I of Chengnan Sewage Treatment Plant has relatively small impact on sewage receiving water body under the circumstance of normal discharging, and relatively large impact under the circumstance of abnormal discharging.

1.4.2 Analysis of impacts of Jingzhou Caoshi Sewage Treatment Plant

1. Overview of Jingzhou Caoshi Sewage Treatment Plant

Caoshi Sewage Treatment Plant has been approved by Jingzhou Municipal Environmental Protection Bureau on November 16th 2007. It can handle 120,000m3 sewage per day. The plant adopts the technology of reinforced secondary treatment of nitrogen and phosphorus removal + modified oxidation ditch + concrete + sand leach + advanced treatment and disinfection process, which can meet the requirement of water quality for discharge.

At present, Caoshi Sewage Treatment Plant runs stably and has received sewage 9.83 million m^3 in total in 2014.Its daily treatment capacity is about 26,900 m^3.

Table 1.4-7 List of Discharge Water Quality of Caoshi Sewage Treatment Plant in 2013, Unit: mg/L

Factor	COD	Ammonia nitrogen	TN	TP
Average value of incoming water	210.7	30.7	21.2	10.69
Average value of discharged water	41.98	4.2	10.7	2.1

2. Environmental impact analysis of tail water of Caoshi Sewage Treatment Plant

(1) Prediction mode and parameters

According to the discharging parameters at running load of Caoshi Sewage Treatment Plant in 2013, normal discharge and abnormal discharge source intensity is shown in table 6.8-8.

Table 1.4-8 List of Wastewater Discharge

	Discharge volume (m^3/s)	Discharge concentration (mg/L)	
		COD	Ammonia nitrogen
Normal discharging	0.31	60	8
Abnormal discharging	0.31	120	16

According to the recommended prediction mode in surface water guideline, one-dimensional steady-state mode is used; the calculation formula is as follows:

$$c = c_0 \exp\left(-K_1 \frac{x}{86400u}\right)$$

x- distance from calculation point to start point (discharge outlet), m

u-river flow velocity, m/s

K_1- coefficient of oxygen consumption, 1/d

C_0-pollutant concentration upstream of discharge outlet, mg/l

Hypothesis condition: ignore longitudinal discrete function, first-order kinetics reaction speed K, taking 0.1/d for COD, 0.06/d for ammonia nitrogen; no side branches to the river and the sectional area of river is a constant.

Table 1.4-9 Hydrologic Parameters of Receiving Water Body

Receiving water body	River width	Discharge outlet near-shore water side distance	Average water depth	Average flow velocity of river	Bottom slope of river
	B (m)	a (m)	H (m)	u (m/s)	I (‰)
Taihugang Channel ditch	8	0	2.1	0.1	0.5

(2) Prediction results

Table 1.4-10 List of Basic Parameters of Prediction (Normal Discharge)

Predictive factor	Water from upstream		Drainage of the proposed project		Assessment criteria mg/L
	Water quantity M^3/s	Concentration mg/L	Draining quantity m^3/s	Concentration mg/L	
COD	1.68	12.8	0.31	60	20
NH_4-N		0.41		8	1

Table 1.4-11 List of Basic Parameters of Prediction (Abnormal Discharging)

Predictive factor	Water from upstream		Drainage of the proposed project		Assessment criteria mg/L
	Water quantity M^3/s	Concentration mg/L	Draining quantity m^3/s	Concentration mg/L	
COD	1.68	12.8	0.31	120	20
NH_4-N		0.41		16	1

Table 1.4-12 Concentration Calculations of Downstream Water Body after Tail Water

Discharge

Downstream distance X(m)	Normal discharging		Abnormal discharging	
	COD	Ammonia nitrogen	COD	Ammonia nitrogen
	c(mg/L)	c(mg/L)	c(mg/L)	c(mg/L)
100	20.1295	1.5913	29.4654	2.8366
200	20.1062	1.5902	29.4313	2.8347
300	20.0829	1.589	29.3973	2.8327
400	20.0597	1.5879	29.3632	2.8307
500	20.0365	1.5868	29.3293	2.8288
600	20.0133	1.5857	29.2954	2.8268
700	19.9902	1.5846	29.2615	2.8248
800	19.967	1.5835	29.2276	2.8229
900	19.9439	1.5824	29.1938	2.8209
1000	19.9209	1.5813	29.16	2.8189
1100	19.8978	1.5802	29.1263	2.817
1200	19.8748	1.5791	29.0926	2.815
1300	19.8518	1.5781	29.059	2.8131
1400	19.8289	1.577	29.0254	2.8111
1500	19.8059	1.5759	28.9918	2.8092
Background value	12.8	0.41	12.8	0.41
Standard value	20	1	20	1

From the table, it can be seen that Phase I of Caoshi Sewage Treatment Plant has relatively small impact on sewage receiving water body under the circumstance of normal discharging, and relatively large impact under the circumstance of abnormal discharging.

