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World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project

Environmental and Social Impact Assessment Report

Hubei Academy of Environmental Sciences

May 2015

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World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project

Environmental and Social Impact Assessment Report

(For Appraisal)

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Hubei Academy of Environmental Sciences

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Project name	**:**	**World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project**
Assessment agency	**:**	**Hubei Academy of Environmental Sciences (official seal)**
Legal representative	**:**	**Zhang Gang (name seal)**
Project leader	**:**	**Liu Zhe Wang Cong**
Project approver	**:**	**Li Songbing**

Contributors and assignment of responsibilities

Member	Certificate No.	Assignment of responsibilities/chapters	Signature
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Revision checklist

	No.	Opinions from World Bank	Revised content	Chapter and Page No.
Report	1	Improve the environemental assessmentreport according to the revised version. Make sure the environmental assessment is consistent with the feasibility report.	According to the content of the latest feasibility report, the total project investment, project content, earthwork balance, dredging project and other contents. In addition, suggestions on the building of wastewater disposal device of Xiongjia Mound are provided	Full text
	2	Highlight the principles of point layout and representativeness of sediment monitoring and testify the scientificity of the selected monitoring points.	Add explaination on the principle of distributing the monitoring points of bottom sediment	Section 2.5.6
	3	Add the environmental protection procedures of the water diversion works from the Yangtze River to the Han River	Add the environmental assessment process of the water diversion works from the Yangtze River to the Han River	Section 7.1.3.1
Management Plan	1	Add the content of policy frameworks	Add the content of frameworks	Section 1.6
	2	Add the contents on the chracteristics ofcultural relics	Add the content of cultural relics protection measures	Section 3.2.4
Abstract	1	Need to add content of social impact, including land requisition and compensation methods, etc.		
	2	Verify the authenticity of pictures in the abstract.		
	3	Add whole process of disposing bottom sediment		

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Preface

Background

Located in central China, Jingzhou is within the radiation scope of Yangtze River Delta Economic Circle and stands on the connection line between Wuhan Metropolitan Area and Yichang Urbanized Area. As one of the 5 metropolises of Hubei Province, according to the *Jingzhou City Master Plan*, Jingzhou City is defined as: state historic and cultural city, important transportation hub of middle reaches of Yangtze River, and central city in south-central Hubei. It is one of the first of noted historic and cultural cities approved by the state and the economic hub in south-central Hubei. It is also a hub port in the middle reaches of Yangtze River and a national base for light and textile industry. The city has a total area of 14067km^2, accounting for 7.6% of total area of Hubei Province. The urban area is 1576km2 and the urban built-up area is 64.9 km2. Jingzhou now administers 3 districts, Jingzhou District, Shashi District and Jingzhou Development Zone, and 3 counties, Jiangling County, Gong'an County and Jianli County, with total population of 6.6 million. The city had a regional GDP of 119.602 billion Yuan, a per capita GDP of 18121 Yuan (2970 US dollars) and fiscal revenue of 9.182 billion Yuan in 2012, ranking fourth in Hubei in terms of economy.

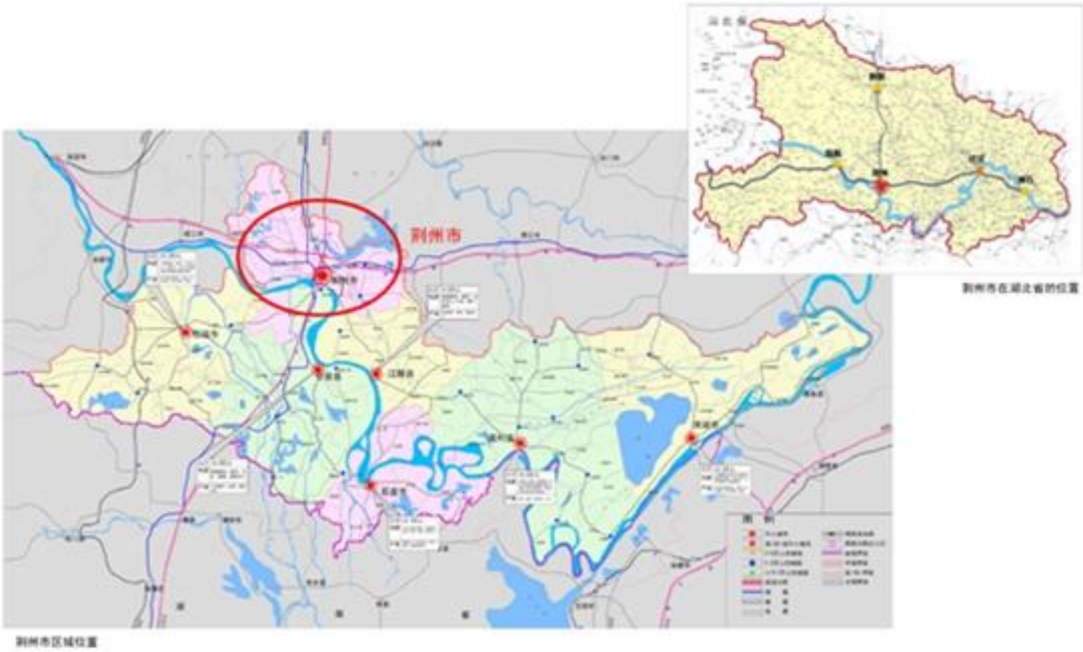
Jingzhou is one of the nine "zhous" in ancient China, the walls of which is the best preserved and grandest ancient walls in south China. Attributing to the historic value of its ancient walls, Jingzhou was determined as one of the first of National Famous Historic and Cultural Cities with traditional scenes.

However, protection of cultural heritages is facing pressure from rapid economic development, poor implementation of previous plan and environmental laws and regulations, and timeworn and outdated infrastructures. At present, there are few ancient architectural heritages preserved inside the ancient walls, and the few preserved ancient buildings and the walls are now facing the risk of increasing damages due to lack of maintenance, uncontrolled sewage drainage into the moat, conflictions in land use and pressure of redevelopment. Due to the economic and industrial scale, the city is unable to provide sufficient support for the protection of the heritages in the national famous historic and cultural city. Occupation of some planned green space and land reclamation by filling river have caused many almost irreparable losses; as a consequence, in some key areas the buildings are too close and of low quality, which does not correspond to the status of Jingzhou as a national famous historic and cultural city at all.

As the whole China is attaching increasing importance to cultural heritages, Jingzhou is focusing more on the protection and reasonable utilization of cultural heritages. After long time of comprehensive consideration, the government of Jingzhou City has proposed the "Hubei Jingzhou Historic Town Conservation and Environment Treatment Project" specially for the protection and utilization of cultural heritages of the historic town to conduct integrated work in restoration of ancient walls, treatment 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 Temple of Confucius 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 1.1104 billion Yuan, including World Bank loan of 100 million USD (about 615 million Yuan) and domestic fund of 495.4 million Yuan. The construction period of the project is from 2015 to 2020.

The construction unit of the project is Jingzhou City Construction Investment and Development Co., LTD. In order for the progressing of the project, Jingzhou City has specially established the World Bank Financed Project Management Office as the daily office of the project to deal with the application, implementation, management and inspection of the project.



Location map of Jingzhou City

Procedures, Requirements and Work Progress of Environmental Impact Assessment of the World Bank Financed Project

Classification of environmental impact by the World Bank

Based on the degree of environmental impact arisen from the construction project, the World Bank classifies environmental impact into 3 types: Type-A, Type-B and Type-C. Type-A project has the highest degree of environmental impact, followed by Type-B and Type-C. The World Bank defines this project as Type-A project according to its characteristics, which means, comprehensive environmental impact assessment on the project is required.

Work progress report as required by the World Bank

In the compilation of the environmental impact report of the project, the assessment agency had held public consultations according to the requirements on environmental impact assessment in China as well as the requirements on environmental impact assessment of the World Bank. At present it has completed the environmental impact report and the environment management plan and has submitted them to the World Bank for internal review.

➢ Preliminary Work Summary

On December 1, 2013, Jingzhou Research Institute of Urban Planning & Design Institute completed the compilation of *Proposal for World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project*.

From December 11 to December 13, 2013, the Expert Mission of the World Bank came to Jingzhou to inspect the Hubei Jingzhou Historic Town Protection and Environment Treatment Project. Jingzhou has proposed project contents, changed the project name, put forward project budget estimate and arranged organizations for the preparation stage of the project. Jingzhou has presented the project proposal to the Mission, for which the Mission suggested that during compilation of the feasibility study report, the focus should be on the fields of society, environment, finance, economy, engineering, cultural heritage protection and sustainable development.

On April 21, 2013, T.Y. Lin International Group (China) completed the draft of *Feasibility Study Report of the Hubei Jingzhou Historic Town Protection and Environment Treatment Project*. The report contains a main report and six sub-reports (in transportation, water environment, vegetation, cultural heritage protection, tourism and organization).

From April 21 to April 26, 2014, the Appraisal Mission of the World Bank came to the project in P.R.C. for appraisal and selection of the project. The Appraisal

Mission had elaborate discussions with Hubei Provincial Department of Finance, Hubei Provincial Development and Reform Commission, Jingzhou Project Management Office (including all related municipal departments as members), Project Leading Group (consisting of the main leaders of the city) and the designers and consultants of the project. The Appraisal Mission also had field inspections at main project sites.

On August 20, 2014, T.Y. Lin International Group (China) completed the revised version of *Feasibility Study Report of the Hubei Jingzhou Historic Town Protection and Environment Treatment Project* according to the requirements of the Appraisal Mission, as well as the revision of the sub-reports.

On September 24, 2014 at the project coordination meeting, the World Bank Financed Project Management Office put forward comments on the latest version of *Feasibility Study Report of the Hubei Jingzhou Historic Town Protection and Environment Treatment Project*.

From October 13 to October 17, 2014, the Inspection Mission of the World Bank inspected the Hubei Jingzhou Historic town Restoration and Protection Project, during which, the compilation unit of feasibility study report gave an account of the latest version of feasibility study report and introduced the design with regard to water environment and transportation, the social assessment agency and environmental impact assessment agency briefed their work progress respectively; the experts from the World Bank inspected each sub-report and preliminary work, and put forward specific requirements. They have reached agreement on the overall development goals basically (in regard to cultural heritage, water environment, traffic convenience, project management and institution building). Further discussions will be held in the next few months on the details of the sub-projects.

From January 25 to January 29, 2015, the Pre-assessment Mission of the World Bank inspected the Hubei Jingzhou Historic Town Restoration and Protection Project, during which the compilation units of the feasibility study report and the sub-reports briefed their work respectively. During the pre-assessment, the Xiongjia Mound Chu Tombs and Kaiyuan Taoist Temple Environment Improvement Project wad added and the Temple of Confucius Protection Project and the West and South Tourist Center Project were cancelled.

On May 10, 2015, the World Bank proposed latest opinions on revising the latest environmental assessment report, which mainly involved content consistency, description of the whole process of dredging, and supplemnting the abstract. Based on the latest requirement, our academy revised the environmental assessment report and environmental management plan accordingly. Hence it is submitted for review of World Bank.

➢ Approach of Environmental Impact Assessment

The Environmental Impact Assessment should be prepared based on (1) the location and the nature of the Project; (2) the requirements in related policies of the World Bank, the Law of Appraising Environmental Impacts, the Regulations of Environmental Protection Management of Development Projects, and the Technical Guideline of Environmental Impact Assessment, (3) approved environmental plans of national, provincial and municipal levels, and the urban master plan. Based on the environmental impact assessment, the project pollution control and environmental protection measures will be identified and will serve as the scientific basis for the project construction and management.

(1) The project is a World Bank financed project focusing on ancient walls and buildings improvement, public transportation and water environment improvement and tourism promotion. The proposed four components include cultural heritage protection and tourism promotion, historic town ecological environment and water environment improvement, historic town transportation enhancement and enhancing

the capacity of project management and institution. The project is special in that in the operation stage the main role of the project is to provide service and it has little pollutant production. Therefore, the focus of the EIA will be the impacts of the construction on the local environment and the pollutant control and impact mitigation measures. The EIA will investigate the impacts of not only the individual components but also of overall Project to mitigate the adverse impacts and to protect the local environment. The EIA Report and the EMP (a standalone document) will be prepared based on the relevant requirements in the documents including the Catalogue for Classification and Management of Environmental Impact Assessment for Development Projects and the World Bank Safeguard Policy OP4.01.

(2) According to the site survey and due diligence investigation, in the historic town, sewage in the area north of Jingzhou Middle Road goes to Caoshi Sewage Treatment Plant and then is exhausted to Taihugang Channel, while sewage in the area south of Jingzhou Middle Road goes to the Chengnan Sewage Treatment Plant and is exhausted to the Gangnan Channel, and then flows into the moat and finally goes to the Taihugang Channel. The feasibility of dependence on the two sewage treatment plants will be a focus for analysis. In the project a certain amount of domestic garbage and dredged sediment will be produced. Analysis on solid waste treatment facilities will be included in this report.

(3) The construction and operation of the tourist center, transportation facilities and the dredging work will cause certain impacts on the local environment. Based on the field investigation to the project area, this EIA will conduct engineering analysis and predict the impacts on environment, and then will propose pollution control and impact mitigation measures as guidance for the environmental management during design, construction and operation phases to achieve the integrated economic, social and environmental benefits.

(4) The project is located within the Jingzhou historic town with a number of

environmental sensitive sites such as enterprises and institutions, cultural, educational and residential areas along the proposed sub-projects. Special attentions should be paid to the impact of the pollution source with variable intensities during the project implementation on the local environment, including the cultural environment and ecological environment.

(5) There will be some land acquisition and resettlement involved in this Project. The land acquisition and resettlement will be a key issue in the EIA. To maximize the project benefits, it is also important to propose feasible environmental protection measures and institutional development measures to improve the urban infrastructure and to promote well organized development of urban environment. In the EIA, the positive environmental impact will be highlighted to protect the local cultural and historical features.

(6) The environmental impact during construction phase and operation phase and the relevant mitigation measures and environmental management measures will be emphasized in the EIA to minimize the adverse impacts on the cultural environmental, health and ecological environment.

(7) Public consultation will be used to compensate the possible defects or flaws in the EIA so that the project plan, the project design and the environmental management can be improved to: (i) optimize the integrated project benefits in terms of environmental, social and economic benefits; (ii) provide a solid basis for the project operational management and environmental management, for the economic development plan and environmental plan, and for the decision making to achieve coordinated environmental protection and development.

➢ Environmental Impact Assessment Process

According to the related requirements of Law of the People's Republic of China on Appraising of Environmental Impacts, State Council Order No. 253 Regulations on

Environmental Protection and Management for Development Projects and Ministry of Environmental Protection Order No. 2 Catalogue for Classification of Environmental Impact Assessment for Development Projects, environmental impact assessment report is required for the project.

On September 11, 2014, Jingzhou World Bank Financed Project Management Office entrusted us to undertake the environmental impact assessment of the "World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project" (Annex 1).

On September 23, 2014, we organized technical staff to conduct site survey and data collection at the Jingzhou historic town and its surrounding areas, had preliminary engineering analysis and impact factor identification, and formulated environment monitoring plan for the project.

On September 26, 2014, we published the first announcement of "World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project" on the website of Environmental Protection Bureau of Hubei Province (http://www.hbepb.gov.cn/).

In mid October, 2014, the Preparation Mission reviewed the first draft of this environmental impact assessment report and put forward corresponding suggestions for amendment.

In late November, 2014, together with the World Bank Financed Project Management Office of Jingzhou City Construction Investment and Development Co., LTD, we completed the first public opinion survey and held the first public participated forum in Jingzhou.

In mid January, 2015, we completed this report for appraisal based on the existing data in a timely manner and submitted it to the World Bank for review.

In late May, 2015, according to the latest revision opinions of World Bank, our academy timely provided the revised version of the environmental assessment report.

➢ Characteristics of the Project and the Main Environment Issues Concerned

The World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project focuses on: (1) vegetation and wall restoration, collection and interception of urban domestic sewage; (2) sediment dredging at part of the moat and construction of urban transportation; and (3) construction of infrastructures such as tourist center and car park. The project has three characteristics: coexistence of positive and negative effects, coexistence of pollution and ecological benefits, and coexistence of long-term and short-term impacts. Since the project has positive effects on the local environment and weak impact on sound environment and the atmosphere, the main issues concerned in the environment impact assessment are: (1) adverse impact of tourist center and car park on the environment; (2) adverse impact of sediment dredging on water environment and ecological environment; (3) comparison and selection of plans for dredging methods, sediment treat technologies, and sediment disposition from the perspective of environment; (4) impact of vegetation enhancement and wall restoration of the historic town on the ecological system of native plants; (5) impact of interconnection of water systems on the water environment and aquatic ecology of the water systems in the historic town; (6) water diversion and population transfer in the historic town.

➢ Conclusion

The assessment agency believes that: by proper sediment dredging and ecological restoration work, the World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project can effectively maintain and improve the water quality and aquatic ecology of the water systems in the historic town on the following preconditions: (1) the pollutions around the moat are effectively intercepted, (2) the pipeline network project in the surrounding area is implemented as planned, (3) disposition of the dredged sediment is reasonable, (4) classification and treatment of walls and vegetation are proper, (4) the impact on atmosphere and the noises arisen from the construction of tourist center, car park, inner ring road and transportation node are under strict control. The project does more good than harm on the environment and has significant ecological and environmental benefits. The local, short-term and reversible adverse impacts of the project on environment are relatively small and can be mitigated by appropriate environmental protection and improvement measures. Therefore, from the perspective of ecology and environment protection, the project is feasible in terms of environment as long as the expansion project of Chengnan Sewage Treatment Plant and Caoshi Sewage Treatment Plant is completed prior to the operation of the sewage interception pipeline network of the project.

1 General

The objective of the assessment is to predict and analyze the impact of the project on natural environment, social environment and ecological environment of the regions based on the characteristics of the project through comprehensive investigation, assessment and analysis on the project area, and to put forward practicable and feasible environment protection countermeasures and measures to mitigate the adverse impacts of project construction, in order to reduce the adverse impacts on environment to the minimum, to make the project correspond to the regional plan and the construction of the Jingzhou historic town and even the whole Jingzhou City, to facilitate the virtuous circle of the ecological environment in the project area, and to achieve the best integrated benefits on the society, environment and economy. At the same time, the environmental impact assessment further demonstrates the feasibility of the project in terms of environment and supplements project design documentation, which will facilitate the smooth commencement of the project; besides, it provides scientific basis for the effective environment management, supervision, monitoring and environmental protection acceptance check of the environmental protection administrative authorities and the construction units.

1.1 Basis of the Environmental Impact Assessment

1.1.1 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 Impact Assessment for Development Projects, October 1, 2008;

(15) Ministry of Environmental Protection [2012] No. 77: Notice on Further Strengthening Environmental Impact 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 Impact 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 Impact 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 Impact Assessment Documents of Development Projects by Authorities at Different Levels;

(28) 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;

(29) 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);

(30) 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);

(31) The National Program for Ecological Environment Protection, November 26,

2000;

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

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

(34) 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.

1.1.2 Entrustment document

Letter from Jingzhou World Bank Financed Project Management Office on Entrusting Hubei Academy of Environmental Sciences to Conduct Environmental Impact Assessment on the "World Bank Financed Jingzhou Historic Town Restoration and Protection Project", September 11, 2014

1.1.3 Project documents and related official documents

(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 City (2003);

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

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

(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) *Proposal for World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project;*

(10) Feasibility Study Report of *World Bank Financed Hubei Jingzhou Historic Town Protection and Environment Treatment Project;*

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

(12) Master Plan of Jingzhou City (2011~2020);

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

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

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

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

(17) Plan for Evacuation in Jingzhou Historic Town (2002);

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

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

(20) Recent Plan for Urban Construction of Jingzhou City (2011-2015);

(21) Plan of Urban Green Space System of Jingzhou City (2011-2020);

(22) Plan of Urban Blue Line of Jingzhou City;

(23) Functional Zoning of Water Environment in Jingzhou City;

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

1.1.4 Relevant regulations of the World Bank

According to relevant regulations of the World Bank, special attention must be paid in the interests of the public in the implementation process of the project, which is also the aim of the environmental impact assessment. Hence, the assessment agency has verified and confirmed the security policies of the World Bank according to the relevant provisions of World Bank document, with the results shown in Table 1.1-1.

World Bank security policy screening table

No.	Content of verification	Yes	No	Remarks
1	Environmental impact assessment	✓		Environmental impact assessment has been conducted.
2	Natural habitat	✓		The moat is a natural habitat, the description of which is included in environment survey.
3	Plant disease and pest management		✓	Use of insecticide and herbicide is not involved in both the construction and operation stage of the project.
4	Ethnic minority issues		✓	The project does not involve ethnic minority issues.
5	Cultural relics and heritage	✓		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	Controversial area		✓	There is no controversial area in the project.
7	Dam safety		✓	There is no dam in the project area.
8	International waters		✓	There are no international waters in the project area.
9	Forest		✓	There is no natural forest or artificial forest in the project area.
10	Involuntary resettlement	✓		The East Gate Tourist Center subproject involves resettlement and special analysis is done on resettlement.

1.1.5 Guidelines and technical specifications

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

(2) Technical Guidelines for Environmental Impact Assessment –Atmospheric

Environment (HJT2.2-2008);

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

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

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

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

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

1.2Functional zoning and environment protection targets

1.2.1 Functional zoning

According to 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 and Response Letter on the Applicable Standards for Environmental Impact Assessment of the World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project of Jingzhou Environmental Protection Bureau, the functional zoning of the project are is detailed in Table 1.2-1.

Table 1.2-1 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 noise	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)	GB3896-2008 Class 4a
	Schools (beyond Class 4a)	GB3896-2008 Class 1
	Other areas (beyond Class 4a)	GB3896-2008 Class 2
Surface water	Moat	GB3838-2008 Class III

	Taihugang Channel	
	North Lake	
	West Lake	
	Horse Washing Pond	
	Jiulaoxiandu Scenic Area	
	Proposed water system to be connected 1	
	Proposed water system to be connected 2	
	Proposed water system to be connected 3	
	Jingsha River	
	Gangnan Channel	
Underground water	The whole project area	GB/T14848-93 Class III

1.2.2 Environment protection targets

The project has a large scope, covering Jingzhou District and Chuandian Town of Jingzhou City. The environment protection targets of the project include schools, hospitals, residential quarters and cultural relics protection units in the project area.

1.2.2.1 Sensitive targets in cultural relics protection and tourism promotion subproject and their distribution

The scope of the cultural relics protection and tourism promotion subproject is the historic town area and Xiongjia Mound Chu Tombs area, the contents of the subproject are: ancient wall renovation, Xiongjia Mound protection and exhibition, museum exhibition and improvement, tourism promotion, historic building restoration and reutilization, Kaiyuan Taoist Temple environmental improvement. Construction is confined to the construction site and is mainly by manual and mechanical equipment. The affected targets are mainly the cultural relics, and the environmental sensitive targets are the cultural relics and a few external sensitive targets. Sensitive targets of the cultural relics protection and tourism promotion subproject are shown in Table 1.2-2 and Figure 1.2.1~3.

Table 1.2-2 List of Main protection targets of the cultural relics protection and tourism promotion subproject

Cultural relics protection unit			
No.	Name	Position	Class of protection
1.1	West Wall	Jingzhou historic town	National (forth group, approved in 1996)
1.2	Xiongjia Mound 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 relics protection unit, others are ordinary cultural relics and folk houses.	
1.5	Kaiyuan Taoist Temple	West of Jingzhou Museum	National (sixth group, approved in 2006)	
Residential area				
1.6	Existing residents on the land planned for tourist center	At the junction of Small North Door Bridge and Taihugang	35 households	100 residents

Figure 1.2-1　　Location map of Jingzhou Historic Town and Xiongjia Mound

Figure 1.2-2　　Distribution of sensitive targets of the cultural relics protection and tourism promotion subproject in the historic town area

Figure 1.2-3 Xiongjia Mound – a sensitive target of the cultural relics protection and tourism promotion subproject

1.2.2.2 Sensitive targets of the historic town water environment and ecological system subproject and their distribution

The scope of the historic town water environment and ecological system subproject is in the historic town area, and the contents of the subproject are: dredging of rivers and lakes, sewage pipeline networks, river and lake wetland, and water system connection. 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 targets are mainly the water systems in the historic town and nearby residents. Sensitive targets of the water environment and ecological system subproject are shown in Table 1.2-3 and Figure 1.2-4

Table 1.2-3 List of main protection targets of the water environment and ecological system subproject

1	**Cultural relics protection unit**		
No.	Name	Position	Class of protection

1.1	Binyang Tower	Near the East Gate	National (forth group, approved in 1996)	
2	**Rivers and lakes**			
No.	Name	Position	Water body function	
2.1	Moat	Outside the wall	Landscape river	
2.2	West Lake	West of the wall	Landscape lake	
2.3	Northeast Pond	Northeast in the historic town	Landscape lake	
3	**Residential area**			
No.	Name	Position	Number of households	Number of residents
3.1	Residents in East Dam Street	South of the former South Gate	960	2100
3.2	Residents in West Dam Street	South of the former South Gate	450	1200
3.3	Residents in Siji Road	South of the new South Gate	150	450
3.4	Residents in Fanrong Street	West of the West Gate	120	420
3.5	Residents in Shuixiexiang Dam Street	West of the West Gate	50	150
3.6	Jingzhou District Disabled Person Recover Center	North of the South Gate Avenue		170
3.7	Jingzhou Institute of Technology	East of the wall		300
3.8	Jingzhou Science and Technology School	East of the wall		500

Figure 1.2-4 Distribution of main protection targets of the water environment and ecological system subproject

1.2.2.3 Transportation enhancement subproject

The contents of the transportation enhancement subproject are: renovation and transformation of Inner Ring Road, improvement of traffic nodes in and out of the historic town, slow traffic system, public transportation system and traffic sign system. The environmental impact of the subproject is mainly on the Inner Ring Road and the main affected targets are the residential areas along the Inner Ring Road.

Table 1.2-4 Distribution of sensitive targets of the transportation enhancement subproject

1	Residential area			
No.	Name	Position	Number of households	Number of residents
1.1	Residents on the Inner Ring Road	Along the Inner Ring Road	220	600

1.3 Applicable standards

According to Response Letter on the Applicable Standards for Environmental Impact Assessment of the World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project of Jingzhou Environmental Protection Bureau, the environmental quality standards and discharge standards are detailed in Table 1.3-1 to Table 1.3-9.

Table 1.3-1 List of applicable standards

Type of standard	Standard No.	Name of standard	Assessment targets	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 Washing Pond, Gangnan Channel, Jingsha River, and other proposed water systems to be connected	Class III
	GB3096-2008	Sound Environment Quality Standards	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
			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
			Tourist center	
	GB22337-2008	Emission Standard for Community Noise	Class 4 area surrounding the tourist center	Class 4
			Class 2 area surrounding the tourist center	Class 2
			Class 1 area surrounding the tourist 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 Sludges from Agricultural Use		—
	GB18918-2002	Pollutant Discharge Standard of Municipal Wastewater Treatment Plants		—
	GB/T23486-2009	Disposal of Sludge from Municipal Wastewater Treatment Plant – Quality of Sludge Used in Gardens or Parks		—
	GB/T23485-2009	Disposal of Sludge from Municipal Wastewater Treatment Plant – Quality of Sludge for Co-Landfilling		—
	HJ350-2007	Standard of Soil Quality Assessment for Exhibition Sites (Interim)		Class B

Table 1.3-2 Environmental air quality standards, unit: mg/Nm^3

Standard No.	Name of standard	indicator	Time interval (hour)	Daily average	Annual average	Assessment targets
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 1.3-3 Surface water quality standards, unit: mg/L (excluding pH)

Standard No.	Name of standard	indicator	Class III (mg/L)	Assessment targets
GB3838-2002	Surface Water Environmental Quality Standards	pH	6～9	Moat, Taihugang Channel, North Lake, West Lake, Horse Washing Pond, Gangnan Channel, 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 1.3-4 Regional environmental noise standard, unit: dB(A)

Standard No.	Name of standard	Indicator	Day	Night	Assessment targets
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 1.3-5 Underground Water Quality Standards, unit: mg/L

Standard No.	Name of standard	Indicator	Class III (mg/L)	Assessment targets
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	
		Ammonias	≤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	
		Cr6+	≤0.05	
		Total coliforms	≤3.0	

Table 1.3-6 Waste gas pollutants emission standards

Standard No.	Name of standard	Indicator	Control item	Allowable maximum emission concentration (mg/m^3)	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 1.3-7 Waste water discharge standards

Standard No.	Class of standard	Indicator	Unit	Discharge value	Pollution source
GB8978-1996 Integrated Waste Water Discharge	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	

Standard		Oil	mg/L	30	
		NH_4-N	mg/L	45	

Table 1.3-8 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 tourist center	70	55	Class 4
		Class 2 area surrounding tourist center	60	50	Class 2
		Class 1 area surrounding tourist center	55	45	Class 1
GB1495-79	Allowable Noise Limits for Motor Vehicles	Car	82		Level I

Table 1.3-9 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 Treatment Plants	Disposal of Sludge from Municipal Wastewater Treatment Plant – Quality of Sludge Used in Gardens or Parks	Disposal of Sludge from Municipal Wastewater Treatment 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	——
Water content	——	——	——	40	60	——
Organic matter	——	——	——	≥25	——	——
Cyanide	——	——	——	——	10	8
Total nitrogen	——	——	——	≥0.3	——	——
Total phosphorus						
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	——	——	——	——	——	1000
Nickel	50	200	200	200	200	2400
Arsenic	30	75	75	75	75	80

1.4Identification of the environmental impacts

1.4.1 Principles

Based on the project nature, engineering features and environmental characteristics in implementation phase (construction phase and operation phase) and in the project area, the Project Office shall identify factors which may impact natural and social environment as well as life quality, and determine nature, time, scope and extents of their impact to help select evaluation factors and confirm assessment focuses.

1.4.2 Identification of the environmental impacts

The Project Office selects matrix identification by sampling to identify environmental impact factors generated in construction phase and operation phase. The identification results can be seen in Table 1.4-1 and 1.4-2.

Table 1.4-1 Identification matrix of environmental impact factors in operation phase

Components	Evaluation factor	Nature	Extent	Time	Possibility	Scope	Reversible or not
Tourist center and parking lot	Surface water	-	Larger	Long	Big	General	Yes
	Air	-	Larger	Long	Big	General	Yes
	Noise	-	General	Long	Big	General	Yes
	Solid waste	-	General	Long	Bigger	Larger	Yes
	Social economy	+	Larger	Long	Bigger	Larger	Yes
Interconnected water system	Surface water	-	Smaller	Long	Small	Smaller	No
	Aquatic organisms	-	Smaller	Long	Big	Smaller	No
	Social economy	+	Larger	Long	Bigger	Larger	No
Tourism development	Surface water	-	Smaller	Long	Big	General	Yes
	Noise	-	Larger	Long	Big	Larger	Yes
	Air	-	Larger	Long	Big	Larger	Yes
	Solid waste	-	Smaller	Long	Small	Larger	Yes
	Plants	-	Small	Long	Small	Small	Yes

Note: "+" represents for positive impacts while "-" represents for adverse impacts.

Table 1.4-2 Identification matrix of environmental impact factors in construction phase

Components	Evaluation factor	Nature	Extent	Time	Possibility	Scope	Reversible or not
Dredging along the river	Surface water	+	Larger	Long	Bigger	Large	No
	Air	-	Smaller	Short	Bigger	Small	Yes

	Noise	-	Smaller	Short	Bigger	Small	Yes
	Solid waste	+	Larger	Long	Bigger	Large	Yes
Pipe laying	Surface water	-	Smaller	Short	Bigger	Small	Yes
	Air	-	General	Short	Bigger	General	Yes
	Noise	-	General	Short	Bigger	General	Yes
	Solid waste	-	Smaller	Short	Bigger	Small	Yes
Civil construction	Surface water	-	Larger	Short	Bigger	Small	Yes
	Air	-	Larger	Short	Bigger	Small	Yes
	Noise	-	Larger	Short	Bigger	Small	Yes
	Solid waste	-	General	Short	Bigger	General	Yes
	Ecological environment	-	Larger	Short	Big	General	No
Road construction	Surface water	-	General	Short	Bigger	Small	Yes
	Air	-	Smaller	Short	Bigger	Small	Yes
	Noise	-	General	Short	Bigger	Small	Yes
	Solid waste	-	General	Short	Bigger	Small	Yes
Xiongjia Mound	Surface water	-	Small	Short	Small	Small	Yes
	Air	-	Small	Short	Small	Small	Yes
	Noise	-	Small	Short	Small	Small	Yes
	Solid waste	-	Smaller	Short	Bigger	General	Yes
Wall protection	Surface water	-	Smaller	Short	Bigger	Small	Yes
	Air	-	Smaller	Short	Bigger	Small	Yes
	Noise	-	Larger	Short	Bigger	Small	Yes
	Solid waste	-	Smaller	Short	Bigger	General	Yes
	Ecological environment	+	Larger	Short	Big	General	Yes
Interconnected water system and wetland engineering	Surface water	+	Large	Short	Big	Large	Yes
	Air	-	Small	Short	Small	Small	Yes
	Noise	-	Small	Short	Small	Small	Yes
	Solid waste	-	Small	Short	Small	Small	Yes
	Ecological environment	+	Large	Short	Big	Large	Yes

Note: "+" represents for positive impacts while "-" represents for adverse impacts.

1.4.3 Selection of evaluation factors

Based on engineering analysis of the project, characteristics of environmental elements and environmental problems in the project area, the Project Office has determined evaluation factors shown in Table 1.4-3.

Table 1.4-3 Identification list of pollution sources and pollution factors

Item	Environmental factor	Pollution sources in construction phase	Pollution factors in construction phase	Pollution sources in operation phase	Pollution factors in operation phase
Pollution interception pipe and sewage pipe network	Air	fugitive dust produced by earth excavation; dust pollution caused by installment and dismantlement, delivery and piling of powder and house demolition, etc.; dust pollution caused by come-and-go of construction vehicles on construction roads	TSP	——	——
	Water	Water pollution in the project area caused by	COD, SS, petroleum	——	——

		disturbance and waste water of construction			
	Noise	Adverse impact of construction on environmental sensitive sites surrounding the project area	Noise	——	——
	Solid waste	Construction waste and spoil		——	——
	Ecological environment	Vegetation destruction and soil erosion prone to occur in road excavation and earth filling		——	
Tourist center and parking lot	Air	Fugitive dust generated in construction phase	TSP	Automobile exhaust of parking lot	NO_2, CO
	Water	Waste water generated by production and construction staff's life	COD, SS, petroleum	Facilities for tourists' sanitary sewage	COD, NH_4-N
	Noise	Machinery, construction operations and construction vehicles	Noise	Loud noise equipment from tourist center	Noise
	Solid waste	Construction waste and spoil		——	——
Dredging along the river	Air	Waste gas emitted by construction machines and transport vehicles, foul gas generated in river dredging	TSP, SO_2, NO_2, H_2S, NH_3	——	
	Water	Sewage and production waste water generated in construction, secondary pollution caused by river dredging	COD, SS, petroleum , TP, TN		
	Noise	Construction machinery and vehicles	Noise		
	Solid waste	River dredging	Sludge		
	Ecological environment	Impact of dredging along the river on aquatic organisms		——	
Revetment	Air	Waste gas emitted by construction machines and transport vehicles	TSP, SO_2, NO_2	——	
	Water	Sewage and production waste water generated in construction	COD, SS, petroleum		
	Noise	Construction machinery and vehicles	Noise		
	Solid waste	Construction waste and spoil			
	Ecological environment	Soil erosion, vegetation destruction and landscape		——	
Interconnected water system and wetland engineering	Air	——	——	——	——
	Water	Interconnection of water system	Impact on water of interconnected water system	water pollution caused by silt dredging in the river	
	Noise	——	——	——	——
	Solid waste	——		Silt from water conveyance channel and box culvert	
	Ecological environment	Impact on survival environment of aquatic organisms		——	

1.5 Evaluation of work levels

1.5.1 Evaluation levels

According to the judging principle and method of work levels and working scope of evaluation, the Project Office has determined evaluation levels and scope of environmental elements.

1.5.1.1 Ambient air

The air pollutants of this project mainly come from automobile exhaust produced in operation of the parking lot of tourist center. However, this 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 Level 3.

1.5.1.2 Surface water

Sewage in the project area mainly comes from domestic sewage produced by tourist 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 Impact Assessment for Surface Water* (HJ/T2.3-93), impact of surface water is evaluated as Level 3.

1.5.1.3 Noise

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

1.5.1.4 Underground water

In terms of *Technical Guide of Environmental Impact Assessment for Underground Water* (HJ610-2011), the proposed project belongs to Type II construction project. Based on nature and features of this 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 hydrogeological 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 Impact Assessment for Underground Water* (HJ610-2011), impact of underground water is evaluated as Level 3.

1.5.1.5 Ecological impact

The evaluation level of ecological impact is confirmed according to Table 1 in *Technical Guide of Ecological Environmental Impact Assessment* (HJ19-2011). See Table 1.5-1 for division of work levels of ecological impact assessment.

Table 1.5-1 Division list for work levels of ecological impact assessment

Ecological sensitivity of impacted area	Land (water area) coverage scope of project		
	Area≥20km^2 Or length≥100km	Area 2km^2～20km^2 Or length 50km～100km	Area≤2km^2 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

In terms of UNESCO list, Jingzhou Historic Town is only a filed project of world cultural heritage sites, not belonging to special sensitive area. Therefore, ecological impact of this project is evaluated as Level 3. See Table 1.5-2 for the details of evaluation levels of various environmental elements.

Table 1.5-2 List for work levels of evaluation

Item	Evaluation level
Environment impact evaluation of surface water	Level 3
Environment impact evaluation of ambient air	Level 3
Environment impact evaluation of noise	Level 3
Environment impact evaluation of ground water	Level 3
Ecological environment impact evaluation	Level 3

1.6 Scope, period and focus of evaluation

1.6.1 Scope

Based on experience on environmental impact assessment of domestic similar projects and relevant guides as well as existing environmental conditions in the project area, the Project Office has confirmed evaluation scope and content of assessment topics shown in Table 1.6-1.

Table 1.6-1 List for evaluation scope of the project

Evaluation factor	Evaluation scope	Evaluation period
Surface water (including sediment)	Moat, Taihugang channel, Gangnan channel, Jingsha River, North Lake, West Lake, Horsepond, interconnected water system; agricultural harbour district	Construction phase, operation phase
Ambient 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 Xiongjia Mound as the center;	Construction phase, operation phase
Noise	200m surrounding areas of sub-projects	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, Horsepond	Construction phase, operation phase
Cultural relics protection	Cultural relics protection area of the project location	Construction phase, operation phase

Moreover, World Bank environmental experts hold that wide coverage of this project requires evaluation of upstream and downstream areas the project involves, so the following content and scope of evaluation is added.

Table 1.6-2 List for project evaluation scope of relevant areas

Evaluation object	Evaluation content	Evaluation scope	Evaluation period	Reason for evaluation
Surface water	Impact of tail water of South sewage plant and Caoshi sewage plant	Gangnan channel, Taihugang channel	Operation phase	Waste water in operation phase is planned to discharge into South sewage plant and Caoshi sewage plant
	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 this project
Crime rate	Impact of tourism improvement on crime rates	The Historic Town area	Operation phase	Increasing quantity of tourists will raise crime rates
Disposal of solid waste	Feasibility of waste incineration engineering	——	Operation phase	Domestic garbage
Transport	Historic Town to Xiongjia Mound	Along the transport lines	Operation phase	Impact of this transportation line on neighbouring residents

1.6.2 Period

As for environmental evaluation of this project, the present situation evaluation is set in the year 2015, and the predictable evaluation is set during 2015 to 2020 for peak time of construction and in 2020 and the future after completion of this project.

1.6.3 Focus

Based on the pollution characteristics of this project, present environmental situation in the project area and relevant environmental protection policies, the Project Office has determined work focus of the environmental assessment as follows:

(1) Impact of traffic noise;

(2) Impact of lake and river dredging, side slope building and pipeline laying in construction phase on water, aquatic organisms, terrestrial vegetation and organisms.

(3) Impact of waste gas from underground parking lot, bridges and roads on air and mitigation measures;

(4) Proper selection of dredging method, treatment and disposal of sediment.

2 Overview of Natural and Social Environment

2.1 Overview of natural environment

2.1.1 Geographical location

Located in middle south of Hubei Province and central region of Jianghan Plain, Jingzhou City 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 5000 m far away from the historical site of former capital of Chu State—Jinan City in the north and 20000 m 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 of central city 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.

2.1.2 Climate and weather

Jingzhou City features subtropical monsoon climate with sufficient sunshine, abundant heat and long frost-free days. In the City, the annual radiation of sunshine totals to 104-110kcal/cm^2, the annual sunshine hours are 1800 to 2000 hours, the annual average temperature is 15.9-16.6℃,the annual accumulative temperature of more than or equal to 10℃ reaches 5000-5350℃, the frost-free period lasts for 242 to 263 days per year. In the past many years, the 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 more than or equal to 10℃ reaches 80%. The climate in which water and heat satisfies the needs of agricultural production is suitable for growth of various crops.

2.1.3 Topography

Jingzhou City 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 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 12219 km^2, accounting for 86.9% of the local territory area, while karst mountain areas cover the area of 1840 km^2, accounting for 13.1%.

2.1.4 Hydrology

Jingzhou City is abundant with 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 80000 hectares. Hereinto, Hong Lake is the largest lake in Hubei Province, covering the total area of 35000 hectares, and Long Lake comes second, with the total area of 12000 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 2.1-1 for water system map of the Historic Town.

Figure 2.1-1　　Water system map of the Jingzhou Historic Town

Water environment of the Historic Town consists of the water system in and around the Town, and the water system around the Historic Town is composed of Taihugang channel, Gangnan channel and Jingzhou-Shashi River surrounding the Town. In the past, these water bodies are integrated into the water system in the 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 Town, including moat and water bodies inside the Town. Water bodies inside the Town refer to a series of independent lakes and ponds, including West Lake, North Lake (the Three Kindoms Park), Horsepond 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 Town totals to 17.5 km^2, including 4.5 km^2 inside the Town and 13 km^2 outside the Town. The water surface area of water system inside the Town 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.

Table 2.1-1 Annual water balance table 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 channel	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								
Name	Evaporation	Water drainage of Jingzhou pump station	Water drainage of Jingzhou-Shashi River Gate	Water drainage of Liumen pump station				Total
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 above, water replenishment of Gangnan channel, direct tail water discharge of sewage plant in south, surface runoff and direct discharge of domestic sewage are main water flow into rivers, accounting for29%, 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%.

We also estimate load of major pollution sources in the researched area of 2013, including CODcr, BOD_5, NH_4-N, TN and TP. Table 2.3-5 shows generation of pollution loads in the researched area, Table 2.3-6 presents statistics on current situation of pollution loads, and Table 2.1-4 lists total quantity of rain sewage discharged into rivers/lakes in the researched area.

Table 2.1-2 Load information list of various districts in the research area

District	Final flow direction of	Remarks

name	load	
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 sewage plant
Old city south	Enter City south sewage plant of moat through overflow port	Including overflowing water, domestic sewage into City south sewage plant and runoff pollution
Old city north	Enter Caoshi sewage plant of moat through overflow port	Including overflowing water, domestic sewage into Caoshi sewage plant and runoff pollution

Table 2.1-3 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 2.1-4 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 channel	North Lake	West Lake
Total rain sewage	80.9	1,074	90	54.7	744	13.7	4.8

2.2 Overview of social environment

2.2.1 Economy

From preliminary estimation, GDP of the whole city of 2013 is 133.49 billion Yuan 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 Yuan, increasing 7.8%; the secondary industry completes 17.42 billion Yuan, increasing 19.4%; the tertiary industry completes 19.13 billion Yuan, increasing 10.1%. The per capita GDP increases from 6844 Yuan in 2012 to 8093 Yuan 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 , 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 1.1%, 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%.

2.2.2 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, that's 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.

2.3Protection planning and protection of cultural relics

(1) Categories and historic value of regional cultural heritage

Cultural relic protection units of Jingzhou City total to 595 sites, including 15 national key cultural relic protection units, 52 Hubei provincial cultural relic protection units and 527 key cultural relic protection units 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%.

This article mainly shows information about major cultural relic protection units in Jingzhou District, Shashi District and Xiongjia Mound. Protection levels and distribution can be seen in detail in the following table.

Table 2.3-1 List for national cultural relic protection units in Jingzhou City

National key cultural relic protection units			
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 City)	The Spring and Autumn Period
	Shashi District	Star Temple Tombs(incorporated into the Jinan City)	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 2.3-2 List for provincial cultural relic protection units in Jingzhou City

Provincial key cultural relic protection units					
Unit name	Date of batch	District	Detailed 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	
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	
Xiongjia Mound	Batch 2	Chuandian Town		Chu Dynasty	

Table 2.3-3 List for urban cultural relic protection units in Jingzhou District

Unit name	Batch or publication date	Counties	Detailed address	Age	Category	Unit code	Remark
Zhangjiashan 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 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	423100013	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	423100015	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	423100017	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	423100018	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	423100488	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	423100489	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	423100490	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	423100491	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	423100494	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	423100495	Doc. No.: JZW [1987] No.31.
Lijiatai site 12	1987.4.18	Jingzhou District	Leihu Village of Jinan Township	The Neolithic Age	Ancient site	423100496	Doc. No.: JZW [1987] No.31.
Lijiatai site 13	1987.4.18	Jingzhou District	Songbo Village of Jinan Township	The Neolithic Age	Ancient site	423100497	Doc. No.: JZW [1987] No.31.
Mingjia Camp site 14	1987.4.18	Jingzhou District	Chuandian Village of Chuandian Township	The Neolithic Age	Ancient site	423100498	Doc. No.: JZW [1987] No.31.
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
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 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 Yingcheng Township	The Warring States period, Ming Dynasty	Ancient tombs	423200388	Doc. No.: JZW [1987] No.31. The originally-published address is Yellow Mountain 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 City	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 City	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 City	Qing Dynasty	Ancient building	423300017	Doc. No.:(60) JWHZ No. 0013. The originally-published address is South Gate of Jingzhou City. 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 representati ve 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 Township Governmen t 64	1987.4.18	Jingzhou District	Linghu Management area	1943	Modern significant historic sites and representati ve buildings	423500480	Doc. No.: JZW [1987] No.31. The originally-published 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 2.3-4 List for urban cultural relic protection units in Shashi District

Unit name	Batch or publication date	Counties	Detailed 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.
Xujiatai site 6	1987.4.18	Shashi District	Niwan Village of Guanyindang Township	The Neolithic Age	Ancient site	423100503	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	423100506	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	423100517	Doc. No.: JZW [1987] No.31.
Wenjiagang site 9	1987.4.18	Shashi District	Guanyindang Township	The Eastern Zhou Dynasty	Ancient site	423100520	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	423100522	Doc. No.: JZW [1987] No.31.
Yanglinkou site 11	1987.4.18	Shashi District	Guanyindang Township	The Eastern Zhou Dynasty	Ancient site	423100526	Doc. No.: JZW [1987] No.31.
Huanggang site 12	1987.4.18	Shashi District	Huanggang Village of Cenhe	Han Dynasty	Ancient site	423100531	Doc. No.: JZW [1987] No.31.

			Township				
Junliutai site in the Neolithic Age 13	1987.9.22	Yuqiao Development Zone	Construction Village of Union Township	The Neolithic Age	Ancient site	423100551	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	423100552	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	423100553	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	423100554	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	423100555	Doc. No.: SZW [1987] No. 78.
Xiyejia River site in the Eastern Zhou Dynasty 18	1987.9.22	Shashi District	Changhu Village of Luochang Township	The Eastern Zhou Dynasty	Ancient site	423100556	Doc. No.: SZW [1987] No. 78.
Fanjiayuan site in the Han Dynasty 19	1987.9.22	Shashi Farm	Fanjiayuan of Zhuanqiao Fishery	Han Dynasty	Ancient site	423100557	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	423100558	Doc. No.: SZW [1987] No. 78.
Ancient City site of Shashi 21	1987.9.22	Shashi District	Victory Street	Qing Dynasty	Ancient site	423100559	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	423200009	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	423200384	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	423200404	Doc. No.: SZW [1987] No. 78.
Dongyue Temple 25	1960.4.23	Shashi District	Shancha Village of Cenhe Township	Qing Dynasty	Ancient building	423300016	Doc. No.:(60) JWHZ No. 0013. The originally-published address is
Shashi 26	1960.4.23	Shashi District	Bianhe Township	Qing Dynasty	Ancient building	423300018	Doc. No.: SZW [1987] No. 78.
Yiyang Temple 27	1960.4.23	Shashi District	Yiyang Village of Guanyindang Township	Qing Dynasty	Ancient building	423300020	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	423300205	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	423300206	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	423400111	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	423500038	Doc. No.:(60) JWHZ No. 0013. The year shall be 1907. The originally-published address is Jiangtai Commune.
Revolutionary site of No. 18, Qingyang Lane 32	1960.4.23	Shashi District	Qingyangxiang Township	1938—1939	Modern significant historic sites and representative buildings	423500041	Doc. No.:(60) JWHZ No. 0013.
Revolutionary site of No. 77, Meitai Lane 33	1960.4.23	Shashi District	Meitaixiang Township	1945—1949	Modern significant historic sites and representative buildings	423500042	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	423500044	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	423500497	Doc. No.: SZW [1987] No. 78.
Martyrs' Cemetery 36	1987.9.22	Shashi District	Hongmen Road	1957	Modern significant historic sites and	423500498	Doc. No.: SZW [1987] No. 78.

					representative buildings		

From the Table above, key national cultural relics total to 11 items, including Hubei Jinan Old City, 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. Among them, Jingzhou Ancient Walls have been in the alternative list of the World Cultural Relics. Moreover, provincial cultural relic protection units sum up to 22 and urban cultural relic protection units in Jingzhou and Shashi Districts amount to 107.

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.

(2) Cultural relic protection units in the project-involved areas

Cultural relic protection in proposed project mainly involves Jingzhou Ancient Walls, Xiongjia Mound, jingzhou Museum, Historic architectures and Kaiyuan Taoist Temple, etc. See Project Analysis and Analysis on Impacts of Cultural Relics for contents of the project.

(3) Protection planning of cultural relics in project areas

In recent ten years, governments at province, city and county levels have formulated corresponding protective plans to protect cultural relics in Jingzhou. The planning ranges from overall regional plans to partial detailed plans.

The most representative 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 safeguards. These planned contents are also taken as important basis to formulate the environmental assessment.

(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.

2.4 Current situation and evaluation of ecological environment quality

2.4.1 Terrestrial ecological environment

2.4.1.1 Overview of environment in evalution areas

The project involves such water systems as moat, horse pond, North Lake, West Lake and Northeast pond, etc. It is seen through on-site survey that the project-involved 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.

2.4.1.2 Scope and method of survey

The survey and evaluation on current situation of ecological environment of this project is conducted based on field survey and existing materials, outdoor survey and analysis on indoor materials, 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.

2.4.1.3 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.

2.4.1.4 Methods of survey and evaluation

1. Material collection

Collect and sort out materials on biodiversity in the project-involved areas, as well as on forestry, environmental protection, water conservancy, agricultural department and territorial resources, and refer to research papers on animals and plants officially published in the involved areas.

2. Outdoor 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.

(1) Survey on terrestrial plants

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.

Based on the field survey, the team confirms typical community sections and does a survey on communities by means of releve method. Lintongyan Company selects and divides path of survey which begins from the old South Gate towards west. Then the team shall investigate the eleven-kilometer-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.

2.4.1.5 The status and evaluation of terrestrial plants

Plant Flora

The evaluation scope belongs to China~Japan forest flora. Here gathers various distributions, among which 42.5% are tropical, and 57.5% belong to temperate zone, reflecting that the area of temperate zone is well-developed.

Vegetation Type and Biomass

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 2.4-1.

Table 2.4-1 The Main Vegetation Types of the Ancient City 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 this 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.

Figure 2.4-1 Chinese weeping cypress (*Cupressus funebris* Endl.)

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)

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 bushwood 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.

Figure 2.4-2 Black locust (Robinia pseudoacacia L)

(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.

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.

Figure 2.4-3 Paper mulberry (*Broussonetia papyrifera* (Linn.))

(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 coverage of about 30%, consisting of calamint (Phytolacca acinosa), buttercup (Ranunculus sp.), rough cocklebur (Xanthium sibiricum), and so on.

Figure 2.4-4 Broad-leaf privet (Ligustrum lucidum)

(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 2.4-5 Camphor Tree (*Machilus ichangensis* Rehd. et Wils)

III Bushwood

In terms of type, the bushwood of this 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.

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.

Key Protected Plants and Ancient and Famous Trees

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.

(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.

2.4.1.6 The status and evaluation of terrestrial animals

i. Amphibian

(1)Species

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 2.4-2.

Table 2.4-2 The 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

(2)Ecological distribution

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

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

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

ii. Reptile

1. Specy, amout and distribution

There are reptiles belong to 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 2.4-3:

Table 2.4-3 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.

2. Ecotype

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

Brushwood-Type: *Eumeces chinensis, lygosoma indicum, agkistrodon blomhoffii, dienagkistrodon acutus* and z*aocys dhumnades.* They mainly live in brushwoods of the evaluation area, and are closely related to human activities.

Residence-Type: *Gekko japonicus*, they live in the houses of residents.

Water-inhabited-Type (reptiles living and foraging in water): includes *Chinemys reevesii* and *Pelodiscus sinensis*. They have a certain distribution in water bodies.

3. Fauna

According to the fauna of reptiles, they can be divided into two catagories: 3 species belong to oriental fauna, and 5 species belong to cosmopolitan fauna, which occupies 37.5％ and 62.5% respectively.

iii. Mammalia

1. Specy, amout and distribution

There are mammalias belong to 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 2.4-4。

Table 2.4-4 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.

2. Ecotype

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

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.

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

3. Fauna

The mammalias of the evaluation area can be divided into 3 faunas: 3 species of cosmopolitan fauna, occupying 50%; 2 species of oriental fauna occupying 50%; one specy of palaearctic fauna, occupying 16.7%.

iv. Aves

1. Specy, amout and distribution

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 6.3-4.

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%.

Table 2.4-5 The status of birds of the evaluation area

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.

2. Ecotype

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.

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.

3. Fauna

According to *Zoogeography of China* (Edited by Zhang Rongzu, 2011), the bird in the evaluation area includes 3 faunas, which are oriental fauna, including 2 species, occupying 25%; palaearctic fauna, including 5 species, occupying 62.5%, and cosmopolitan fauna, including 1 specy, occupying 12.5%.

4. Residential type

According to birds' behavior of migration, we can devide the birds of the evaluation area into 2 residential types: summer visitor, including 1 specy, occupying 12.5%; resident bird, including 7 species, occupying 87.5%.

iv.Key protected animal

The 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.

2.4.2 The status and evaluation of aquatic organism

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

2.4.2.1 The status of 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.

2.4.2.2 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 city moat is poor.

2.4.2.3 The status of fish resources

The fishes of the city moat includes: L. tientaiensis hansuiensis, misgurnus anguillicaudatus, P. potanini, Ctenopharyngodon idellus, Opsariichthys bidens, Pseudorasbora parva, Abbottina rivularis, Percocypris, Acrossocheilus yunnanensis, Onychostoma simum, Garraorientalis, Pseudogyrinocheilus prochilus, Schizothorax sinensis, etc.

2.5 The evaluation of the status of the environmental quality

This project includes dredging project, sewage pipe network project, wetland project, revetment project and water systems connection project. 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, we mainly considered the effect of tail gas from relevant underground garages. This part of evaluation and analysis are based on relevant results from Jingzhou Environment Monitoring Station from December 2014 to February 2014.

Figure 2.5-1 Monitoring points distribution

2.5.3 The Evaluation of Environmental Quality of Surface Water

This monitoring is conducted by Jingzhou Environmental Monitoring Station, in December 2014. For detailed monitoring report, please take a look at the document Jingzhou Environmental Monitoring Station (2014) Huan Jin Zi NO. 108 *World Bank Financed Hubei Jingzhou Historic Town Conservation and Protection Project.* From table 2.3-3 and table 2.3-4, we can see that the water quality changes a lot over time, and the water quality of different sections is also different. The existing monitoring data is not enough to analyze the variation of water quality in different seasons and sections, but it can reflect that the general water quality of the historic town is worse than Grade v defined in *Environment Quality Standard of Surface Water* (GB3838-2002). The main exceeding pollutant is ammonia nitrogen, total nitrogen and total phosphorus. The water quality of Taihu Gang canal is better than the moat, which reaches Grade V. The main exceeding pollutant is total nitrogen and total phosphorus.

The monitoring results of the water quality of water systems of the historic town show that, the waterquality of all monitoring points can't reach the standard of Grade III of *Environment Quality Standard of Surface Water* (GB3838-2002). 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.

Table 2.5-3 The monitoring data statistics of the surface water of the city on June 5, 2014 and June 27, 2014

The latest monitoring data of 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
500m east of the south gate	Drought	June 5th	6.87	16	5.56	3.37	8	2.77	7.24	0.372
	Rain	June 27 th	7.02	28.6	9.17	2.65	10	1.06	4.14	0.205
100m south of the east gate	Drought	June 5th	7.4	33.8	11.1	17.85	5	0.66	5.75	0.325
	Rain	June 27 th	7.05	29.8	10.1	3.25	6	0.94	4.6	0.433
200m east of the new north gate	Drought	June 5th	7.17	57.6	18.1	6.13	7	15.1	17.1	1.36
	Rain	June 27 th	7.24	32.2	10.2	1.08	10	7.06	9.54	1
Taihugang entrance of the city	Drought	June 5th	6.59	10.8	3.96	4.34	14	0.47	4.38	0.493
	Rain	June 27 th	6.95	12.7	4.12	4.03	12	0.46	2.67	0.215

Taihugang exit of the city	Drought	June 5th	6.59	10.8	3.96	4.34	14	0.47	4.38	0.493
	Rain	June 27 th	6.95	12.7	4.12	4.03	12	0.46	2.67	0.215
Center of the North Lake	Rain	June 27 th	7.16	37.1	11.7	2.55	13	1.62	4.3	0.59
Center of the West Lake	Drought	June 5th	6.75	63.8	20.3	2.3	19	2.88	5.55	1.36
	Rain	June 27 th	6.7	85.7	25.8	0.84	130	6.8	7.5	1.25
Center of the Xima Lake	Drought	June 5th	6.69	15.6	5.34	6.53	5	0.5	2.26	0.127
	Rain	June 27 th	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		1	1	0.2

Table 2.5-4 2012～2014 The routine monitoring data statistics of Jiulongyuan Section of the City Moat, North Lake, West Lake and Xima Lake

The routine monitoring data statistics of 2012~2014									
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	2012-3-1	7.91	15.6	3.9	6.17	0.895	2.28	0.18
Jiulongyuan	normal	2012-5-4	7.93	11.5	2	7.45	0.912	2.32	0.18
Jiulongyuan	high	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
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
Center of the North Lake	high	2013-8-5	8.43	38.6	6.81	8.66	1.19	3.31	0.91
Center of the North Lake	low	2014-12-30	7.58	37	12.9	8.34	4.34	7.05	0.4
Center of the West Lake	high	2013-8-5	8.31	38.2	8.9	4.81	0.909	3.34	0.87
Center of the West Lake	low	2014-12-30	6.43	23.7	8.29	0.86	5.91	7.2	0.7
Center of the Xima Lake	high	2013-8-13	8.12	43.7	9.52	8.05	0.811	3.23	0.7
Center of the Xima Lake	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

2.5.4 Status evaluation of atmospheric environment quality

In order to understand the air quality of the project area, we entrusted Jingzhou Environmental Monitoring Station to monitor the atmospheric environment quality of the project area in December 2014.

(1) Monitoring items: Sulfur dioxide, nitrogen dioxide, particulate matter, ammonia, hydrogen sulfide, with a simultaneous meteorological observation of wind direction and wind speed.

(2) Monitoring points: set two monitoring points at 500m upwind and downwind direction of the proposed visitor center, and four monitoring points at 500m upwind and downwind direction of the northwest and southwest of the city wall.

Table 2.5-5 Atmospheric monitoring points

Number		Position	Direction of the site	Distance	Setup instructions
Visitor 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 corner	3#	Upwind	N	500m	Clean control point in upwind direction, 0 degree.
	4#	Downwind	S	500m	Control point in downwind 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
The point name above will be subject to the actual point setting.					

(3) Monitoring time and 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.

(4) Monitoring and analyzing methods: as shown in table 2.5-5。

Table 2.5-6 List of atmospheric monitoring and analyzing method

Category	Monitoring items	Analyzing method and its resource
Atmosphere	SO_2	Formaldehyde-hydrochloric pararosaniline spectrophotometry method. HJ 483-2009
	NO_2	N-(1-naphthyl)-ethylenediamine dihydrochloride spectrophotometric method HJ 479-2009
	PM10	Gravimetric method HJ618-2011
	Ammonia	Sodium hypochlorite - salicylic acid spectrophotometric method HJ534-2009
	Hydrogen sulfide	Methylene blue spectrophotometric method *Air and Waste Gas Monitor Analysis Method (Fourth edition, SEPA, 2003)*

(5) Monitoring results

Table 2.5-7 List of standard index of atmospheric monitoring results

Area	Point	Item	Pollutant	Concentration range mg/m³		Standard values mg/m³	Over standard rate	The maximum concentration of standard rate	Demonstrating compliance
				Minimum value	Maximum value				
Visitor center	1	Hour value	SO_2	0.025	0.055	0.5	0	11%	Reach the standard
			NO_2	0.015	0.029	0.2	0	14.5%	Reach the standard
		Daily average value	SO_2	0.02	0.028	0.15	0	18.7%	Reach the standard
			NO_2	0.014	0.019	0.08	0	23.75%	Reach the standard
			PM_{10}	0.105	0.214	0.15	85.7%	143%	Exceed standard
	2	Hour value	SO_2	0.021	0.056	0.5	0	11.2%	Reach the standard
			NO_2	0.013	0.026	0.2	0	13%	Reach the standard
		Daily average value	SO_2	0.017	0.029	0.15	0	19.3%	Reach the standard
			NO_2	0.013	0.018	0.08	0	22.5%	Reach the standard
			PM_{10}	0.096	0.21	0.15	85.7%	140%	Exceed standard
The yard in the northwest corner	3	Hour value	NH_3	0.055	0.128	0.2	0	64%	Reach the standard
			H_2S	——	0.003	0.01	0	30%	Reach the standard
	4	Hour value	NH_3	0.046	0.106	0.2	0	53%	Reach the standard
			H_2S	——	——	0.01	0	0	Reach the standard
Southwest corner	5	Hour value	NH_3	0.046	0.108	0.2	0	54%	Reach the standard
			H_2S	——	——	0.01	0	0	Reach the standard
	6	Hour value	NH_3	0.041	0.123	0.2	0	61.5%	Reach the standard
			H_2S	——	——	0.01	0	0	Reach the standard

The monitoring results indicate that, in the area of the Vistor Center, the hour values and daily average values of SO_2, NO_2 all meet the standard of the second area of GB3095-2012 *Ambient Air Quality Standard.* In the northwest corner and southwest corner of the city, NH3 and H2S 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 Visitor Center exceed the imiting value of the second 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%.

2.5.5 Status Evaluation of Environmental Quality for Noise

In order to understand the status of local acoustic environment quality, we entrusted Jingzhou Monitoring Station to set up 16 monitoring points around the project area, according to Environmental Quality Standard for Noise (GB3096-2008).

2.5.5.1 Monitoring points and the locations

According to the setting principle of noise monitoring points in HJ2.4-2009, the monitoring points are set as following:

Table 2.5-8 The setting of noise monitoring points

Location	Number	Function	Notes
East vistor center	4	Perimeter monitoring	The location of the visitor center can be found in atmospheric monitoring points as a reference.
The side facing Dongdi Street of the Catholic Church on Dongdi Street	1	Sensitive point	Area of category 2
The 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

2.5.5.2 Monitoring items and methods

(1) Monitoring item: Leq(A)

② Monitoring periods, methods and instruments: An one-time measurement is set to be conducted in December 2014, 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. Monitoring method is with reference to recommendation method in *Emisson Standard for Industrial Enterprises Noise at Boundary* (GB12348-2008), and Environmental Quality Standard for Noise (GB3096－2008). Measuring instrument is hs5670 pulse integrating sound level meter.

2.5.5.3 Monitoring Results

The monitoring results (shown as table 2.5-8) 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.

Table 2.5-9 Environmental noise monitoring results

No.	Monitoring points	Monitoring date	Monitoring results	
			Day dB(A)	Night dB(A)
1	North of the northeast visitor center	February 12, 2015	58.4(65)	46.9(55)
2	West of the northeast visitor center		59.8(65)	49.2(55)
3	South of the northeast visitor center		61.3(70)	48.2(55)
4	East of the northeast visitor 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.				

2.5.6 Status Evaluation of Groundwater Environmental Quality

2.5.6.1 Monitoring points and the locations

This project selects the sampling of the underground water well on Democratic Street to analyze.

2.5.6.2 Monitoring items and methods

①Monitoring 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.

②The method of monitoring sample: Water samples collection, preservation and analysis are according to Environmental Monitoring of Groundwater (HJ/T

164-2004).

2.5.6.3 Monitoring time and frequency

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

2.5.6.4 Monitoring Results

As shown in table 6.4-6, among the present situation of the groundwater well point on Democratic 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 are 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.

Table 2.5-10 The List of the standard indexes of groundwater monitoring results

Item	The vistor 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
Cr6+	0.006	0.01

2.5.7 Status Evaluation of Sediment Environmental Quality

Because the moat and water body within city mainly receive domestic sewage discharged directly from surrounding and tail water from sewage plant on the south of the city, 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 point and layer.

2.5.7.1 Monitoring Points

Table 2.5-11 Field Data Log Sheet of Lacustrine Sediment Sampling

Sampling Time: March 5 - March 6		The 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 H≤0.3	Gray	Stench	30°21′8.67″	112°10′39.01″
	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		

2.5.7.2 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.

2.5.7.3 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 Treatment Plant.* The analytical method is as shown in table 2.5-11.

Table 2.5-12 The analytical method of pollutant in lacustrine sediment

No.	Item	Measuring method	Detection limit (mg/kg)
1	Ph value	Glass electrode method	——
2	Moisture content	Frozen difference method	——
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

2.5.7.4 Monitoring results

In this evaluation, we conducted 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.

- **Analysis on compliance with the secondary standard of *Environmental Quality Standard for Soils (*GB15618-1995)**

As shown in table 2.5-12, 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*).*

- **Analysis on compliance with *Control Standards for Pollutants in Sludges from Agricultural Use(*GB4284-84*)***

As shown in table 2.5-12, 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.

- **Analysis on compliance with table 6 of *Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (*GB18918-2002*).***

According to table 2.5-12, 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 Treatment 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.

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

According to table 2.5-12, 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 Treatment 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 Treatment 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 Treatment 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 Treatment 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.

- **Analysis on compliance with standard GB/T23485-2009 Disposal of Sludge from Municipal Wastewater Treatment Plant – Quality of Sludge for Co-Landfilling**

As can be seen in Table 2.5-12, the content of heavy metors 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 Treatment 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 Treatment 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 Treatment 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.

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

As seen in Table 2.15-12, 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 2.5-13 Monotoring results of sediment

Indicator		pH	Water content	Organic matter	Cyanide	Total nitrogen	Total phosphorus	Mercury	Zinc	Copper	Cadmium	Lead	Total chromium	Total selenium	Nickle	Arsenic
		(no dimension)	(%)	(%)	(mg/kg)	(%)	(%)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(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 Sludges from Agricultural Use		≥6.5	——	——	——	——		15	1000	500	20	1000	1000	——	200	75
GB18918-2002 Pollutant Discharge Standard of Municipal Wastewater Treatment Plants		≥6.5	——	——	——	——		15	3000	1500	20	1000	1000	——	200	75
GB/T23486-2009 Disposal of Sludge from Municipal Wastewater Treatment 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 Treatment 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

2.6Existing problems in the project area

Table 2.6-1 Environmental condition in the Jingzhou historic town area

City	Subproject	Current conditions of the area	Waste water discharge condition
Jingzhou City	Cultural relics protection and tourism promotion	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 Xiongjia Mound 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 Sewage Treatment Plant (15.4258 million m^3/a) and direct discharge of domestic sewage (8.2466 million m^3/a)
	Water environment and ecosystem improvement	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 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 treatment plants need to be enhanced.	
	Transportation enhancement	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 environmental protection and cultural relics protection are the urgent needs of the project area.

Current conditions of the moat and the West Lake

Section of a typical wall and construction technology

Current conditions of pinion wall and abutment wall

Current conditions of vegetation on the walls

Sewage discharge outlets

Current conditions of historic streets

Current conditions of Kaiyuan Taoist Temple

Current conditions of the museum


Current conditions of Xiongjia Mound


Current conditions of the land planned for tourist center


Current conditions of the water diversion works from the Yangtze River to the Han River


Current conditions of the surface of Inner Ring Road

Dirt road section of the Inner Ring Road

Car parking condition inside the historic town

Traffic conditions of Jingzhou Middle Road and the East Gate

3 Project Profile

3.1 Project name, nature and location

Name: World Bank Financed Hubei Jingzhou Historic Town Restoration and Protection Project;

Nature: Comprehensive environmental treatment (including treatment for newly-built, rebuilt and expanded buildings);

Location: Jingzhou District, Jingzhou City, Hubei Province;

Project construction period: 5 years, with total investment of 1.1104 Billion Yuan.

3.2 Project Content

The project mainly includes four major projects, as listed and explained in the following table.

Table 3.2-1 Contents of Projects to Be Completed

Project No.	Name of sub-project	Project Content
A	Protection of cultural heritage and development of tourism	
A1	Restoration and protection of Jingzhou ancient city wall	
A1-1	Protection of West City Wall	Repair of brick city wall: 12609m^2, repair of brick buttress wall: 2196 m, repair of walkway on top of city wall: 4831.2 m^2,1518.3 m^3, repair of mud city wall: 6307.6 m^3
A1-2	Construction of retaining wall of ancient city wall	Construction of retaining wall:950m^3
A1-3	Plant protection and restoration of ancient city wall	1. Reservation and protection of good vegetation; 2. Removal and replacement of poor vegetation 3. Plant more good vegetation; total area of 94800 m^2
A2	Environmental improvement and utilization of Kaiyuan Taoist Temple	
A2-1	Environmental engineering of roads and greening	Road maintenance, afforestation, repair of fence
A2-2	Scenic spot construction engineering	Including some project construction such as Shanmenwai square, Shanmennei square, Xianyun pavilion, Handan Qijun, and Shuangting Beilang.
A2-3	Protection and exhibition of other portable antiques	Mainly including renovation of Scholars Memorial Archway, protection and exhibition of stele and stone carving and protection of stone manger
A3	Transformation and upgrading on display of cultural relics in Treasures Museum of Jinzhou City Museum	
A3-1	Comprehensive renovation engineering on building in the Treasures Museum	Adjustment of visitor stream, adding of public service facilities and barrier-free facilities, renovation of earthquake resisting, thermal insulation and energy saving, water proof and moisture proof and appearance for building,
A3-2	Engineering of exhibition and display of Treasures Museum	1, Chule Palace is new multi-functional display hall with both performance and exhibition contents; 2, Exploration site and background introduction in *Jingzhou Lantau Peak-No. six eight Han Dynasty Tombs Exhibition* will be added by multimedia; 3, Exhibition and display antique will be increased in *Ancient Lacquer Wares Exhibition* to extend introduction on achievement, print making and colored drawing processes for Chinese ancient printing culture archaeology 4, The manufacturing process and traditional loom for copy to exhibiting ancient silk will be increased in *Chu-han Embroidery Exhibition*
A3-3	Facility installation engineering of Treasures Museum	1, Optimal air conditioning equipment, adopt air-cooling module and fan coil or cabinet type and ceiling suspended air handling. New fan and desiccating machine constitute semi-central air conditioning system to strengthen moisture control. Lake type water source heat pump is used to be cold and heat source. 2, Safety and security facilities, including adjustment and addition of alarm point, removal and recovery of fire control broadcast and installation and perfection of automatic spray and auxiliary gas fire extinguishing system.
A3-4	Landscape and accessory engineering	Remove the hall, the space on the left is reconstructed to rest pavilion. The most of road facing the hall is removed. Enter space viewing platform is built by landscape design and barrier-free ramp is arranged around the pavilion.