ANNEX II Publication Questionnaire

[Overview of the project] the proposed project is seated in Jingzhou District, Jingzhou Municipal; it belongs to integrated control of environmental pollution and consists of three components, namely, (1)protection of cultural heritage and promotion of tourism development project, (2)improvement of ecologic and water environments of historic town project, and (3)enhancement of traffic convenience of historic town project; component (1) consists of west historic town wall protection construction, retaining wall of earthen town wall construction, protection and restoration of historic town vegetation construction, various exhibition construction in Xiongjiazhong Tomb, enhancement of museum exhibition, visitors' center and parking construction, auxiliary construction of tourism development infrastructure, renovation and reuse of heritage architecture as well as environmental renovation of Kaiyuan Taoist Temple construction; component (2) consists of dredging works of moat and lakes inside historic town, construction of sewage pipelines, moat, lakes & wetland construction, waterfront revetment construction, and water resource connection and improvement as well as ecological construction of river and lakes; component (3) consists of inner ring reconstruction, inner ring nodes renovation construction, renovation of key nodes in historic town construction, renovation of key nodes out of historic town construction, slow drive system, shuttle bus system, static traffic sign system, and dynamic traffic sign system.

Total investment is 1.081 billion CNY, including USD100 million (Approx. 615 million CNY) World Bank loan; Construction period is 2016~2020.

[Introduction of Environmental Impact] Generally, the positive impact of the project is much greater than the negative impact. The ecological and environmental benefits are remarkable, and the adverse impacts are local, short-term, reversible and can be mitigated through corresponding mitigation measures and improving means.

The adverse impacts are mainly focused in the construction of visitor center, dredging project, sewage pipeline project and building projects. From time's perspective, the impact can be divided into impact of construction period and operation period; from the perspective of space, it mainly comes from the construction of visitor center, underground parking lot, dredging project. The construction, earth works transportation, and road transformation can easily cause traffic block, generate noise, raise dust and other environmental pollution, which may inevitably have impact on the surrounding environment. Meanwhile, large amount of spoil (residue) generated in the course of dredging and building demolition, if not properly treated, may cause water and soil loss, soil damage, and other environmental problems. Additionally, the connection project of water systems will stir the bottom materials, and cause adverse impact on the water quality of the moat. In consideration of the special meaning of the moat, the impact on it shall be paid special attention to. When the project comes into service, it can improve the road network and facilitate the development of the historic town. But, as the population and vehicles increase, the supporting parking lot of the visitor center and the automobile exhaust will increase, which will have certain impact on the life of residents near the underground parking lot. The sewage generated in the operation of the project is of small amount with single water quality, and was discharged into Caoshi WWTP and Chengnan Sewage Plant through the municipal pipelines, which has relatively little impact on the water environment.

[Note] According to *Environmental Protection Law of the People's Republic of China* and *The Environment Impact Assessment Act of China,* in environmental impact assessment of the project, the opinions of the residents and organizations of where the project is located should be solicited. For the purpose of benefiting the public and reduce the negative impact on the environment, we sincerely hope that you can put forward your precious opinions about the environmental protection along the line of the projects. We will record your opinions and suggestions actually in the environmental impact report, reflecting them to the construction and design organizations.

You may also put forward opinions and suggestions to us through letters, e-mail, and telephone.

And here is our contact information:

Name of the construction organization: Jingzhou Municipal Construction Investment Corporation

Mailing address: No.440, Beijing West Road, Jingzhou Municipal.

Contact: Zhong Yanxia Tel: 0716—4081878

E-mail：458402442@qq.com

Name of the environmental impact assessment organization: Hubei Academy of Environmental Sciences

Mailing address: No.338 Bayi Road, Wuchang District, Wuhan City. Postal code: 430072

Contact: Wang Cong Tel: 027-87868785-818

E-mail: 513903001@qq.com

Individual Inquiry of Public Consultation

Name： _________ Residence:_________ Age:_________ Tel:_________ Profession: _________

Degree of education: _________ (1) Primary school or below (2) Junior high school (3) High School (4) Junior college and above

Type of the organization you belong: _________ (1) Enterprise (2) Public institution (3) Commerce (4) Government agency

1. From which way do you know the information about that World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project is to be constructed？

(1) Website (2) Newspaper (3) TV (4) This questionnaire (5) Others

2. Are you satisfied with the environmental condition of the location where you live or work at present?

(1) Satisfied (2) Relatively satisfied (3) Not satisfied (4) Not to matter

3. The impact of the water quality of the moat on you is

(1) Serious (2) Not serious (3) General

4. The construction of the project may cause environmental pollution or interference to your life, what do you think will be the main impact?