A4	Restoration and reutilization of historic buildings	Two building groups are selected, including 13 historic buildings and land plots with total land area of 4282 m^2, as Exemplary Base of history building rehabilitation and reusing in Jingzhou ancient city heritage protection
A5	Phase II construction of national archaeological site park of Xiongjia Tomb	
A5-1	Landscape and infrastructure projects	Mainly including Chuyulin landscape engineering, farmland consolidation engineering, construction engineering of Phase II parking, laying engineering of bituminous pavement from parking to main ring road, renovation engineering of academic exchange center, construction engineering of outdoor green spray system and construction engineering of tourist service felicity.
A5-2	Site exhibition engineering	Including carriages and horses pit site protection and exhibition hall display engineering and memorial ceremony for tombs protection exhibition engineering
A5-3	Excavation exhibition engineering	Mainly including construction engineering of display hall, landscape engineering of display hall and surrounding, exhibition engineering of indoor exhibition and equipment purchase for multi-functional hall.
A5-4	Identification and navigation system engineering	Including identification system, navigation system and online museum establishment.
A5-5	Management system engineering	Including public management system construction and safety and security management system construction.
A6	Support development of tourism industry	
A6-1	Visitor center	East door visitor center 2451 ㎡, parking
A6-2	Greenbelt construction and improvement in the park and garden	
A6-3	Tourism identification and navigation information service system for ancient city	
B	Improvement of ecological environment and water environment of historic town	
B1	Dredging of moat and lakes in historic town	Dredging of moat and the fish ponds on its two sides, West Lake, Northeast Pond, including transportation of sludge and sediment of 301,900 m3 in total
B2	Sewage pipe network subproject	Including three parts: new construction of main sewage pipes outside the moat, supplement and improvement of combined system main interception pipes in historic town, and supplement of combined system collection pipes in historic town.
B3	Moat, lakes and wetland subproject	Constructed wetland of moat, ecological revetment, constructed wetland of lakes and ponds
B4	Improvement of water resources connection and ecological building of river and lake	Including water system connection, water source improvement (water supplement system) and construction of power system in historic town
C	**Traffic convenience enhancement**	
C1	Road traffic system	
C1-1	Inner Ring Road renovation	Make plans for local anticlockwise one-way traffic and local two-way traffic on Inner Ring Road, and make renovations for some motor ways and sidewalks.
C1-2	Inner Ring Road node renovation	Renovate intersection of Inner Ring Road/Yingdu Road (New South Gate), intersection of Inner Ring Road/Aimin Road(Old South Gate), intersection of Inner Ring Road/Renmin Road (New North Gate), intersection of Inner Ring Road/Tuotafang Road, intersection of Inner Ring Road/Jingnan Road (East Gate). Renovation measures include optimizing channelization design for intersections, adding pedestrian crossings and

		non-motor ways.
C1-3	Renovation of key nodes inside the historic town	Renovate 5 nodes at the intersections of Jingzhong Road/Yingdu Road, Jingzhong Road/Quyuan Road, Jingnan Road/Quanyuan Road, Jingzhong Road/Renmin Road, and Jingbei Road/Renmin Road; renovation measures include optimizing the channelization design for intersections, optimizing timing plan for traffic lights, and improving non-motor ways and pedestrian crossing facilities.
C1-4	Renovation of node at Jingzhou Avenue/Jingnan Road	Optimize the channelization design for intersections, optimize timing plan for traffic lights, and improve non-motor ways and pedestrian crossing facilities, so as to meet the traffic requirements in 2020 and reduce delay at nodes.
C1-5	Node at East Gate Tourist Center on Jingzhou Avenue	The node does not have any channelization markings or traffic lights at present. When the East Gate Tourist Center is completed, the channelization renovation and traffic lights at supporting nodes should be equipped.
C2	Slow traffic system	
C2-1	Bikeway system renovation	(1) For two-way 4-lane roads that have marked bikeway with width of over 1.5m (such as Jingzhong Road (West Gate-Quyuan Road Section) and Quyuan Road), colored asphalt bikeway shall be paved; (2) add separated bikeway with separation guardrails in the one-way sections of Inner Ring road; (3) add colored asphalt bikeways inside the scenic spot (such as the Horse Pit Park) and form a system with the slow traffic lanes in the road network; (4) add supporting facilities for bikeways such as indication signs.
C2-2	Footpath system renovation	(1) For roads that have sidewalks with width of over 6m (Jingbei Road, Quyuan Road, Jingzhong Road, Jingdong Road), add separation piles that separate motor vehicles and clean up vehicles that park on the sidewalks; (2) Renovate the sidewalks and pedestrian crossing facilities on Inner Ring Road; (3) Restore and renovate the bridleway.
C2-3	Renovation of pedestrian crossing facilities	Transform existing 12 zebra crossings into three-dimensional zebra crossings and add yellow lamp. It is suggested to adjust traffic signal lights at 4 intersections.
C3	Public transit system	
C3-1	Tourist attraction connection bus system	Line 1 and Line 2 are both ring lines. Line 1 is anticlockwise along the Inner Ring Road with 18 stations; Line 2 is clockwise along the bridleway with 15 stations.
C3-2	Improvement of public transit system in historic town	(1) Change the 12 linear bus stops into bay bus stops and renovate the shelter at 1 bus stop; (2) set up 28 electronic bus-boards; (3) upgrade 50 buses of Line 15, Line 18 and Line 103 to hybrid power buses.
C3-3	Tourist bus system from historic town to Xiongjia Mound	The bus line between the historic town to Xiongjia Mound starts at the East Gate Tourist Center and ends at Xiongjia Mound via Jingzhou Avenue, North Ring Road, and Jing-Ying Highway. The whole bus line is about 40km. Average run time is 1.5h. Two main stations are built, namely the East Gate Tourist Center Station and the Xiongjia Mound Station. It will be required to equip 10 hybrid power tourist buses (each with 45 seats).
C4	Traffic Marking system	
C4-1	Static traffic marking system	Including the traffic markings within and outside the historic town (markings of scenic spots will be completed in the tourist sits special plan, while the traffic markings have been included in the above sub-projects and will not be repeated here.

C4-2	Dynamic traffic marking system	Including traffic guidance marking system (VMS), parking guidance marking system and control center of historic town dynamic transportation guidance.
D	**Project management and institution ability enhancement**	
D1	Design review, project management and monitoring and evaluation consulting services	Including project management consultation, tendering agency services, resettlement plans, environment, external social monitoring, consultation services for external resettlement monitoring, consulatation services for environmental management plan
D2	Equipment procurement of project office and implementing institutions	Including collaborative office management system, development of subsystems such as project management system; debugging and maintenance
D3	Training and investigation	Including international and domestic training, service training of resident's tourism service skills; special training on protection of the historic and cultural relics of historic town (conduct investigation on the involved Jingzhou cultural relics protection institutions and conduct training of cultural relics protection. Conduct training on management skills of cultural relics.
D4	Research project and management system	Including hydraulic and water quality model, construction of related management websites and conduct planning research.

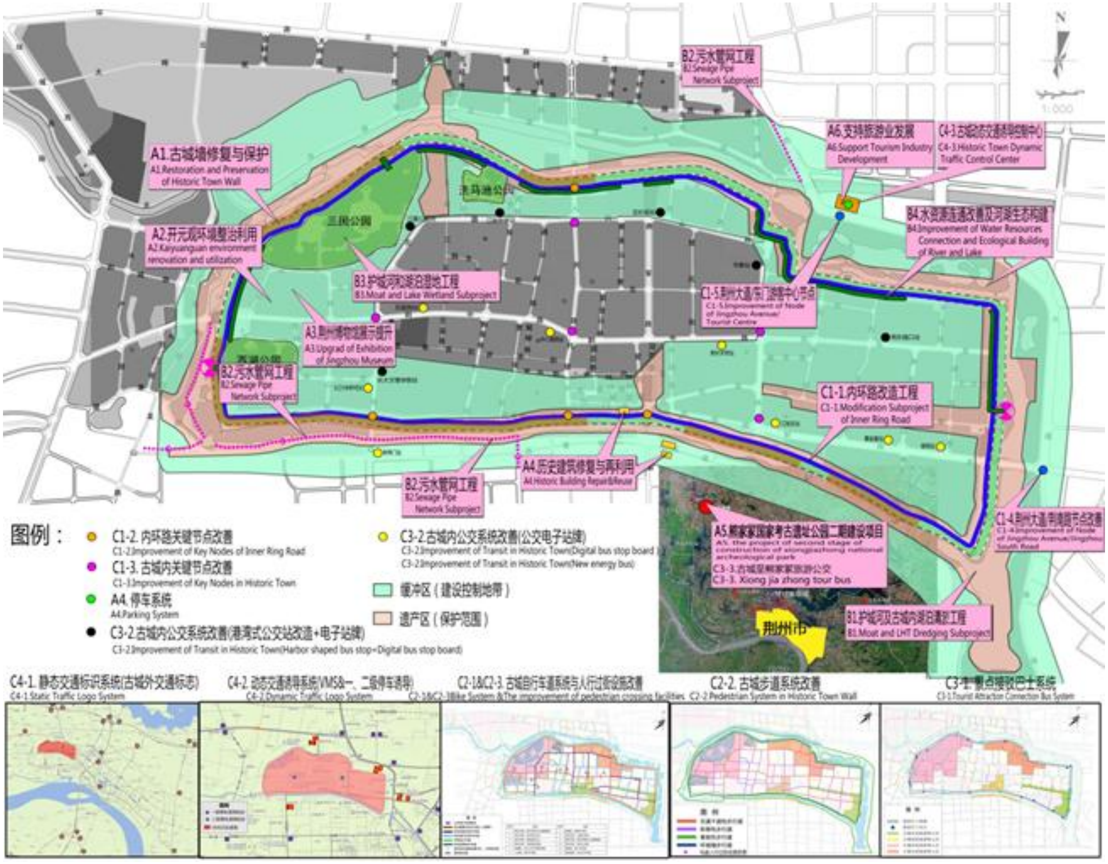


Figure 3.2-1 Specific location of each sub-project

3.3 Project location

For specific project schemes, refer to the feasibility report and each specific report. This environmental assessment mainly introduces the location of the specific projects. Moreover, this environmental assessment only provides analysis for A, B, C types of projects. Type D projects are only listed in Table 3.2-1 but will not be analyzed in this report.

Figure 3.3-1 Map of Location of Historic town restoration, enhancement of museum, environmental management of Kaiyuanguan Temple, restoration of historic streets, tourist center and parking lot

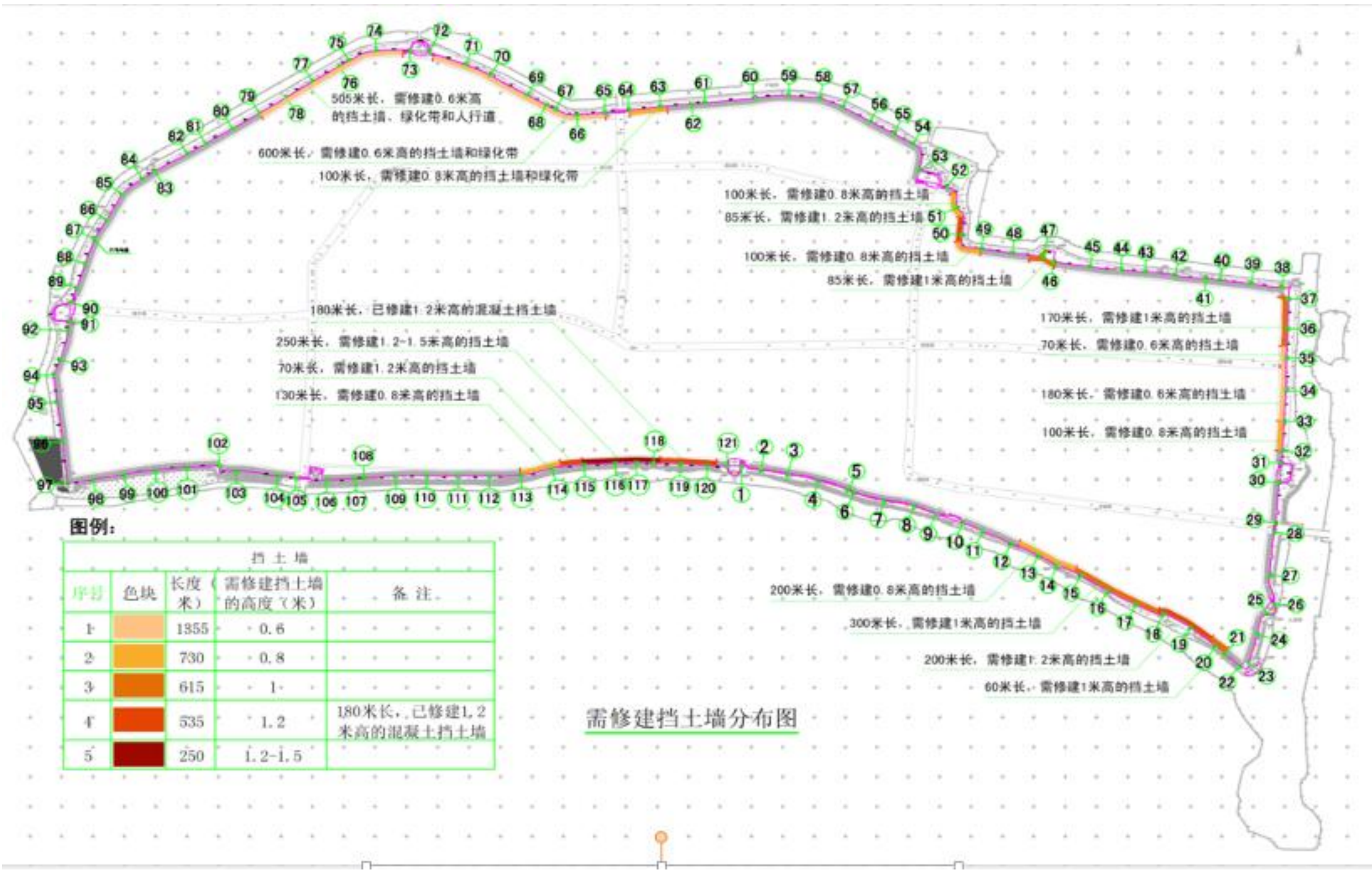


Figure 3.3-2 Distribution of retaining wall

Figure 3.3-3 Planning of Xiongjia Mound

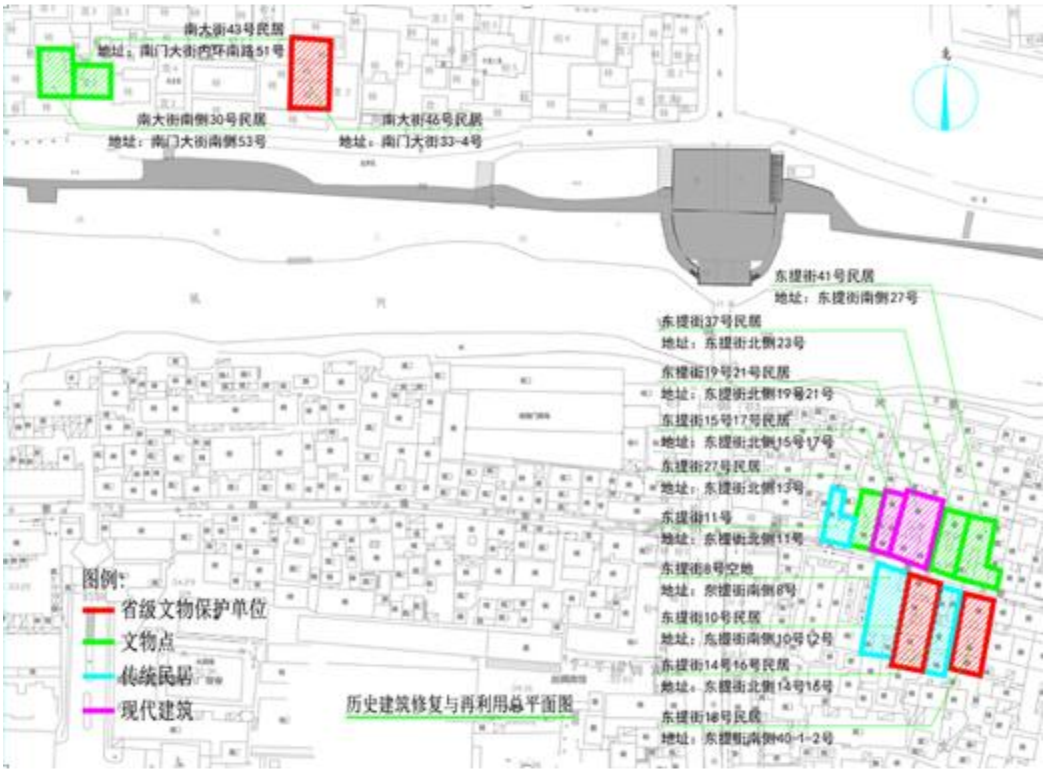


Figure 3.3-4 Layout of historic streets

Figure 3.3-5 Overall layout of Kaiyuan Taoist Temple

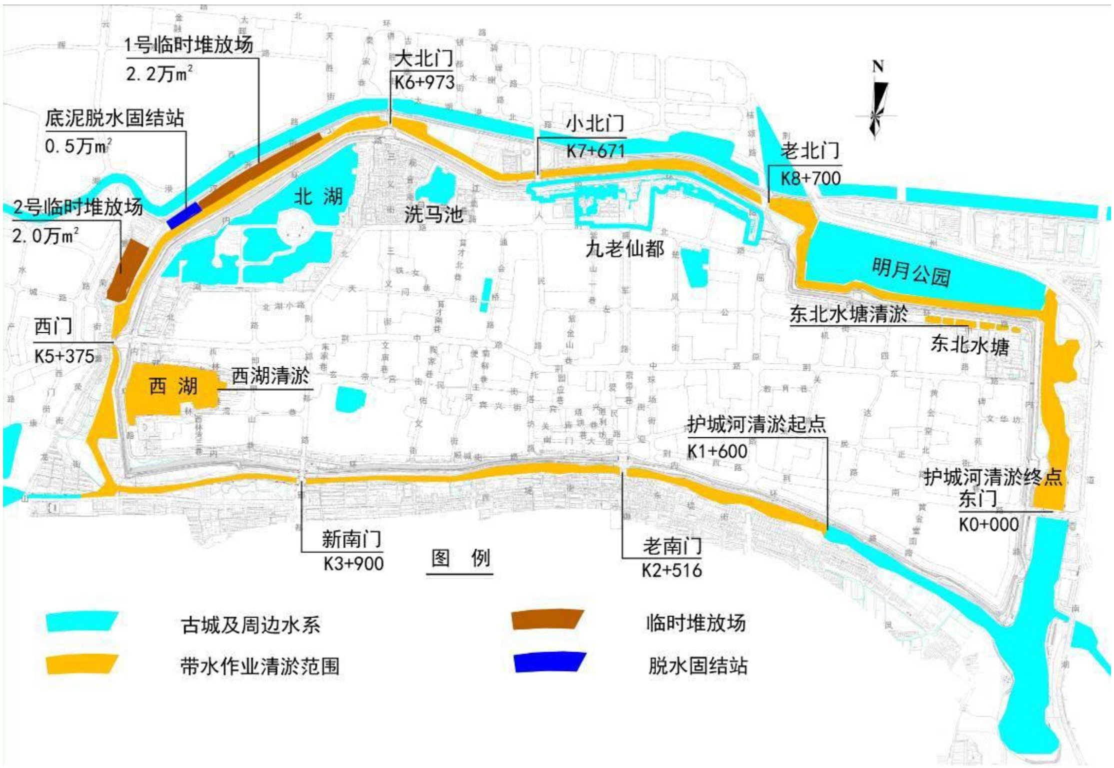


Figure 3.3-6 Sketch map of desilting scope

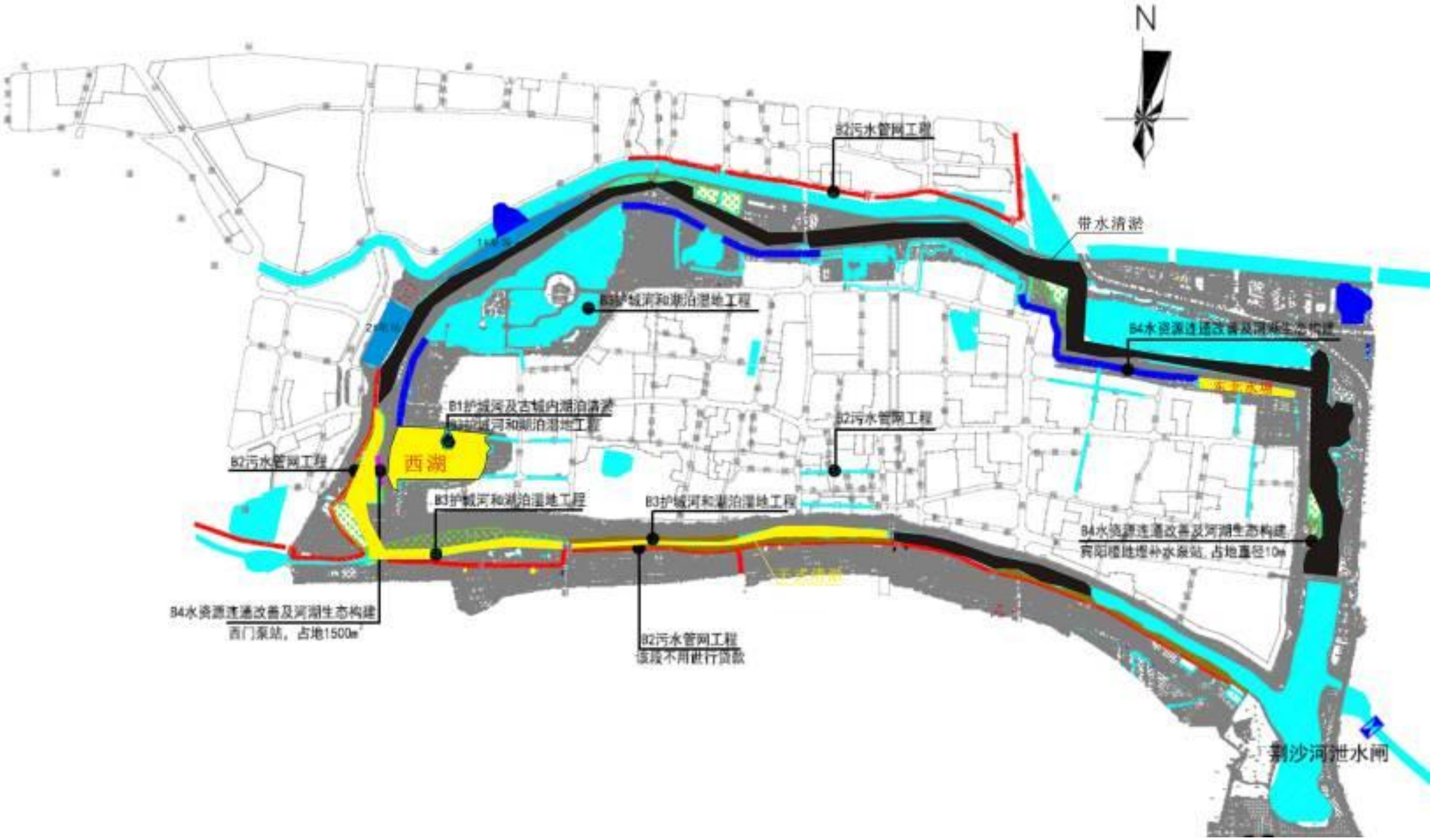


Figure 3.3-7 Project layout of water environment and ecological system project

3.4 Construction technologies and schemes

Construction technologies and schemes of each sub-project is listed in the following table.

Table 3.4-1 Construction technologies and schemes of each sub-project

No.	Sub-project content		Construction technologies	Materials needed
1	Cultural heritage protection and tourism development	Historic town wall restoration	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 management	Reserve the 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		Protection and demonstration of Chariot and Horse Fleets of King of Chu	Increase software and electronic devices in the current halls	Instruments and devices
5		Demonstration of pit for sacrifices, and simulated excavation demonstration of accompanying mound	Increase excavation devices in the current halls	Excavation devices
6		Comprehensive exhibition hall construction projects	To clean the land surface, conduct basic engineering and main construction	Concrete, sand and gravel, all kinds of decorative materials
7		comprehensive exhibition hall security project	Add monitoring system	All sets of monitoring devices
8		Improvement of museum demonstration	Upgrade museum layout and increase devices	All kinds of lights and decorations
9		Tourist reception center and parking lot	To clean the land surface, conduct basic engineering and main construction	Concrete, sand and gravel, all kinds of decorative materials
10		Infrastructures project for Xiongjia Mound tourism development	(1) General civil engineering and equipment installation (2) Asphalt road: mix up bituminous concrete according to approved ratio → transport and deliver bituminous concrete to the site → pave up by machine→ roll and compact by professional equipments (until reaching the standards) → Pass standard testing	No. 70 petroleum asphalt, sand-gravel material, soil and green plants

			(3) Land consolidation and greening	
11		Historic streets	Repair, upgrade, earth surface treatment	Sand and gravel, roof tiles, wood
12		Environmental treatment of Kaiyuanguan Temple	Overall afforestation	Afforestation, sand-gravel material, roof-top bricks and tiles, wood
13	Restoration of the ecological environment and water environment of the historic town	Dredging of rivers and lakes	Integrate dry dredging and watery dredging; combine integrated dehydration and natural drying; recycling of bottom mud, garbage from of dredging to be delivered to sanitation departments	——
14		Sewage pipe network	Excavation of trench, , piping welding, assembly, putting the pipes into the trench, pressure test, backfilling, ash cleaning, comissioning	Pipeline
15		Wetland project	Release and plant aquatic organisms	Aquatic organisms
16		Revetment project	Ecological bank protection	Vegetation and a small amount of concrete
17		Interconnection of river systems	Connecting channel exaction and civil engineering of pump station	Sand and gravel, concrete
18	Improve traffic convenience	Upgrade project of inner ring road	(1) Asphalt road: mix up bituminous concrete according to approved ratio → transport and deliver bituminous concrete to the site → pave up by machine→ roll and compact by professional equipments (until reaching the standards) → Pass standard testing (2) Bricks on the pedestrian road: replace the broken bricks (3) Flagstone road: attach, repair or replace with original materials for serious breakage; for minor breakage, carry out protective repair and treatment	No. 70 petroleum asphalt, pedestrian road bricks
19		Improve intersections of inner ring road	Increase auxiliary facilities	auxiliary facilities
20		Improve key intersections within the historic town	Increase auxiliary facilities	auxiliary facilities
21		Slow-traffic System	Increase auxiliary facilities, for flagstone road breakage: attach, repair or replace with original materials for serious breakage; for minor breakage, carry out protective repair and treatment	auxiliary facilities
22		Feeder bus system	Increase auxiliary facilities	auxiliary facilities
23		Static traffic marking system	Increase auxiliary facilities	auxiliary facilities
24		Dynamic traffic marking system	Increase auxiliary facilities	auxiliary facilities

3.5 Types, quantity and source of major materials

The main materials needed for the project include: lime paste, filling mortar, lime glutinous rice mortar, cement, wood, brick (antique-finished brick), sand, stone, glass, lime plaster, asphalt, etc., as well as other auxiliary materials such as monitoring devices, piping, lights, decorations, etc. Based on the construction area, the quantity of the main materials are: cement of 150kg/m^2, wood of 0.020m^3/m^2, yellow sand of 200kg/m^2, stone of 100kg/m^2, glass of 0.05m^2/m^2, lime paste of 5kg/m^2, asphalt of 3kg/m^2. The quantity of antique-finished brick can be provided by feasibility design unit. The total quantity of antique-finished brick for the entire project is about 10000m^3. Total construction area is 41647m^2, while the total area for restoration is 34000m^2, and the length of the asphalt road is about 20km.

Table 3.5-1 Consumption of main materials

No.	Material	Unit	Consumption	Storage
1	Cement	t	6247.05	50kg/bag
2	Wood	t	918.58	-
3	Yellow sand	t	8329.4	-
4	Stone	t	4164.7	-
5	Glass	m^2	2082.35	-
6	Lime paste	t	170	50kg/bag
7	nodular cast iron pipe, PE PIPE, HDPE or PVC Pipeline	m	11400	-
8	Sand stone	m^3	960	-
8	Petroleum asphalt	t	360	-
9	Antique-finished brick	m^3	10000	-
10	auxiliary facilities	t	——	-

Building materials such as cement , wood , yellow sand , stone , glass, lime paste, PVC pipeline, sandstone are in sufficient supply from the surrounding market, and can be purchased from the market. Antique-finished brick can be purchased from the companies approved by the administrative departments for cultural heritage.

3.6Earthwork balance

According to statistics, earthwork balance of the project is shown in Table 3.6-1.

Table 3.6-1 Earthwork balance of the project (Unit: 10 thousand m^3)

	Excavation	Fill	Balance
Road	0	-0.5	-0.5
Excavation of underground project	0.8	0	0.8
Water system interconnection	1	-0.2	0.8
Pipe networks	0.9	-0.8	0.1
Dredging of riverway	25	0	25
Wetland and revetment	0	-20	-20
Demolition and construction waste	0.55	-0.15	0.4
Landscaping and land sorting of the whole city	0	-5	-5
Other soil needed project of the city	0	-1.6	-1.6
Total	28.25	28.25	0

From Table 3.6-1, it can be seen that 250 thousand m^2 of river sludge was cleared and dewatered, of which 200 thousand m^2 is filled for wetlands and revetment, while other 50 thousand m^2 of sludge is stacked to the temporary storage yard and recycled for landscaping and site leveling of Jingzhou City.

3.7 Construction demolition and land occupation

3.7.1 Demolition

The building demolition and resident resettlement of this report mainly comes from the *Resettlement Action Plan for the Hubei Jingzhou Historic Town Restoration and Protection Project* compiled by the Involuntary Resettlement Research Center, Wuhan University.

Land requisition and house demolition is mainly required for the land requisition of tourist reception center. The specific parameters for land requisition and house demolition is listed in the following table.

Table 3.7-1 Project land requisition and house demolition

Name of sub-project	Requisition of state-owned land (Mu)	Land for temporary use (Mu)	Demolition area (m^2)	Number of affected enterprises and public institutions	Number of affected shops	Number of affected households (Household/person)
Tourist reception center	1.95	0	3316	1	8	35/100

3.7.2 Impact of land requisition

During the implementation of lake dredging and wetland project in the city moat and historic town of this project, it will need land of 467.43 mu for temporary use.

This land is mainly used for two aspects: 1st, the water surface will be occupied for clearing the bottom mud of west lake, north lake and horse-pond; 2nd, it will be used for stacking and disposing.

Table 3.7-2 Affected water surface for clearing up the bottom mud

Location of water surface	Area (Mu)	Ownership	Current use
West lake	121	Jingcheng Village	Lotus root plantation
North lake	260	Bureau of Parks and Woods	Aquaculture
Horse-pond	40	Jingcheng Village	Aquaculture
Total	421		

Figure 3.7-1 Surface of west lake for lotus root plantation

Figure 3.7-2 Surface of north lake for aquaculture

Figure 3.7-3 Surface of horse-pond for aquaculture

Table 3.7-3 Land occupation for stacking and disposing bottom mud

No. of stacking field	Area (m^2)	Ownership	Current use
1	13000	Bureau of Parks and Woods	Aquaculture
2	18000	Jingcheng Village	Aquaculture
Total	31000		

Currently these two stacking fields are both used as fish pond. The water of the two fish ponds is polluted to some extent and the water quality is bad. During project implementation, it will temporarily be used for stacking and disposing the bottom mud. Meanwhile, this will also help dredge the fish pond so that it can be used for aquaculture after the completion of the project.

Figure 3.7-4 Fish pond used as a temporary stacking field of bottom mud

3.8 Useful public infrastructure for the project

3.8.1 Water supply engineering

Jingzhou City 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 City.

All the plants use raw water from the Yangtze River. If the Yangtze River is free of industrial pollution, then the water quality for the whole year can reach the Class II water quality standard of the *Surface Water Quality Standard*. Currently the water quality of the raw water is sound, and the synthetical qualification rate of the supplied water is 100%. The water quality of the urban water supply network is generally stable. Although the color, turbidity, iron content and manganese content of the pipe water increased slightly compared from the finished water, the increase is within the standard limits. On the other hand, the content of free chlorine has slight decreased. However, the water of local water pipe network of the historic town areas shows a tendency of deterioration.

Table 3.8-1 Location, area, water-intake location and water supply capacity of the current water plants

Administration	Name of water plant	Location of water plant	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

3.8.2 Drainage project

(1) Chengnan sewage treatment district

The south and west area of the Jingzhou Historic Town were originally used for farming, scientific research and education. However, due to the construction 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 treatment 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 accommodates sewage 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.

Table 3.8-2 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
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 treatment district

In 2009 Caoshi Sewage Plant Phase 1 was built to the east of Chudu Avenue and north bank of the Taihugang Port. The treatment 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, then enters Caoshi Sewage Plant from the Caojiao Road sewage pipe through the Taihugang Port.

In 2009, Chengnan Sewage Plant Phase I was built to the south of Jingli Road and the west of Jiuyang Avenue. The treatment capacity is 50,000 m^2/ day. Based on the improved oxidation ditch technique, it mainly treats the sewage of the local region.

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

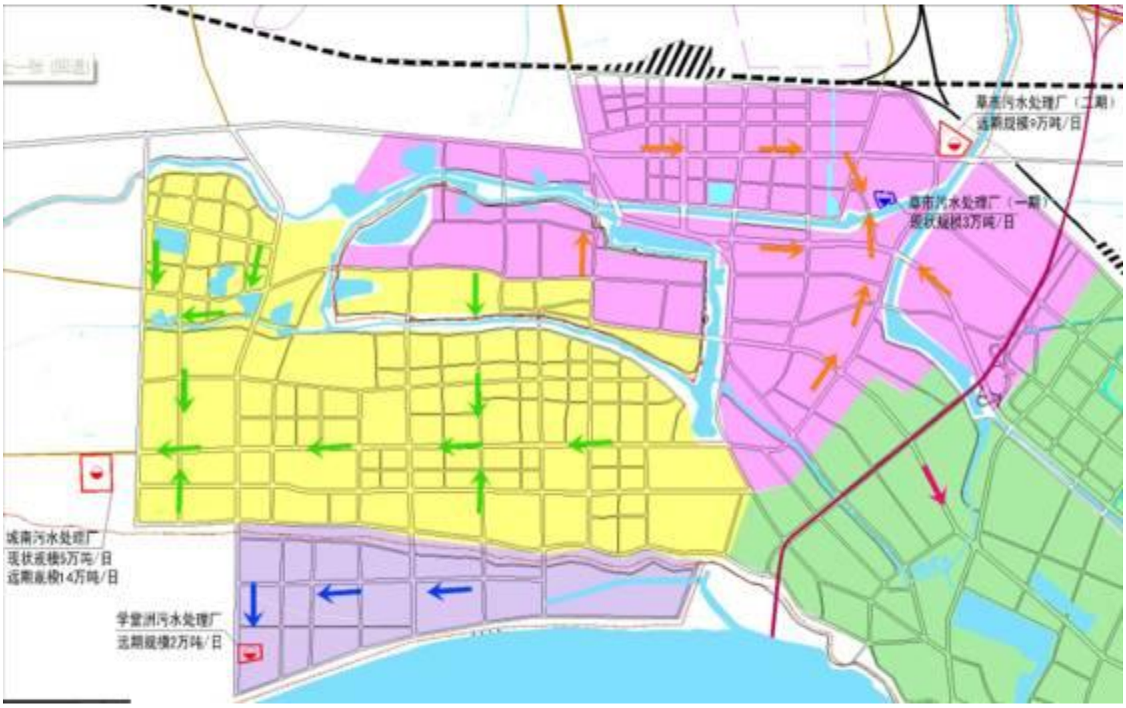


Figure 3.8-1 Map of sewage distribution in the historic town

3.8.3 Gas engineering

In the district, there is a middle-pressure gas pipe along the Taqiao Road. There is no high-pressure or middle-pressure gas network on any other roads. As a result, the energy structure of the residents and commercial users is a mixture of multiple gas sources including natural gas, liquefied petroleum gas, and coal, etc.

3.8.4 Electrical power engineering

Currently there are 3 power supply points within the scope of the historic town area, i.e. 220 KV Jinan Transformer Substation, 110KV Longtan Substation and 110KV South Gate Substation. The 10KV distribution network within the historic town district has inefficient 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.

3.8.5 Solid waste disposal system

Currently, the household garbage of Jingzhou City 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 City (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 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. The previous Hubei Province environmental protection agency approved the environmental impact assessment in April 2006 (E. H. H.【2006】No. 140). The project started construction in September 2009 and finished construction in June 2011, and began trial production in July 2011 upon the approval of Jingzhou Protection Agency. In May 2012, the project was put into operation upon acceptance of the Hubei Provincial Environmental Protection Bureau.

Figure 3.8-2 Location of the Jimei Waste Incineration Power Generation Project

3.8.6 Current Status of Xiongjia Mound

Xiongjia Mound is located in the Zhangyang Village, Chuandian Town, Jingzhou District, Jingzhou City, 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), the land occupied is 232.32 mu.

The sanitary sewage in the tomb area is mainly disposed by micro-power integrated sewage-disposal facilities and then used for farming irrigation. As for household garbage, after collected by the garbage collection center, it is transfer 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 equipment for Xiongjia Mound has not started yet.

3.9 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. The project within the territory of Jingzhou mainly covers five projects: 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 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.

4 Comparative Analysis of the Schemes

The analysis of alternative plan will be conducted from two aspects: the first is to compare the schemes of river system connection, schemes for each stage of the dredging project, and the wetland system schemes; the second is comparison of the overall project schemes.

4.1 Comparison of river system connection schemes in the city

Table 4.1-1 Comparison of river system connection schemes

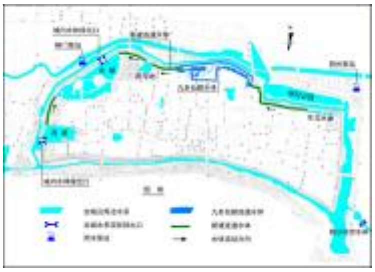
Scheme	Content	Features
Scheme 1 	Only connects major water bodies in the city such as west lake, north lake, horsepond, etc. The characteristic is that river connection line spares a relatively wide green belt and space, making it easier for project implementation and small project volume.	Partly connected
Scheme 2 	Connects all the river systems in the city, including west lake, north lake, horsepond 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 4.1-2 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	According to the DHI's *Report on the Water Conservation and*	According to the DHI's *Report on the Water Conservation and*	Scheme 2

	environment	*Water Quality Models*, Scheme 2 can better improve water quality than Scheme 1	*Water Quality Models*, Scheme 2 can better improve water quality than Scheme 1	
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

By considering the factors of landscaping, construction and investment, it is recommended to adopt the layout of Scheme 2 and connect all the river 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. Therefore, combining the project factor and environmental protection, Scheme 2 is the Recommended Scheme of this comparative analysis.

4.2 Comparative analysis of dredging schemes

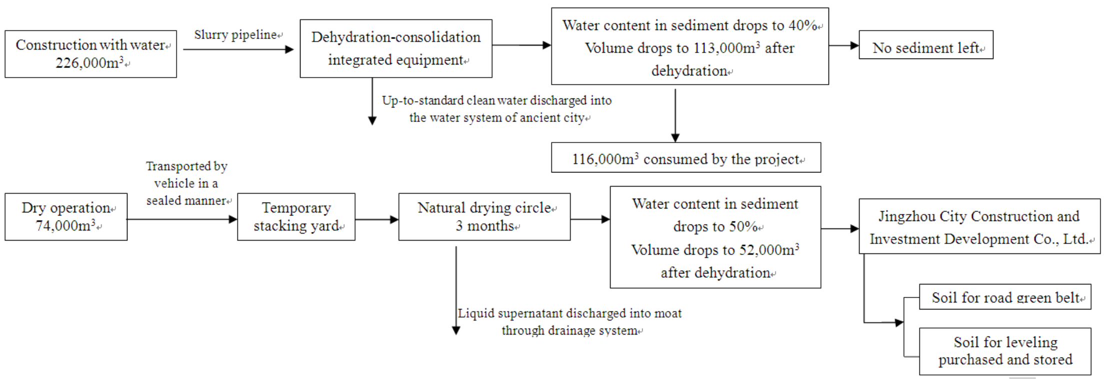
4.2.1 Comparison of dredging methods

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

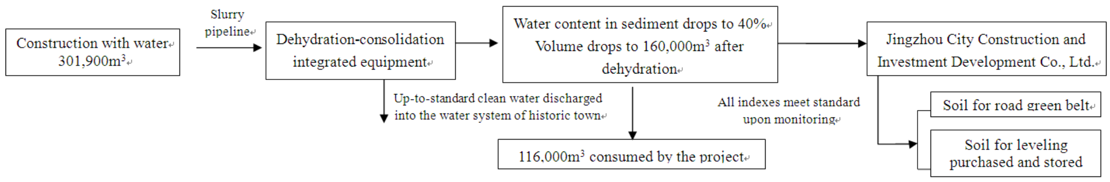
Scope of wet dredging:

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:



(2) Scheme 1: completely wet dredging, as shown in the following figure:



(3) Selection of Schemes

Although dry dredging is cost efficient and is easier for construction, the sediments can only be dewatered by natural drying, which takes a long time and will occupy a large area for the drying site. Moreover, the transportation can result in second pollution; wet dredging requires larger investment but it has less environmental impact; besides, the sediments can be dewatered by multiple methods, so it can be applied flexibly, so that it is better for the reutilization of sediments. On the other hand, Scheme 2 combines the use of sediment transportation piple and pump, which has little impact on the external environment. Hence, it is recommended to select Scheme 2 for dredging of the water system of the historic town.

4.2.2 Comparative analysis on sludge dehydration schemes

Since the sludge dredged has high water content, it needs to be dehydrated before further disposal. Comparative analysis on sludge dehydration schemes is shown on the following table.

Table 4.2-1 Comparative analysis on different sludge dehydration schemes

Scheme	Sludge decrease	Hazard-free treatment	Reutilization	Investment	Site requirement
Scheme 1 Natural dehydration	Low dehydration efficiency, long period of drying and insignificant decrease of sludge volume	No hazard-free treatment; low content of pollutants and little risk of pollution transfer	High-water-content sludge, difficult for reutilization, and it needs long-time stacking or drying under the sun	55 Yuan/ m^3	Large area occupation
Scheme 2 Geotube dehydration	Self-weight compression dehydration, Low dehydration efficiency, long cycle of drying, little decrease of sludge volume, may need months or years to finish dehydration.	No hazard-free treatment; low content of pollutants and little risk of pollution transfer	High-water-content sludge, no hardness, difficult for reutilization, and it needs long-time stacking	100 Yuan/ m^3	Large area occupation, and the site needs to be flat and clean
Scheme 3 Belt dryer with continuous dehydration	Significant decrease of sludge volume (water ratio less than 40%); continuous operation, short processing cycle	No hazard-free treatment; low content of pollutants and little risk of pollution transfer	Water content is less than 40% after compaction and , suitable for further disposal and solidification	140 Yuan/ m^3	Small area occupation, all the equipment can be installed onsite, little requirement on site conditions

Table 4.2-2 Comparative analysis on environmental impact

No.	Environmental factors	Scheme 1	Scheme 2	Scheme 3	Recommended Scheme
1	Noise	Natural drying, no impact	Gravity compaction has little noise	Certain noise during the dehydration of the machines	Scheme 1 or Scheme 2
2	Impact on aquatic environment	Natural drying, no impact	Little impact on aquatic environment after the treating the residual water	Little impact on aquatic environment after the treating the residual water	Little difference
3	Ecological impact	Large area occupation and has certain ecological impact	Large area occupation and has certain ecological impact	Small area occupation, easy for management	Scheme 3
4	Social impact	Malodorous gas from long term dehydration has large impact on the passersby	Malodorous gas from long term dehydration has large impact on the passersby	Malodorous gas has less impact on the passersby from short-term dehydration	Scheme 3
5	Landscaping impact	Large area occupation is bad for landscaping	Large area occupation is bad for landscaping	Small area occupation has little impact on landscaping	Scheme 3
6	Planning consistency	Consistent	Consistent	Consistent	Little difference

According to Table 4.2-2, compared to the natural drying and eco-tube dehydration methods, although belt-type drying machine has higher direct disposing cost, it is more advantageous in terms of area occupation, site requirement, environment protection, management and disposing cycle, and the overall cost is the lowest.

According to Table 4.2-3, from the perspective of environmental impact, although Scheme 3 has less landscaping and social impact, and it is more efficient, but it will create noise during hydration, so it will affect the sensitive targets of the surrounding area. Moreover, since there are two fish ponds near the project site and they can be used for temporary sludge stacking, it is suggested that for dry dredging, natural drying method should be adopted, while for wet dredging, belt-type drying machine 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, dumping and land utilization will be compared in the following table.

Table 4.2-3 Comparative analysis on the advantages and disadvantages of sludge disposal methods

No.	Way of disposal	Advantages	Disadvantages
Scheme 1	Sanitary 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 sludge	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 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	Farmland utilization	Low investment, low energy consumption, low operating costs, and the organic part can be converted into soil conditioner	There is certain risk of farmland utilization of sludge; the research on this field in China is not mature yet

Table 4.2-4 Comparative analysis on environmental impact

No.	Environmental factors	Scheme 1	Scheme 2	Scheme 3	Scheme 4	Recommended 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 Scheme 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 Scheme 4

4	Social impact	Occupation of the capacity of the landfill site	Ashes, slag and flue has large environmental impact and has certain social impact	Significant negative impact	Good disposal of sludge; low social impact	Scheme 4
5	Landscaping impact	Bad to surrounding landscaping	Minimizes volume of sludge, low landscaping impact	Bad to surrounding landscaping	Low landscaping impact	Scheme 4
6	Planning consistency	Consistent	Consistent	Inconsistent	Consistent	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.

By comprehensively considering transport priority interest, urban development, construction cost and environmental impact, it is recommended to use land reutilization as the final disposal of sludge.

4.3 Comparative analysis of constructed wetland system schemes

According to the different types of constructed wetland, three schemes are proposed. The design parameters and the removal efficiency of the schemes are shown in the next two tables respectively.

Table 4.3-1 Design parameters of constructed wetlands schemes of lakes and ponds within the historic town

西湖+北湖人工湿地设计参数（方案一）							
人工湿地类型	人工湿地编号	BOD5负荷	水力负荷	水力停留时间	面积	设计流量	备注
		[kg/hm2.d]	[m3/(m2.d)]	d	万m2	m3/s	
表面流	西湖1	100~150	0.1	7	5	0.10	总水面面积6万m2，除湿地外设置景观小品及浮岛等
水平潜流	北湖2~4	120~200	0.4	2	3	0.10	需打通2~3号单元之间的通道，新建涵桥
水生生物带	北湖5	50~100	0.4	2	6	0.20	西湖及洗马池两侧来水各0.1m3/s
西湖+北湖人工湿地设计参数（方案二）							
人工湿地类型	人工湿地编号	BOD5负荷	水力负荷	水力停留时间	面积	设计流量	备注
		[kg/hm2.d]	[m3/(m2.d)]	d	万m2	m3/s	
表面流	西湖1	100~150	0.1	7	5	0.10	总水面面积6万m2，除湿地外设置景观小品及浮岛等
表面流	北湖2~4	100~150	0.1	7	7	0.10	需打通2~3号单元之间的通道，新建涵桥
水生生物带	北湖5	50~100	0.4	2	6	0.20	西湖及洗马池两侧来水各0.1m3/s
西湖+北湖人工湿地设计参数（方案三）							
人工湿地类型	人工湿地编号	BOD5负荷	水力负荷	水力停留时间	面积	设计流量	备注
		[kg/hm2.d]	[m3/(m2.d)]	d	万m2	m3/s	
水平潜流	西湖1	120~200	0.4	2	5	0.30	总水面面积6万m2，除湿地外设置景观小品及浮岛等
垂直潜流	北湖2~4	120~200	0.6	2	4	0.30	需打通2~3号单元之间的通道，新建涵桥
水生生物带	北湖5	50~100	0.4	2	8	0.40	西湖来水0.3m3/s，洗马池来水0.1m3/s

Table 4.3-2 Removal efficiency of constructed wetland of lakes and ponds of each scheme

方案	BOD5	CODcr	SS	TN	TP
方案一	60	60	90	70	70
方案二	50	50	85	60	60
方案三	80	75	90	75	75

As shown in the above table, the decline ratio of Scheme 3 is largest. On the condition that the original site is IV water body, and only the Chengnan Sewage Treatment Plant is considered (i.e. no run-off pollution during the dry season), the water body upon purification of the constructed wetland can generally become IV water quality. Moreover, apart from TN, the other major pollution parameters are better than Class III water quality indicators. Therefore, it is highly necessary to construct wetlands for ponds and lakes in the city.

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

4.4Comparative analysis between cultural heritage protection plan and Zero plan

Scheme 1: Jingzhou Historic Town Restoration and Protection Project;

Scheme 2: No project plan, i.e. Zero plan

The analysis and conclusions of the comparison are shown in Table 7.1-1.

Table 4.4-1 Comparison of having a plan and not having a project plan

	Scheme 1 (Implementation of this project plan)	Scheme 2 (No plan)

Advantages	(1) Able to protect and develop cultural heritage resources involved in the project area under the concept of World Bank (2) Able to improve the environment of the project site, improve people's living standard; enhance economic development and promote the sustainable development of the tourism in the historic town area (3) Consistent to the overall planning of the scenic area, cultural heritage protection area and the tourism development, and it is an important step to promote the tourism industry of Jingzhou (4) Create conditions for developing service industry and optimizing economic structure (5) suit the demand of building a new urban district and building a harmonious society (6) Since this project emphasizes social equality, the vast majority of the public surveyed expressed their support for this project, so the construction of this project complies with the basic wishes of the general public (7) By improving the relevant protective measures, the negative environmental impact arising from regional development and construction activities can be mitigated.	(1) Able to maintain the status quo of the original area of cultural heritage in a relatively conservative manner, and avoid harming cultural heritage by irrational development (2) Able to maintain the status quo of regional environment and the current land use, and avoid the adverse environmental impacts of construction and operation period of project
Disadvantages	(1) A small amount of dust, waste (sewage) water, noise, solid waste pollution generated in the construction, to a certain extent, may affect the vegetation and landscape construction site, and cause some water and soil loss (2) The project permanently occupied some land, and changed land use patterns; the noise created during running of pumping station and air pollutants generated by underground garage may have some impact on the surrounding environment (3) Some problems caused by tourists: visitors may have some negative impact on the local culture, and lead to a more commercial culture; inappropriate behavior of tourists may impact or even harm the cultural heritage resources; at the same time, an increase in visitors will produce a series of environmental problems, and pose threat to the bearing capacity of the local environment	(1) Development trends of cultural heritage: not conducive to the rational development of cultural heritage; no further inheritance and development of the cultural heritage (2) social and economic trends: the increasing pressure to increase social development; lack of economic structural adjustment and optimization; unable to utilize the cultural heritage resources; cannot improve infrastructure (3) Environmental quality trends: environmental conditions in the project area will further deteriorate as social and economic pressures increase
Conclusion	The implementation of this project can push forward the protection of Jingzhou historic town cultural heritage and fast tourism development of Jingzhou, create positive image and impact of Jingzhou on the world stage. Some negative impact caused during the project implementation can be mitigated or avoided by environmental management measures. Therefore, Scheme 1 is recommended. Although Scheme 2 will have no negative environmental impact due to project construction, however, in the long run, it cannot improve the outdated infrastructure and therefore is bad for protecting and developing the cultural heritage, and unable to enhance the regional socioeconomic development and living standards of local people. Therefore, Scheme 2 is not recommended.	

As can be seen from the table, although the implementation of this project will generate some negative environmental impacts during construction and operation, these effects are limited in term and space, and such impact can be minimized or eliminated by multiple measures, so that it will not cause wide adverse impact on the regional environment. In the long term, the project construction can change the status quo of the local tourism, improve the living standards of local residents, and promote sustainable development of tourism in Jingzhou. Moreover, it is also in line with the will of the public. In conclusion, this assessment considers that the construction of the project is positive and effective.

5 Project Analysis

5.1 Analysis of compliance with industrial policy

The project complies with relevant requirements of the state industrial policies because "dredging project for river, lake and reservoir" and "urban water supply and drainage pipe network project" are "encouraged" project according to the Industrial Restructuring Guidance Catalogue 2011 (revised in 2013) by the National Development and Reform Commission of the People's Republic of China.

5.2 Analysis of compatibility with planning

5.2.1 Overall City Planning of Jinzhou (2011-2020)

This planning points out, "we will protect the brick city, soil city and city moat, the historic conservation areas including Sanyi street – Deshen street and south gate of the ancient city of Jingzhou, officially protected monuments and sites at all levels of the city area, and historical buildings as well. Meanwhile, the ancient city of Jingzhou is demarcated into key protection zone, key coordination zone and common coordination zone at three levels to keep the height, number, style and color of its architectures under control. Nine streets or alleys with traditional features in the historic urban area of the ancient city of Jingzhou, namely, Sanyi street, Deshen street, Nanmen avenue, Zhang Juzheng street, Fanrong street, Guandai alley, Binxing street, Dongdi street and Xidi street, will be under protection.

This project proposes protective measures and programs specifically for soil city and brick city in terms of sub-project of ancient city protection and presents remediation programs for water city in terms of water environment, which complies with the overall city planning of Jingzhou.

5.2.2 Planning for protecting the historic city of Jingzhou

The content of this planning includes: while the pattern and overall feature of the historic urban areas are protected, the protection is focused on the overall feature of the ancient city of Jingzhou and its historic conservation area, the historic conservation areas and traditional streets or alleys of the historic urban area of Shashi, official protected monuments and sites such as ancient ruins and ancient tombs, modern and contemporary architectures and industrial heritage, and national intangible heritage; in this way a 3D system combined with points, lines and planes will be built to protect the historic city and a pattern of protecting both tangible and intangible cultural heritages will be brought into being. Meanwhile, this planning requires that the overall pattern of the ancient city of Jingzhou and the pattern features of its streets and alleys should be strictly protected, that the pattern features of belt-like city street and alley of Shashi formed along the river should be protected, and that the water systems around the historic city should be protected as well, highlighting the pattern of ecological landscape of Jingzhou that is “a water city at the south of the lower reaches of Changjiang river”.

This project has strictly protected the overall pattern of the ancient city of Jingzhou during the overall remediation of the ancient city and vegetation counting and has been focused on restoring the water environment functions of the ancient city, which is consistent with the Planning for Protecting Historic City of Jingzhou.

5.2.3 Regulatory Detailed Planning of Ancient City District of Jingzhou

This planning determines the strategic development goal for the ancient city district as “function adjustment, population decentralization, overall protection and systematic updating”. The priority for the ancient city district development is environment improvement and function promotion. The city functions of the ancient city district as the center of commerce, entertainment and tourism are reinforced. Combination of protection and updating will put new vigor to he ancient city district and promote the city's economic development. The planning regards the ancient city district as "a comprehensive historical, cultural and tourist center that, with the culture of Chu, the culture of Three Kingdoms and the culture of water as the core connotations, highlights its main functions such as ancient city protection and cultural tourism."

This project supports the development of local tourism and can promote the economic progress of the city after it is implemented; therefore, the project complies with the regulatory detailed planning of the ancient city district of Jingzhou.

5.2.4 Overall Planning of the Ancient City Tourist Area of Jingzhou

This planning is still waiting for approval. The overall goal is, by the end of the planning period (2020), to make the tourism of the ancient city tourist area of Jingzhou to expand scale, increase quality and optimize profit, foster tourist products that have domestic or international competitiveness, and become a tourist destination featuring ancient city culture known at home and abroad, and important strategic pole in the ecological cultural and tourist circle of western Hubei. The description of ancient city development goal in the planning is: the ancient city scenic area of Jingzhou is an industrial clustering area with the most realistic advantages and prospecting potential across the ancient city tourist area of Jingzhou, a core focus for regional tourism breakthrough, and takes lead in overall development. Through construction and operation within the planning period, the ancient city scenic are of Jingzhou will be crafted into a state 5A tourist area, an oriental historic city and a world cultural heritage resort that ranks top at home and known to the world.

At present, the ancient city is applying for being listed in the list of world cultural heritage sites. Implementation of this project can keep the original features of the ancient city and fully improve the infrastructures and ecological environment around the ancient city, which plays an active role in applying for being listed as a world cultural heritage site; therefore, the construction of this project complies with the requirement of the Overall Planning of the Ancient City Tourist Area of Jingzhou.

5.2.5 Overall Planning of Jingzhou City Wall Relics Protection

This planning emphasizes integration of city walls and urban space of Jingzhou and the relationship between the city and the relevant historical environment around. It proposes city wall protection for protecting and displaying city walls to form a layout that focuses on city walls and city moat with the historical, natural and cultural environment around the city walls as affected area so that road facilities and display facilities can be arranged and adjusted.

This project will not only protect and renovate city walls, but also display intangible cultural heritages by combining the existing resources. It complies with the Overall Planning of Jingzhou City Wall Relics Protection that focuses on protection and display.

5.2.6 Other plannings

According to Regulations for Environmental Protection Function Zone Division of Surface Water of Urban Area of Jingzhou (1998, EBF Category of Environmental Function Areas of Surface Water of Hubei Province (2000) and Overall Remediation Planning of Water Environment of Urban Area of Jingzhou (2010-2020) (2010, the water system of the ancient city has reached grade III function of water body specified in Environmental Quality Standards for Surface Water (GB3096-2002).

This project will carry out necessary dredging, intercept domestic sewage and modify pipe network, etc., in the water system of the ancient city, which is of great significance for restoring the water system of the ancient city.

5.3 Link of pollution generation from the planned project

This project includes a lot of subprojects, which include protecting cultural heritage and promoting tourism development (western city wall protection, soil city retaining wall, ancient city vegetation protection and remediation, environmental improvement of Kaiyuan Taoist Temple, promotion of museum exhibition, tourist reception center and parking lot, historical architecture restoration and reutilization, construction of Phase 2 Xiongjia Mound National Archaeological Park, tourist center and parking lot, parks and gardens, information guide). Improving ecological environment and water environment of the ancient city (dredging in city moat and the lake inside ancient city, sewage pipe network, cit moat lake and wetland engineering, revetment engineering, improving water resources channeling and ecological construction of river and lake), and improving traffic convenience in the ancient city (inner ring road modification, inner ring road node improvement, key node improvement inside ancient city, key node improvement outside ancient city, slow-traffic system, bus system, static traffic sign system, and dynamic traffic sign system). The division of evaluation time frame for each subproject is shown in the following table.

Table 5.3-1 Division of evaluation time frame of every subproject

Evaluation content		Construction period to be evaluated	Operation period to be evaluated
	Western city wall protection	√	X
	Retaining wall engineering	√	X
	Vegetation protection and remediation	√	X
Protection of cultural heritage and promotion of tourist development	Phase 2 Xiongjia Mound National Archaeological Park	√	√
	Museum upgrading	√	X
	Tourist reception center and garage	√	X
	Gardens and parks and information guide	√	X
	Historical architecture utilization and renovation	√	X
	Environmental improvement for Kaiyuan Taoist Temple	√	X
Improvement of ancient city water environment and ecological environment	River and lake dredging	√	X
	Sewage pipe network	√	√
	Wetland engineering	√	X
	Revetment engineering	√	X
	Water system channeling	√	X
Subprojects for improving traffic convenience	Inner ring road modification	√	X
	Key node modification inside ancient city	√	X

	Node improvement outside ancient city	√	X
	Slow-traffic system	√	X
	Feeder bus system	√	X
	Static traffic sign	√	X
	Dynamic traffic sign	√	X

5.3.2 Analysis of pollution generation from the planned project

Uniform analysis is carried out on civil work of similar construction methods, basic on which separate analysis is conducted on three special subprojects, namely, Xiongjia Mound excavation unit, dredging in city moat and lake inside ancient city, and sewage pipe network.

5.3.2.1 Analysis of pollution generation node from civil work construction

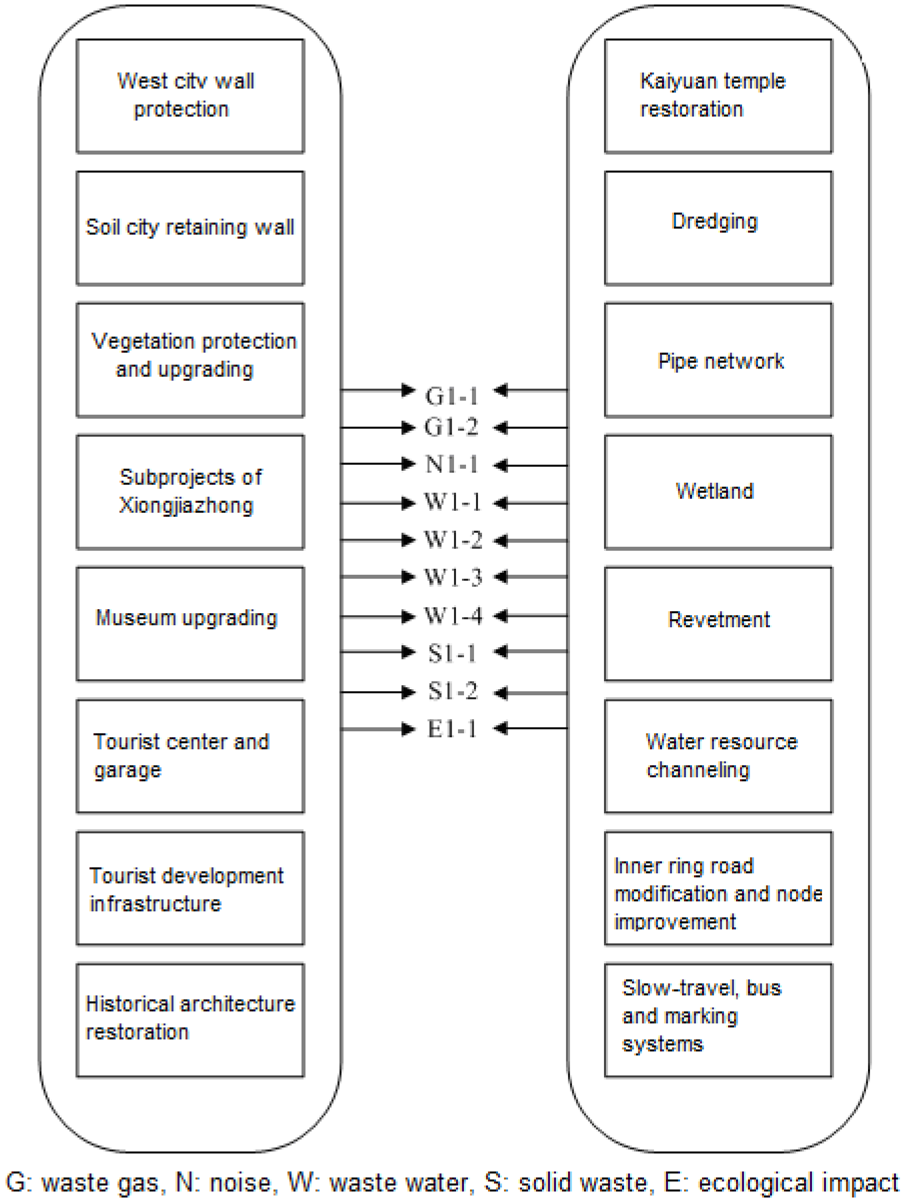


Figure 5.3-1 Nodes of pollution discharge during civil work construction

The links of pollution generation during the construction period of civil work are as follows;

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

G1-2: Waste gas will be generated from fuel burning by excavator, bulldozer and truck to be used during construction in this project, 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 subprojects 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.

5.3.2.2 Analysis of pollution generation node from dredging

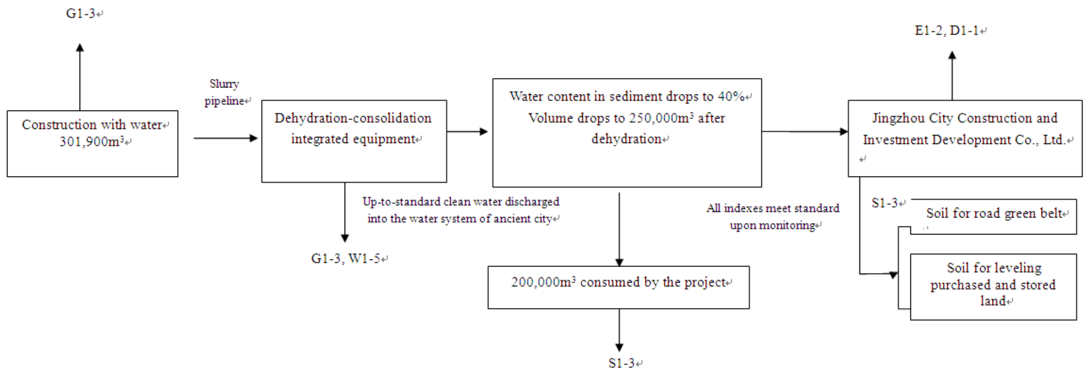


Figure 5.3-2 Nodes of pollution discharge during dredging

The links of characteristic pollution from dredging are as follows:

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, that are released in an unorganized state.

W1-5: after dredging, the sludge has relatively high water content. The filtrate from dehydration shop and supernatant from spill pit during sludge dehydration and consolidation will cause pollutants such as TP, TN and SS. 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 Wastewater Treatment 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 treatment. Some dried sludge from operation with water will be reused for wetland engineering and revetment engineering, and some will be used in city greening.

E1-2: Sediment dredging influences the aquatic ecology of river or lake, and sludge treatment site affects the ecological environment in the site. These ecological disturbances during construction will be 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, so anti-seeping measures should be taken at the storage yards.

5.3.2.3 Analysis of pollution generation node in pipe network construction

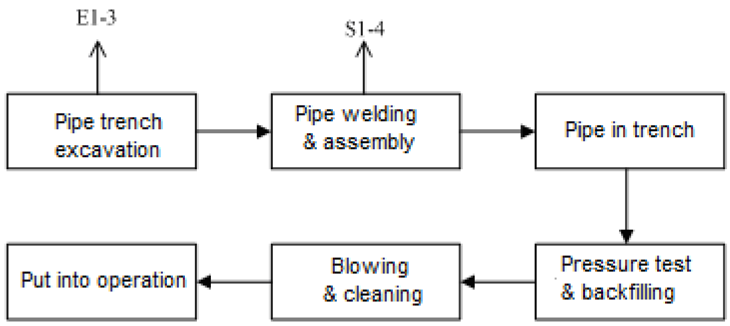


Figure 5.3-3 Characteristic pollution discharge node during pipeline construction

Nodes of characteristic pollution generation in pipe network construction:

S1-4: abandoned pipe materials will be collected and recycled by the pipe supplier.

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

5.3.2.4 Analysis of pollution generation nodes from Xiongjia Mound excavation

S1-5: the surface of pit wall after digging the excavation unit needs to be solidified with curing agent. Abandoned earthwork mixed with curing agent and remaining agent will be 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 octyl diether; here there is no waste fluid discharge.

5.3.3 Analysis of pollution generation during operation period of the planned project

The major environmental impact of this project comes from construction period. The environmental impact during operation period is relatively small, which mainly comes from Xiongjia Mound exhibition hall, tourist reception center and parking lot, tourist infrastructure, improvement of water resource channeling and ecological building of river and lake.

5.3.3.1 Tourist center and parking lot

G2-1: the air pollution source mainly comes from automobile tail gas from the ground parking lot and underground garage. 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 garage 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 sewage treatment plant of Caoshi for treatment 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: N1oise will come from underground garage 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 tourist 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.

5.3.3.2 Xiongjia Mound 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.

5.3.3.3 Water resources channeling and construction of river and lake ecology

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

5.3.4 Summary

Please refer to Table 5.3-2 for summary of pollution generation links and preventive measures to be taken for the planned project.

Table 5.3-2 List of summary of pollution generation links and preventive measures to be taken for the planned project

Time frame	Type	Pollution generation node	Pollution source	Main pollutant	Pollution control measures to be taken
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, BOD5, 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 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 period	Waste gas	G2-1	Underground garage 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 treatment plant of the city and discharged to Caoshi sewage treatment plant
		W2-2	Wastewater from Xiongjia Mound 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.
		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 Xiongjia Mound		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

5.4 Analysis of pollution source of the planned project

5.4.1 Analysis of pollution source during construction

5.4.1.1 Pollution intensity of waste gas during construction

G1-1: Flying dust during construction will be calculated by means of analogy analysis on monitoring data of similar projects; the flying 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, SO_2＜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, that 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 5.4-1 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. This project adopts analogy method to analyze the class of odor pollution intensity. According to the analysis of river dredging in this 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.

5.4.1.2 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.

5.4.1.3 Wastewater pollution intensity during construction

W1-1: reinforced concrete during all kinds of civil work 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 this project is about 2947m^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 2579t, and 24814t 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 subprojects 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 2000mg/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 $600\sim1400m^3/d$, and the tail water drainage at single sludge dehydration and consolidation treatment site is $300\sim700m^3/d$.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 $1400m^3/d$, 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.

5.4.1.4 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 41647m2, and 1248t of construction waste will be generated and recycled.

3316m2 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 this 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: the dredging quantity of the project is about 300 000m3 in total; 116 000m3 of sludge will be used for wetland and revetment construction; and the remaining will be reused in gardening and greening of the city.

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.

5.4.1.5 Ecological damage intensity 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 00m2, which will keep large area of natural environment for the ancient city and provides good habitation and activity site for original terrestrial animals, especially birds and amphibians.

Impact by land occupation: permanent occupation (0.24hm2) will cause loss of land use functions to some degree; project construction will disturb the original terrain and damage vegetation for 2.5hm2. 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.

5.4.2 Analysis of pollution source during operation

5.4.2.1 Waste gas pollution intensity during operation

G2-1: Underground garage in tourist center. The pollution emissions from vehicles in underground garage mainly depend on the frequency of vehicle travelling. Most vehicles in and out of the underground garage 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 garage 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 5.4-2 Statistics of underground garage information

Location	Number of stalls	Floor area	Number of exits or entrances	Floor height m	Exhaust outlet height m	Designed air change rate, times/h	Number of daily running hours of ventilation	Number of running days	Hourly discharged waste gas (cubic 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 this project is shown in Table 5.4-3.

Table 5.4-3 Pollution intensity of northeast garage

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

5.4.2.2 Waste water pollution intensity during operation

W2-3: Domestic wastewater from visitors in tourist center Sewage generated in this 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 this project is 4.5L/m^2.d. The area of every tourist center is shown in the following table.

Table 5.4-4 Basic information of tourist center and Xiongjia Mound

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 Environmental Impact Assessment for Social Areas compiled by the former occupational qualification training management office of the State Environmental Protection Administration, 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 this project is shown in Table 5.4-5.

Table 5.4-5 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 sewage plant
	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 XiongjiaozhongSewage generated in this 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 Xiongjia Mound in this project is $4.5L/m^2.d$.

Table 5.4-6 Basic information of Xiongjia Mound

Location of tourist center	Xiongjia Mound
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 Environmental Impact Assessment 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 Environmental Impact Assessment Report Form for Xiongjia Mound Tomb Archeological Excavation and Field Exhibition. The water pollutant emissions are shown in Table 5.4-7.