(1) Noise (2) Vibration (3) Raise dust (4) Sewage mud (5) Ecological damage (6) Others

5. The operation of the project may cause environmental pollution or interference to your life, what do you think will be the main impact?

(1) Noise (2) Automobile exhaust (3) Others

6. Which area do you think the environmental quality must be guaranteed?

(1) Regional environment (2) The whole living environment (3) The bedroom

7. Which do you think are the mitigation measures should be taken during the operation period?

(1) Sewage intercepting pipes (2) Sound proof window (3) Relocation (4) Greening (5) Planning and control

8. If the construction of the project brings impact on your living environment, which way do you expect to solve the problem?

(1) Economic compensation (2) Require to be treated to meet standards (3) Relocation (4) Not to matter

9. What is your attitude toward the temporary impact during the construction period?

(1) Forgivable and understandable (2) Forgivable and understandable, but mitigation measures should be taken (3) Complaining

10. Which way do you think is more effective for solving the environmental problems caused by the project?

(1) Making a complaint to environmental protection departments (2) Through legal procedure

(3) Prevent the construction and operation of the project

11. After the implementation of the project, which of the following do you think will be improved?

(1) Economic development (2) Traffic will be more smooth (3) Living environment (4)No impact

12. What's your attitude toward the construction of the proposed project?

(1)Support (2) Support under conditions (reason:)

(3) Not support (reason:)

13. Except the questions above, what other impacts do you think the construction of the project will have on your working and living environment? Do you have other opinions and suggestions？

Organizational Inquiry of Public Consultation

1. From which way does your organization know the information about that World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project is to be constructed？

(1) Broadcast, newspaper, TV, Website and other medias (2) This questionnaire (3) Others

2. Are you satisfied with the environmental condition of the location where you live or work at present?

(1) Satisfied (2) Relatively satisfied (3) Not satisfied (4) Not to matter

3. As far as environmental protection is concerned, what does your organization think will be the main impact of the project during the construction period?

(1) Raise dust (2) Noise (3) Vibration (4) Sewage mud (5)Traffic interference (6) Land expropriation and house demolition (7) Others

4. What is your organization's attitude toward the temporary impact during the construction period?

(1) Forgivable and understandable (2) Forgivable and understandable, but mitigation measures should be taken (3) Withhold opinions

5. As far as environmental protection is concerned, what does your organization think will be the main impact of the project during the operation period?

(1) Automobile noise (2) Automobile exhaust (3) Landscape (4) Others

6. If the impact of the construction of the project on the working environment of your organization exceeds standards, which way does your organization expect to solve the problem?

(1) Economic compensation (2) Require to be treated to meet standards (3) Relocation (4) Not to matter

7. What's your organization's attitude toward the construction of the proposed project?

(1)Support actively, expect to speed up the construction (2) Support (3) Not support

If your organization holds the attitude of "Not support", please state the main reasons:

8. According to the situation of the project, combining with the reality of your organization, please put forward precious opinions and suggestions of your organization for environmental

protection.

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____

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Responding Organization:

Name of the Organization (seal) ： ______________________________

Nature of the organization:______________________________

Tel:____________________ Contact:____________________

Date:_________________

ANNEX III List of Disclosed Personal Information

Table 1.4-1 List of Disclosed Personal Information

No.	Name	Residence	Age	ID No. or Tel. No.	Education	Attitude
1	Yi Yuanyao	No.6 Zhangjuzheng Street	57	13445622466	High school	Support
2	Jin Mei	No.6 Zhangjuzheng Street	46	18972105689	High school	Support
3	Yang Cuilan	No.6 Zhangjuzheng Street	52	13085109799	Middle School	Support
4	Cheng Daming	Outside of South Gate	57	13227694488	Middle School	Support
5	Teng Chun	Jingzhou District	47	15927962599	High school	Support
6	Mr. Guo	Jingzhou District	44		High school	Support
7	Li Jianying	Jingzhou District	46	13797501037	College degree or above	Support
8	Yang Wanqin	Jingzhou District	47	13707215044	High school	Support
9	Peng Xiaoyan	Quyuan Road	41	18672551916	College degree or above	Conditinal support
10	Lu Fei	Group III, Meicun Village	20	18601715012	High school	Support
11	Sun Wenjun	Jingzhou District	29		College degree or above	Support
12	Li Fang		43	8465238	High school	Support
13	Zhang Aiping				Middle School	支持
14	Zhu Xiaoying	Papermaking factory	59		College degree or above	Support
15	Wang Jiahe	East Ring Road	64	15672445199	High school	Support
16	Peng Jinyong	East Ring Road	35	13607212571	College degree or above	Support
17	Zhou Dai	Jingzhou			Middle School	支持
18	Duan Hua	Jingzhou District	40	13094205637	High school	Support
19	Zou Lihua	Jingzhou	30	13872298388	College degree or above	Support
20	Yu Xiuzhi		34	18972391363	High school	Support
21	Wu Qin	Renmin Road	33	18972391359	High school	Support
22	Zhou Jiafeng	Renmin Road	61	13677165778		Support
23	Xian Wenliang	Jusong Street	61	13872351709	High school	Support