Table 5.4-7 Waste water pollutant discharges of Xiongjia Mound

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	
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 nitrogen	31.5	15	——	0.315	0.165	0.15	

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

5.4.2.3 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 garage fan, water pump and outdoor unit of central AC fitted for the tourist center. Underground garage 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.

5.4.2.4 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 Xiongjia Mound. 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.

5.4.3 Summary of pollutants in operation period

Summary of generation and discharge of main pollutants from the project is shown in Table 5.4-8.

Table 5.4-8 Summary of generation and discharge of main pollutants from project

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

5.5 Positive benefit of environmental impact

After this project is implemented, the water system of the ancient city of Jingzhou will become mutually connected and related natural water bodies, and such connection is a kind of systematic and dynamic relationship. Improving river connection has great ecological significance. The implementation of this project will produce significant benefit for ecological environment, which is mainly manifested as follows:

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

Healthy and stable water ecosystem will be brought into being by channeling river and lake. In terms of system level and landscape pattern, structure composition and function of every water body will be increased and expanded, 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 clearing up endogenous pollution of water course

Dredging and disposing1 the sediments in river and lake 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 900m^3 sediments in the water system of the ancient city 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 ancient city. 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 ancient city 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 profit from pipe engineering for pollution interception

The water system of the ancient city is an important landscape water source of Jingzhou, the quality of which has been severely influenced 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 treatment plant for treatment to standards before being discharged, which can effectively reducing pollution of sewage to the water system of the ancient city. According to estimation, under the condition of full-load running of sewage treatment 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 ancient city will be increased to 90%.

(5) Environment benefit from water supply engineering

The water supply engineering is not the subproject of this project, but it has obvious effect in improving the water quality of the water system of the ancient city. It can be seen from DHI water quality model result that, after the entire water environment remediation project is carried out, the overall water quality of the water system of the ancient city 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 ancient city 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 ancient city 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.

6 Environmental Impact Prediction and Analysis

6.1 Analysis of 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 city moat water environment and ecological environment. Seen from the project content, every subproject 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.

6.1.1 Analysis of environmental impact on 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 cedarwoods in the assessment area, but this 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 cedarwoods in the area.

6.1.2 Analysis of environmental impact on 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.

6.1.3 Impact on 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 ancient city 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.

6.1.4 Analysis of revetment construction impact

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 this 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 period 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.

6.1.5 Analysis of landscape environment impact

(1) Current impact on landscape

Currently, visual landscape has been severely impacted by the exposed discharge of sewage directly from the west of the ancient city, 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

This 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 city moat will be increased.

6.2 Analysis of atmospheric environment impact

The impact of the project on air is focused in construction period, in which the waste gas such as flying dust from construction (secondary flying 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 garage will have tail gas from automobiles.

6.2.1 Analysis of atmospheric environmental impact during construction

(1) Analysis of impact of flying 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/m3 of flying dust will be caused at 50m lower wind direction, 1.65mg/m3 at 100m lower wind direction, and 0.3mg/m3 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 flying dust caused by truck transportation at similar construction site, 11.625mg/m3 of flying dust will be caused at 50m lower wind direction, 9.694mg/m3 at 100m lower wind direction and 5.093mg/m3 at 150m lower wind direction, which exceeds grade II standard in Ambient Air Quality Standard (GB3095-2012). The flying 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 flying dust pollution caused by construction activities can not 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/m3 ~ 0.18mg/m3 at 15m~18m lower wind direction. According to the construction organization design, only a few machines are used in this 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

This 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 40m (Fanrong street), and more than 40m away from other sensitive goals. Therefore, the odor generated in sludge disposal will have limited impact on sensitive points around and the odor will disappear after the construction is finished.

6.2.2 Analysis of atmospheric environment impact during operation

(1) Prediction mode

Point source diffusion mode is selected according to the terrain conditions and pollution discharge characteristics in accordance with relevant regulations in HJ2.2-2008 Guidelines for Environmental Impact Assessment - Atmospheric Environment.

(2) Predictive factors and intensity

The predicted intensity of the planned project is shown in Table 6.2-1, and the predictive factors are CO and NO_2.

Table 6.2-1 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 grade II standard concentration in GB3095-2012 Ambient Air Quality Standard, the standard values are shown in Table 6.2-2.

Table 6.2-2 Assessment standard value of CO and NO_2

Pollutant	Average per hour
	Grade II
CO	10mg/m^3
NO_2	0.2mg/m^3

(4) Analysis of environmental impact in underground garage during operation

The highest ground concentration is shown in Table 6.2-3, and the specific leeward concentration distribution is shown in Table 6.2-4.

Table 6.2-3 Highest ground concentration and appearing 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 6.2-4 List of ground concentration prediction for every parking lot

Leeward distance from source center, m	Northeast underground garage			
	NO_2		CO	
	Leeward concentration c/(mg/m^3)	Ratio to standard concentration P/%	Leeward concentration c/(mg/m^3)	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
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 6.2-5 Analysis of concentration of sensitive points 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 0.2mg/m3 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/m3 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 ancient city, the final ratio of NO_2 to standard concentration is 14.5%.Therefore, the sensitive points near to the ancient city can meet the requirement of grade II standard limit in GB3095-2012 Ambient Air Quality Standard, and the underground garage will have relatively small impact on surrounding environment after being put into operation.

6.3 Analysis of impact on surface water environment

After the project is completed and put into operation, it will be favorable to improving the water environment quality of the water system of ancient city. 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, 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 Xiongjia Mound and water system channeling.

6.3.1 Construction period

6.3.1.1 Impact of dredging on water environment

Where the remaining water at storage yard will go

(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 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 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 Wastewater Treatment Plant and discharged to into the city moat nearby.

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 storage yard, the length of river mixing process section downstream the storage yard is determined as shown in the following table.

Table 6.3-1 Calculation result of length of mixing process section

S.N.	Name of storage yard	Receptor of remaining 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 storage 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 storage 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 remaining 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

Value of parameters

c_0 - Initial concentration, mg/L, water quality measured on June 27^{th} 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 remaining 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 6.3-2 List of background concentration, unit: mg/L

Name of storage yard	COD	Ammonia nitrogen	TP	TN
No.1 storage yard	28.3	1.06	0.205	4.14

Q_h-upstream flow of river, calculated according to river width, depth and flow velocity, m3/s.

Table 6.3-3 Calculation value of river flow, unit: m^3/s

S.N.	Name of storage yard	Receptor of remaining water	Average flow
1	No.1 storage yard	City 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.

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.

The calculation result of normal discharging and abnormal discharging is shown in Table 6.3-4 and 6.3-5.

Table 6.3-4 List of predicted basic parameters of No.1 storage yard remaining water (normal discharging)

Predictive factor	Water from upstream		Drainage of the planned 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 6.3-5 List of predicted basic parameters of No.1 storage yard remaining water (abnormal discharging)

Predictive factor	Water from upstream		Drainage of the planned 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 6.3-6 Calculated value in downstream water body after discharging of remaining water from No.1 storage 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
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 6.3-7 Calculated value in downstream water body after discharging of remaining water from No.1 storage 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

Analysis of impact of dredging on river water environment

This 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 this 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.

6.3.1.2 Impact of construction wastewater on water environment

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 subprojects 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 flying dust on road after being treated with sedimentation to the grade I standard in Table 1 of Integrated Wastewater Discharge Standard.

6.3.1.3 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 ancient city.

6.3.1.4 Others

(1) 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.

(2) 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.

(3) 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.

6.3.2 Operation period

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

6.3.2.1 Analysis of impact of domestic wastewater of tourists

Water quality analysis

Wastewater in operation of this 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 Caoshi sewage treatment plant for treatment. According to “Analysis of water pollution source in operation period”, the emission concentration OF pH, COD, BOD5, SS and ammonia nitrogen in the water discharged from this 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 sewage treatment plant (COD300mg/L, $BOD_5$160mg/L, SS200mg/L).

Environmental impact analysis and assessment

Caoshi sewage treatment plan is located at the north of Jingzhou city, the northwest of Jingsha avenue and Wude road, east of Caojiao road and in Group I, Yuexin village. Its serving area covers 1712hm2 including the area of Jingzhong road of Jingzhou ancient city 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 sewage treatment plant is put into operation and its capacity is 300 000m^3/d.

Table 6.3-8 Overview of the sewage treatment plant

Name	Scale (10 000 m^3/d)	Location	Main process	Fitted pipe network construction	Serving area	Treatment depth	Receiving water body
Phase I of Caoshi sewage treatment plant	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 ancient city 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 treatment plant for treatment.

The sewage quantity to be treated in Caoshi sewage treatment plant is about 8.82m^3/d, which is about 0.029% of the treatment capacity of the plant.Therefore, it is feasible for Caoshi sewage treatment plant to treat sewage in this project.The discharged water quality of this project meets the receiving standard of Caoshi sewage treatment plant. 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 this project generates will have relatively small impact on surrounding environment.

6.3.2.2 Analysis of domestic wastewater impact in Xiongjiazhong

After relevant fitted subprojects of Xiongjiazhong are implemented, it is estimated to add 27.36m3/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.

6.3.2.3 Analysis of 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 this project will have relatively small impact on the quality of water environment.

6.3.2.4 Analysis of intercepted sewage load

It is known from DHI yearly water equilibrium diagram of ancient city 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 sewage treatment plant is 2600m^3/d, and that of Caoshi sewage treatment plant is about 3100m^3/d, so, the total treatment quantity is only 5700m^3/d; therefore, the present sewage treatment scale can not meet the requirement after the sewage interception pipe network is put into operation. After this project is completed, even if all the domestic wastewater of the ancient city is sent to be treated in the two sewage treatment plants, still 16893m^3/d of sewage treatment capacity is needed.

According to the long-term plan of the two sewage treatment plants, in future, Chengnan sewage plant may have a capacity of 140 000m^3/d and Caoshi sewage plant 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 this 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 treatment plant project to this project, it is suggested to set up a special leader team to supervise the expansion project of the two sewage treatment 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.

6.4 Acoustic environment impact prediction and assessment

Acoustic environment impact by this 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 garage vehicles, equipment running in tourist center, crowd in tourist center and pump running.

6.4.1 Acoustic environment impact and analysis during construction

The impact of this project on acoustic environment is highlighted in construction period, the impact mainly comes from noises of large construction machines such as dredging pump, excavator, bulldozer, agitator and concrete mixer, and of transportation vehicles (mainly earthwork transportation). Noise will be generated from large construction machines such as dredging pump, excavator, bulldozer, agitator and concrete mixer that feature strong sound source, large sound level and continuity; for example, the noise of a dredging pump generates 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.

(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 source and mobile sound source.

(1) Prediction mode of point source noise source

$$L_A(r) = L_{WA} - 20\lg r - k$$

Where:

$L_A r$- sound level A from sound source r(m), dB;

L_{WA} – 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

$$L_{pn} = L_{wi} - TL + 10\lg(\frac{Q}{4\pi r^2_{ni}} - M\frac{r_{ni}}{100})$$

Where:

L_{pn} – sound level of the nth sound receiving point, dB;

L_{wi} – sound level of the ith noise source, dB;

TL – sound reduction of barrier, dB;

r_{ni} – 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 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 6.4-1 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 GB12523-2011Emission Standard of Environment Noise for Boundary of Construction Site. When the construction machine is 110-280m away from the boundary, the noise level for construction site can meet the requirement of nighttime discharge standard GB12523-2011 Emission Standard of Environment Noise for Boundary of Construction Site. Therefore, if there is no noise control measure to be taken, 50m in the daytime and 300m at night outside every construction site can meet the standard value. Some enterprises, public institutions and residents are within the affected scope at both sides of the section, their normal life, 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; while at night, it is planned 40 vehicles/h at the speed of 35km/h.The prediction result of impact scope of mobile noise is shown in Table 6.4-2.

Table 6.4-2 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.

6.4.2 Acoustic environment impact and analysis during operation

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

6.4.2.1 Impact of garage vehicle noise

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.

6.4.2.2 Noise impact of equipment running at tourist 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.

6.4.2.3 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.

6.4.2.4 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 6.4-3 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.

6.5 Impact analysis of underground water environment

6.5.1 Impact analysis 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 sand 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 10~35m, and 57m 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.

This project adopts Concrete Modularized Septic Tank 08SS704 No.13 septic tank, which is 18~50m^3 for effective volume and 2.1m 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 this 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 2~4m 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 1m 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 this project is very small, and the impact on the underground water environment in the project area is also very small.

6.5.2 Impact analysis 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:

❶Anti-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.

❷The height of stored sludge should be determined according to the ground bearing capacity.

❸Liner should be placed at one foundation of base.

❹Liner should be able to cover the scope that bottom sludge or its dissolved matter may extend to.

❺Liner material should be compatible with the stored sludge.

❻Design and build leachate collecting and eliminating system.

❼The stored sludge should be kept from wind, rain and sunshine.

❽Incompatible 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.

6.6 Environmental impact analysis of solid waste

6.6.1 Environmental impact analysis of solid waste during construction

6.6.1.1 Sediments from dredging

(1) Where to

About 301 900m3 of sludge will be dredged in total; for the dried sludge through dehydration and consolidation, the monitoring index can meet the requirement of corresponding standard limit in Standard of Soil Quality Assessment for Exhibition Sites (provisional) (HJ350-2007) and GB/T23486-2009 Disposal of Sludge from Municipal Wastewater Treatment [lant—Quality of Sludge Used in Gardens or Parks; about 250 000m3 of the dried sludge will be reused in wetland and revetment backfilling; the remaining sludge will be reused in city landscaping, so its environmental impact is relatively small.

(2) Environmental impact of storage yard

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 the river will be avoided as possible (the nearest sensitive point from the storage yard is about 40m, which is the Fanrong community, and the other storage yard is more than 40m away from sensitive points). Seen from the prediction result, Fanrong community will be affected to some degree when sludge is under temporary disposal, but the impact is limited and will not last long. 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.

6.6.1.2 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.

6.6.1.3 Domestic waste and abandoned pipe material

This project is mainly centralized at the ancient city 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.

6.6.1.4 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 ancient 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.

6.6.2 Environmental impact analysis of solid waste during operation

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:

S2-1: Domestic waste from visitors in tourist center. The east tourist center will generate domestic waste 182.5t/a every year.

S2-2: Domestic waste in Xiongjiazhong. 36.5t/a of domestic waste will be generated every year.

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

6.7 Social impact analysis

Relevant content in the Social Impact Assessment Report of World Bank Financed Hubei Jingzhou Ancient City Restoration and Protection Project compiled by the project resettlement center of Wuhan University will be used as main reference.

6.7.1 Social impact of city wall restoration

(1) Positive impact

More work should be done to enhance attraction of Jingzhou ancient city walls to tourists if the city is compared with other similar cities in terms of the absolute number of tourists. The restoration of the ancient city walls will attract more tourists to the ancient city 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 ancient city walls will undoubtedly drive the economic and social development of the ancient city, bring new appearance to the ancient city, and inject powerful momentum to the social and economic development of the eastern and western city streets.

(2) Negative impact

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 ancient city 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.

6.7.2 Social impact of water system remediation

According to the collected information from the abovementioned activities, the social assessment unit holds that the subproject of water system has very good social impact and relatively high operability and has gained extensive support at all social classes, so there is no obvious social risk. The main reasons are as follows:

1. Jingzhou water conservancy bureau pays great attention to the remediation of water system inside and outside the ancient city and has proactively discussed better way to

solve the water environment problem of the city moat. There is a lot of failures that can be learnt as experience in terms of the remediation; some river sections have been treated by technical means but the problems remain; meanwhile, there are also successful experience in handling the river section at the east gate. Currently, the main difficulty for water system remediation lies in insufficiency of fund. The work will have tremendous progress if the project can be accommodated into the loan project of the World Bank.

2. The neighboring residents are in urgent need for city moat remediation because the pollution of the moat has already affected their normal life; and they hope that the problem of city moat pollution can be eliminated from the root.

3. Tourists are very interested in the tourism project of city moat. Driven by the profit of developing tourist products, the continuity of water system remediation and management inside and outside the ancient city can be guaranteed.

6.7.3 Subprojects of traffic and tourist infrastructure improvement

According to the collected information from the abovementioned activities, the social assessment team holds that the subprojects of traffic improvement and tourist infrastructure will have very good social impact on the whole.

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. All the residents in ancient city in interview and questionnaire expressed active support to building parking lot for alleviating traffic condition.

Demolition involved in parking lot and tourist reception center is not much, which is mainly at the north of Mingyue park. Through field investigation and focus group interview, the social assessment team came to know that the demolition may not encounter too much resistance if it can be cooperated with improving the living environment of the residents.

Meanwhile, there are potential social risks in demolition as follows:

(1) Demolition has relatively large impact on the local residents' life. The general living standard of the residents at the place where the tourist center is to be built is not high; they may not have the ability to bear the risks in transition from demolition to resettlement.

(2) Demolition has impact on tenants. The living environment there is not good so the rent is very cheap; the living standard of the tenants here is not high and demolition means that they need to find other places to live, and thus face the risk of higher rent and higher traffic cost.

6.8 Analysis of cumulative impact

The construction period and operation period of this project have both positive and negative benefits on water environment. Cumulative impact analysis is carried out on every subproject related to the water system of the ancient city for environmental impact assessment, and specific indexes of COD, ammonia nitrogen, TN and TP are superposed in calculation.

The sewage interception subproject has the most obvious positive benefit, which can reduce 70.54t of COD, 52.68t of ammonia nitrogen, 133.97t of TN and 10.04t of TP. Besides, water supply subproject and wetland engineering also have relatively large benefit. The water supply subproject 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. The quantified calculation result of environmental impact of every subproject is shown in Table 6.7-2.

Table 6.8-1 List of subproject of assessed cumulative impact on water environment

S.N.	Item	What impact	Impact type
1	Dredging	Reduce endogenous	Positive profit

		pollution by eliminating sediment	
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 6.8-2 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 ancient city according to the current situation. Water supply engineering will supply water 730 hours a year, 8m3/s of water every second will be supplied.

7 Analysis of Impact on Associated Area

Based on the opinions of the World Bank experts, the assessment scope should be appropriately expanded because this project involves in extensive area; so assessment will be conducted on the associated areas upstream and downstream involved in this project. Therefore, the following content and scope are added for assessment.

Table 7.1-1 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 sewage plant and Caoshi sewage plant	Gangnan ditch and Taihugang ditch	Operation period	Wastewater during the project operation will be discharged to Chengnan sewage plant and Caoshi sewage plant
	Impact of water supply project on water system of ancient city	Water system of ancient city	Operation period	The water supply project is not in the scope of this project but is directly related to this project.
Crime rate	Impact of tourism upgrading on crime rate	Ancient city area	Operation period	Increasing number of tourists will promote crime rate to some degree.
Solid waste disposal	Waste incineration project relying on feasibility	——	Operation period	Domestic waste
Traffic and transportation	Tourism route from the historic town to Xiongjia Mound	Along the transportation route	Operation period	Impact will be caused on residents along the route

7.2 Analysis of impact on surface water

7.2.1 Analysis of impact of Chengnan sewage plant

7.2.1.1 Introduction to environmental protection formality of Chengnan sewage plant

The 140000m3/d sewage treatment engineering environmental impact report of

Chengnan sewage plant has been compiled in November 2007 and the employer is the Jingzhou construction committee. Jingzhou environmental protection bureau replied the project environmental assessment report on November 16th 2007, "we have received the 140000m3/d sewage treatment engineering environmental impact report of Chengnan sewage plant that your committee submitted. Your committee plans to invest 127.866 million Yuan to build 140000m3/d sewage treatment project (50000t/d for early phase) between the south ring road at the west of Xichu avenue and the Jingjiang river Levee. The project will adopt 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. This project is a kind of environmental remediation project that can improve the regional water environment and promote sustained economic development of Jingzhou. Also the location selected complies with the overall planning of the urban development. Our bureau approves that this project is built at the selected location. But the project should carry out sludge dehydration and burying and keep 200m sanitation protection distance from environmental sensitive goals such as residential community and school. The project after completion shall not be put into operation until it is accepted by our bureau."

At present, Chengnan sewage plant 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 sewage plant is shown in the following table.

Table 7.2-1 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

7.2.1.2 Environmental impact analysis of tail water of Chengnan sewage plant

Prediction mode and parameters

According to the discharging parameters of phase I full load running of Chengnan sewage plant, for normal discharge, calculation is conduced as per average value of actual incoming water concentration, and for abnormal discharge, it is calculated as per 5 times under the circumstance of normal discharging:

Table 7.2-2 Parameters of wastewater discharging

	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 7.2-3 Hydrologic parameters of 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

Prediction result

Table 7.2-4 List of basic parameters of prediction (normal discharging)

Predictive	Water from upstream	Drainage of the planned project	Assessment

factor	Water quantity M^3/s	Concentration mg/L	Draining quantity m^3/s	Concentration mg/L	criteria mg/L
COD	0.75	28.3	0.58	22	20
NH_4-N		1.06		1.2	1

Table 7.2-5 List of basic parameters of prediction (abnormal discharging)

Predictive factor	Water from upstream		Drainage of the planned 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	0.58	60	20
NH_4-N		1.06		8	1

Table 7.2-6 Downstream water body concentration calculations after tail water discharging

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
Background value	28.3	1.06	28.3	1.06
Standard value	20	1	20	1

It can be seen that phase I of Chengnan sewage 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. Overall, under normal discharging condition, Chengnan sewage plant plays a role of improving the sewage receiving water body to some degree and the phase I of Chengnan sewage plant has relatively small impact on the city moat.

7.2.2 Impact analysis of Caoshi sewage plant

7.2.2.1 Introduction to environmental protection formalities of Caoshi sewage treatment plant

The 120000m^3/d sewage treatment engineering environmental impact report of Caoshi sewage plant has been compiled in November 2007 and the employer is the Jingzhou construction committee.Jingzhou environmental protection bureau replied the project environmental assessment report on November 16th 2007, “we have received the 120000m3/d sewage treatment engineering environmental impact report of Caoshi sewage plant that your committee submitted. Your committee plans to invest 69.54 million Yuan to build 120000m3/d sewage treatment project at the west of Jingsha avenue and Wude road and east of Caojiao road. The project will adopt 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. This project is a kind of environmental remediation project that can improve the regional water environment and promote sustained economic development of Jingzhou. Also the location selected complies with the overall planning of the urban development. Our bureau approves that this project is built at the selected location. But the project should carry out sludge dehydration and burying and keep 200m sanitation protection distance from environmental sensitive goals such as residential community and school. The project after completion shall not be put into operation until it is accepted by our bureau.”

At present, Caoshi sewage plant runs stably and has received sewage 9.83 million m^3 in total in 2014.Its daily treatment capacity is about 26900 m^3.

Table 7.2-7 List of discharge water quality of Caoshi sewage plant in 2013, unit: mg/L

Factor	COD	Ammonia nitrogen	TN	TP
Average value of	210.7	30.7	21.2	10.69

incoming water				
Average value of discharged water	41.98	4.2	10.7	2.1

7.2.2.2 Environmental impact analysis of Caoshi sewage plant tail water

Prediction mode and parameters

According to the discharging parameters of running load of Caoshi sewage plant in 2013, for normal discharge, calculation is conduced as per grade I B, and for abnormal discharge, it is calculated as per 2 times of normal discharging condition:

Table 7.2-8 List of wastewater discharging

	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:

$$c = c_0 \exp\left(-K_1 \frac{x}{86400\,u}\right)$$

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 7.2-9 Hydrologic parameters of 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 ditch	8	0	2.1	0.1	0.5

Prediction result

Table 7.2-10 List of basic parameters of prediction (normal discharging)

Predictive factor	Water from upstream		Drainage of the planned 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 7.2-11 List of basic parameters of prediction (abnormal discharging)

Predictive factor	Water from upstream		Drainage of the planned 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 7.2-12 Calculation value of downstream water body concentration after tail water discharging

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

It can be seen that Caoshi sewage 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.

7.2.3 Impact of water supply engineering on water system of ancient city

The Project of Water Diversion from Changjiang river to Hanjiang river is one of the subprojects for improving upper and middle reaches of Hanjiang river in the middle route phase I of South-to-North Water Diversion project. The task of the subproject is to meet the conditions for ecology, irrigation, water supply and navigation in the lower river section of Xinglong of Hanjiang 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 Hanjaing river will be alleviated.

As an important source for improving water environment of this project, the water supply project plays an important role. According to the impact of the water supply project on the water quality of the ancient city water system, the Environmental Impact Assessment Report of Water Diversion from Changjiang River to Hanjiang 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 Ancient City of Jingzhou are taken as references.

7.2.3.1 Environmental protection procedures of the Water Diversion from Changjiang River to Hanjiang River Project

7.2.3.2 In order to comprehensively analyze the impact of Water Diversion from Changjiang River to Hanjiang 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 Changjiang River to Hanjiang 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 Changjiang River to Hanjiang River Project and the areas along the middle and lower reaches of Hanjiang River to conduct field investigations. Based on sufficient studies on the current status of ecological environment in the region, we composed the Environmental Impact Assessment Outline for Water Diversion from Changjiang River to Hanjiang 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 Environmental Impact Assessment Outline for Water Diversion from Changjiang River to Hanjiang River Project as the Phase I of South-to-North Water Diversion Middle Route Project (hereinafter referred to as the Environmental Impact Assessment Outline) in Wuhan City, Hubei Province. After the meeting, the assessment organization carefully modified the Environmental Impact Assessment Outline according to the Assessment Opinions for Environmental Impact Assessment Outline for Water Diversion from Changjiang River to Hanjiang 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 assessment organization composed the Environmental Impact Report of Water Diversion from Changjiang River to Hanjiang 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.**Analysis of environmental impact on main channel**

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 Hanjiang rive and that in which the diverted water goes into Hanjiang river. The middle scenario will have slightly lower concentration of potassium permanganate while the latter one will improve the water environment quality of Hanjiang 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 Changjiang river to Hanjiang 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 Hanjiang 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 Hanjiang 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 Changjiang river to Hanjiang river is not taken into consideration, the guarantee rate of $500m^3/s$ sectional flow of Hanjiang river at Xiantao 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 Hanjiang 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 Hanjiang river, there is great chance that the growth rate of algae at the lower reaches of Hanjiang river will increase and it is very likely to have “water bloom” occurrence from Hanchuan to Wuhan section of Hanjiang river; such impact, however, will be greated reduced by the function of water supply from Changjiang river to Hanjaing river, and the impact factor has dropped to 20~30%; so occurrence of “water bloom” at the lower reaches of Hanjiang river can be under good control. After considering the change of hydrologic situation of Changjiang river after the Three Gorges project, the middle route project of south-to-north water diversion and the project of diverting water from Changjiang river to Hanjiang river, under the most unfavorable condition, the probability that the flow of Hanjiang river is less than 0.3m/s under the backwater effect of five-year-return high water level of Changjiang river; therefore, the construction of water diversion from Changjiang river to Hanjiang river will play an extremely important role in improving the water environment quality of the lower reaches of Hanjiang river, controlling and diminishing the impact of “water bloom” on the water body of Hanjiang river.

When the channel of water diversion from Changjiang river to Hanjiang 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 Changjiang river to Hanjiang 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.

7.2.3.3 Impact analysis of Gangnan ditch water supply

According to the Planning of River-Lake Channeling Engineering for Jingzhou Downtown (2013), water supply to the water system of the ancient city all comes from the water supply system of Changjaing river; the water is supply to the city moat from Taihugang ditch and Gangnan ditch through Juzhang river and the channel of water diversion from Changjiang river to Hanjiang river.On the one hand, the water supply project will supplement the ecological use for the water system of the ancient city; on the other hand, it can provide power source necessary for the city moat.Water supply from Taihugang ditch is one of the main sources of water supply to the water system of the ancient city 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 Changjiang river to Hanjiang river, and the water quality of Changjiang 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 ditch after being treated in Chengnan sewage plant) and Gangnan ditch water supply (the actual water supply flow in 2013 is replaced with the flow of the water supply project) 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 ditch 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. The water supply quantity and the water quality of supplied water have significant impact on the water quality of the water system of the ancient city. 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 project has significant effect on improving the water system of the ancient city.

Table 7.2-13 Statistics of yearly average concentration of overall water quality indexes of ancient city water system by the water supply program

Water supply program comparing index			Yearly average concentration of water quality indexes of ancient city 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	
		Index level	Ⅳ	Ⅳ	Ⅳ	Ⅴ	Ⅴ	
	II	Calculatio	22.24	3.79	0.99	1.34	0.26	Ⅳ

		n value						
		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	

7.3 Analysis of impact on crime rate

7.3.1 Background factors for tourism-related crime field

7.3.1.1 Factor of time

The factor of time in the tourism-related crime field is mainly manifested as the regularity of time distribution of tourism-related crime. Tourism features obvious seasonal characteristic, so tourist business shows obvious busy season and off season. In the Northern Hemisphere, the busy season mainly includes the period from April to October.

7.3.1.2 Factor of space

A tourist destination is a preferred space for potential criminals to hide and commit a crime as the place is full of crowded tourists and features strong anonymity. When the traffic for tourism is relatively advanced and the reputation and influence at home and abroad is high, the tourist destination will attract a lot of tourists and potential criminals as well. Therefore, the tourism-related crime rate in the east tourist destination is relatively high while that in the middle and in the west is relatively low.Besides, the hot spots of crime such as scenic area, scenic spots, restaurant and hotel, shopping mall and entertainment place and traffic place also show different level of tourists gathering, and the more tourists gather at one place, the more likely a tourism-related crime is to happen.

7.3.1.3 Factor of victim

When a tourist comes to a strange tourist destination from his familiar residence, she/he usually does not have sufficient experience and resources to judge the security situation in this area and possible tourist-targeted crime derived therefrom. Meanwhile, a potential criminal can distinguish a tourist, who might be a potential victim, from local resident in a short time from her/his dialect and clothing, and the cash, map, camera and backpack she/he carries. Besides, usually a tourist is not vigilant of self-defense when traveling and may attempt to try some activities against morality and laws such as gambling and prostitution, which aggravates the potential of becoming a victim. Finally, even if she/he was infringed upon, the tourist may give up the chance of legal remedies for some minor offenses due to trust barrier caused by environment and influence on travel agenda delayed by reporting the crime. In this way, the tourist-targeted crime activities will remain unknown and such result may have a dispersion effect among potential criminals.

7.3.1.4 Factor of social control oversight

Among the background factors of crime field, the factor of social control oversight is the one that has the strongest influence and the widest influential area. The oversight in tourism-related crime field is mainly manifested in negligence of government authorities, of travel agencies and of community residents in controlling tourism-related crime. The containment theory holds that a crime is a result from lack of individual's internal control ability and of external control factors in society, and that it is caused because the driving force and drawing force for pushing and inducing a person to commit a crime are not contained.

7.3.2 Control of crime rate

Tourism-related crime field is a form of crime field labeled with tourist activities. Its characteristics are focused on the seaonality, concentration of crime space, victim's vulnerability to infringement and oversight of social control. These characteristics also reflect the characteristics of tourism-related crime to some degree, and thus become the theoretical foundation of tourism-related crime field. To control tourism-related crime field is, based on destroying the environment for the survival and development of tourism-related crime field, to separate background factors with potential criminals, weaken or eliminate the attraction of tourism-related crime field to them and finally promote the structure of tourism-related crime field to come apart to achieve the effect of controlling tourism-related crime.

Tourism-related crime field is firstly a system, showing the characteristics of integrity in terms of structure; it is not simple addition of every factor, but a whole systematically made of every factor. Therefore, controlling tourism-related crime field should also 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 these background factor from promoting tourism-related crime; secondly, as a special form of crime field, the tourism-related crime field will have quantitative change and qualitative change in terms of structure as the tourist environment changes, showing the dynamic characteristics of system, therefore, 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 ancient city of Jingzhou 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.

7.4 Impact analysis of solid waste incineration

7.4.1 Project overview

Jimei garbage power generation project is located in Paima village, Jinan town, Jingzhou city, about 7km away from the ancient city. 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 environmental impact assessment of this 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.

7.4.2 Technological process

The technological production process of the domestic waste power generation project of Jingzhou Jimei thermal power Co., Ltd. is shown in Figure 7.3-1.

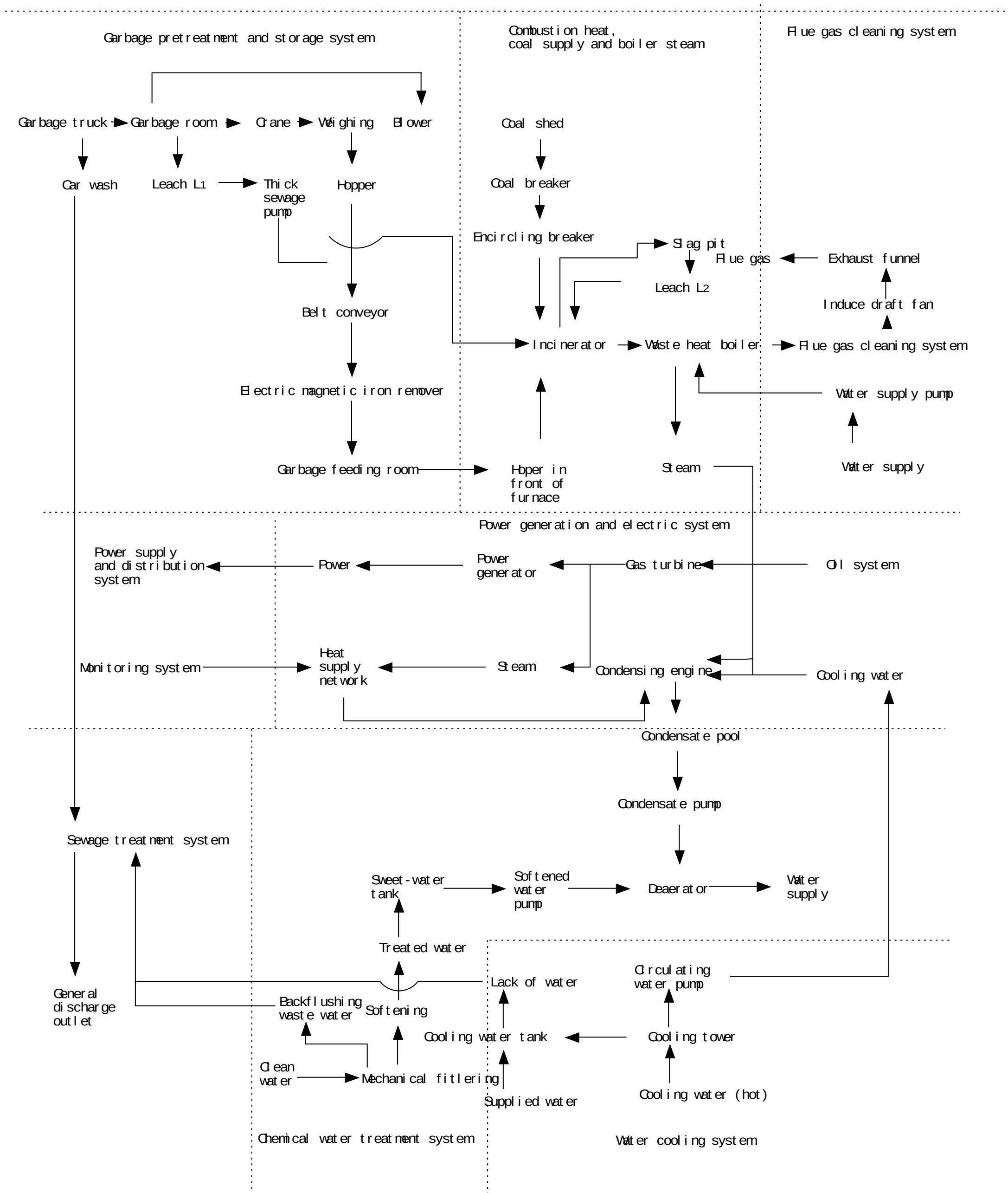


Figure 7.4-1 Flowchart of production process

7.4.3 Main environmental protection measures

7.4.3.1 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 SO_2 in the flue. The eliminating rate of chlorides and SO_2 by semi-dry washing tower can reach 91.00% and above, and 80.00% and above, respectively; after the treatment, both chlorides and SO_2 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, this 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: this 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 this 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 this 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.

7.4.3.2 Preventive measures against solid waste

(1) Measures against flying ash: it is recommended to adopt cement solidification method for ashes in this 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.

7.4.3.3 Preventive measures against water pollution

(1) Measures of separating polluted water by grades and cycling use of water: after this 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. This 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 601.950m3/d; after being treated at sewage treatment station, COD, NH4-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.

7.4.4 Environmental impact analysis

The assessment is conducted according to the Environmental Protection Acceptance Monitoring Report of the Domestic Garbage Incineration Power Generation Project Completion of Jingzhou Jimei Thermal Power Co., Ltd. provided by the environmental monitoring center of Hubei province.

7.4.4.1 Waste gas

(1) Organized waste gas emission

All the largest emission concentrations of smoke, SO2, NOx, CO, H2S, 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).

(2) 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).

7.4.4.2 Waste water

(1) 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).

(2) 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).

7.4.4.3 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).

7.4.4.4 Summary

It can be known from the acceptance result 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.

7.5 Impact analysis of traffic and transportation

The bus line between the historic town to Xiongjia Mound starts at the East Gate Tourist Center and ends at Xiongjia Mound via Jingzhou Avenue, North Ring Road, and Jing-Ying Highway. The whole buse line is about 40km. Average run time is 1.5h. Two main stations are built, namely the East Gate Tourist Center Station and the Xiongjia Mound Station. In 2020 the round-trip tourist bus line between the historic town and Xiongjia Mound will have a passenger capacity of 2306 trips per day and will require 10 hybrid power tourist buses.

Since the tourist bus has hybrid power and the air quality along the line is good, generally it will have very small impact on the atmospheric environment of the surrounding area.

8 Evaluation of Impact on Cultural Relics

As a cultural heritage conservation project, the investment in cultural relics conservation and tourism development has surpassed 50% of the total investment in this proposed project and constituted the most important part of this project. This project involves many national, provincial and municipal cultural relics protection units, so the protection of cultural relics is particularly important during the project construction process. The identification of cultural relics, status quo of cultural relics damage, preservation and restoration and other information related to cultural relics involved in this project are provided by local cultural and tourism authorities.

8.1 Identification of Cultural Relics in the Project Area

There is a total of 595 cultural relics protection units in Jingzhou City, including 15 national key cultural relics protection units, 52 Hubei provincial cultural relics protection units and 527 city (county) level key cultural relics protection units. The details of cultural relics and historic sites are shown in the chapter of natural and social environment overview. Therefore, this analysis of impact on cultural relics mainly focuses on sensitive cultural relics protection units involved in this project. According to field investigation, collected information and confirmation of local cultural relics bureau, this analysis of impact on cultural relics involves the following cultural relics protection units, as shown in Table 8.1-1. Apart from the following cultural relics, other cultural relics listed in the natural and social environment overview are outside the project area and not within the influence scope of the project.

Table 8.1-1 List of sensitive cultural relics protection units involved in the project area

No.	Name	Location	Protection level
1.1	Ancient city wall	Jingzhou Ancient City	National level (4th batch in 1996)
1.2	Xiongjiazhong Chu Tomb	45km north from Jingzhou urban area	Provincial level (2nd in 1981)
1.3	Jingzhou	In the north of Jingzhou Middle Road	4A level scenic spot (2000)

	Museum		
1.4	Historical buildings	13 historical building along Dongdi Street and Nanmen Avenue	Folk houses at Dongdi Street No. 18 and No. 10 and Nanmen Avenue No.46 are provincial cultural relics protection sites, others are cultural heritage sites and traditional dwellings.
1.5	Kaiyuan Taoist Temple	On the west side of Jingzhou Museum	National level (6th batch in 2006)

8.2 Problems and Status quo of Cultural Relics Conservation

8.2.1 Local cultural relics conservation progress and its correlation with this project

Since the first batch of cultural relics protection units were designated in1961, the national, provincial, city and county governments have identified the cultural relics in the project area and specified the protection level of these cultural relics. All cultural relics protection units involved are under strict protection of state laws. The Jingzhou Ancient Wall in this project is a focus of the protection. In particular, the Jingzhou Ancient Wall and Kaiyuan Taoist Temple were included in the national key cultural relics protection units in 1996 and 2006 respectively, under the protection of the relevant laws and regulations.

In terms of planning, the local government and cultural relics department have formulated a number of conservation plans, taken full account of cultural relics conservation 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 relics conservation, the ancient city wall had undergone many restorations in the Qing Dynasty. In the early years since the founding of new China, the ancient city 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 ancient city wall has undergone a total of five restorations. The restoration scope includes ancient city 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 Ancient Wall since 1979. From 1979 to 2012, the Jingzhou ancient city wall, 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 yuan. The length of restored ancient city wall has reached 6,783m.

The capital investment in cultural relics conservation involved in this project will expand the diversified fund channels for cultural relics restoration, expand the influence of cultural heritage sites via the platform of the World Bank, and further enhance the cultural value of heritage.

8.2.2 Existing problems in cultural relics conservation

⑴Lagging management

The cultural relics protection units in the project area have generally failed to provide satisfactory conservation to cultural relics, and the situation is very serious in some cultural heritage sites. The cultural relics conservation involves investment in cultural relics conservation, selection of conservation technology, maintenance of heritage authenticity, management and development methods, etc. It is obviously necessary to conduct in-depth review from the strategic conservation framework to specific technical details.

The materials for restoring some historical buildings in the project area are blindly selected, and many supporting facilities are lagging behind. Some historical 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.

⑵Historical and cultural blocks are arbitrarily transformed

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 style.

⑶Residents' weak awareness of cultural relics conservation

Most local residents don't know much about the laws and regulations for cultural relics conservation and have weak awareness of cultural relics conservation.

8.2.3 Cultural relics damage in the project area

The cultural relics in the project area are generally in poor condition. Some sections of ancient city 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 ancient city wall has become dangerous rock body. Some outdoor stone pavement are in a serious damage state.

The earth wall section of the ancient city wall has not been protected and continued suffering from weathering and rain erosion. Due to the long-term erosion and garbage discarded by tourists, the earth wall has not been effectively protected. The native vegetation on the ancient wall has been threatened by some overly lush vegetation, which has affected the stability of the ancient city wall.

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 ancient city wall. The quality of water system around the ancient city 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 ancient city area has lagged far behind. It has been an important task for local government to carry out the renovation of the ancient city.

Insufficient capital investment in the project area is an important cause of cultural heritage damage. Therefore, in order to protect the cultural heritage sites, the use of foreign capital to preserve and restore cultural relics and historic city has become an important way to solve the problem of local fund shortage.

8.3 Cultural Heritage Conservation Plan and Conservation Works

8.3.1 Principle, objective and protected objects of the cultural relics conservation plan

(1) Principle: adhere to the cultural relics conservation policy of "focusing on conservation and restoration, rational utilization and enhanced management"; implement cultural heritage rescuing conservation projects; continue the local matured building technique when restoring the buildings, and strictly protect the local construction techniques and technologies; comprehensive renovate the surrounding environment of existing cultural relics based on the "authenticity" and "integrity" of historical and cultural heritage;

(2) Objective: adhere to the cultural relics conservation policy of "focusing on conservation and restoration, rational utilization and enhanced management"; protect and inherit the historical culture, and also adapt to and promote local development, fully integrate protection and construction, conservation and utilization, coordinate the relationship among cultural relics conservation, improvement in livelihoods and tourism development, so as to realize the objective of effective protection, rational utilization and enhanced management.

(3) Protected objects: ancient city wall and ancient buildings in the protected area; cultural relics and important documents kept by relevant conservation management institutions or collected, stored and registered by some households; underground cultural relics within the scope of protection; historic character and natural environment constituting the entire ancient city; ancient building technique featured by wooden architecture, and other cultural relics to be protected.

8.3.2 Cultural relics conservation plan or regulations

8.3.2.1 Cultural relics protection scope and construction control zone

As shown in Table 8.3-1, it is consistently stated in the four documents that, the protection scope of ancient city wall is centered on the body of ancient city wall, consisting of earth wall, brick wall and moat.

With respect to the protection scope of the ancient city wall and definition of construction control zone, the overall urban plan has not clearly defined the protection scope; the historic city conservation plan has most clearly defined the protection scope; the overall plan for cultural relics conservation of Jingzhou ancient wall has defined the protection scope of ancient city wall, surrounding cultural heritage sites and historic blocks, rather than the city wall itself; the cultural heritage application documents focused on the definition of key protection zone and general protection zone, and its definition of construction control zone is consistent with that in the overall plan for cultural relics conservation of Jingzhou ancient wall.

The ancient city wall protection project shall take into account a complete renovation of the main body of ancient city wall, including earth wall, brick wall and the moat. Such three components shall be properly restored by traditional techniques according to their specific damage conditions and under the internationally recognized cultural relics restoration principles such as integrity, authenticity and minimum intervention, so as to achieve the rational restoration of the ancient city wall.

Table 8.3-1 Definition of protection scope of the ancient city wall and construction control zone in various documents

No.	Document name	Protection scope	Construction control zone	Coordination area	Heritage area	Buffer area
1	Overall urban plan of Jingzhou city	Brick wall, earth wall and moat of Jingzhou ancient wall	Grade I: 25~50 m outward from the protection scope of ancient city 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	Jingzhou historic city conservation plan	Ancient city 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. Grade II: about 25m from the construction control zone Grade I; Grade III: about 50m from the construction control zone Grade II	The area extending from the construction control zone to the boundary of Jingzhou ancient city 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.	-	-
3	Overall plan for cultural relics conservation of Jingzhou ancient wall	Ancient city wall and moat; the area between 50m from internal wall base and 50m from moat river bank, including other cultural heritage sites surrounding the ancient city wall, such as Xuanmiao Temple, Kaiyuan Taoist Temple, Tienv Temple, Confucian Temple, Quan Cong Temple, Sanyi Street, Zhangjuzheng Street, Xiejiashan Guanyu Temple, Zhijiashan and Songjiashan, Sanguanbi, Taihui Temple and Desheng Street (277 hectares)	Grade I (290 hectares): Inside the ancient city 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 ancient city 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): Inside the ancient city wall: all the area inside the ancient wall excluding protection scope and the construction control zone Grade I. Outside the ancient city 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 ancient wall	Ancient city wall and moat	Grade I (290 hectares): Inside the ancient city 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 ancient city 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 protection scope (277 hectares)	Construction control zone Grade I and Grade II (860 hectares)
		Key protection zone: the area between 50m from the internal wall base to 200m outside the wall; General protection zone: 200m~600m outside the ancient wall	Grade II (570 hectares): Inside the ancient city wall: all the area inside the ancient wall excluding protection scope and the construction control zone Grade I. Outside the ancient city 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.			

8.3.2.2 Other provisions for cultural relics conservation during the project construction process

In accordance with relevant provisions of *Cultural Relics Protection Law of the People's Republic of China* and *Implementation Regulations for Cultural Relics Protection Law of the People's Republic of China*, the proposed project shall abide by the following provisions:

(1) The infrastructure construction of Jingzhou ancient city wall and Xiongjia Tomb shall be coordinated by the archeological department and approved by the Hubei provincial government or Jingzhou city government and superior cultural relics department.

(2) The institutions in charge of the restoration and reconstruction of cultural relics protection units shall obtain the appropriate level of qualification certificate for cultural relics conservation engineering issued by the cultural relics administrative department and the appropriate level of qualification certificates issued by the construction administrative department.

(3) The restoration programs or plans for cultural relics protection units involved in this project shall be approved and based on the recommendations of cultural relics administrative department of the people's government.

(4) During the construction process, in case any unit or individual discovers cultural relics, the construction shall be terminated to protect the site. The situation shall be immediately reported to the local cultural relics administrative department, and handled in accordance with the provisions of *Cultural Relics Protection Law of the People's Republic of China* and requirements of cultural relics department.

8.3.2.3 Content and measures for cultural relics conservation

In accordance with the provisions of *Cultural Relics Protection Law of the People's Republic of China* and requirements of cultural relics administrative department, and based on local realities and damaged facilities of cultural relics protection units, protective measures will be taken from the following aspects: the main body of cultural relics will be protected by reversible restoration technology and engineering measures; the carrier of cultural relics will be reinforced; natural disasters will be effectively monitored and prevented; management will be strengthened.

The specific contents of cultural relics conservation for each cultural relic protection unit involved in this project are listed in Tab. 8.3-2.

Table 8.3-2 Specific contents of cultural relics conservation for sensitive cultural relic protection units involved in this project

No.	Name	Contents of restoration	Remark
1	Ancient city wall	Brick walls, top wall trail, earth wall, retaining wall construction, vegetation planting, road maintenance	National cultural relics protection unit
2	Xiongjiazhong Chu Tomb	Paving asphalt on access road, improving security facilities throughout the region, and building cultural relics exhibition hall and temporary storage room	Provincial cultural relics protection unit
3	Jingzhou Museum	Treasures hall renovation and upgrading	4A level scenic spot
4	Historical buildings	Pavement improvement, house restoration, modern building renovation	Provincial cultural relics protection unit
5	Kaiyuan Taoist Temple	Greening and environmental improvement	National cultural relics protection unit

As can be seen from the table, the contents of cultural relics conservation in the project area can be summarized as city wall restoration, vegetation planting, road maintenance, security facilities upgrading, renovation of cultural relics exhibition hall and treasures hall, pavement improvement and restoration of historic buildings. Among these works, vegetation planting, building restoration, treasures hall and security facilities involve relatively small quantities of work and mainly affect the environment in the project area; wall restoration, road maintenance and asphalt pavement involve relatively large quantities of work and may exert some impact on the surrounding environment during the construction process.

⑴Focus of protection

(1) Renovate the ancient city wall and ancient buildings in the cultural relics protection area, improve the local environment for heritage retention, remove or relocate vegetation, attachment or support facilities that may adversely affect the

original pattern of cultural relics protection units, restore the original pattern of various traditional streets as much as possible according to historical information, and make the local cultural relics protection zone more complete;

② Adjust land use plan and functional zone division, determine the construction projects to be controlled, including demonstration projects, research projects, tourism facilities projects and tour route improvement projects, so as to avoid constructive destruction;

③ Clean, renovate and protect the surrounding environment of cultural relics protection zone, clean, renovate and decorate cultural heritage in the cultural relics protection zone, and achieve the unified harmonious atmosphere in all cultural relics protection units;

④Increase the necessary facilities and signs for cultural relics conservation and tourism services, provide convenient services to tourists, and create high-quality ecological environment.

⑵Special protection of ancient city wall

(1) Before the renovation of ancient city wall, special studies shall be conducted on the local building materials and techniques to summarize a set of approaches or regulations in written form to be followed in practical work. The existing cultural heritage shall be systematically measured and comprehensively studied based on old photos and historical documents. Referring to the same type of construction, the basic pattern of the ancient city wall's layout, volume and decorative arts shall be summed up, and the ancient city wall shall be renovated according to its shape, structure, materials and craftsmanship. Specialized agency shall be appointed to supervise and guide the renovation of the ancient city wall. The renovation of the ancient city wall shall follow the uniform appearance, color, materials and other styles. Meanwhile, materials combining traditional techniques and modern technology shall be used to extend the life of the materials;

② During the renovation of the ancient city wall, the status quo and historical information of existing cultural relics, as well as various historical environmental factors shall be strictly protected;

③The project will renovate the status quo of the ancient city wall. According to *Cultural Relics Conservation Project Management Approach*, cultural relics conservation project is composed of maintenance works, emergency reinforcement works, renovation works, conservation facilities works and relocation works, etc." *Protection Regulations for Chinese Cultural Relics Sites* emphasized that, "Conservation project is a technical measure to renovate the cultural relics and improve related environment. The renovation of cultural relics includes routine maintenance, protection and reinforcement, status quo restoration and focused restoration efforts."

⑶Special protection of historic streets

①The protection scope of historic streets includes valuable old houses, traditional courtyards, key lanes and traditional lifestyle within the construction control zone. The houses that damage the courtyard pattern will be demolished; unsafe houses will be restored and renovated; related facilities in the courtyard will be improved; and those places that don't match the traditional style will be added green space of lanes and courtyards, so as to improve the environment and living conditions of the historic streets. The architectural form, colors and exterior decoration will follow those of traditional houses, and interior decoration may be appropriately upgraded;

② The living environment will be appropriately improved, and the traditional customs and living atmosphere will be reproduced to enrich local tourism culture;

③The tourist routes will be combined with historic streets, so that tourists can experience the local history, culture and folk life.

8.4 Restoration Process Scheme and Rationality Analysis

8.4.1 Restoration Process Scheme

8.4.1.1 Restoration process scheme for the ancient city wall

For the renovation of brick wall in the west of the ancient city wall, stretcher bricks are alternately laid with header bricks. For the general wall body, lime putty and mortar are used for jointing; for key parts of the wall, the conventional lime mortar can be used for laying the bricks.

The original drainage at city wall footing is natural drainage. Now the antique ring road is built around the ancient city wall and installed with drainage facilities. In this renovation project, the garbage and residual soil at the wall footing will be cleaned up, and some low-lying places will be backfilled, so as to maintain the natural slope and allow rainwater to be discharged into the moat via the drainage facilities along the ring road.

Horse-faced wall structure and its laying technique are the same as the city wall. The three wall surfaces are protruding on the city wall, without crenels. The stone under the loophole will be restored by bluestones with the same specifications. The perforation will be restored by city wall bricks to restore its original appearance.

The severely damaged wall section will be reinforced. The wall sections that have collapsed, tilted, precarious or dilapidated shall be demolished for reconstruction based on the circumstances. The construction process shall involve as little demolition as possible. Restoration and reinforcement approaches shall be taken as much as possible to restore and maintain the authenticity of the ancient city wall.

Less demolition: only those wall sections that pose serious security risks will be demolished. The demolition range must strictly be controlled and reduced as much as possible. For those wall sections that are seriously damaged by tree stump at the height of 1~1.5m on the city wall and should be demolished to dig out tree stump and rule out risks, the wall section shall be demolished as needed depending on specific conditions. Those wall sections that are tilted or dilapidated and pose great risks shall be dismantled without hesitation.

No demolition: try to reduce demolition range as much as possible. Only those wall sections that have been damaged by tree stumps will be demolished. After the demolition of the wall, try to use the old tiles from demolished wall, and lay the new wall using the original process, original approach and original shape and structure.

8.4.1.2 Restoration process scheme for the ancient buildings

According to the provisions of *Technical Code for Maintenance and Strengthening of Ancient Timber Buildings*, this project will adhere to the design principle of "focusing on conservation and restoration, rational utilization and enhanced management", follow the cultural relics conservation principle of "original design, original materials and original process", use original components as much as possible, restore in accordance with the traditional process, maintain the original state of cultural relics and ensure authenticity of cultural relics. The following renovation plan has been proposed according to the status quo of ancient buildings:

(1) Ancient buildings

1) Overhaul: those ancient buildings of which foundations have sunk, pillars have severely tilted and deformed and wood framework is on the verge of collapse will be overhauled and restored to their original appearances.

2) Roof renovation: for those ancient buildings with less damage, the tiles on the roof will be uncovered, deadwood framework will be dismantled, and tilted beams will be set right.

3) Restoration: Those ancient buildings of which original appearances have been transformed, water supply and drainage pipes are laid randomly, the original earth walls are on the verge of collapse, indoor environment has high humidity, columns and beams have seriously rotten, shall be restored according to the historical site and referring to the design drawings.

4) Demolition: Some additional buildings have seriously affected the cultural landscape. Such buildings should be fully dismantled, and archaeological survey shall be carried out after the demolition process to discover any cultural relics below the building foundation.

5) Indoor environment and others:

Courtyard wall: the existing courtyard walls shall be renovated. Any missing walls shall be restored to maintain the privacy of the original courtyard. In this way, not only the original appearance of the courtyard is restored, but also the security of the entire courtyard is guaranteed.

Greening: the existing trees and flowers in the courtyard will be retained. The trees will be trimmed on an annual basis, so as to avoid the damage to buildings caused by stretched tree branches. The dead trees will be replaced with new trees of the same species.

Walkway and pavement: the walkway and pavement inside the courtyard will be renovated. The deformed and sunk pavement shall be dismantled and re-paved with bricks or stones.

8.4.2 Rationality Analysis on Restoration Process Scheme

The proposed project is located in a national cultural relics protection zone, and is a cultural relics conservation project. Most cultural relics here are scenic spots and historical sites. Due to long ages, as well as economic, technical and administrative reasons, some cultural relics have been seriously damaged and must be renovated and restored. The restoration program of this project will conform to the following principles or provisions:

(1) Under the guidance of relevant state laws and regulations and with the permission of cultural relics administrative department, the cultural relics restoration program of this project will adhere to the design principle of “focusing on conservation and restoration, rational utilization and enhanced management”, follow the cultural relics

conservation principle of “original design, original materials and original process”, use original components as much as possible, restore in accordance with the traditional process, maintain the original state of cultural relics and ensure authenticity of cultural relics.

(2) The restoration plan of ancient city wall will be prepared according to the basis provided by the cultural relics administrative department. The contents of restoration will be specified and implemented one by one according to the standards for restoration of ancient city wall. Meanwhile, the restoration and reinforcement of the ancient wall must be based on the structural reliability evaluation. Each identified damage shall be properly restored in order of priority. Any damage that significantly affects the structural safety should be immediately supported or reinforced. In addition, the original characteristics should be maintained during the restoration process. The comprehensive restoration program shall be prepared according to the damage survey drawings. The original components should be cautiously replaced. Restoration and reinforcement should be made to retain the original components as much as possible. Any replaced wooden components must be marked the date of replacement in hidden places. The cultural relics restoration program of this project will be prepared by specialized institutions and approved by the local government and superior cultural relics administrative department.

(3) According to the provisions of *Technical Code for Maintenance and Strengthening of Ancient Timber Buildings*, the maintenance of ancient timber buildings and related projects should only be done after the completion of the building survey. In case the urgent restoration is needed by the buildings, it is allowed to take temporary reinforcement measures that won’t affect the architectural features. The maintenance and restoration of ancient buildings involved in this project will comply with the above provisions.

(4) Due to the particularity of cultural relics conservation project, cultural relics

restoration should be completed by local construction unit with relevant construction experience, and their qualifications should be verified by relevant administrative department. According to the actual survey, since some cultural relics protection units in the project area have gone through multiple overhauls, the local construction workers have accumulated rich experience in cultural heritage conservation and can meet requirements of this project.

Judging from the above principles, the restoration program adopted by the proposed project is within the controllable scope. The renovation or restoration program for damaged cultural relics involved in the proposed project is necessary and rational.

8.5 Cultural Relics Management and Monitoring

8.5.1 Cultural Relics Management

This project covers a wide area and includes dispersed construction contents. Since the local government suffers serious shortage of research funds for cultural heritage protection, sets up incomplete management institutions and management measures, the local cultural relics department has failed to clearly divide the responsibilities for cultural relics protection and management, and carried out insufficient cultural relics management measures. In order to strengthen the protection of cultural relics, inherit the excellent Chinese historical and cultural heritage, promote scientific research, and build socialist spiritual civilization and material civilization, the cultural relics management and monitoring system for the proposed project will be established in accordance with *Cultural Relics Protection Law of the People's Republic of China*.

The cultural relics management institutions of the proposed project mainly include the project management office, the Hubei provincial and local cultural and tourism bureaus. The specific conservation work is coordinated and supervised by the Hubei Provincial Cultural Relics Bureau. The local government and its cultural relics administrative department will develop a management system, implement the management measures and supervise the cultural relics conservation in the administrative zone, specifically including the preparation of conservation program, definition of the standards and focus of conservation, classification of protection measures, and incorporation of the conservation program into national economic and social development plan, overall plan for land utilization and urban and rural plan of the local people's governments above the county level.

8.5.2 Cultural Relics Monitoring

Immovable cultural relics within the project area shall be verified and approved as cultural relics protection units according to their historical, artistic and scientific values, and protected and managed in accordance with relevant provisions of *Cultural Relics Protection Law of the People's Republic of China* and *Implementation Regulations for Cultural Relics Protection Law of the People's Republic of China*. The protection scope and construction control zone shall be defined, publicized and marked with descriptions including the name of the cultural relics protection unit, core area, buffer zone and protection agency, etc. In addition, the local government should keep records of cultural relics conservation, and its cultural relics administrative department should submit the records to the Hubei Provincial Cultural Relics Bureau. When necessary, new technologies should be used to establish a dynamic information system and early warning system for cultural relics management. The cultural relics conservation agencies should carry out routine maintenance and monitoring on cultural relics on a regular basis and keep relevant records. Once any safety hazards are detected, the conservation agency should take control measures and promptly report to the local people's government above the county level and the provincial cultural relics authorities.

When any emergency situation endangering the security of cultural relics occurs or may occur, the conservation agency should take control measures and promptly report to the local people's government above the county level and the provincial cultural relics authorities. Upon the receiving the report, the provincial cultural relics authorities should decide on the solution according to the specific circumstances and implement the measures, inspect the handling of emergency situations, and propose the specific plan to prevent the occurrence of similar incidents.

8.6 Impact of Cultural Relics Conservation Project

The impacts of cultural relics conservation project are mainly concentrated in the construction period. Due to small quantities of work, the impact of project construction is mainly in the vicinity of construction zone. The wastes produced by the project have little impact on the external environment. The infrastructure construction around the ancient city wall will enhance the social value of cultural relics without any adverse impacts on the wall body. Therefore, this cultural relics conservation project will produce positive effects far greater than negative impacts.

8.6.1 Positive effects of cultural relics conservation project

(1) Promote the efforts of cultural relics conservation

Due to financial and technical reasons, cultural relics in the project area have not been fully protected, and some cultural relics have been seriously endangered. In the proposed project, the city wall sections that have cracked or deformed will be restored or reconstructed; ancient buildings in Dongdi Street that have been seriously damaged will be renovated; moreover, the river system around the ancient city wall will be connected, and revetment works will be carried out to improve the coordination between environment and cultural heritage and form a complete cultural system of ancient city wall. The proposed project will restore and protect cultural relics with the funds provided by the World Bank, so as to inherit the culture of Jingzhou, pass on valuable material and spiritual wealth to future generations and greatly promote the efforts of cultural relics conservation.

(2) Enhance the protection of historical city and infrastructure construction

This project will reduce a large number of drain outlets in the ancient city and improve water system and environment of the ancient city, and demonstrate the historical features of the ancient city. On the other hand, this project will improve the inner ring road, improve sidewalks as well, restore damaged stone road, improve traffic conditions and improve the living standards of residents. The renovation of infrastructure in the ancient city will improve the urban environment, perfect the infrastructure of the ancient city, further upgrade the city's service functions, and further improve the image of the city, which is of great importance to improve the living environment of residents and promote social security and stability.

(3) Promote sustainable development of cultural relics conservation

The proposed project will enhance the cultural relics conservation and positively promote the image updating of the ancient city. The improvement of cultural relics conservation will greatly enhance the attractiveness of Jingzhou ancient city to tourist groups, and thereby promote the development of service industry and promote the integrated development of the city.

8.6.2 Negative effects of cultural relics conservation project

8.6.2.1 Pollution control measures during construction period

With respect to the impact analysis during the construction period, we take into account the impact of project construction on the surrounding environment and impact of construction process on the cultural relics, which are hereinafter referred to as the impact on the surrounding environment and impact on the cultural relics respectively. In terms of impact of soil erosion and landscape, we mainly consider the impact of external environmental conditions on cultural relics.

(1) Waste gas

Impact on the surrounding environment: this cultural relics conservation project is mainly composed of western city wall conservation and restoration of historic buildings. These works are only within the construction site, and are generally manual works instead of mechanical operations. The waste gas is mainly composed of dust and a small amount of exhaust gas from mechanical facilities. Due to the small area of construction, scattered construction sites and low consumption of raw materials, the waste gas will rapidly spread into the air without any impacts on the surrounding environment. The construction sites and roads are sprayed water and regularly cleaned to reduce dust emissions.

Impact on the cultural relics: vegetation planting and museum renovation involve small quantities of work, and thereby produce low dust emissions. Since road and pipeline construction is close to some cultural relics protection units, less than 10m in some areas, dust emission has certain impact on cultural relics. During the construction process, excavation and earthwork must be strictly controlled. Temporary dustproof wall shall be built around the cultural relics protection units, and reasonable construction plan shall be formulated to minimize the adverse impact of construction on cultural relics. A small amount of spoil produced by construction process should be cleared up in time. The exhaust gas produced by construction machinery belongs to temporary emissions and will not exert any negative impact after the completion of construction.

(2) Waste water

The domestic sewage during the construction process will be discharged into the municipal sewage pipe network via public toilets of various cultural relics protection units, and finally disposed by the sewage treatment plant in the south of the city and Caoshi Sewage Treatment Plant. Construction wastewater is mainly composed of concrete wastewater and mechanical washing wastewater, etc. The construction waste water will be reused after disposal. Therefore, the construction wastewater generated by the proposed project has small impact on the environment.

(3) Noise

Impact on the surrounding environment: the noise produced by the cultural relics conservation project is mainly generated by construction machinery and transport vehicles. The construction will certainly affect the surrounding residents. However, this project mainly involves manual works, so construction machinery only generate a small amount of noise occasionally. Meanwhile, the cultural relics restoration project is generally carried out at daytime, and proper construction techniques are adopted to reduce or even eliminate the use of large-scale equipment, reduce vibration during the construction process. Therefore, the proposed project has small impacts on the acoustic environment.

Impact on the cultural relics: road excavation and pipeline construction involves some construction machinery and transport vehicles. The traffic noise and mechanical vibration will produce certain impacts on cultural relics and management staff. During the construction process, construction machinery will be arranged away from the cultural relics protection boundary or construction control boundary as far as possible, so as to reduce the vibration and noise to the minimum level. Construction schedule will be reasonably arranged to shorten the construction period as much as possible.

(4) Solid waste

Impact on the surrounding environment: solid wastes during construction process are mainly composed of waste from old buildings generated by restoration and renovation process and domestic garbage produced by construction workers. Since the dismantled construction materials are made use of as much as possible, there is a small amount of abandoned building materials. The recycled building materials are transported to the acquisition site of old building materials or directly utilized. Domestic garbage will be piled up in the designated places and cleared up in time, and not allowed to mix with construction waste. The sediment from river dredging will be directly used for revetment construction and landscaping. After proper disposal, the solid waste will produce little impact on the environment, and instead beautify the urban water environment.

Impact on the cultural relics: infrastructure construction and historic street renovation of the proposed project will produce some solid wastes. The construction unit should promptly clean up any spoil and dismantled building materials to be accepted by the spoil disposal office of the municipal department, or transported to the designated place of the spoil disposal office. It is forbidden to pile up earthwork and waste building materials near the boundary of cultural relics protection units for a long time, so as to prevent dust pollution on cultural relics.

(5) Water and soil conservation: the excavated earthworks will be partially used for building roads and embankment. The excavated earthworks should be used for land leveling and backfill as much as possible. Construction should be carried out in different zones and phases, so as to shorten the duration of the individual works. Preventive measures should be taken to shorten the exposure time of excavated surface and reduce soil erosion. A small amount of spoil or borrowed earth occupies a small area in the temporary stocking area, so they will be covered to avoid soil erosion during the rainy season. The mound should have small slope, and be compacted, covering a small area and free from rainwash. Construction management should be enhanced, and workers' awareness of water and soil conservation should be strengthened as well. Construction should be suspended during rainstorms to reduce soil erosion.

(6) Impact on urban landscape and cultural relics

In order to improve the urban landscape and properly protect cultural relics, this project should take the following protective measures:

1) Engineering design should take full account of the cultural relics protection units, so as to avoid any negative impact of this project on cultural relics. Before construction, construction scheme should be designed according to the characteristics of each building, and the implementation of the scheme must ensure the security and stability of ancient buildings. The infrastructure construction must take into account

the protection boundary of cultural relics, and the works within the boundary must be approved before commencement of construction.

2) The construction unit should work with relevant units to formulate the cultural relics protection plan during construction process.

During house demolition, earthwork excavation and pipeline laying processes, if any ancient ruins or relics buried underground are detected, the construction should be immediately suspended, special personnel should be assigned to protect the site, and the situation should be promptly reported to the responsible person of the construction unit. In accordance with the pre-established cultural relics protection plan, contacts should be made with cultural relics conservation department, and assistance should be provided to archaeological excavations. The engineering design or pipeline route should be altered when necessary to bypass the heritage sites of great archaeological value.

8.6.2.2 Environmental impacts and mitigation measures during operational period

Generally, cultural relics will not produce any waste during operational period. Cultural relics will subject to weathering, corrosion and damage under the influence of external environment. Therefore, routine maintenance and monitoring of cultural relics is of great importance. Cultural relics administrative department or institutions should strengthen the management and monitoring of cultural relics during operational period, so as to reduce the damage of cultural relics to the minimum level.

(1) Waste gas: the exhaust gas from underground garage is discharged into the 2.5m-high vent stack, which may exert some impact on cultural relics. In addition, traffic road management near the project area will be strengthened, traffic flow will be controlled, and vehicles burning fuel oils are denied access to the cultural relics protection zones. Battery cars or sightseeing buses will be gradually used as

transportation means in the protection zone, so as to reduce the impact of automobile exhaust on cultural relics. It is recommended to build parking lot away from the cultural relics protection zone, use battery car as transportation means to reduce the impact of traffic exhaust on cultural relics.

(2) Wastewater: the infrastructure renovation in the project area will improve the water supply and drainage systems and rainwater drainage system. All sewage will be discharged into the sewage pipe network. The domestic sewage from tourist center and local residents will be discharged into the new sewage pipe network laid by this project, and finally treated by the municipal sewage treatment plant and discharged after reaching standards.

(3) Noise: After the completion of this project, the noise is mainly generated by management staff, traveling tourists and vehicles. The noise source belongs to non-continuous social noise. The noise pollution can be effectively prevented as long as tourists' awareness of civilized travel can be enhanced through education and guidance.

(4) Solid waste: After the completion of this project, solid waste is mainly the garbage collected by daily cleaning. All solid wastes will be collected at the designated place and disposed through incineration.

8.6.2.3 Impacts on cultural relics and mitigation measures

The impacts on cultural relics and mitigation measures are shown in Tab. 8.6-1.