No.	Name	Residence	Age	ID No. or Tel. No.	Education	Attitude
24	Gao Qunjiao	North Ring Road	50	15972754884	Middle School	Support
25	Zhou Zhigui	Renmin Road	58	13872396429	Middle School	Support
26	Wang Zhou	North Ring Road	52	18956708183	High school	Support
27	Zhou Rong		43	18972391319	High school	Support
28	Yang Yiming	Yongjun Road	52	15997571736	High school	Support
29	Xiao Bing	Yuhe Bridge, Jingzhou	52	8496380	High school	Support
30	Mr. Wang		50	13972395399	High school	Support
31	Wen Hongliao	Jingbei Road	42	13797493923	College degree or above	Support
32	Zheng Qigui	No. 34, Yongjun Road	58	13677208406	High school	Support
33	Yu Chuntao	Yongjun Road, Jingzhou	40		High school	Support
34	Chen Qinglin	Minzhu Street	47	13997636776	High school	Support
35	Liu Fang	South Gate Avenue	36	13797478449	College degree or above	Support
36	Tian Xueqin	JingzhouRoad Middle	26	15571631802	College degree or above	Support
37	Xia Jiujiu	South Gate Avenue	30	13329778337	College degree or above	Support
38	Liu Kan	No. 94, Yuhe Road	34	18972391206	High school	Support
39	Ting Cai	No. 100, Yuhe Road	47	18972391213	High school	Support
40	Chen Xuefu	Sand Mine	70	15827724814	Primary school or below	Support
41	Zhou Daling	Sand Factory	44	13545785508	College degree or above	Conditional support
42	Wang Shihong	New Village, Xidi Street	58	13617264979	Middle School	Support
43	Dai Tangling	New Village, Xidi Street	50	15207217441	Middle School	Support
44	Li Zhengfeng	Jiancai Domitory, Nanxiao Road	64	13797395520	College degree or above	Support
45	Deng Huili		44	13997616979	High school	Support
46	Chen Shengxiu	Nanxiao Road	54	18040630268	Middle School	Support
47	Li Guoping	Zilin Residential Area	47	13607150815	College degree or above	Support
48	Liu Li	No. 129, Yuhe Road	43	13872316126	High school	Support

No.	Name	Residence	Age	ID No. or Tel. No.	Education	Attitude
49	Wang Junyuanhui	No. 87, Xidi Street	49	13997569369	Middle School	Support
50	Zhou Zhiying	No. 31, Xidi Street	67	15971619274	Middle School	Support
51	Li Changui	No. 385, Yuhe Road	60	8471928	Middle School	Support
52	Dai Zhongfu	No. 45, Dongdi Street	57	8473914	High school	Support
53	Ning Liangcheng	No. 102, Yuhe Road	43	13477813987	High school	Support
54	Li Juan	No. 83, Xidi Street	37	13986715611	College degree or above	Support
55	Liu Rong	No. 83, Xidi Street	36	13697309499	High school	Support
56	Zhu Yongxiu	No,2 Hangfeng Lane	66	15927974803	Middle School	Support
57	Zheng Yunmei	No,11 Hangfeng Lane	56	13997615744	Middle School	Support
58	Wang Ping	Outside of South Gate	49	13972307677	Middle School	Support
59	Xiao Bo	No. 25, Nanxiao Road	48	15927922735		Support
60	Yang Shanshan	Dongdi Street	27	18627223354	College degree or above	Support
61	Qin Chao	Gongmin Road	40	18972398999	High school	Support
62	Zhou Yanping	Minzhu Road	45	18972391237	High school	Support
63	Jin Ju		49	8434582		Support
64	Liu Zhongyu	West Gate	55	8498545	College degree or above	Support
65	Pan Changsha	Jingbei Road	42	8497487	College degree or above	Support