Table 8.6-1 List of impacts on cultural relics on mitigation measures

No.	Project phase	Main impacts	Main mitigation measures	Executor	Institutions in charge
1	Construction period	This project involves national or provincial-level key cultural relics protection units. Any improper maintenance and restoration methods will exert adverse impacts on cultural relics. In addition, improper building activities and behaviors of construction workers will also produce certain impacts on the protection of cultural relics.	1. Cultural relics conservation work involved in this project must be carried out within the allowable range of relevant national laws, regulations, cultural heritage protection framework of the World Bank. 2. The cultural relics protection units and management departments in the project area should supervise the construction activities outside the boundary of the cultural relics protection zone. Apart from cultural relics conservation project, other construction activities must be carried out outside the construction control boundary. Any renovation and reconstruction works within cultural relics protection zone must be compatible with the surrounding landscape as a whole. It is not allowed to conduct any construction activities that will affect the security of cultural relics and their surrounding environment. 3. The infrastructure construction of this project shall be coordinated by archeological departments and approved by Hubei provincial government or Jingzhou city government and superior cultural relics department. 4. The cultural relics restoration program of this project will be prepared by specialized institutions and approved by the local government and superior cultural relics administrative department. Cultural relics restoration should be completed by local construction unit with relevant construction experience, and their qualifications should be verified by relevant administrative department. The local matured building technique will be continued to use when restoring the buildings, and the local construction techniques and technologies will be strictly protected. 5. During house demolition, earthwork excavation and pipeline laying processes, if any unit or individual detects cultural relics, the construction should be immediately suspended, special personnel should be assigned to protect the site, and the situation should be promptly reported to the responsible person of the construction unit. In accordance with the pre-established cultural relics protection plan, contacts should be made with cultural relics conservation department, and assistance should be provided to archaeological excavations. The engineering design or pipeline route should be altered when necessary to bypass the heritage sites of great archaeological value. 6. The main body of ancient buildings will be protected by reversible restoration technology and engineering measures. It is necessary to use original components as much as possible, restore in accordance with the traditional process and maintain the original state of cultural relics. The restoration and reinforcement of the ancient buildings must be based on the structural reliability evaluation, and carried out according to approved standards. 7. The houses that damage the courtyard pattern will be demolished, unsafe houses will be restored and renovated; related facilities in the courtyard will be improved; and the residents in the historical streets will be properly evacuated to improve living environment; 8. Management will be enhanced on cultural relics restoration unit and construction workers. Training will be provided to improve their awareness of cultural relics conservation, so as to prevent the	Contractor, Culture and Tourism Bureau	Culture and Tourism Bureau and Project Management Office

			occurrence of any destructive activities.		
2	Operational period	Cultural relics will subject to weathering, corrosion and damage under the influence of external environment. In addition, the increases in floating population, pollutants and improper behaviors during the operational period will exert adverse impacts on cultural relics.	1. Routine maintenance and monitoring of cultural relics is of great importance. Cultural relics administrative department or institutions should strengthen the management and monitoring of cultural relics during operational period, so as to take any protective measures including waterproof works and reinforcement efforts, and reduce the damage of cultural relics to the minimum level. 2. Enhance management on floating population, establish a complete pollutant collection and disposal system, and prevent environmental pollution and any damage to cultural relics. 3. Take effective monitoring and preventive measures against natural disasters. 4. Enhance management on land use and functional zone division, control the construction projects in the project area, and avoid constructive destruction; 5. Add necessary facilities and signs for cultural relics conservation and tourism services, provide tourists with convenient services, standardize tourists' behaviors and create high-quality environment.	Culture and Tourism Bureau	Culture and Tourism Bureau, Project Management Office

8.7 Conclusion of Impact Assessment on Cultural Relics and Environment

Under the premise of fully protecting historical and cultural heritage of the ancient city of Jingzhou, this project will restore and protect the damaged city wall and historic buildings, renovate infrastructure in the region, build supporting facilities for the historical site, and continue in-depth study on cultural heritage of the ancient city of Jingzhou. 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, this project is necessary and feasible based on the status quo of the ancient city of Jingzhou, support provided by national policy and need of environmental protection.

9 Environmental Protection Measures and Total Emission 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.

9.1 Environmental Protection Measures

9.1.1 Vegetation Protection Measures

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.

(1) 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.

(2) 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.

(3) 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.

(4) 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.

9.1.2 Countermeasures & Measure for Protection of Aquatic Life

(1) 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.

(2) 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.

(3) 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.

(4) 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.

(5) 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 wastewater treatment 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.

(6) 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.

9.1.3 Measures for Control of Water and Soil Loss

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 tourist center, underground parking, sewage interception pipe network, branch sewer and other works should be handled to deposit at temporary spoil ground nearby, and temporary protective measures should be taken. Stripped humus enriched topsoil is amount to 180000m³, depositing at 2 temporary spoil grounds, the final borrow fill of revetment and wetlands, barrow earth for planting and etc may use up this part of topsoil.

I. 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 spoil ground appointed in the design without unapproved dumping along the route, river or ditch.

The spoil depositing amount and level vary at various temporary spoil grounds; 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 spoil ground 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.

II. Measures for Recovering Spoil Ground

Due to the site is a pound, at the end of earth depositing, the occupied part of pound should be resumed aquiculture.

III. Temporary Measures

(1) Temporary barriers：temporary spoil ground 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.

② Temporary interception and drainage：before temporary earth depositing, earth drainage ditch should be set around temporary spoil ground; 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.

③ Temporary covering: centralized topsoil deposit is protected by temporary covering with plastic film to prevent topsoil loss.

Quantity: 0.21hm^2 rehabilitation, planting of 8400 trees, 0.03hm^2 greening, 124m long temporary retaining wall, 350m long temporary drainage ditch, 6 grit chambers, 0.16hm^2 temporary covering.

9.2Measures for Mitigation of Social & Environmental Impact

(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) Accelerate construction progress 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) Ensure sanitary and clean drinking water in work area, comply with sanitation standard for drinking water, strengthen food sanitation management, avoid serving of unhealthful food to avoid outbreak of epidemic diseases such as hepatitis, diarrhea and the like; for dorm and kitchen facilities in the quarters of construction personnel, sanitation condition of sufficient and functional systems, toilet facility and waste management should be made available.

9.3Protective Measures against Water Environmental Pollution

9.3.1 Selection of Non-polluting Dredging 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.

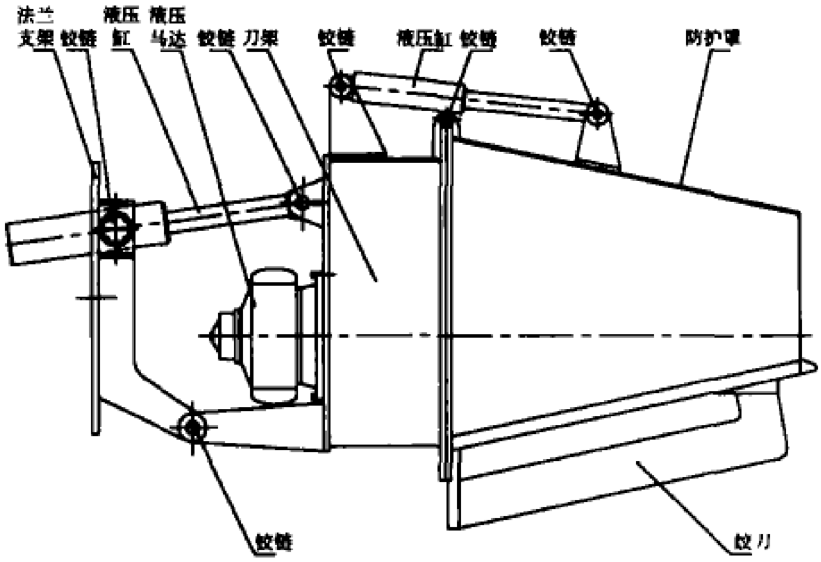


Figure 9.3-1 Schematic Diagram of Non-polluting Dredger Cutter (Flange support; hinge; hydraulic cylinder; hydraulic motor; hinge; hydraulic cylinder; hinge; hinge; protective shield)

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 this project has only small impacts on environment.

9.3.2 Protective Measures against Pollution by Construction Wastewater

(1)Spoil ground residual water

Spoil ground 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 spoil ground residual water.

Technical principle: under the effect of coagulant, colloid and fine SS in wastewater are coagulated into floccule 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 9.3-1。

Table 9.3-1 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/($mg \cdot L^{-1}$)	6201	6854	6038	7262	6527	2366
CODCr removal rate/％	56.3	51.7	57.5	48.9	54.0	83.3
Supernatant turbidity	32.48	4.8	34.99	30.91	94.2	25.8

/NTU						
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 9.2-1 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 spoil ground 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 spoil ground residual water of this project meets Grade-A standard. Treatment process of spoil ground residual water is shown in Figure 9.3-2.

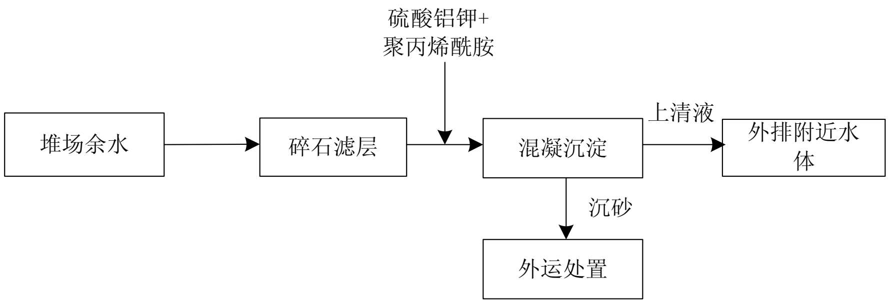


Figure 9.3-2 Treatment Process of Spoil Ground Residual Water (Spoil ground residual water; rubble filtrate; aluminum potassium sulfate + polyacrylamide; coagulating sedimentation; grit sedimentation; carry away for disposal; supernatant; discharge into water area nearby)

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 spoil ground 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 9.3-2 Analytical Results of Compositions in Clarified Liquor of Wastewater

(Test item; PH value, OK; soluble matter, OK; insoluble matter, OK; chlorides, OK; sulfate radical, OK; alkali content, OK; quality indicator; test results; comments on test results; clear, nil)

检验项目		PH值	可溶物 (mg/L)	不溶物 (mg/L)	氯化物 (mg/L)	硫酸根 (mg/L)	碱含量 (mg/L)
质量指标		>4	<10000	<5000	<3500	<2700	<1500
检验结果	1	12.6	1850	55	35.0	34.5	205.5
	2	13.5	1900	透明,无	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
评价结果		合格	合格	合格	合格	合格	合格

Treatment process of basic washing wastewater:

(Basic washing wastewater; sedimentation; grit sedimentation; carry away for disposal; supernatant; reuse for mixing concrete)

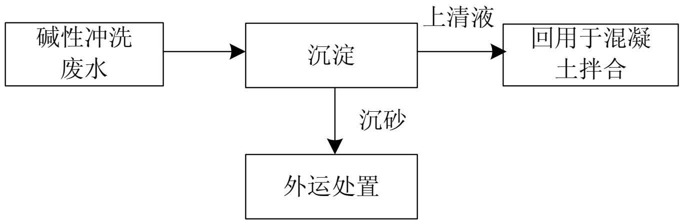


Figure 9.3-3 Technical Treatment Process of Sludge Wastewater

(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:

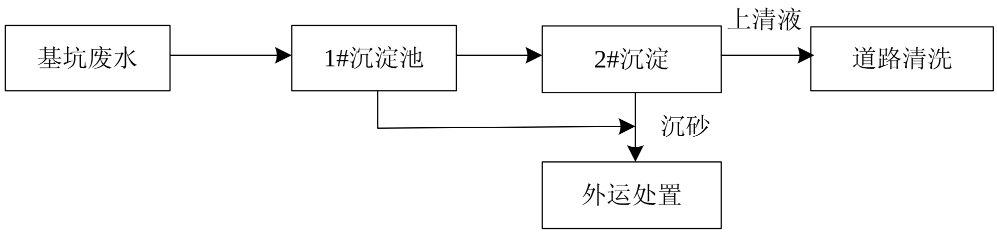


Figure 9.3-4 Technical Treatment Process of Foundation Pit Wastewater (Foundation pit wastewater; 1# sedimentation tank; 2# sedimentation tank; grit sedimentation; carry away for disposal; supernatant; road cleaning)

(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:

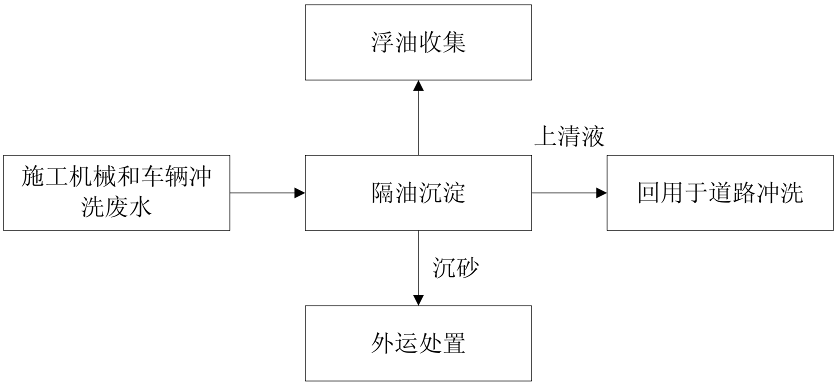


Figure 9.3-5 Technical Treatment Process of Construction Vehicles and Machinery Washing Wastewater (Construction vehicles and machinery washing wastewater; collect floating oil; oil separation & sedimentation; grit sedimentation; carry away for disposal; reuse for washing road)

(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.

9.3.3 Measures for Prevention and Control of Other Pollutions during Construction Period

(1) 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.

(2) When bulk powder materials such as gravel and cement are stacked at construction site, spoil ground 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.

9.3.4 Measures for Prevention and Control of Water Environmental Pollution during Operation period

9.3.4.1 Measures for Prevention and Control of Environmental Pollution by Living Sewage

Upon completion of the project, tourist center and the exhibition hall will periodically produce tourist living sewage; living sewage from tourist center is discharged to wastewater treatment plant after standard treatment in cesspool according to handover standard of Caoshi Wastewater Treatment Plant, sewage is collected before passing through coarse sewage grid at Caoshi Wastewater Treatment Plant, 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 Wastewater Treatment Plant is 120000m^3/d, and actual treatment capacity at present is 30000m^3/d. considering tourist center in the east belongs to handover range of sewage treatment pipelines of Caoshi Wastewater Treatment Plant, thus living sewage from tourist center in the east is discharged to Caoshi Wastewater Treatment Plant for treatment, estimated load of sewage from tourist center in the east is about 8.82t/d.

Upon completion of the project, Xiongjia Mound will produce 27.36t/d additional sewage. The additional sewage will be treated by planned micro-power wastewater treatment equipment.

Wastewater Treatment Technology

Particular technical process of wastewater treatment adopted by Caoshi Wastewater Treatment Plant is as shown in Figure 9.3-6.

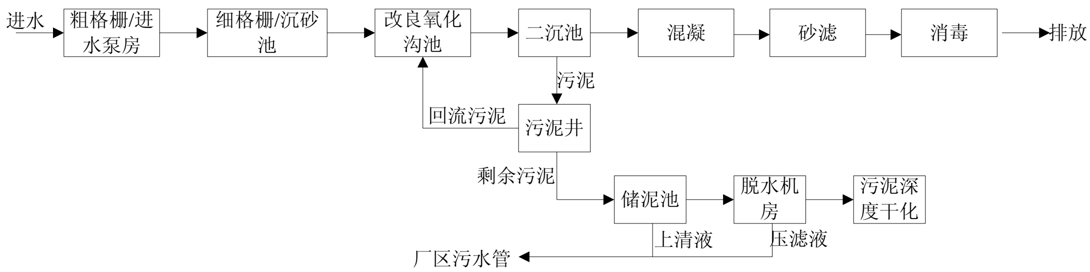


Figure 9.3-6 Technical Process of Wastewater Treatment (Incoming water; coarse grid/to water pump room; fine grid/to grit chamber; modified oxidation ditch;

backflow sludge; 2# sedimentation tank; sludge; sludge well; residual sludge; coagulation; sand filtration; disinfection; sludge storage tank; supernatant; dewatering machine house; pressure filtrate; sludge further drying; waste pipe in the sewage treatment plant; discharge)

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 Wastewater Treatment Plant (GB18918-2002), Grade-1-B, and finally, tail water is discharged after disinfection with chlorine dioxide.

Feasibility Analysis of Standard Sewage

Municipal wastewater treatment plant functions to treat with municipal living sewage and industrial wastewater in small amount, treatment effect of various treatment units are listed in Table 9.3-3.

Table 9.3-3 Schedule of Main Treatment Units of Municipal Wastewater Treatment Plant and Respective Treatment Efficiency

Pollutant / Treatment unit		CODcr	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 wastewater treatment plant, mg/L		193.44	18.78	20.73	1.41	197.22

1. Table 9.3-3 shows that, municipal wastewater after wastewater treatment station is discharged according to Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002), Grade 1-B.

2. According to actual operation condition of Caoshi Wastewater Treatment Plant, 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 Wastewater Treatment Plant in 2013, the quality of outgoing sewage from Caoshi Wastewater Treatment Plant meet the requirements of Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918-2002), Grade 1-B.

Time Schedule Linkage

To date, Caoshi Wastewater Treatment Plant is put into operation; upon operation and official production of the project, it can be connected to Caoshi Wastewater Treatment Plant for wastewater treatment.

The Xiongjia Mound Micro-Power Sewage Treatment Device should be completed and put into use simultaneously with Phase I project. Since the Micro-Power 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 treatement facilities in Xiongjia Mound should be put into use as soon as possible and before that, Xiongjia Mound Phase II project should not be allowed to be put into operation.

Feasibility of Wastewater Treatment Capacity

The load of living sewage produced by east tourist center is about 8.82m^3/d; near-term design capacity of Caoshi Wastewater Treatment Plant is 30000m^3/d, actual treatment capacity of this wastewater treatment plant is about 26900m^3/d, so Caoshi Wastewater Treatment Plant has 3100m^3/d spare capacity, and it's feasible for this wastewater treatment plant to accommodate wastewater of the project in terms of capacity.

Additional load of living sewage produced by Xiongjia Mound is about 27.36m^3/d; design capacity of auxiliary wastewater treatment facility in Xiongjia Mound 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.

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 Wastewater Treatment Plant; base on the findings of site survey, sewage produced by east tourist center can be interconnected with existing sewage pipelines.

Additional sewage produced by Xiongjia Mound can be discharged to agricultural irrigation channel via Phase I drain pipe.

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 wastewater treatment plant after treatment in the cesspool, the sewage after treatment at wastewater treatment plant will meet Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant (GB18918—2002), Grade 1-B before discharging to Taihu Port canal. To cum up, it’s feasible for interconnection of living sewage from tourist center to Caoshi Wastewater Treatment Plant.

According to current EIA report, Grade-1 standard sewage is achievable with micro-power wastewater treatment equipment in Xiongjia Mound, so it’s feasible to interconnect additional living sewage from Xiongjia Mound to auxiliary wastewater treatment facility.

9.3.4.2 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 wastewater treatment 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.

9.4 Measures for Prevention and Control of Noise Pollution

9.4.1 Measures for Prevention and Control of Noise Pollution during Construction Period

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.

9.4.2 Measures for Prevention and Control of Noise during Operation Period

9.4.2.1 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).

9.4.2.2 Equipment Noise

Variable refrigerant flow multi-split central air conditioning should be sued at tourist 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.

9.4.2.3 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.

9.5 Protective Measures against Air Environmental Pollution

9.5.1 Protective Measures against Air Environmental Pollution during Construction Period

9.5.1.1 Protective Measures against Environmental Pollution by Construction Related Fugitive Dust

Main sources of construction related fugitive dust are earthwork excavation, mixing of ash and earth during construction of tourist 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 fugitive dust on the environment, following measures should be taken to suppress construction related fugitive dust:

(1) 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.

(2) Effective and clean construction enclosure should be erected around construction site.

(3) 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.

(4) Materials such has 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,

(5) 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.

(6) 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.

(7) From the perspective of protecting human health, operators should be provided with dustproof respirator.

9.5.1.2 Protective Measures against Environmental Pollution by 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.

9.5.1.3 Environmental Protection Measures against Stinking Spoil Ground

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, environmental protection measures against stinking spoil ground 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.

9.5.2 Measures against Ambient Air Pollution 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.

9.6 Measures for Prevention and Control of Pollution by Solid Waste

9.6.1 Disposal of Construction Solid Waste

(1) 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.

(2) 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.

(3) 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.

9.6.2 Feasibility Analysis of Outlet for Dredged Sediment

According to feasibility study report of the project submitted by TYLIN INTERNATIONAL, dredged sediment in project area will be disposed by local reuse, following is feasibility analysis thereof.

9.6.2.1 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.

9.6.2.2 Analysis of Conformity with Disposal of Sludge from Municipal Wastewater Treatment 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 Wastewater Treatment 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.

9.6.2.3 Analysis of Land Demand

According to feasibility study report and analysis of balanced earthwork and stonework in water & soil conservation plan of the project submitted by TYLIN INTERNATIONAL, wetland area is about 166000m^2, revetment area is 57000m^2; total demand for earthwork and stonework is about 200000m^3 , while dredged sediment of the project is about 250000m^3; therefore, from the analysis of earth demand for the project, part of dredged sediment after drying disposal can be reused as wetland and revetment filling earth, remaining dredged sediment will be carried to final temporary dump for future construction of gardens and parks in Jingzhou City.

9.6.3 Disposal of Solid Waste during Operation Period

Main sources of solid waste are domestic waste and common wastes produced during operation of tourist center, Xiongjia Mound 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 9.6-1 Output of Main Solid Wastes

Source of solid waste	Number of solid waste	Type of solid waste	Out put, t/a	Outlet
Waste from tourist 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	

9.7 Collective Measures for Environmental Protection and Ecological Restoration

Measures for prevention and control of pollution for the proposed project are listed in the table below.

Table 9.7-1 Schedule of measures for prevention and control of pollution for the proposed project

<table>
<tr><th>Period of time</th><th>No.</th><th>Type</th><th>Location</th><th>Pollutant name</th><th>Equipment name</th><th>Size</th><th>QTY</th><th>Remark</th></tr>
<tr><td rowspan="5">Construction period</td><td>1</td><td>Noise</td><td colspan="2">Heavy-duty construction machinery running noise</td><td>——</td><td>——</td><td>——</td><td>Proper construction timing</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Wastewater</td><td rowspan="4">Construction of civil works</td><td>Basic washing wastewater</td><td>Sedimentation tank</td><td>$20m^3/d$</td><td>13 sets</td><td>——</td></tr>
<tr><td>Transport machinery and vehicles oily washing wastewater</td><td>Oil separator + sedimentation tank</td><td>$40m^3/d$</td><td>9 sets</td><td>——</td></tr>
<tr><td rowspan="2">foundation pit wastewater</td><td rowspan="2">Primary & secondary sedimentation tanks</td><td rowspan="2">$200m^3/d$</td><td rowspan="2">17 sets</td><td>——</td></tr>
<tr><td>——</td></tr>
</table>

				spoil ground residual water	Coagulation-sedimentation system	1400m³/d	2 sets	——
				Sludge and spoil ground percolate	Anti-seepage of spoil ground	——	——	——
	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	400000 m³	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	Tourist center	Living sewage	Cesspool	80m³/d	1 set	——
	3	Noise	Pump station	Noise	Buried	2 points	——	Additional acoustic shield
	4	Solid waste	Tourist center	Domestic waste	Trash bin	——	7 sets	Collection and handover to sanitation department for centralized disposal
			Xiongjia Mound	domestic waste	Trash bin			
			Lift pump station and box culvert	sludge	Collection of sediment			

9.8 Control of Total Emission

9.8.1 Total Emission 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

9.8.2 Total Emission 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 wastewater treatment plant, thus pollution emission indicators with living sewage outgoing from discharge port at tourist center and Xiongjia Mound are used as assessment indicators. With final emission from Caoshi Wastewater Treatment Plant be used as control indicators, total emission control indicators of pollutants for proposed project are defined as shown in Table 9.8-1below.

Table 9.8-1 Emission of various pollutants of the proposed works

Total emission control factor		Proposed works, t/a	Total demand, t/a	Remark
COD	Assessment indicator	1.626	——	Wastewater from tourist center to be disposed at Caoshi Wastewater Treatment Plant; wastewater from Xiongjia Mound to be disposed by
	Control indicator	1.186	1.186	
Ammonia-nitrogen	Assessment indicator	0.25	——	
	Control	0.17	0.17	

	indicator			existing auxiliary wastewater treatment facility
NOx	Control indicator	0.00456	0.00456	

9.8.3 Source of Total Emission Control Indicators

1. Policy Requirements for Total Emission 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 emission 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 emission 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 Emission Control Indicators

The quota for total emission of the project is1.186t/a total COD, 0.17t/a ammonia-nitrogen and NOx0.00456t/a, total emission indicators is subject to reassignment and distribution by Jingzhou Environmental Protection Bureau and final validation by Department of Environmental Protection of Hubei Province.

10 Public Consultation and Information Publicity

10.1 Purpose and Principle

According to the requirements of The Provisional Measure of Public Participating in Environmental Assessment issued by State Environmental Protection Administration, Law of the Peoples Republic of China on Environmental Impact Assessment, World Bank's Policy on Environmental Impact Assessment (OP4.01), World Bank Operation Manual-BP17.50 Policy on Information Publicity and other related documents, information publicity and public participation in environmental impact assessment are required for the project. The purpose of information publicity and public participation in environmental impact assessment for the project is to allow local residents timely and accurately understanding 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.

10.2 Way of Participation

For public participation, release of questionnaire, hearing, inquiry by family visit, interview of related units and like method will be relied on; time for inquiry is arranged during Sep 9, 2014~Oct 1, 2014, Nov 11, 2014~Nov 28, 2014 and Mar 21, 2015~Mar 27, 2015; objects of inquiry are residents from project construction subareas of Jingzhou historic town and the leaders of relevant governmental departments.

10.3 Public Consultation

For direct hearing of public opinions and collecting logic proposals, public consultation has been conducted in the areas affected by project construction **(Especially** resettlement areas**)** by EIA unit and resettlement authority; method of consultation includes public questionnaire (Inquiry of individuals and groups), hearing, inquiry by public visit and interview of related units; in addition, reference is made to Action Plan on Resettlement of Affected Residents for Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project (Hereinafter referred to as Resettlement Report) worked out by Center for Involuntary Resettlement, Wuhan University, so as to gain valuable outcome from public inquiry and supplement content of public inquiry; furthermore, in the stage of adjustment and determination of subunits, EIA unit conducted public consultation in the areas affected by project adjustment to hear public opinions and suggestions in affected project area, so as to facilitate smooth initiation and improvement of the project.

10.3.1 Questionnaire

10.3.1.1 Inquiry of Public Individual

The purpose of public individual questionnaire is to hear basic attitude of the residents from the areas affected by project construction (In particular, those residents potentially affected by the activity of project construction, and affected by land expropriation and demolition for the sake of the project), problems relating to land use, relocation & resettlement as a result of project construction, as well as potential environmental impact by project construction and etc, ask for their suggestions about measures for mitigating such adverse impact and so on. Finally, after collection of these public opinions and proposals, the inquiry outcome will be fed back to construction contractor and appointed design institute for acceptance or treatment and settlement by them as appropriate. During inquiry, local residents were called in for hearing their voice at first, and then questionnaire was directly released to each object of inquiry, with detailed explanation about their unclear or unknown maters of inquiry, and finally questionnaire was completed by the interviewee.

Time for the inquiry was Nov 28, 2014~Mar 27, 2015; the inquiry had coverage of Jingzhou historic town and surrounding areas. 70 questionnaires were released to the public and individuals, of which 65 effective questionnaires were taken back. The inquiry findings include:

(1) Public attitude and acquaintance of the project

96.92% interviewees totally support project construction; 3.08% interviewees reserve conditional support of project construction; and no public disagreement against project construction.

All interviewees know something about the project; some of them express they'll continuously concern about the project and wish timely to be informed of project progress.

(2) Public understanding of environmental status in the project area

As for public position to environmental condition in project area, the inquiry finding is 10.77% satisfaction,58.46% basic satisfaction, 30.77% dissatisfaction and 0% disinterest; 38.46% interviewees believe serious water pollution of the moat, 16.92% interviewees believe no serious water pollution of the moat, and 44.62% interviewees believe moderate water environmental impact, suggesting that local people are conscious of environmental protection, know something about the fact of environmental pollution, but to an insufficient manner, thus it's necessary to strengthen public education to enhance their notion of environmental protection.

(3) Public attitude toward the impact from restoration construction of historic town

Majority of the public believe that, undesirable impact of construction process of the project is noise and fugitive dust, about 24.62% of them worry about noise pollution, and about 49.23% of them worry about fugitive 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, about 36.92% of them worry about exhaust gas pollution, and about 9.23% of them worry about other nuisance; noise impact will intensify upon completion of the project, 41.54% and 58.46% of them most expect to ensure environmental quality in connection with regional environment and overall residence environment, 41.54%, 1.54%, 7.69%, 18.46% and 26.15% of them concern about taking mitigation measures for sewage interception, low-noise road, sound insulation window, removal and planning control respectively; 16.92% interviewees believe project construction will lead to more smooth traffic, 35.38% interviewees believe project construction will drive forward local economic development, and 50.77% interviewees believe project construction will help improving the living environment.

10.3.1.2 Inquiry of Groups

It's found from the opinions of inquired groups that, surrounding street-level social management offices and governmental departments know well about proposed project, 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 environmental condition. All of them support project construction, of which one unit dissatisfies of existing environmental quality on the ground of illegal discharge of living sewage along the moat without standard treatment. Environmental condition is poor. Flood hazard exists in flood season. Other units put forth respective requirements and suggestions relating to the project: they expect to take effective measures and take into consideration of the requirements on geological disaster risk assessment report to ensure the safety of project construction. In addition, extra care should be exercised to avoid unnecessary groundwater and soil pollutions during construction. Various technical means should be strengthened to minimize the impact of noise, dust and exhaust gas pollution during construction period and operation period.

10.3.2 Hearing

For better understanding of public opinion to project construction, in addition to residents' interviewing and inquiry of groups, group interviewing by public hearing should be conducted with all street-level social management offices in Jingzhou region affected by project construction; two hearings with public participation were held on Nov 28, 2014 and Mar 27, 2015 respectively; more than 20 participants attended at each hearing, and officials from local government and governmental authorities were in presence. Major agenda of the hearing 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 public hearing is illustrated in Figure 10.3-1 and Figure 10.3-2. The first hearing with public participation was briefing of project overview and content of EIA report; the second hearing with public participation was answer to questions of public concern, as well as communication of matters about project change.

Figure 10.3-1 First Hearing

Figure 10.3-2 Second Hearing

10.3.3 Inquiry by Family Visit

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 tourist 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 10.3-3　Inquiry by Family Visit

10.3.4　Interviewing of Institutions

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, and Handicapped Association of Jingzhou District; time of inquiry: Mar 24~27, 2015.

All units interviewed understand the project, 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.

Figure 10.3-4　Interviewing of Institutions

10.3.5　Inquiry Outcome of Resettlement Working Group

During Mar to Oct 2014, when social impact assessment of the project was in progress, a questionnaire for opinions and suggestions with public participation of affected residents in project area was launched by Center for Involuntary Resettlement, Wuhan University, 447 questionnaires were released and taken back, with public opinions and proposals in the aspects of project design, project construction and resettlement of affected residents in connection with the project, such opinions and proposals are valuable for reference in design optimization and relevant policy-making of the project.

Starting with the most pressing problems in face of Jingzhou historic town reflected in public opinion, priority of the project will be control of water system inside and outside historic town, as well as restoration of historic town rampart and improvement of traffic condition, so as to cater townspeople's requirements for protection and sustainable development of historic town.

It's found from residents' opinion to recognition of several subunits that, the whole project is highly supported by all residents, of which control of water system inside and outside historic town is most supported subunit; even the subunit of the lowest support ratio is more than 87%. Of the objectors, the inquirer found that they do not object the project but doubt about potential negative impact during implementation of the project; to eliminate their doubt, project management office and design institute will take targeted settlement measures during plan optimization and future execution.

Figure 10.3-5 Ask for Opinions and Suggestions of Affected Population on Fanrong Street of West City Gate

10.3.6 Collection of Public Consultation Outcome

Collection outcome is listed in Table 10.3-1.

Table 10.3-1 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, TYLIN 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	(1) Project management office will provide affected residents for their option of Dongsheng apartment resettlement community in the east of Jingzhou city 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	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,

						channel for hearing opinions and suggestions by affected population	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 hearing attended by representatives from project management	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.

							office, street-level social management offices, villagers' committee and 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	Law of the Peoples Republic of China on Environmental Impact Assessment; The Provisional Measure of Public Participating in Environmental Assessment;	(1) Alternative options should be available for river-way dredging, ecological restoration, restoration of inner ring and etc; dredged sludge and	(1) Design institute of the project has designed alternative plans for various subunits; in addition, outlet of dredged sediment is defined in project design plan;	

				Conservancy Bureau; Jingzhou Water Conservancy Bureau and etc	World Bank's Policy on Environmental Impact Assessment (OP4.01); World Bank Operation Manual-BP17.50 Policy on Information Publicity	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 cultural heritages; maintain original	(2) Road blacktopping work is required for the road connecting to inner ring and Xiongjia Mound; 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 Wastewater Treatment Plant	

						bluestone pavement; (3) During dredging of West Lake, construction notice should be made to ensure municipal sewage be discharged to wastewater treatment plant for treatment; (4) All levels of departments should strengthen publicity of environmental protection to enhance citizens' awareness of environmental protection.	and Caoshi Wastewater Treatment Plant for treatment. (4) Strengthen publicity of environmental protection is also an important concept of the project to be 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.	

10.4 Information Publicity

After preparation of EIA program, we publicized the project on official website of Department of Environmental Protection of Hubei Province on Sep 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.

After drafting of EIA report, we edited the content of second information publicity, and second information publicity was made on official website of Department of Environmental Protection of Hubei Province on Mar 24, 2015 (http://www.hbepb.gov.cn/wsbs/gsgg/hpgs/hpdwhp/201503/t20150324_76021.html). After pre-assessment of EIA report, third information publicity was made on official website of Department of Environmental Protection of Hubei Province on Mar 26, 2015 (http://www.jingzhou.gov.cn/article/zxgg/138612.html). Main contents of information publicity are listed in table 10.4-1 and shown in Figures 10.4-1~5.

Table 10.4-1 Environmental Information Publicity

	Time	Place	Content	Policy basis
First information publicity	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	Law of the Peoples Republic of China on Environmental Impact Assessment; The Provisional Measure of Public Participating in Environmental Assessment; World Bank's Policy on Environmental Impact Assessment (OP4.01); World Bank Operation Manual-BP17.50
Second information publicity	2015.3.24	Governmental and internet publicity of affected areas	Project title and construction content; summary of potential	

		by the project	environmental impact with construction project; key points of EIA put forth in environmental impact assessment report; particular method for consulting public opinion	Information Publicity Policy
Third information publicity	2015.3.26	Publicity by Jingzhou Daily, billboard and official website of Jingzhou Municipal People's Government	Revised draft of Project EIA report and environmental & social management plan	

World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project

First EIA Notice

According to applicable rules of the Law of the People's Republic of China on Environmental Impact Assessment and the requirements of Provisional Measures on Public Participation in Environmental Impact Assessment (HUAN FA NO. 2006[28])issued by former State Environmental Protection Administration, information on World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project is publicized as follows:

I. Title and Summary of Construction Project

Project title: World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project

Project summary: Jingzhou City Construction Investment Corporation has planned to construct "World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project" in Jingzhou District, Jingzhou City; the construction works include protection and exhibition of historic and cultural heritages; rehabilitation of historic town and upgrading of infrastructure; strengthening of technical support and management capacity for rehabilitation of historic town; strengthening of project management and institutional capacity.

II. The Employer's Name and Contact

The employer's name: Jingzhou City Investment Corporation

Figure 10.4-1 First Online Notice

湖北省环境保护厅

首页 信息公开 网上办事 政民互动 环境质量 信息资源 专题专栏

建设项目环境影响评价第二次公示

信息来源： 发布日期：2015-03-24

根据《中华人民共和国环境影响评价法》等规定和原国家环保总局环发2006[28]号《环境影响评价公众参与暂行办法》的要求，对世行贷款湖北荆州古城修复与保护项目有关信息公开如下：

（一）建设项目情况简述

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包括西城墙保护工程、土城墙挡土墙工程、古城植物保护及修复工程、熊家冢各类展示工程、博物馆展示提升、游客接待中心及停车场工程、旅游开发基础设施配套工程、历史建筑修复与再利用、开元观环境改造工程。改善古城生态环境及水环境包括护城河及古城内湖泊底泥清淤工程、污水管网工程、护城河调蓄池工程、驳岸工程、水资源连通及河湖生态构建、提升古城交通便利度项目包括内环路改造工程、内环路节点改善工程、古城内关键节点改善、古城外关键节点改善、慢行系统、接驳巴士系统、静态交通标识系统、动态交通标识系统。

Second IEA Publicity of Construction Project

According to applicable rules of the Law of the People's Republic of China on Environmental Impact Assessment and the requirements of Provisional Measures on Public Participation in Environmental Impact Assessment (HUAN FA NO. 2006[28])issued by former State Environmental Protection Administration, information on World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project is publicized as follows:

(I)**Summary of Construction Project**

The proposed project is seated in Jingzhou District, Jingzhou City; it belongs to integrated control of environmental pollution and consists of three subunits, 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; subunit (1) consists of west rampart protection construction, retaining wall of earth rampart construction, protection and restoration of historic town vegetation construction, various exhibition construction in Xiongjia Mound, enhancement of museum exhibition, tourist reception center and parking construction, auxiliary construction of tourism development infrastructure, renovation and reuse of heritage architecture as well as environmental renovation of Kaiyuan Temple construction; subunit (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; subunit (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.

Figure 10.4-2 Second Online Notice

World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project

Notice of EIA Report and Environmental Management Plan

World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project EIA Report

World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project Environmental and Social Management Plan

Figure 10.4-3 Third Online Notice

Figure 10.4-4 Posting of Notice

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、糖家冢保护与展示、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、水资源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：种晁俟　联系电话：0716—4081878
E-mail：jingzhoupmo@163.com
环境影响评价单位：湖北省环境科学研究院
通讯地址：武汉市武昌区八一路338号
邮政编码：430072　联系人：王聪
联系电话：027-87868785-818
E-mail：513903001@qq.com

(上接1版)

Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project

Notice of Information on Public Participation in Environmental Impact Assessment

In order to protect cultural heritage of Jingzhou historic town, promote tourism development, upgrade tourist infrastructure and services, and improve the habitation of surrounding residents, construction of Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project funded by World Bank will be launched, following is IEA information of the project:

[**Project Overview**] Total investment is ￥1.127 billion, including USD100 million (Approx. ￥615 million)World Bank loan and ￥512 million self-financed fund; construction period is 2015~2020.

The proposed project is seated in Jingzhou District, Jingzhou City; it belongs to integrated control of environmental pollution and consists of three subunits, 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; subunit (1) consists of west rampart protection construction, retaining wall of earth rampart construction, protection and restoration of historic town vegetation construction, various exhibition construction in Xiongjia Mound, enhancement of museum exhibition, tourist reception center and parking construction, auxiliary construction of tourism development infrastructure, renovation and reuse of heritage architecture as well as environmental renovation of Kaiyuan Temple construction; subunit (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; subunit (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.

[**About Environmental Impact**] The project has environmental impact with benefit out weighting disadvantage in terms of remarkable ecological and environmental benefits; adverse environmental impact of the project is local, short-term and reversible in relatively minor degree, and such environmental impact can be mitigated by taking effective environmental protection measures and improvement means.

Adverse environmental impact of the project is sludge dredging construction of tourist reception center and construction of sewage pipeline work, including construction period and operation period in time sequence; from the perspective of space concept, environmental impact is mainly caused by construction of tourist reception center, underground parking and dredging works; civil work, earth transportation, road reconstruction and like works during construction period will likely to cause traffic jam, produce unfavorable noise, fugitive dust and similar environmental pollution, which will unavoidably disturb the surroundings; in addition, great amount of spoil (Debris) from dredging and building demolition will cause environmental problems such as water and soil loss, soil erosion and etc, if these wastes are not disposed properly; upon completion and operation of the project, road network system of the whole historic town will be improved to promote local tourism development; however, with increasing population of number of motor vehicles, environmental noise and car exhaust gas will also increase in auxiliary parking of tourist reception center, which will disturb the residents living around the parking; sewage from project operation is in small volume and single water quality, which will finally be discharged to Caoshi wastewater Treatment Plant and south wastewater treatment plant for treatment, thus environmental impact is minor.

[Statement] According to the Environmental Protection Law of the People's Republic of China and the Law of the People's Republic of China on Environmental Impact Assessment, the institutions and residents in affected areas of construction project should be consulted for opinions on environmental impact assessment. For better service of local residents and mitigate negative environment impact against the public in project area, we sincerely ask for your opinions on environmental protection works and surroundings. We'll incorporate your valuable opinions and suggestions in EIA report and tell the same to the employer and design institute.

Also, you may let us know your opinions and suggestions by letter, email and/or call to the following address:

Project management unit: Management Office of **Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project**

Communication address: West #2 Building in Jingzhou Governance Service Center, 440 West Beijing Road, Jingzhou City,

Liaison: Zhong Yanxia

TEL: 0716-4081878

Email" jingzhoupmo@163.com

EIA agent: Hubei Academy of Environmental Sciences

Communication address: 338 Bayi Road, Wuchang District, Wuhan, Hubei, China PR 430072

Liaison: Wang Cong

TEL: 027-87868785-818

Email: 513903001@qq.com

Figure 10.4-5 EIA Information Publicity ob Newspaper

10.5 Conclusion on Public Consultation and Information Publicity

To sum up, all public participating in EIA questionnaire and hearing 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 environmental protection measures recommended in EIA 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.

11 Environmental Management Plan

In order to protect the environment in project area, ensure effective control and mitigation of various hazardous environmental impacts of construction, stringent and scientific follow-up management as well as environmental and management and environmental monitoring must be implemented in the whole process of construction works.

11.1 Environment Management and Supervisory Organizations

11.1.1 Environmental Management Organization

The Jingzhou World Bank Financed Project Management Office (PMO) affiliated to Jingzhou City Construction Investment Corporation is responsible for environmental projection management, development of environmental projection protection plan, coordination among various regulatory authorities and the employer regarding environmental management, instruction to the employer for execution of various management measures, environmental activities and environmental management during construction period, organization for feasibility study of project construction, environmental protection planning, environmental management in design stage; Jingzhou City 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 environmental protection measures during operation period.

11.1.2 Supervisory Organization

The environment supervisory organizations of the project are Department of Environmental Protection of Hubei Province and Jingzhou Environmental Protection Bureau. Supervisory organization should implement the following stages:

(1) 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 works relating to the project, 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 management of project related environmental protection works, organization and coordination of relevant organizations for service of project environmental protection works, supervision of implementation of environmental action plan for the project, completion acceptance of environmental protection installations of the project, instruction to local environmental protection bureau in charge of the subunit regarding environmental supervision management during construction period and operation period of the project.

(2) Design stage: Environmental protection administration of project management office (PMO) affiliated to Jingzhou City Construction Investment Corporation is responsible; Jingzhou City Construction Investment Corporation is responsible for supervision and approval during collective review of project preliminary design.

(3) Construction stage: Environmental protection administration of project management office (PMO) affiliated to Jingzhou City Construction Investment Corporation and Department of Environmental Protection of Hubei Province are responsible. Jingzhou Environmental Protection Bureau is accepts guidance of the project by Department of Environmental Protection of Hubei Province, supervision of the employer for implementation of environmental action plan, enforcement of applicable laws and standards in connection with environmental management; coordination of various departments for proper environmental protection; take charge inspection, supervision management of project construction, completion acceptance, operation of environmental protection installations for the project, with following particular functions:

① Work out 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 prevention and control of pollution set forth in specific construction plan and this EIA 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.

② 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;

③ Inspection and treatment of compliant about disturbance to local residents or environmental pollution occurring in the process of construction;

④ Submission of environmental management stage report to local environmental protection administrative department;

(4) Operation stage: Department of Environmental Protection of Hubei Province, Jingzhou Environmental Protection Bureau and the authority having jurisdiction to subunit are responsible. Authority having jurisdiction to subunit is responsible for implementation and enforcement of laws and standards for environmental protection, establishment and supervision for execution of environmental protection bylaws, understanding of project related environmental condition, establishment of environmental quality control objectives suitable for assessment, proposal on environmental control measures and submission to superior environmental protection department and industry authority, organization of environmental protection personnel for exam of qualified assignment and personnel training, technical communication and scientific study relating to environmental protection.

(5) 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 City. Upon completion of various subunits, respective environmental protection departments will be set up, and full-time staff will be appointed to take charge environmental protection work of the project.

11.1.3 Environmental Management Procedures

Environmental protection management procedures of the project are illustrated in Table 11.1-1.

Figure 11.1-1 Environmental Protection Management Procedures

Preparation for initiation	Project proposal	Preliminary analysis of project related environmental impact
Pre-assessment	Project feasibility study	Program of EIA tasks
Assessment	Planning assignment	EIA report
Official assessment	Preliminary design	Action plan of mitigation measures (Draft review)
Negotiation	Tendering documents	Action plan of mitigation measures (Review of final draft)
Approval by executive directorate	Project construction plan	Supervision of action plan of mitigation measures
Take effective for execution	Construction supervision	Inspection of action plan of mitigation measures and acceptance of environmental protection installations
	Delivery for operation	

11.1.4 Content of Environment Management

Effective control of environmental pollution during construction period of the project; during construction stage of project construction, not only construction quality and progress management of the project is required, but also supervision inspection of the extent of civilized construction, implementation of environmental impact mitigation measures, as well as performance of contract terms applicable to environmental protection without failure.

(1) The employer should incorporate in the contract text environmental protection 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 environmental protection measures and proposals recommended in EIA report.

(3) Qualified supervision agent should be consigned to appoint full-time environmental protection supervision engineer for supervision of implementation of environmental protection 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.

11.1.5 Environmental Supervision Management 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 11.1-1.

Table 11.1-1 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 spoil ground 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 Protection of Hubei Province	1.Inspect implementation of environmental monitoring plan 2.Inspect whether it’s necessary to take further environmental protection measures (Unexpected environmental problems may arise)	1. Implement environmental monitoring plan 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	

11.2 Environmental Monitoring Plan

11.2.1 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 environmental protection measures and suggestions set forth in EIA report, so as to control environmental impact from project construction within the limit of applicable national laws, regulations and standards.

11.2.2 Environmental Monitoring Organization

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.

11.2.3 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 11.2-1.

Table 11.2-1 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	TSP	Quarterly (More frequent during construction peak, if necessary) 3-4 times per quarter		Jingzhou Environmental Monitoring Station

		Community					
		Various sludge spoil grounds	H_2S, NH_3	Once environmental monitoring before dredging work as background value; Once environmental monitoring during busy use of spoil ground 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 spoil grounds	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
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
		Outgoing sewage from tourist center	COD, BOD, ammonia-nitrogen	6 monitoring per year, namely once in Feb, April, June, Aug, Oct and Dec respectively			Jingzhou Environmental Monitoring Station

11.2.4 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 ￥100000/year×5 years=￥500000; 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 ￥120000/year×3 years=￥360000.

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.

11.2.5 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.

11.2.6 Environmental Monitoring Report

(1) Environmental monitoring report in construction stage: construction period if about 5 years for various subunits, 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 environmental protection 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.

11.3 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.

11.3.1 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, EIA report (Inc. recommended environmental protection 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.

11.3.2 Scope and Term of Environmental Supervision

Scope of environmental supervision: project area and affected area.

Scope of work: 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 environmental protection measures are taken to mitigate environmental impact by project operation.

Working stage：construction preparation stage; construction stage; environmental supervision.

Term of supervision service: from construction preparation stage to completion of construction.

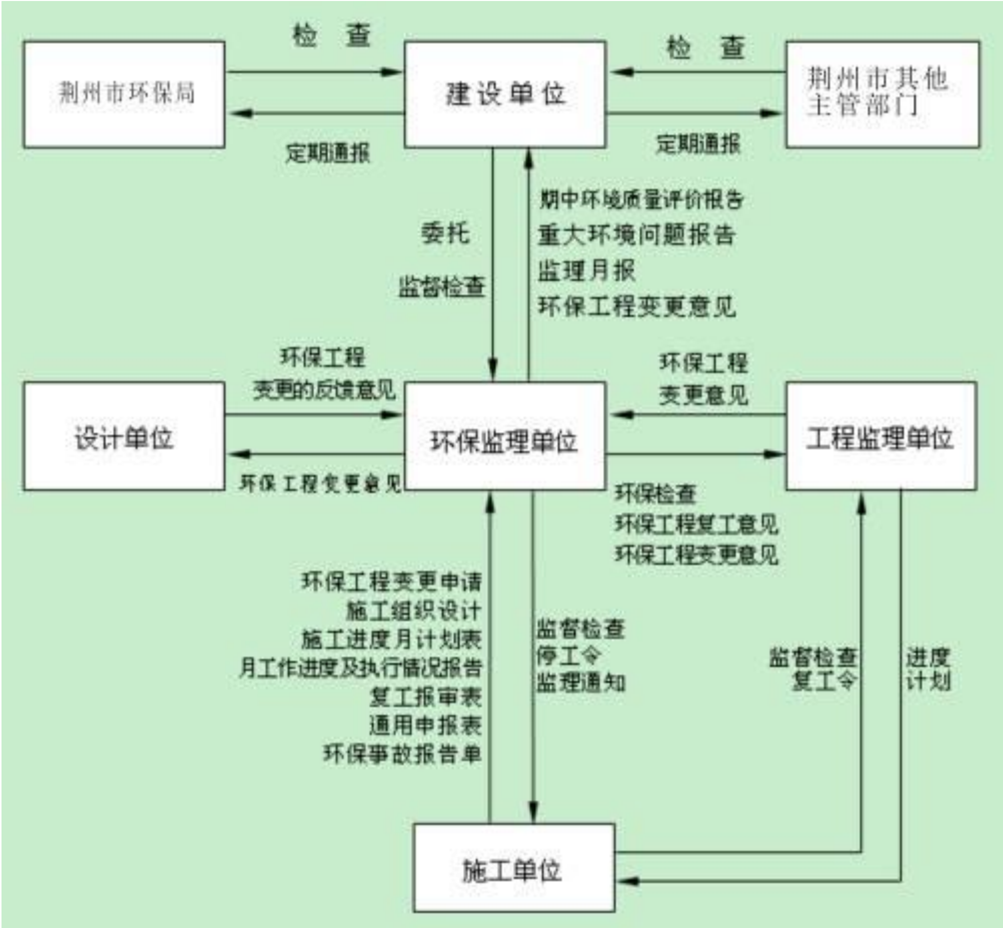
11.3.3 Working Method and Procedure for Environmental Supervision

(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:



Jingzhou Environmental Protection Bureau〓Inspection; Periodic notice〓The employer〓Inspection; Periodic notice〓Other authorities in Jingzhou City

Entrusted supervision inspection 〓 In-process environmental quality assessment report; Major environmental problem report; Monthly supervision report; Comments on change of environmental protection project

Design institute〓Feedback on change of environmental protection project; Comments on change of environmental protection project〓Environmental protection supervising unit〓Comments on change of environmental protection project; Environmental protection inspection; Comments on resumption of environmental protection project; Comments on change of environmental protection project〓project supervising unit

Application for change of environmental protection project; construction origination design; monthly schedule of construction progress; report of monthly working progress and implementation status; request for resumption form; universal declaration form; report sheet of environmental protection accident〓supervision inspection; cease order; supervision notice〓supervision inspection, resumption order 〓schedule

Construction contractor

Figure 11.3-1 Environmental Protection Supervision Procedures

11.3.4 Main Workload of Environmental Supervision

11.3.4.1 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 City will directly supervise the employer and design institute to implement various environmental protection measures recommended in EIA report and officially approved by Department of Environmental Protection of Hubei Province; these environmental protection 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 EIA 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 environmental protection 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.

11.3.4.2 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 EIA 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 fugitive dust, so as to prevent environmental pollution by fugitive dust along the route.

11.3.4.3 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.

11.3.5 Requirement for Supervision Effect

(1) 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.

(2) Responsible for control of environmental protection measures critical to main construction quality, supplement, supervise and guide environmental protection in construction supervision work.

(3) Work with environmental protection authority to implement and fulfill national, provincial and municipal environmental protection policy and laws, play the role of third-party supervision to the fully extent.

11.4 Acceptance of Environmental protection installations upon Completion

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: EIA 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 11.4-1.

Table 11.4-1 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 EIA 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 EIA report	
IV	Environmental protection installation effect monitoring	Inspection report on environmental protection installations effect during trial operation period	
V	Environmental protection measures		
Period of time	Control objects	Content of measures for prevention and control of pollution	
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 spoil ground residual water to be discharged to surface water area nearby after standard coagulation-sedimentation treatment according to Discharge Standard of Pollutants for Municipal Wastewater Treatment 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 City
		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 spoil ground 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 spoil ground	
Operation	Wastewater	Living sewage	Wastewater from tourist center

period			discharged to secondary wastewater treatment plant for treatment after sedimentation in the cesspool; wastewater from Xiongjia Mound to be treated by planned micro-power wastewater treatment station
	Noise	Tourist 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 Wastewater Treatment Plants shall be carried out before operation of sewage interception pipe network of the project. Since the Xiongjia Mound Phase I Project has been put into operation, Xiongjia Mound Micro-Power Wastewater 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.

11.5 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 environmental protection 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 11.5-1.

Table 11.5-1 Training Program of Environmental Protection Technicians

Type	Feature	Trainee	Training content	Number of trainees	Time	Date (Year)	Cost (￥10000)
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 environment	Basic environmental theory and	10～20	4 days/class	2016-2019	8.5

		al protection personnel	monitoring method, monitoring report and job training; once training per year; environmental management plan, environmental monitoring and report, emergency response plan				
	supervision	Environmental protection supervision engineer, construction contractor's environmental management personnel	Environmental protection laws, construction planning, environmental monitoring rules and planning, ambient air monitoring and control technology, noise monitoring and control technology	5～10	5 days/class	2016-2019	5.5
Total							**70**

12 Analysis of Environment and Economic Profit & Loss

12.1 Budget for Environmental Protection Investment

12.1.1 Budget for Lump-sum Environmental Protection Investment

Estimated total investment of the project is ￥1.127 billion. 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 EIA report, initially estimated lump-sum environmental protection investment for the project is ￥7.88 million, environmental protection investment accounts for 0.7% total investment of the project, of which ￥1.37 million is included in the budget for project investment, additional ￥6.51 million environmental protection investment. Composition of environmental protection investment is listed in table 12.1-1.

Table 12.1-1 Budget for Investment in Environmental Protection Measures

	Environmental protection measures			Treatment effect	QTY	Investment (￥10000)	Remark
	Part Ⅰ. environmental monitoring						
	Environmental monitoring during construction period			￥100000/year	5 years	50	Added in EIA
	Environmental protection acceptance and monitoring upon completion				-	70	Added in EIA
	Part Ⅱ environmental protection 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
		Spoil ground residual water	Discharge after coagulation-sedimentation	Standard treatment according to Discharge Standard of Pollutants for Municipal Wastewater Treatment Plant, Grade-1	2 spoil grounds	150	Added in EIA
	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 处	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	300000 m^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 Wastewater Treatment Plant after sedimentation in the cesspool, then discharged to secondary Caoshi Wastewater	Standard discharge according to Discharge Standard of Pollutants for Municipal Wastewater Treatment	1 cesspool	4	Included in project investment

			Treatment Plant for further treatment	Plant, Grade-1			
		Connection channel	Sludge cleaning		9 points	5	Included in project investment
	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	Set up sorted trash bin, timely cleaning and pick-up	Timely cleaning and pick-up, maintain clean site		20	Included in project investment
		Common waste					
	Part Ⅲ environmental management						
	Training of environmental management participants during construction period					70	Added in EIA
	Cost for external monitoring consultation of environmental management plan					100	Added in EIA
	Total environmental protection investment					788	

12.1.2 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 EIA report, which is amount to ￥1.14 million, as listed in detail in Table 12.1-2.

Table 12.1-2 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	20	living sewage treatment facilities, solid waste

	environmental protection installations		collecting system and etc
4	Wage and labor cost paid to serviceman	4	
Subtotal		38	
Total during operation period		114	3 years

12.2 Analysis of Environmental Economic Profit & Loss

12.2.1 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 City.

(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 Hanjiang 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, this project as an environmental protection project will bring remarkable environmental, social and economic benefits, thus project construction is practically feasible.

12.2.2 Environment Benefit

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 City; 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 wastewater treatment 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 Wastewater Treatment Plant, 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 Hanjiang River is not included in the scope of work of this 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 rampart and vegetation enhances and improve ecologic sight

Protection of west rampart project and rampart vegetation upgrading project will substantially improve rampart sight and environment, also, it’ll create condition for residents surrounding historic town to closely view the rampart 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.

12.3 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 spoil ground, 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 fugitive 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.

12.4 Conclusion of Profit & Loss Analysis

It’s found from above profit & loss analysis that, environmental and economic loss is mainly of cost for taking environmental protection 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.

13 Assessment Conclusion

13.1 Project Overview

The proposed project is seated in Jingzhou District, Jingzhou City; it belongs to integrated control of environmental pollution and consists of three subunits, 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; subunit (1) consists of west rampart protection construction, retaining wall of earth rampart construction, protection and restoration of historic town vegetation construction, various exhibition construction in Xiongjia Mound, enhancement of museum exhibition, tourist reception center and parking construction, auxiliary construction of tourism development infrastructure, renovation and reuse of heritage architecture as well as environmental renovation of Kaiyuan Temple construction; subunit (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; subunit (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 ￥1.104 billion, including USD100 million (Approx. ￥615 million)World Bank loan and ￥495.4 million self-financed fund; construction period is 2015~2020.

13.2 Conclusion on Environment Status Assessment

13.2.1 Environment

The project site is located in urban built-up area, where it’s centered for human activity, belonging to artificial ecosystem on the basis of urban life; there’re only a few native vegetations on earth rampart within the scope of the project, where there's no large wild animal. Within the scope of assessment, ecosystem is featured by relative stability and functional integrity; due to effective manual management and energy replenishment, the ecosystem will be maintained and developed stably with certain anti-interference capacity.

13.2.2 Ambient Air

SO_2 and NO_2 hour-value/day in project area of tourist 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 tourist 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, exceeding 85.7%, maximum concentration over-limit rate is 143%; 2# point PM10 daily average maximum monitoring value is 0.21 mg/L, exceeding 85.7%, maximum concentration over-limit rate is 140%.

13.2.3 Surface Water

Water quality at all monitoring points fails meeting standard for water quality of Surface Water Environment Quality Standard (GB3838-2002), Class Ⅲ, mainly by following three causes: (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 Wastewater Treatment Plant will degrade water quality of historic town water system; (2) rare exchange of historic town water system and external water, slow water flow rate, poor self-purifying capacity of water quality; and (3) long release of sediment internal pollution, leading to further degrading of water quality of historic town water system.

13.2.4 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.

13.2.5 Groundwater

Status of groundwater wells in Minzhu Street, ammonia-nitrogen and Mn exceed Groundwater Quality Standard (GB/T14848-93), Class Ⅲ, other indicators meet the requirements of Groundwater Quality Standard, Class Ⅲ. Main cause of exceedance of ammonia-nitrogen and Mn is water conservancy relation of local groundwater and over-limited historic town surface water system.

13.3 Analysis of Compliance with Industry Policy and Relevant Planning

(1) Analysis of compliance with industry policy

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, “sludge dredging project of rivers, lakes and reservoirs” and “ township drainage pipelines project” are encouraged projects, thus this project is in compliance with related requirements of national industry policy.

(2) General Municipal Planning of Jingzhou City (2011-2020)

According to the planning, protection of brick rampart, earth rampart of Jingzhou rampart and the moat; protection of Sanyi Street-Desheng Street historic and cultural streets, as well as historic and cultural streets in south gate of Jingzhou historic town; protection of protected historic heritage units of various levels; protection of heritage architectures; in addition, key protection areas, key coordination areas and ordinary coordination areas are demarcated in the planning for control of height, size, style and color of buildings in Jingzhou historic town; the scope of protection in Jingzhou historic town include nine traditional style streets and lane, namely, Sanyi Street, Desheng Street, south gate street, Zhangjuzheng Street, Fanrong Street, Guandai Lane, Binxing Street, Dongdi Street and Xidi Street.”

For historic town protection subunits of the project historic town, special protection measures and protection plans are developed for the protection of above earth rampart and brick rampart; as for water environmental protection subunit, water renovation plan is developed; generally, it’s in compliance with General Municipal Planning of Jingzhou City.

(3) Planning on the Protection of Jingzhou Historic Town

Content of this planning include: structure and overall style of historic city zone; focus on protection of overall style of and historic & cultural streets of Jingzhou historic town, historic & cultural streets of and flavored old lanes of Shashi historic city zone, historic sides, ancient tombs and like protected heritage units, contemporary and modern architectures and industrial heritages, national-level intangible cultural heritages, construction of the structure of space system for protection of historic & cultural town of combined points, lines and planes, as well as combined tangible and intangible cultural heritages; furthermore, the planning demands strict protection of integral structure pattern and street/lane structure features of Jingzhou historic town composed of Jingzhou rampart and the moat, protection of Shashi street/lane structure features along riverside, protection of water system surrounding historic city zone, so as to highlight the ecological sight structure of Jingzhou as “water city in left river”.

During overall renovation and vegetation restoration of historic town of the project, strict protection of overall structure of Jingzhou historic town is defined, and the project will focus on functional restoration of historic town water environment, and it’s in compliance with Planning on the Protection of Jingzhou Cultural & Historic Town.

(4) Controlled Particular Planning on the Redevelopment of Jingzhou Historic Town Area

According to this planning, strategic development targets for historic town area are “functional adjustment, population decentralization, overall protection and organic renovation”, which focuses on improving the environment in the development of historic town area, upgrade functionality; strengthen municipal function of historic town area as urban center of commerce, entertainment and tourism; combined protection and renovation; empower historic town area with new energy and boost urban economic development; this planning defines historic town area as” an integrated historic and cultural tourism center including main functions of historic town protection and cultural tourism, as well as Chu civilization, culture of Three Kingdoms and water culture as the core connotation”.

This project supports local tourism development, which, upon initiation, will promote economic progress of Jingzhou City; therefore, construction of this project is in compliance with Controlled Particular Planning on the Redevelopment of Jingzhou Historic Town Area.

(5) General Planning on the Redevelopment of Jingzhou Historic Town Tourism Zone

This planning is still for approval. General objective of this planning is that, by the end of planning period (2020), tourism enlargement, quality upgrading and benefit optimization of Jingzhou historic town tourism zone are realized, tourism products of domestic and international competitiveness are fostered, the tourism zone becomes a famous domestic and international tourism destination for culture-oriented historic town, as well as an all-important strategic polar in ecological culture tourism circle in western Hubei. In this planning, development target of historic town is described as follows: Jingzhou historic town scenic area is a industrial clustering area of most realistic edges and prospective potential in the whole Jingzhou historic town, core keystone for breakthrough of regional tourism development, as well as leading momentum for driving overall development. Through construction and operation within planning period, Jingzhou historic town scenic area will become well-known domestic national-level 5A tourism resort of international fame, famous oriental historic and cultural city as well as famous scenic spot of world cultural heritage.

At present, historic town is applied for listing in the Catalogue of World Cultural Heritage; initiation of this project can preserve original style and features of Jingzhou historic town, and will improve peripheral infrastructure and surrounding environment of historic town, making it significantly positive to apply historic town for listing in the Catalogue of World Cultural Heritage; therefore, construction of this project is in compliance with General Planning on the Redevelopment of Jingzhou Historic Town Tourism Zone.

(6) General Planning on the Protection of Jingzhou Rampart Sites

This planning emphasizes integration of rampart and urban space of Jingzhou City, relation with surrounding related historic environment, proposes rampart protection measures for protection and exhibition of rampart, forms a structure pattern with rampart and the moat as the core, and historic, natural and humanity surroundings of the rampart as influential areas, and deploys and adjusts road establishment and exhibition service installations.

This project will not only protect and renovate rampart, but also exhibit intangible cultural heritage by making use of existing resources; therefore, construction of this project is in generally compliance with General Planning on the Protection of Jingzhou Rampart Sites with protection and exhibition as the core.

(7) Other planning

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

(GB3096-2002), Class Ⅲ water area function.

This project consists of necessary sediment dredging, living sewage interception, sewage pipeline reconstruction and other works in favor of Jingzhou historic town water system, thus it's notably significant to the restoration of Jingzhou historic town water system.

13.4 Conclusion on Environmental Impact Assessment

13.4.1 Environmental Impact Assessment

(1) Project construction permanent land will cause perennial and irretrievable damage to natural vegetation within the area assessed; upon completion of the project, artificial planting landscape and ecological revetment and similar constructions will mitigate impact on local vegetation. Project temporary land has short-term impact on natural vegetation, which can be restored gradually at the end of construction. Project construction has minor impact on local vegetation.

(2) Construction period of the project has certain impact on terrestrial animals such as birds and amphibians, it'll affect structural parameter of bird flock in terms of lower species number and diversity. Upon completion of the project, majority of terrestrial animals such as birds and amphibians will gradually recover with planting along rivers and lakes and vegetation restoration.

(3) During construction period of the project, some works will cause reduction of planktons, but in a short-term and limited manner. With completion of construction, project related planktons will soon recover. Upon completion of the project, number of planktons might increase due to better environmental condition of water niche. Dredging activities of the project 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. Fish in project area is common fish species.

(4) The project will trim and renovate the river bank slope with combined natural revetment and hard revetment, cleaning of river-way floating wastes and area planting will substantially promote visual sight benefit on both sides of the river-way. In addition, construction of artificial wetland will increase greenbelt area in surrounding areas, attract waterfowls to inhabit and promote natural landscape benefit of the moat.

(5) By forecast assessment and reasoning of water & soil conservation plan, design outcome regarding route selection, general layout, construction method and measures functional for water & soil conservation in main construction feasibility study basically meet water & soil conservation requirements; from the perspective of water & soil conservation, project construction is feasible without water & soil conservation restrictive factor.

13.4.2 Analysis of Water Environmental Impact

By dredging operation, the project will effectively remove pollutants in river-way sediment 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 tourist center after secondary treatment at township wastewater treatment plant instead of direct discharge in river-way without proper treatment, which will effectively control point source of historic town water system. After removal of riverbed sediment, and by construction of ecological revetment, ecological project such as reconstruction of water plant, 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 degrade pollutants contained in water. Therefore, river-way water quality will be improved remarkably upon initiation of the project.

Impact on groundwater by the project mainly includes residual water discharged from sludge disposal as well as percolate from temporary spoil ground of sludge; by implementation of anti-seepage measures proposed in the EIA report, sediment percolate at spoil ground has minor secondary pollution to groundwater.

13.4.3 Analysis of Acoustic Environmental Impact

1. Construction period

According to forecast, in general case, 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 construction period of the project, which is worse in terms of noise at nighttime.

Noise pollution is in pervasive during construction period in terms of different affected areas at different time, but generally featured by irregularity and 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 source is mobile, which prevents taking measures to suppress construction noise. The project should be conducted by strengthening construction organization and management during construction period, 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 equipments, low-noise equipments 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 equipments; 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 tourist 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, 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.

13.4.4 Analysis of Ambient Air Impact

1. Construction period

(1) Analysis of impact by construction fugitive dust

Lime-clay mixing is usually conducts at mixing station during construction of piping and civil work. 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 section. 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 fugitive 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; fugitive dust produced by construction transport vehicles causes serious air pollution along the route.

It's found from above analysis that, fugitive 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 project, 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 are is expected with exhaust gas emitting by construction machinery, which will not notably worsen pollution of regional ambient air quality, except for certain adverse effect to the residents near construction working area and along construction transportation route, thus, necessary protective measures should be taken to mitigate adverse effect of fuel-fired exhaust gas of construction activity to the residents along construction transportation route.

(3) Stink from sludge disposal yard

For the project, intensity degree of stink pollution and noise source is analyzed by comparison; by analysis of the type of river-way dredging work, sediment will emit pungent stink during dredging operation, at Intensity 2 outside 30m with undesirable smell, lower than the limit standard of stink intensity (Intensity 2.5-3.5)；basically no odor outside 50m; within the range of sediment spoil ground leeward 30m, stink intensity is Intensity 2 with undesirable smell 50m, basically no odor outside 50m.

Sludge dewatering and solidification treatment of the project is mainly conducted during early winter and late spring, when the weather is chilling and suppressive to stink volatility; furthermore, spoil ground of sludge dewatering and solidification is a temporary structure, 40m from the nearest ambient air sensitive point (Fanrong Street), other spoil grounds are more than 40m from sensitive objects; thus, stink produced during sediment disposal has limited impact on surrounding sensitive points. The stink will disappear at the end of project construction.

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.

13.4.5 Analysis of Solid Waste Pollution Impact

1. Construction period

Total dredging quantity of the project is about 301900m^3; monitoring indicators with dried sludge after dewatering and solidification and sediment after drying disposal meet the requirements of corresponding standard limit of Standard of Soil Quality Assessment for Exhibition Sites (Provisional) (HJ350-2007); sediment after drying treatment can be reused as wetland and revetment refill and has minor environmental impact; remaining sludge can be reused for planting in whole Jingzhou City.

During civil work of the project, 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 not be cleaned and carried away in a timely manner. During construction period, broken brick, stone, tile, cement slag and like construction wastes, most of these wastes are inorganic, and most of them have minor direct impact on water and ambient air quality, but occupy large land area and cause secondary pollution. Thus, construction waste should be disposed timely, reused in the process of construction, or reused to backfill and level up pit and depression.

Construction sites of the project is centralized and mainly distributed in historic town and surrounding areas; most construction personnel live in surrounding area of city zone instead of centralized living at construction site, they work at construction site at daytime and go off work to their own homes at nighttime; due to construction personnel go home after work at nighttime and come to work at construction site at daytime, and they reside in sporadic locations, 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 be produced by 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.

13.4.6 Analysis of Impact on Related Areas

South Wastewater Treatment Plant and Caoshi Wastewater Treatment Plant are approved environmental impact assessment by Jingzhou Environmental Protection Bureau and put into operation, emission of tail water from both wastewater treatment plants will cause minor impact on water quality of sewage receptor, however, due to both wastewater treatment plants belong to pollutant cutting project, both wastewater treatment plants bring positive benefit to water environment of historic town water system.

Although water compensation of water transfer project from Yangtze River to Hanjiang River is not included in the scope of work of this 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.

Upon completion of renovation construction of Jingzhou 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 Refuse Incineration Power Plant 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.

13.5 Environmental Protection Measures

13.5.1 Ambient Air

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, environmental protection measures against stinking spoil ground 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.

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

13.5.2 Water Environment

1. Construction period

Spoil ground residual water 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 spoil ground 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 spoil ground residual water of this project meets Grade-A standard.

2. Operation period

Tourist center will periodically produce tourist living sewage; living sewage from tourist center is discharged to wastewater treatment plant after standard treatment in cesspool according to handover standard of Caoshi Wastewater Treatment Plant, sewage is collected before passing through coarse sewage grid at Caoshi Wastewater Treatment Plant, 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 Wastewater Treatment Plant (GB18918-2002), Grade-1-B, and finally, tail water is discharged after disinfection with chlorine dioxide

13.5.3 Acoustic Environment

1. Construction period

Construction period: 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. 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 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)

Variable refrigerant flow multi-split central air conditioning should be sued at tourist 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, 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.

13.5.4 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. Remaining sludge after wetland fill and revetment construction can be reused for the whole Jingzhou City.

2. Operation period

Main sources of solid waste are domestic waste and common waste from operation of tourist center, Xiongjia Mound 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.

13.5.5 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 spoil ground appointed in the design without unapproved dumping along the route, river or ditch.The spoil depositing amount and level vary at various temporary spoil grounds; 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 spoil ground 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 0.76hm^2.

13.6 Public Participation

For environmental impact assessment of the project, 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 participation questionnaire and other forms, with following outcome:

(1) Project construction authority 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 payment of land compensation 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 equipments 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 equipments in use to reduce disturbance to local residents by construction noise. 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.

13.7 Conclusion on Project Specific Environmental Feasibility

The EIA report concludes that: assuming effective cutoff of external pollution and implementation of surrounding sewage pipe network and auxiliary wastewater treatment project as planned, World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project, will effectively improve and sustain water quality and aquatic ecosystem of Jingzhou historic town water system through rational dredging and wetland revetment construction. The environmental impact by World Bank Financed Hubei Jingzhou Historic Town Conservation and Environmental Improvement Project has profit overweighing loss in terms of remarkable ecological and environment benefits; the bad part is local, short-term and reversible environmental impact, which is minor and can be mitigated by taking corresponding environmental protection measures. Therefore, from the perspective of ecological and environmental protection, construction of the project is environmentally feasible on the grounds that the expansion of Chengnan Wastewater Treatment Plant and Caoshi Wastewater Treatment Plant is ahead of operation of sewage interception pipe network for the project and that the Xiongjia Mound Micro-Power Sewage Treatment device is equipped as soon as possible.